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**HEC MONTRÉAL**
École affiliée à l'Université de Montréal

# Lean cultural trajectories of healthcare organizations: notions of cultural friction and Lean cultural clusters in three essays

**par**
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Thèse présentée en vue de l'obtention du grade de Ph. D. en administration
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## Lean cultural trajectories of healthcare organizations: notions of cultural friction and Lean cultural clusters in three essays

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# Résumé

Motivé par des soucis de mieux comprendre pourquoi l'implantation et la pérennité de la méthode Lean dans les organisations de santé représentent tant de défis et d'apprendre de nouvelles façons pour mieux finalement aider les patients, ce travail offre, en trois articles, des réponses partielles mais originales à ces questions.

Le premier article étudie en profondeur la culture Lean au moyen d'une vaste revue systématique de la littérature d'un échantillon de 1066 documents tirés de quatre de ses segments (articles scientifiques, livres, thèses et documents commerciaux). Il y est démontré que la culture Lean est un concept sous-développé avec un haut niveau d'ambiguïté pragmatique. Deux définitions basées sur des évidences, une de la culture organisationnelle et une autre provisoire de la culture Lean y sont aussi proposées.

Dérivé de la notion d'écart culturel issue du premier article, le concept de friction culturelle Lean est présenté dans le deuxième article pour appuyer cinq trajectoires théoriques que les organisations de santé peuvent emprunter durant leur cheminement vers un archétype postulé de maîtrise de la culture Lean santé ultime. Il y est proposé qu'une génération d'un plus ou moins grand niveau de friction culturelle survient quand la culture courante d'une organisation de santé s'approche ou s'éloigne de cet archétype et qu'une gestion appropriée de cette friction peut faciliter une transformation organisationnelle Lean. Ceci est l'essence du modèle conceptuel descriptif de l'adoption contingente de la culture Lean (ACCL).

Comme premier effort vers une description éventuelle de la culture Lean santé dans un état de maîtrise ultime, quatre pôles culturels Lean – opérations, changement, collectivité et humanité – ont été révélés par une analyse de texte facilitée par ordinateur (ATFO) du contenu de 33 livres de référence Lean (générique et santé) dans le troisième article. Des liens entre le Lean et la théorie des systèmes sociotechniques y sont démontrés. Cette première analyse savante d'ouvrages principalement destinés aux praticiens fait une démonstration que les connaissances des domaines scientifiques et professionnels peuvent mutuellement s'enrichir.

Les résultats de ce travail suggèrent qu'une nouvelle explication des défis que représentent l'implantation et la pérennité du Lean dans les organisations de santé est la génération de friction culturelle. Des précisions sur la nature, les sources et les niveaux de friction culturelle Lean nécessiteront d'autres recherches fondamentales et empiriques qui mèneront vraisemblablement au développement d'un cadre conceptuel d'adoption de la culture Lean et possiblement même vers une théorie de la friction culturelle Lean. L'identification des quatre pôles culturels Lean – opérations, changement, collectivité et humanité – devrait faciliter ces efforts. Les gestionnaires et les autres professionnels de la santé peuvent déjà appliquer ces connaissances en apprenant à mieux travailler ensemble (collectivité) et en ciblant leurs efforts d'amélioration continue vers tout ce qui a un impact direct sur la provision des soins (opérations) qu'ils et elles offrent aux patients (humanité) au quotidien (changement).

**Mots clés :** Lean, santé, gestion des opérations, culture organisationnelle, changement organisationnel, trajectoires, friction, pôles

**Méthodes de recherche :** revue systématique de la littérature, modélisation conceptuelle, analyse de contenu, rapport de cas multiple qualitative.

# Abstract

Motivated by an eagerness to understand better why Lean methodology is so challenging to implement and to sustain in healthcare organizations and to learn better ways to ultimately help patients, this work presents, in three essays, partial but novel answers to these questions while making several scientific and practicable contributions.

The first essay investigates Lean culture comprehensively through an extensive systematic literature review of a 1066 documents sample obtained from four source segments (academic papers, books, theses and commercial documents). Lean culture is shown to be an under-developed concept with high level of pragmatic ambiguity. Evidence-based definitions of organizational culture and a tentative one of Lean culture are also proposed.

Derived from the notion of cultural gap identified in the first essay, the concept of Lean cultural friction is introduced in the second essay to support five theoretical trajectories healthcare organizations may experience during their Lean transformation journey toward a postulated ultimate Lean healthcare culture mastership archetype. It is proposed that more or less cultural friction is generated when current organizational culture of a healthcare organization gets closer or farther to this archetype and proper management of this friction may facilitate successful Lean organizational transformation. This is the essence of the Contingent Lean Culture Adoption (CLCA) descriptive conceptual model.

As an initial effort to guide eventual characterization of Lean healthcare culture in ultimate mastership state, four Lean cultural clusters – operations, change, collectivity and humanity - were identified by computer-aided text analysis (CATA) of the content of 33 Lean references books (generic and healthcare) in the third essay. Ties between Lean and sociotechnical systems theory are shown. This first academic inquiry of primarily Lean practitioners-directed reference sources demonstrates how knowledge from academic and professional domains can fruitfully cross-fertilize.

Findings of this work suggest that a novel explanation for the challenges of Lean implementation and sustainability in healthcare organizations is generation of cultural friction in the process. Precisions on the nature, sources and levels of Lean cultural friction warrant further fundamental and empirical research but could lead to development of a Lean culture adoption conceptual framework and potentially even a Lean culture friction theory. Identification of four Lean cultural clusters – operations, change, collectivity and humanity - may help to direct these efforts. Healthcare managers and other healthcare professionals may already apply this knowledge by learning to work better together (collectivity) and focusing their continuous improvement efforts on everything that has a direct effect on their care (operations) of patients (humanity) day to day (change).

**Keywords:** Lean, healthcare, operations management, organizational culture, organizational change, trajectories, friction, clusters

**Research methods:** systematic literature review, conceptual modelization, content analysis, qualitative multiple-case reports

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Chapter 3

# List of acronyms

| | |
|---|---|
| BPR | business process remodeling |
| CAGE | cultural – administrative and political – geographical - economic |
| CATA | computer-aided text analysis |
| CCE-CATA | cultural cluster(s) exploration – computer-aided texts analysis |
| CEO | chief executive officer |
| CLCA | contingent Lean culture adoption |
| CVF | Competing Value Framework |
| EMR | Electronic medical records |
| IJQSS | International Journal of Quality and Service Sciences |
| IJPPM | International Journal of Productivity and Performance Management |
| LCF | Lean cultural friction |
| Nummi | New United Motor Manufacturing, Inc. |
| PA | pragmatic ambiguity |
| PDCA | plan-do-check-act |
| RIE | rapid improvement event |
| TMMC | Toyota Motor Manufacturing Canada |
| TOC | theory of constraints |
| TPS | Toyota Production System |
| TQM | Total Quality Management |

*Pour tous ceux et celles qui, à l'instar de Daniel Bélanger, se souhaitent de rêver mieux.*

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Finally, to my patients. You have been sources of inspiration and of courage to pursue these studies toward an ultimate goal of making some contribution to continuous improvements in care and healthier organizations.

# Preface

This work remains a work-in-progress.

But it lays foundations to provide new answers to two compelling questions: ‘why is it so hard to implement Lean in healthcare?’ and ‘what can we all do better for patients?’

Healthcare appears to be in perpetual crisis everywhere. Concerns about quality, unsustainable rising costs and scarcer resources facing ever increasing demand date as far back Hippocrates to Donabedian (1966), Blumenthal (1996), Chassin (1996, 1998), Shortell *et al.* (1998), the Institute of Medicine (2001), Spear (2005) and Porter (2010) to name a few predominant reporters and accounts continue to pile up with no end seemingly in sight.

Many solutions have been proposed, tried and evidently, been deplorably failing. Among them, Lean now has a greater than 30-year history in manufacturing and has been experimented for more than 20 years in healthcare. Lean draws from the best features of Total Quality Management, Theory Z of organization, the notion of social capital, the learning organization concept, the swift and even flow and the sociotechnical systems theories, the search of excellence principles, the art of Japanese management and the teachings of Shewhart, Crosby, Deming, Feigenbaum and Juran, among other offerings. As such, Lean remains arguably the most attractive and suitable organizational system for healthcare. Focus on customers (patients), work in teams, increase value, eliminate waste, respect for people, systematic continuous improvement, long term vision, the fundamentals of Lean could hardly be more desirable and compatible for this field.

Lean represents an operations management summit for organizations of all domains, as evidenced by the epic success of the Toyota Production System and similar practices. But this ‘common sense’ business method has been very challenging to implement and to sustain in most organizations and particularly ones in healthcare (Radnor *et al.*, 2012). Unfortunately, there are no exceptions in Canada.

In 2011, Dr Yves Bolduc, then healthcare minister of the province of Quebec, announced a Lean healthcare implementation initiative in three organisations over three years (communiqué, 2011). I was fortunate enough to part of an external evaluation team mandated to study progress that were made. Materials collected during the project was originally planned to be used as source documents for this thesis. However, early on, it became manifest that several preliminary steps had to be taken before analysis of the rich and substantial data (over one hundred interviews) could be properly performed.

First came the inspiration to adopt a focused cultural perspective analytical approach over other organizational change perspectives, recognizing that what could be lost in comprehensiveness may be gained in depth. Then, an initial unsatisfying literature search screen on Lean culture lead to a full-blown comprehensive systematic literature review to build confidence in findings and uncover gaps of knowledge (essay 1). Meanwhile, a conceptual model building exercise intended to guide qualitative analysis took substantial efforts and creative thinking to attain a novel, reasonably clear and usable model (essay 2). A crucial element of this model though requires an explicit understanding of Lean healthcare culture in its ultimate form. This explains why, before even attempting to touch on any field data, the third piece of this large puzzle became a content analysis of Lean reference books (essay 3). This is in a nutshell what is to be found in this thesis.

Practicing medicine for more than 30 years including 20 years as a nephrologist and obtaining a first master degree in public health (MPH) in clinical effectiveness and then a second master in business administration (MBA) provided me with uncommon background education, training and experience to be inquisitive, determined, structured and perseverant enough to tackle these ambitious tasks of studying Lean healthcare culture and pursuing a PhD degree in management. It has been a fantastic and challenging ride. Please read on to discover how much.

# Introduction

When John F. Kracik pinpointed the term ‘Lean’ to describe generically the Toyota Production System and other similar bufferless organizational systems in 1988, little did he likely appreciate what worldwide lasting academic and professional phenomenon he has contributed to launch. This all too familiar deceptively plain four-letter word caught on and Lean still remains the word in English that best fit this equally deceptively simple at first glance, “common sense” but very challenging to master business method.

The more recent proposed academic definition of Lean appears to come from Gupta *et al.* (2016): ‘an integrated multidimensional approach encompassing wide variety of management practices based on philosophy of eliminating waste through continuous improvement’ (p. 1026). It is derived from a compilation of eight other definitions found in the literature. As fair and legitimate as this definition may be, it somewhat seems to fall short in its depiction of the fine, precise and intricate interactions and demanding capabilities Lean requires to work at its full potential. Keywords such as ‘multidimensional’, ‘wide variety of management practices’, ‘philosophy’ and even ‘continuous improvement’ beg for further clarification and greater understanding.

There would be many ways to accomplish this, but looking at matters from a specific or different perspective may be among the most powerful research strategies to yield greater knowledge over data triangulation by multiple documentation sources which aim more at increasing accuracy of findings.

Lean certainly offers several analytical access points: vertically, unit could be set at individual, team, organizational, local, national, or even international level; horizontally, it could be studied within or between fields of activity (such as automotive, construction, healthcare, …) or compared to others of similar or different nature (for example: manufacturing or service) or specialized domain (for example: accounting, human resources, information technology, leadership, marketing, professions, ...).

Moreover, as 'common sense' approach as it has been labelled, Lean, as an organizational system, is not natural and does not happen spontaneously. It represents a change. Fortunately, organizational change is one of the most extensively studied topics in management. Multiple perspectives have been described and even several organizational change theories have been developed. A few of them are presented and discussed in this thesis. They all represent complimentary analytical lenses, compensating for each other blind spots. Selecting one analytical perspective over others may nevertheless have advantages in research at it may enhance clarity and relevance of findings, allow for deeper investigations and decrease risks of fruitless intellectual wandering.

Finally, two very different basic research methods, qualitative and quantitative approaches, need to be considered in management research. Each have strengths and limitations. Both can be used for inductive as well as deductive inquiries and may be combined (Miles *et al.*, 2014). Quantitative research becomes most appropriate when research questions lend themselves to numerical answers and statistical analysis, when concepts are well-described, when variables are well-documented and adequately valued, when valid measure instruments exist and when large dataset are available or collection of sufficient numerical data is readily feasible (Patton, 2002). This is not the case for Lean and particularly for its culture. Qualitative methods allow then to study issues in more depth and details without the constraints of predetermined categories using a wide range of data, words and numbers, from an even wider range of source documents from official statements to casual interviews or experiential exposition. Research questions may be more open and broader at the start and gradually gain clarification and precision as the project is going on and learnings are made iteratively (Patton, 2002).

These points explain why, in this work, Lean is being approached from a focused cultural perspective, using a mixed methods methodology albeit mainly qualitatively, at an organizational unit of analysis level, with a keen interest on the healthcare sector, while leveraging out, of course, knowledge and insights of other service and manufacturing domains acquired over the entire 100- year history of the Toyota Production System and Lean (Holweg, 2007). These choices were partly arbitrarily and strategically set based on: 1- personal interests, as I am a physician and full-time nephrologist practicing medicine

for more than 30 years, and of my thesis director, 2- opportunity seizure as it was quickly realized that Lean culture was an under-developed concept from an academic standpoint and consequentely 3- some necessity because much ground work in defining concepts and describing research processes had to be performed to support findings.

This thesis is composed of three interrelated but self-contained scientific articles, each having its own introduction, methods, findings, discussion and conclusion, presented in two versions: detailed versions are found in each chapter of this document and abridged versions are included as appendices (1.1, 2.1, 3.1, respectively). The latter's have been constrained by instructions to authors of each target journal (less than 10000 words for the International Journal of Productivity and Performance Management (IJPPM) (article 1) (eprint March 6th, 2019 - https://doi.org/10.1108/IJPPM-03-2018-0087) and article 3 (in submission) and less than 8000 words for the International Journal of Quality and Service Sciences (article 2) (in submission). All versions have benefitted from incremental improvements recommended by multiple rounds of mentors' and reviewers' feedbacks. This thesis ends with a conclusion that highlights main contributions made by this work and plan for future research and inquiries.

# Theoretical framework

Although numerous models and conceptualizations of organizational culture can be found in the literature and are presented and discussed in the thesis, no actual theory appears to have been developed yet for this organizational change perspective and could have framed this work. This void was filled by following a standard process of scientific inquiry: formulate a research question, design a study, collect and analyse data and diffuse results.

For essay 1, the basic research question was: ‘what is Lean culture?’. For essay 2, the fundamental research question was: ‘what could be Lean cultural trajectories of healthcare organizations?’. For essay 3, considering that words may be viewed as cultural artefacts, its research question was: ‘what are leading cultural focuses of Lean reference books that could guide further Lean culture research’, which notion of leading cultural focuses or dominant cultural topics was subsequently renamed as cultural clusters.

This thesis adheres methodologically to the principles of mixed-methods designs as put forward by Miles, Huberman and Saldana (2014), which facilitate analytical linkage between qualitative and quantitative data and allow flexibility, albeit with rigor, in conducting studies.

Finally, whereas an ethnographic orientation could have been expected in such a study on organizational culture, this work is rather set epistemologically in a constructionist paradigm. As explained by Patton (2002), referring to Michael Crotty (1998), constructionism differs from the more familiar constructivism paradigm as the former is concerned by the collective generation and transmission of meaning and the latter about sense-making of the individual mind. Both schools of thought emphasize that reality is socially constructed under the premise that the human world is different from the physical world. It recognizes that human perceptions are not real in an absolute sense and therefore cannot be studied in a truly positivist, objective way. Constructionism has the appeal of considering truth and reality as being relative, dynamic, contextual and seeking consensus as opposed to being absolute, static, independent and unquestionable which, in regards to the complex field of healthcare, seems utterly fitting and suited.

# Chapter 1
# Lean Culture: a comprehensive systematic literature review


## Abstract

Purpose: This work seeks to assess the level of pragmatic ambiguity (PA) Lean culture has currently in the manufacturing and service literature.

Design/Methodology/Approach: A comprehensive systematic review of academic (journals, books and thesis) and commercial literature was undertaken drawn from a six databases search of two key words ('lean' and 'culture') and related citations.

Findings: A total sample of 1066 references (678 academic papers, 121 books, 103 theses, 164 commercial documents) were analyzed. We found contributions from 67 countries. 89% of citations were directly about Lean culture. However, for 86% of them, Lean culture was only discussed superficially. All four literature segments show an over 85% agreement on Lean culture being an organizational aim. We encountered 103 definitions of organizational culture and found 13 definitions of Lean culture. Issues of culture gap, leadership, human resource management, sustainability and innovation are found to amplify Lean culture's already high PA level.

Research implications: Further research and development are needed to decrease Lean culture's PA level and improve understanding of Lean from a cultural perspective.

Practical implications: Current Lean culture's high pragmatic ambiguity level has positive and negative effects on Lean implementation. Taking Lean implementation from a cultural perspective may facilitate an organization's Lean transformation journey.

Originality/Value: This is the first systematic literature review on Lean culture using a broad and inductive approach. Original evidence-based definitions of organizational and Lean culture are proposed.



Key Words: Lean, Culture, Manufacturing, Service, Review, Organization,

## 1.1 Introduction

With the ebbing of the Total Quality Management (TQM) movement and the seminal publication of Womack *et al.* `s 'The Machine that changed the world', Lean has become one of the prominent contemporary performance enhancing business proposition for both manufacturing and service organizations (Gupta *et al.*, 2016; Hines *et al.*, 2004). Portrayed as a salutary solution by its numerous advocates, it is also described as a waning fad by perhaps as many detractors in the academic and practitioner world of all fields (Atkinson and Nicholls, 2013; Newman, 1998; Seddon, 2011; Womack and Jones, 1996). As controversial as TQM once was, Lean finds its origins in the same principles and Operation Management Master Pioneers teachings of Shewhart, Deming, Juran and others (Bicheno and Holweg, 2009). But it took the ingenuity, the hard work and peculiar contextual circumstances of the Toyota car company to demonstrate the power of Lean on operational effectiveness and lead the way (Liker, 2004). Lean instructs organizations to continuously improve all of their operation elements by relentlessly creating value and removing non-value added or waste activities from the stance of the ultimate end-customer through initiatives of an entire body of trained motivated personnel (Mann, 2015; Rother, 2010; Womack *et al.*, 1990). It is often labelled as a 'common sense' approach that is very attractive and appears deceptively simple to master (Holweg, 2007; Radnor *et al.*, 2012).

Lean remains however notoriously difficult to implement with a reported adoption failure rate as high as 90% (Bhasin, 2012). It is puzzling that, even though it has been more than 40 years since Sugimori *et al.* (1977) published the first English account on Toyota Production System (TPS), Toyota's foundational actualisation and prime inspiration of Lean, managers and scholars are still struggling to crack open its code and replicate similar success as Toyota. Amongst all reported possible factors of this enigma, culture has been repeatedly evoked to be as much an explanation, a cause and a key solution (Amhad, 2013; Bortolotti *et al.*, 2015; Wong, 2007). But which culture though?

Culture in management can indeed take several meanings. In their review, "The Many Faces of Culture: Making Sense of 30 years of Research on Culture in Organizations Studies", Giorgi *et al.* (2015) present a framework in which, according to them, culture in management has been approached into five interrelated ways: as values, as stories, as frames, as toolkits and as categories. National culture, one of the earliest and longstanding hypotheses to explain Lean's successful development in Japan (Schonberger, 2007) falls into their first form, culture as values. However, national culture is less and less considered to be the issue. Although it took decades to demonstrate, Lean has now been convincingly shown not to be exclusively 'Japanese' as evidenced by the positive experience of the American Nummi (New United Motor Manufacturing, Inc.) project, the success of many other international Lean organizations in all domains and the simple fact that not all organizations in Japan are Lean (Krafcik, 1988; Kull *et al.*, 2014; Netland *et al.*, 2012).

In their paper, 'Culture change: an integration of three different views', Meyerson and Martin (1987), further highlight that analysis of culture in management needs to be interpreted in accordance to three paradigms: 1- an integrative one, which acknowledges the existence of organization-wide culture; 2- a differentiative one, which recognizes that, within any organization, there are sub-cultures that co-exist; and 3- an ambiguous one, which stresses the fact that individuals in organization bring their own cultural contributions which are continuously influenced by other cultures outside the organization and are to be addressed appropriately by management for optimal organizational performance.

Determining what kind of culture (individual, team, organizational, communal) or whose culture (leaders, managers, employees, suppliers, customers) are more important in Lean or which features of culture are relevant for Lean success or in fact, finding out what is exactly a Lean culture does not come by easily with rapid search in the manufacturing or service literature. In fact, the notion of Lean culture appears to be rather used freely by all for all. Lean culture seems indeed to be in a state of convenient pragmatic ambiguity.

Pragmatic ambiguity is a construct developed by Giroux which she defines as: 'the condition of admitting more than one course of action' in her analysis of the TQM movement and management fashions (Giroux, 2006). Pragmatic ambiguity allows the co-existence of multiple, even possibly diametrically opposite, interpretations of the same concept leading to many different applications. It creates a situation in which concepts such as Lean and its culture find sufficient recognition to exist but may be used in many different ways to support any argument liberally. When there is pragmatic ambiguity, everyone has sort of an idea of what the actual concepts are and mean. Everyone kind of agrees of what they are not or ultimately agrees to disagree but the concepts survive and may even thrive for a while. However, a condition of pragmatic ambiguity can only last for so long before flaws and inconsistencies are exposed, confusion sets and interest wanes. As TQM's faith demonstrates, what may have been in the limelight for a while is at risk of vanishing away unless the concepts are clarified and properly characterized.

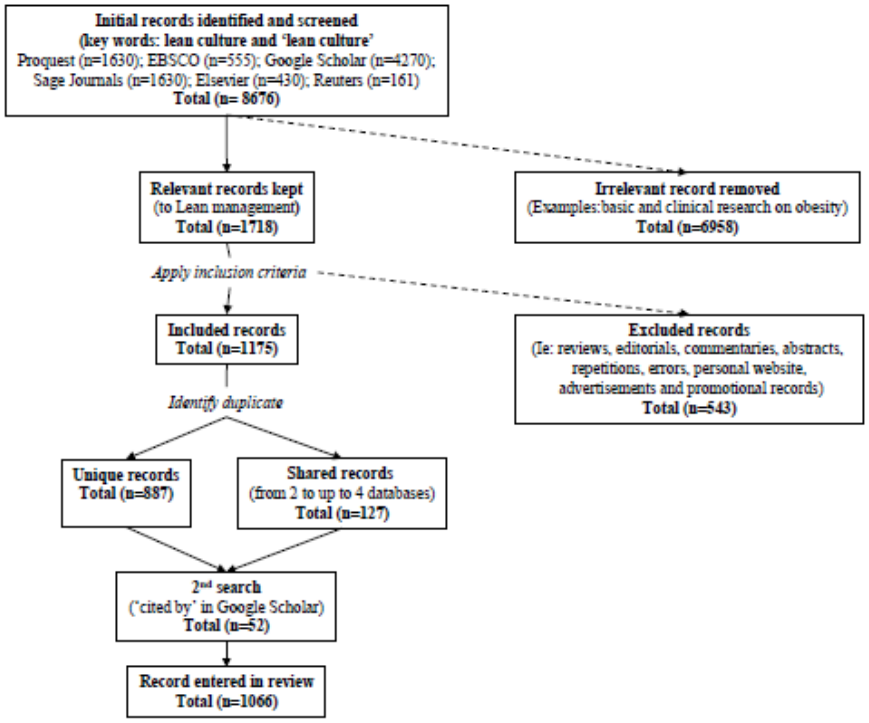
For this purpose, systematic literature reviews can be very useful and effective. Templier and Paré (2015) have identified four different types of systematic literature reviews: the narrative, the developmental, the cumulative and the aggregative types. Each one has strengths and challenges which direct selecting the proper type to use. As brief examples, a narrative review aims to strictly summarize knowledge in a topic but does not include novel propositions or theory validation; a developmental review uses a selection of leading documents for the construction of new conceptual framework and theories; a cumulative review compiles evidence methodically to identify patterns and generate new knowledge whereas aggregative review pools knowledge of similar documents for the performance of evidence-based meta-analyses.

This work intends to assess the level of pragmatic ambiguity Lean culture currently has in the literature and describes its source, its range and its scope through a comprehensive systematic review of Templier and Paré's cumulative type. A discussion is provided highlighting the positive and negative implications of Lean culture's current pragmatic ambiguity level and the paper concludes with its limitations and suggestions for further research and development on Lean culture.

## 1.2 Methods

This systematic literature review emulates, adapts and extends methodology of other recent literature reviews on Lean services (Gupta *et al.*, 2016), Lean Healthcare (Costa and Filho, 2016; D'Andreamatteo *et al.*, 2015) and Lean Six Sigma in Manufacturing (Albliwi *et al.*, 2015). Findings of the latest one on Lean research by Danese *et al.* (2017) are considered in the discussion. This review respects the three generic stages (planning, conducting and reporting) recommended by Tranfield *et al.* (2003) for systematic literature reviews and methods is of the cumulative type as described by Templier and Paré (2015). Because the purpose of the study was to investigate the extent of Lean culture pragmatic ambiguity which revealed itself during the conduct of the study, we purposely did not pre-determine a data collection plan and proceeded and coded information iteratively. We also did not apply any search restrictions in the literature type and timeframe based on the perception that valuable Lean knowledge may actually lie in all literature segments. A first literature search was performed October 30th and 31st, 2016 on six electronic databases (1-ABI/inform (Proquest), 2- Business Source Complete (EBSCO), 3-Sage Journals, 4- Science Direct (Elsevier), 5- Web of Science (Reuters), 6-Google Scholar) in triplicate to confirm stability of listings, using simply two key words: 'lean' and 'culture' to maximize findings without brackets and without a time frame limit. 6 month later, April 30th, 2017, a second literature search was then done with the same two key words 'lean culture' with brackets in all same six electronic databases in triplicate to enhance this work`s comprehensiveness and validity. When permitted, filters were applied to restrict listing regarding management, which allowed avoidance of irrelevant entries relating, for examples, to basic and clinical research on obesity. Then, citation abstracts were screened for relevance to the purpose of investigating the Lean culture concept in the literature. To maximise inclusiveness, we did not rate or restrict documents based on their quality but reviews, editorials, commentaries and abstracts were discarded. Figure 1 presents a records selection flowchart.

Figure 1 Record selection flowchart




Interestingly, although there was a certain amount of cross-detection between databases (12% or 127), no record was unanimously cited by all of them. ABI/inform (Proquest) and Business Source Complete (EBSCO) had the most similar search (48 shared citations or about 40%) in the first search (31-10-16). There were very few shared records in the second search (30-04-17) (6% or n=37). Search in Business Source Complete (EBSCO) had the most repeat within its own listing citations followed by Google Scholar. Google Scholar had the highest number of erroneous citations. After eliminating these repeats and errors, citations from personal website or of promotional nature were discarded as they carry the heaviest bias load and have little or no review process for diffusion. Citations in foreign languages other the English or French were not considered. Note that only one record in French ended up in the review. As scientific knowledge is traditionally built incrementally, we took advantage of the contemporary 'cited by' feature enabled in Google Scholar to re-search all found citations for additional recent references. Many recurrent citations were encountered but 52 new entries were identified by this scheme (for more details, see Table 1).

Table 1 Results of literature search

| Key words : Lean Culture (31-10-16) | Initials | Relevant | Discarded | Sub-total | Unique | Shared |
|---|---|---|---|---|---|---|
| ABIM/Inform (Proquest) | 1506 | 144 (10%) | 12 (8%) | 132 | 60 (14%) | 72 |
| Business Source Complete (EBSCO) | 507 | 167 (33%) | 66 (40%) | 101 | 38 (9%) | 63 |
| Google Scholar (sorted*) | 2100 | 227 (11%) | 28 (12%) | 199 | 154 (35%) | 45 |
| Sage Journals (filtered**) | 1620 | 15 (1%) | | 15 | 14 (3%) | 1 |
| Science Direct (Elsevier) (filtered***) | 366 | 21 (6%) | 2 (10%) | 19 | 17 (4%) | 2 |
| Web of science (Reuters) (filtered****) | 135 | 49 (36%) | 3 (6%) | 46 | 17 (4%) | 29 |
| Shared (by 2 up to 4 databases) | | | | | 90 (21%) | |
| 2nd search | | | | | 47 (11%) | |
| Total | | | | | 437 (100%) | |
| Key words : 'Lean Culture' (30-04-17) | | | | | | |
| ABIM/Inform (Proquest) | 124 | 103 (83%) | 79 (77%) | 24 | 19 (3%) | 5 |
| Business Source Complete (EBSCO) | 48 | 46 (96%) | 28 (61%) | 18 | 13 (2%) | 5 |
| Google Scholar (sorted*) | 2170 | 865 (40%) | 300 (35%) | 565 | 531 (85%) | 34 |
| Sage Journals (filtered**) | 10 | 10 (100%) | 3 (30%) | 7 | 5 (0.8%) | 2 |
| Science Direct (Elsevier) (filtered***) | 64 | 46 (72%) | 10 (22%) | 36 | 16 (2.5%) | 20 |
| Web of science (Reuters) (filtered****) | 26 | 25 (96%) | 12 (48%) | 13 | 3 (0.5%) | 10 |
| Shared (by 2 up to 4 databases) | | | | | 37 (6%) | |
| 2nd search | | | | | 5 (0.8%) | |
| Total | | | | | 629 (100%) | |
| Entire Literature Review | | | | | | |
| ABIM/Inform (Proquest) | | | | 156 | 79 (7%) | 77 |
| Business Source Complete (EBSCO) | | | | 119 | 51 (5%) | 68 |
| Google Scholar (sorted*) | | | | 764 | 685 (64%) | 79 |
| Sage Journals (filtered**) | | | | 22 | 19 (2%) | 3 |
| Science Direct (Elsevier) (filtered***) | | | | 55 | 33 (3%) | 22 |
| Web of science (Reuters) (filtered****) | | | | 59 | 20 (2%) | 39 |
| Shared (by 2 up to 4 databases) | | | | | 127 (12%) | |
| 2nd search | | | | | 52 (5%) | |
| Total | | | | | 1066 (100%) | |

Note: * 798000 primary entries the sorted by relevance; ** 11421 primary entries filtered by 'management' and 'organizational studies'; *** 34132 primary entries filtered by 'journal' and 'organization'; **** 1067 primary entries filtered by 'management', 'business', 'operations research management', 'science', 'sociology', 'healthcare science services', 'health policy services', 'social sciences interdisciplinary', 'psychology' and 'psychology multidisciplinary'.

Retrieval of documents took 16 weeks (2 periods of 8 weeks) with a success rate of 98% (24 missing). Baseline information of each document (authors' name; country of first author; nature, methods and base industry of the document; publication title, subject and year; and publisher) were collected in an Excel spreadsheet and validated by a research assistant (agreement > 95%). Discordances were settled by discussion and senior author decision. Then Lean culture information were extracted from each document and

processed in additional Excel spreadsheets. Coding was conducted by making as little inference as possible. Definitions to be considered had to be explicitly stated as well as any features of Lean culture. hence, records were determined superficial if Lean culture was basically mentioned without any other precision or along with use of a plain synonym such as culture of continuous improvement (the most common). Substantial records include some form of construct development: either by details on organizational culture or on definition or description of Lean and/or of Lean culture. For the aim to indicate greater support in our results, when appropriate, statistical analyses (chi-squared tests) were performed with Excel software v 16.0.9001.2080. Threshold for significance is set at standard $p < 0.05$.

## 1.3 Findings

### *1.3.1 Source documents about Lean culture pragmatic ambiguity assessment*

This systematic literature review covers the content of a total of 1066 documents including 678 academic journal papers, 121 books, 103 theses and 164 commercial literature articles. No previous systematic review on Lean culture was found in our search. Source documents about Lean culture pragmatic ambiguity assessment's analysis covers information about countries of origin, authorship and timeline, publishers, fields of study, documents' method, academic contribution and by its extent.

The notion of Lean culture is found to have a wide international appeal with contributions from 67 countries. The six most productive countries, as determined by affiliation of the first author, were: the USA (n=413, 39%), the UK (n=129, 12%), Sweden (n=52, 5%), Malaysia (n=38, 4%), Canada (n=33, 3%) and India (n=30, 3%). This finding that sourcing from the USA and UK represents greater than 50% of references is consistent among all recent systematic reviews (Danese *et al.*, 2017; Costa and Filho, 2016; Gupta *et al.*, 2016). By continent, 448 Lean culture documents were hence from North America, 388 from Europe, 154 from Asia, 33 from Africa, 27 from South America and 16 from Australia (Table 2). Remarkably, only two Japanese articles addressing Lean accounting were found. They essentially though simply referred to the notion of Lean culture without any development. Sparsity of Japanese communication on Lean has been previously noted

by Guimaraes *et al.* (2012) who did not find any publications from Japan in their Lean Healthcare literature review. This is also observed in the other three recent aforementioned systematic reviews. Japan's silence over Lean is puzzling. Any explanation at this point would be speculative and requires further investigation, which is more likely to come from Europe as overall, this review findings suggest that European authors contribute to Lean culture literature with more scientific contents than North American's, who write more books and commercial literature ($p < 0.0001$).

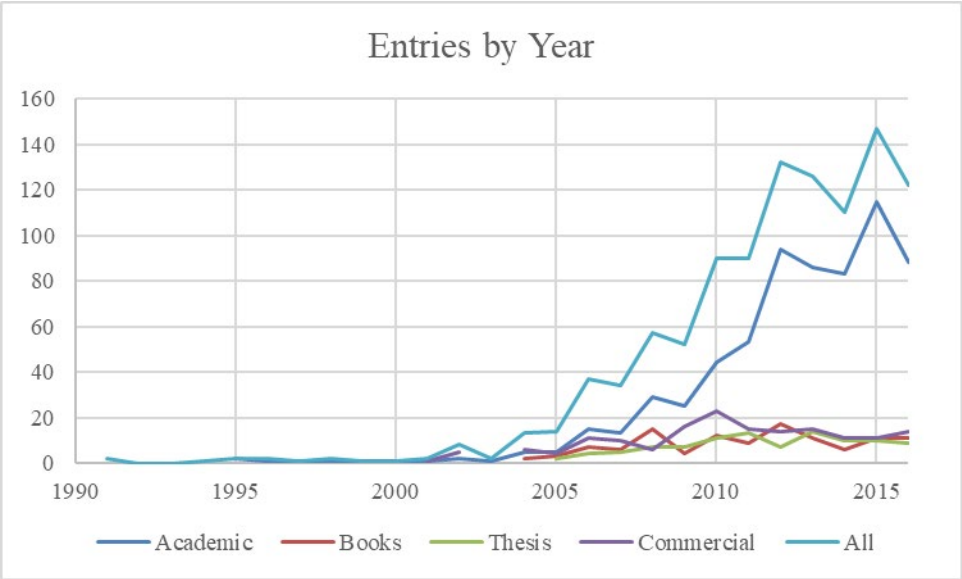
Table 2 Entries by continent

| 31-10-16 | North America | Europe | Asia | Africa | South America | Australia | Total |
|---|---|---|---|---|---|---|---|
| Academic papers | 79 (27%/42%) | 138 (47%/81%) | 50 (17%) | 10 (3%) | 7 (2%) | 7 (2%) | 292 |
| Books | 31 (77%/17%) | 9 (23%/5%) | | | | | 39 |
| Thesis | 11 (48%/6%) | 9 (39%/6%) | 2 (9%) | 1 (4%) | | | 23 |
| Commercial articles | 66 (80%/35%) | 15 (18%/9%) | | 1 (1%) | 1 (1%) | | 83 |
| Sub-total | 187 (43%) | 171 (39%) | 52 (12%) | 12 (3%) | 8 (2%) | 7 (2%) | 437 |
| 30-04-17 | North America | Europe | Asia | Africa | South America | Australia | |
| Academic papers | 102 (26%/39%) | 156 (40%/72%) | 88 (23%/85%) | 17 (4%) | 17 (4%) | 6 (2%) | 386 |
| Books | 48 (59%/18%) | 22 (27%/10%) | 9 (11%/9%) | | 3 (4%) | | 82 |
| Thesis | 41 (51%/16%) | 30 (38%/14%) | 5 (6%/5%) | 4 (5%) | | | 80 |
| Commercial articles | 70 (86%/27%) | 8 (10%/4%) | 1 (1%/1%) | | | 2 (2%) | 81 |
| Sub-total | 261 (41%) | 216 (34%) | 104 (17%) | 21 (3%) | 20 (3%) | 7 (1%) | 629 |
| Entire Review | North America | Europe | Asia | Africa | South America | Australia | |
| Academic papers | 181 (27%/40%) | 295 (44%/76%) | 138 (20%/90%) | 27 (4%) | 24 (4%) | 13 (2%) | 678 |
| Books | 79 (65%/18%) | 30 (25%/8%) | 9 (7%/6%) | | 3 (2%) | | 121 |
| Thesis | 52 (50%/12%) | 40 (39%/10%) | 6 (6%/4%) | 5 (5%) | | | 103 |
| Commercial articles | 136 (83%/30%) | 23 (14%/6%) | 1 (1%/1%) | 1 (1%) | | 3 (2%) | 164 |
| Total | 448 (42%) | 388 (36%) | 154 (14%) | 33 (3%) | 27 (3%) | 16 (2%) | 1066 |

With ten contributions, S Bhasin is the most prolific author on the topic. However, seven of his papers are essentially re-analysis of the same data collection involving a detailed survey questionnaire of 68 UK manufacturing organizations followed by a comprehensive audit of a subset of 20 of these organizations. We also identified late in the analysis four academic articles published twice, word for word, in two distinct journals under different titles. These are two examples of the risk of conducting systematic reviews on discovering anomalies in the literature. 63% entries had more than one author (670/1066), suggesting greater validity through collaborative work. The earliest entry found in our review was

published in 1991. 61% (655/1066) have been published in the last 5 years with a peak in 2015 (n=147,14%) (Figure 2).

Figure 2 Lean culture entries by year of publication




Over the years, Lean culture has caught the interest of 418 different publishers: the most important being the Emerald Group Publishing (106/1066; 10%), closely followed by Taylor and Francis Group (82/1066; 8%) and then Elsevier (71/1066; 7%). This finding is very similar to Gupta *et al.* (2016) review. With 18 entries, International Journal of Lean Six Sigma is the main journal on the topic, followed by Journal of Manufacturing Technology Management (n=12), International Journal of Productivity and Performance (n=12), International Journal of Production Research (n=10) and International Journal of Operations & Production Management (n=10). 16 records were from proceedings of IIE Annual Conference (IISE) (Institute of Industrial and Systems Engineers). Overall, management publications (67%) predominates engineering (33%) one.

The majority of entries were clearly from the manufacturing world (598/1066; 56%), 31% (330/1066) came from the service domain and the remaining 138 (13%) were general. Authors were inspired from experiences from over 70 different industrial fields (Table 3). Most documents reported on multiple fields. It is remarkable that healthcare, a service, is the highest single field interest on Lean culture (186/304; 61%) far ahead the next second

one, construction (86/321; 27%), which is surprisingly outnumbering motor vehicle (85/321; 26%), both from the manufacturing sector. Despite the large coverage, several important industries such as retail, legal, entertainment or tourism appear to be missing.

Table 3 List of single fields and Lean culture by industry

| Manufacturing (n=321) | Services (n=304) |
|---|---|
| Construction (27%) | Healthcare (61%) |
| Motor vehicle/parts/tires (26%) | Education/library (10%) |
| Electronic/communication/IT (9%) | IT (9%) |
| Aerospace/aviation/defense/weapon (7%) | Logistics/supply chain/transport/warehousing (5%) |
| Steel/metal/mining/forge/heavy/die casting/pipes (7%) | Public/power/energy (4%) |
| Energy/oil/electric/air conditioning (6%) | Accounting/administration |
| Furniture/wood/building material/saw/fixture (6%) | Bank/finance |
| Chemical/pharma/healthcare/lab/life sciences (5%) | Aerospace/aviation/airports/automotive |
| Agriculture/food/beverage/wine (3%) | Communication/mobile phone/telecom/photo |
| Packaging/styrofoam/plastic/composite | Food |
| Apparel/garment/textile | Construction |
| Miscellaneous | |

Note: in order of frequency; % less than 3% not indicated

Note that out of the 103 theses retrieved in this literature search, 22 were at PhD level. Content of the other 81 have been thereafter excluded since main purpose of baccalaureate and master degree`s thesis is to demonstrate capability and conceptual understanding and not particularly to contribute to the literature. Moreover, thesis's gradings are not provided. Hence, a total of 985 documents were ultimately considered for further analysis.

In terms of methods, there is almost an even split with a predominance for qualitative analysis: single case (221/985; 22%) and multi-case (150/985; 15%) whereas quantitative analysis accounted for 21% (204/985); conceptual nature/modelization for 15% (148/985) and literature review for 7% (67/985). Ultimately, the remaining documents were based on expert opinion (195/985); 20%) (Table 4).

Table 4 Entries by methods

| 31-10-16 | Quali(case) | Quali(multi-cases) | Quanti | Conceptual/model | Lit review | Expert opinion | Total |
|---|---|---|---|---|---|---|---|
| Academic papers | 64 (22%) | 53 (18%) | 79 (27%) | 61 (21%) | 33 (11%) | 2 (1%) | 292 |
| Books | 6 (15%) | 4 (10%) | | 3 (8%) | | 26 (67%) | 39 |
| Thesis (PhD) | 2 (33%) | 2 (33%) | 2 (33%) | | | | 6 |
| Commercial articles | 4 (5%) | 1 (1%) | | 1 (1%) | | 77 (93%) | 83 |
| Sub-total | 76 (18%) | 60 (14%) | 81 (19%) | 65 (15%) | 33 (8%) | 105 (25%) | 420 |
| 30-04-17 | Quali(case) | Quali(multi-cases) | Quanti | Conceptual/model | Lit review | Expert opinion | |
| Academic papers | 104 (27%) | 54 (14%) | 106 (27%) | 69 (18%) | 33 (9%) | 20 (5%) | 386 |
| Books | 11 (14%) | 23 (28%) | 8 (10%) | 13 (16%) | 1 (1%) | 25 (31%) | 81 |
| Thesis (PhD) | 2 (13%) | 6 (38%) | 7 (47%) | 1 (6%) | | | 16 |
| Commercial articles | 28 (34%) | 7 (9%) | 2 (2%) | | | 45 (55%) | 82 |
| Sub-total | 145 (26%) | 90 (16%) | 123 (22%) | 83 (15%) | 34 (6%) | 90 (16%) | 565 |
| Total | Quali(case) | Quali(multi-cases) | Quanti | Conceptual/model | Lit review | Expert opinion | |
| Academic papers | 168 (25%) | 107 (16%) | 185 (27%) | 130 (19%) | 66 (10%) | 22 (3%) | 678 |
| Books | 17 (14%) | 27 (23%) | 8 (7%) | 16 (13%) | 1 (1%) | 51 (43%) | 120 |
| Thesis (PhD) | 4 (18%) | 8 (36%) | 9 (41%) | 1 (5%) | | | 22 |
| Commercial articles | 32 (19%) | 8 (5%) | 2 (1%) | 1 (1%) | | 122 (74%) | 165 |
| Total | 221 (22%) | 150 (15%) | 204 (21%) | 148 (15%) | 67 (7%) | 195 (20%) | 985 |

Table 5 provide an overview of the extent and range of pragmatic ambiguity found in this literature searches. 89% (879/985) of documents concerned directly Lean culture whereas the remaining 11% covered the topic indirectly either by discussing techniques related to Lean such as Six Sigma, Lean Six Sigma, TQM or by making general comments about culture and organizational change not specifically associated to Lean. Most of the former addressed the issue of Lean culture superficially (753/879; 86%) and only 14% (126/879) treated the subject with some substance either by providing definitions or any depth in their discussion. A prime example can be found in David Mann's book, Creating a Lean Culture. It does not contain a Lean culture definition but suggests a workplace culture definition such as 'the way we do things here' and it explains: 'As Lean management, with its closed-loop focus on process, becomes habitual, little by little—almost unnoticeably at first—a Lean culture begins to grow. The new Lean culture emerges as leaders replace the mindset to work around problems today, …' (Mann, 2015, p.9).

Table 5 Extent and range elements of Lean culture pragmatic ambiguity

| Entire review | | Academic | Books | Thesis (PhD) | Commercial | total |
|---|---|---|---|---|---|---|
| | | | | | | |
| by point | Direct | 600 (88%\68%) | 108 (90%\12%) | 20 (91%\2%) | 151(92%\17%) | 879 (89%\ ) |
| | Indirect | 78 (12%\74%) | 12 (10%\11%) | 2 (9%\2%) | 14 (8%\13%) | 106 (11%\ ) |
| total | | 678 ( \69%) | 120 ( \12%) | 22 ( \2%) | 165 ( \17%) | 985 |
| | | | | | | |
| by coverage | Superficial | 521 (87%\69%) | 74 (69%\10%) | 15 (75%\2%) | 143(95%\19%) | 753 (86%\ ) |
| | Substantial | 79 (13%\63%) | 34 (31%\27%) | 5 (25%\4%) | 8 (5%\6%) | 126 (14%\ ) |
| total | | 600 ( \68%) | 108 ( \12%) | 20 ( \2%) | 151 ( \17%) | 879 |
| | | | | | | |
| by culture nature | Pre-requisite | 16 (3%\84%) | 1 (1%\5%) | 0 | 2 (1%\11%) | 19 (2%\ ) |
| | Mean | 47 (8%\82%) | 3 (3%/5%) | 2 (10%\4%) | 5 (3%\9%) | 57 (6%\ ) |
| | Aim | 525 (88%\67%) | 102 (94%\13%) | 18 (90%\2%) | 141(93%\18%) | 786 (89%\ ) |
| | Outcome | 12 (2%\ 71%) | 2 (2%\12%) | 0 | 3 (2%\18%) | 17 (2%\ ) |
| total | | 600 ( \68%) | 108 ( \12%) | 20 ( \2%) | 151 ( \17%) | 879 |
| | | | | | | |
| by main bearer | Leaders | 156 (26%\64%) | 36 (33%\15%) | 9 (45%\4%) | 43 (28%\18%) | 244 (28%\ ) |
| | Managers | 30 (5%\65%) | 4 (4%\9%) | 0 | 12 (8%\26%) | 46 (5%\ ) |
| | Personnel | 19 (3%\59%) | 4 (4%\13%) | 1 (5%\3%) | 8 (5%\25%) | 32 (4%\ ) |
| | Other | 6 (1%\60%) | 1 (1%\10%) | 1 (5%\10%) | 2 (1%\10%) | 10 (1%\ ) |
| | Not specified | 389 (65%\71%) | 63 (58%\12%) | 9 (45%\2%) | 86 (57%\16%) | 547 (62%\ ) |
| total | | 600 ( \68%) | 108 ( \12%) | 20 ( \2%) | 151 ( \17%) | 879 |

Notes: See appendix for supplemental table 5a and 5b for breakdown of table into first (31-10-16) and second (30-04-17) literature search

### *1.3.2 Range of Lean culture pragmatic ambiguity*

Although analysis of source documents provides already much diversity in the medium, greater evidence of pragmatic ambiguity is uncovered by looking into their content in the forms of range presented first and scope discussed later. Range of Lean culture pragmatic ambiguity is here found to be demonstrated in terms of nature and bearer, publication bias, manufacturing vs service treatment, quantitative method analysis, CVF (Competing Value Framework) vs Lean culture, national culture and deeper exploration.

As it can be appreciated also in Table 5, for the large majority (786/879; 89%), Lean culture was presented as 1- an organizational aim, a status to aspire, as opposed to 2- a pre-requisite or a condition precedent to Lean (19/879; 2%), 3- a mean or a tool used to master Lean (57/879; 6%) or 4- an outcome (17/879; 2%), i.e. a by-product of Lean. The role and responsibility of primary Lean culture bearer was allocated to the organization

leaders (CEO or upper management team) in 244 articles (28%) as opposed to middle managers (46/879; 5%) or front-line personnel (32/879; 4%). Other includes all and government (10/879; 1%). For 547 (62%), no one in particular was mentioned to be responsible for upholding Lean culture.

The relative similar distribution of all these proportions amongst each literature segment (academic, books, thesis, commercial) suggests that these findings legitimately represent the current Lean culture situation. It supports their validity and the quality and relevance of this literature search.

There is however suggestion of probable publication bias in the review sample records since most authors but three documents state positive aspects of Lean culture for organizations. We found the earliest dissenter in Newman and Chaharbaghi (1998). In their paper 'The Corporate Cultural Myth', they stand strongly against any use for the notion of organizational culture. Their virulent argumentation even compares culture to a cancer that may destroy defenseless organizations despite the fact that they paradoxically define culture as 'the by-product of a technology that has been developed in exploiting an opportunity'. The second negative view on the concept of Lean culture comes from Bicheno and Holweg (2009). In their book 'The Lean ToolBox', they share (Peter) Scholtes' scepticism about culture and claim that it is a greatly misused word and a too easy fallback excuse for Lean`s failure. Finally, the third and last counter argument against Lean culture we found resides in Seddon (2011). For him, Lean and its culture can only be a fad since it essentially only 'solves problems managers think they have' and 'is as far as from (Taiichi) Ohno's philosophy as it is possible to get'. He, however, does not provide much more explanation to support his position.

Our analysis reveals several statistically significant differences between contributions from the manufacturing and the service sectors (Table 6). Manufacturing Lean culture literature appears to be of more scientific content than for service's with a greater relative number of academic papers and lesser books and commercial articles than service and general domains. General domains authors tend to write more books compared to those in manufacturing and service activities ($p < 0.0001$).

Table 6 Contributions of manufacturing vs service sectors

| 31-10-16 | Manufacturing | Service | General | Total |
|---|---|---|---|---|
| Academic papers | 155 (78%\53%) | 98 (64%\34%) | 39 (59%\13%) | 292 (70%\ ) |
| Books | 13 (7%\33%) | 10 (6%\26%) | 16 (24%\41%) | 39 (9%\ ) |
| Thesis | 1 (1%\17%) | 5 (3%\83%) | 0 | 6 (1%\ ) |
| Commercial articles | 31 (16%\37%) | 41 (27%\49%) | 11 (17%\13%) | 83 (20%\ ) |
| sub-total | 200 ( \48%) | 154 ( \37%) | 66 ( \16%) | 420 |
| 30-04-17 | | | | |
| Academic papers | 259 (78%\67%) | 93 (54%/24%) | 34 (53%\9%) | 386 (68%\ ) |
| Books | 30 (9%\37%) | 27 (16%/33%) | 25 (39%\30%) | 82 (15%\ ) |
| Thesis | 9 (3%\56%) | 5 (3%\31%) | 2 (3%\13%) | 16 (3%\ ) |
| Commercial articles | 32 (10%\40%) | 46 (27%\57%) | 3 (5%\4%) | 81 (14%\ ) |
| sub-total | 330 ( \58%) | 171 ( \30%) | 64 ( \11%) | 564 |
| Entire review | | | | |
| Academic papers | 414 (78%\61%) | 191 (59%\28%) | 73 (56%\11%) | 678 (69%\ ) |
| Books | 43 (8%\36%) | 37 (11%\31%) | 41 (32%\34%) | 121 (12%\ ) |
| Thesis | 10 (2%\45%) | 10 (3%\45%) | 2 (2%\9%) | 22 (2%\ ) |
| Commercial articles | 63 (12%\38%) | 87 (27%\53%) | 14 (11%\9%) | 164 (17%\ ) |
| Total | 530 ( \54%) | 325 ( \33%) | 130 ( \13%) | 985 |

Chisqrd $p < 0.0001$

From Table 7, service and general sectors seem to have less direct Lean content predominance than manufacturing, which suggests more exploration on other forms of business performance improvement model such as Six Sigma. Authors from the general domain seem to discuss Lean culture more substantially. There is no difference between manufacturing, service and general documents in regard to their vision of Lean culture which is seen by over 89% to be an organizational aim as opposed to a pre-requisite, a mean or an outcome (p=0.28 NS). High level of pragmatic ambiguity certainly exists not only because of the consequent 11% having alternate vision but also because very little information is actually given about what is precisely meant by aim as majority of documents remain superficial. All segments (manufacturing, service, general) put leaders as the main bearer of Lean culture in concordance with all growing evidence supporting the crucial impact of leadership on Lean mastership (p=0.07 NS) (Al-Najem *et al.*, 2012; Keiser, 2012; Mann, 2009; Schein, 2010; White *et al.*, 2013).

Table 7 Range of Lean culture ambiguity (manufacturing vs service sectors)

| Entire review | | Manufacturing | Service | General | Total |
|---|---|---|---|---|---|
| | | | | | |
| by point | Direct | 510 (94%\58%) | 262 (85%\30%) | 107 (82%/12%) | 879 (89%\ ) |
| | Indirect | 34 (6%\32%) | 48 (15%\45%) | 24 (18%/23%) | 106 (11%\ ) |
| total | | 544 ( \55%) | 310 ( \31%) | 131 ( \13%) | 985 |
| | | | | | |
| by coverage | Superficial | 447 (88%\59%) | 231 (88%\31%) | 75 (70%\10%) | 753 (86%\ ) |
| | Substantial | 63 (12%\50%) | 31 (12%\25%) | 32 (30%\26%) | 126 (14%\ ) |
| total | | 510 ( \58%) | 262 ( \30%) | 107 ( \12%) | 879 |
| | | | | | |
| by culture nature | Aim | 449 (88%\57%) | 240 (92%\31%) | 97 (91%\12%) | 786 (89%\ ) |
| | Other | 61 (12%\66%) | 22 (8%\24%) | 10 (9%\11%) | 93 (11%\ ) |
| total | | 510 ( \58%) | 262 ( \30%) | 107 ( \12%) | 879 |
| | | | | | |
| by main bearer | Leaders | 111 (67%\47%) | 92 (77%\39%) | 35 (81%\15%) | 238 (73%\ ) |
| | Other | 54 (33%\61%) | 27 (23%\30%) | 8 (19%\9%) | 89 (27%\ ) |
| Total | | 165 ( \50%) | 119 ( \36%) | 43 ( \13%) | 327 |

Notes: Culture nature and main bearer had to be dichotomized since there was not enough spread of data to allow statistical analysis, which could not be performed either by literature segment for the same reason.

See appendix for supplemental table 7a and 7b for breakdown of table into first (31-10-16) and second (30-04-17) literature search

Additional evidence of the large range of the current Lean culture pragmatic ambiguity level is demonstrated by methodology analysis of the 185 direct quantitative academic papers retrieved in our literature search. There appears to be little consensus on the proper survey instrument to use as 81% (150/185) developed their own original questionnaire making any comparison of findings challenging. Main stated sources of inspiration for construction of these surveys were Liker`s Toyota Way, Hosfstede's and the Globe study cultural dimensions, Cameron and Quinn`s Competing Value Framework and Shah and Ward`s Lean performance indicators. Table 8 illustrates predicted impact and, whenever actually performed, study findings related to cultural dimensions proposed by Hofstede and the Globe study.

Table 8 Hofstede and Globe study cultural dimensions Lean culture comparison

| Cultural | Bortolotti et al (2015) | | Kull et al (2014) | | Wincel and Kull (2013) | | Martins et al. (2015) | Lacksonen et al. (2010) | Abrahamsson and Isaksson (2012) |
|---|---|---|---|---|---|---|---|---|---|
| Dimensions | predicted | found | predicted | found | predicted | found | predicted | predicted | predicted |
| Assertiveness | lower | lower | lower | lower | lower | lower | low | | |
| Future orientation | higher | higher | **higher** | lower | lower | lower | high | high | high |
| Humane orientation | higher | higher | **higher** | ***no effect*** | **neutral** | **higher** | high | | |
| In-group collectivism | **higher** | ***no effect*** | **higher** | ***no effect*** | neutral | neutral | moderate | high | |
| Institutional collectivism | higher | higher | **higher** | ***no effect*** | **higher** | ***no effect*** | moderate | high | |
| Performance orientation | **higher** | ***no effect*** | **higher** | ***no effect*** | **lower** | ***no effect*** | high | | |
| Power distance | **lower** | ***no effect*** | **lower** | ***no effect*** | neutral | neutral | moderate | low | low |
| Uncertainty avoidance | **higher** | ***no effect*** | higher | higher | higher | higher | high | high | high |

Note 1 : as reported by Martins et al. (2015) : Assertiveness refers to 'the degree to which organizations or societies are assertive, confrontational, and aggressive in social relationships'; Future orientation refers to 'the degree to which individuals in organizations or societies engage in future-oriented behaviours such as planning, investing in the future, and delaying gratification'; Humane orientation refers to 'the degree to which individuals in organizations or societies encourage and reward individuals for being fair, altruistic, friendly, generous, caring, and kind to others'; In-group collectivism refers to 'the degree to which individuals express pride, loyalty, and cohesiveness in their organizations or families'; Institutional collectivism refers to 'the degree to which organizational and societal institutional practices encourage and reward collective distribution of resources and collective action'; Performance orientation refers to 'the extent to which an organization or society encourages and rewards group members for performance improvement and excellence'; Power distance refers to 'the degree to which members of an organization or society expect and agree that power should be unequally shared' and Uncertainty avoidance refers to 'the extent to which members of an organization or society strive to avoid uncertainty by reliance on social norms, rituals, and bureaucratic practices to alleviate the unpredictability of future events'.

Note 2 : Bortolotti et al. (2015), Kull et al. (2014) and Wincel and Kull (2013) compared lean manufacturing organizations to non-lean manufacturing organizations which explains why higher and lower estimation are indicated; whereas for Martins et al. (2015), Lacksonen et al. (2010) and Abrahamsson and Isaksson (2012) only provide their predictions about what Lean culture should be, hence use of high, moderate and low estimate.

Note 3: *no effect* is short for *no statistically significant effect*

The most glaring discordance is seen in the dimension of future orientation, which relates to long-term planning and working relationships (Wincel and Kull, 2013; Martins *et al.*, 2015). The majority predicted Lean to culturally make organizations to have long-term outlook in accordance to the famed Hoshin Kanri tool and to discourage a mentality of short-term gains at any means and any cost. But Kull *et al.* (2014) actually found the opposite in their analysis with Lean manufacturing organizations showing lower future orientation than non-Lean organizations, a result which they could hardly explain. Wincel and Kull (2013) had a similar observation but they offer the following explanation: long future oriented organizations lack drive to improve their processes based on the Western view that their future is predictable and manageable. There is hence no rush and perhaps even harm in changing anything rapidly whereas Lean organizations with short future orientation stay restless and more agile, discontent by the status quo and eager to change every day. This duality and peculiar mix of long and short-term orientation reveal some of the paradoxical features of Lean's nature. Lean seems to contain many nuances that are not well accounted for in prominent management models and frameworks assessment tools such as the cultural dimensions of Hofstede and the Globe study or the Competing

Value Framework (CVF) of Cameron and Quinn. This may explain the discordant findings reported.

Further evidence of wide pragmatic ambiguity range and common management models' inadequacy can indeed be also found in the works of Hardcopf and Shah (2014), Losonci *et al.* (2017) and Paro *et al.* (2015) using Cameron and Quinn`s CVF (Table 9). Hardcopf and Shah hypothesized that ambidextry and adhocracy models of organizations would be more favorable to Lean but could only find partial support for adhocracy in their study. Results of Losonci *et al.* suggest Lean to be closer to clan and adhocracy organizational types and Paro *et al*., based on an analysis of the 14 principles of the Toyota way, show that Lean has predominantly a hierarchy nature.

Table 9 Cameron and Quinn`s Competing Value Framework and Lean culture

| Culture Type | Hardcopf and Shah (2014) predicted | found | Losonci et al. (2017) predicted | found | Paro et al (2015) predicted |
|---|---|---|---|---|---|
| Hierarchy | **negative** | **neutral** | ? | **neutral** | **46%** |
| Clan | neutral | neutral | ? | **positive** | 25% |
| Market | **neutral** | **negative** | n/a | n/a | 25% |
| Adhocracy | **positive** | **partial** | ? | **positive** | 4% |
| Ambidexterity | **positive** | **neutral** | n/a | n/a | n/a |

Note 1: As reported by Losonci et al. (2017), Adhocracy culture type refers to an organization that have external focus and flexibility and 'uses ad hoc approaches to solve problems incurred from the surrounding environment with flexibility and discretion. This, combined with the external focus and differentiation, indicate a willingness to take risks, creativity and innovation. Independence and freedom are highly respected' in these organizations; Clan culture type refers to organizations that have internal focus and flexibility and is 'characterized by internal cohesiveness with shared values, participation and collectivism'. They focus 'on internal problems and concerns of individuals and perpetual employment with an informal approach to work characterized by flexibility and discretion.'; Hierarchy culture type refers to organizations that have internal focus and control with 'centralized decision-making and attention to stability and control through formalized structures, standardization and rigidity with policies, instructions and procedures' and where 'conformity is encouraged'; Market culture type refers to organizations that have external focus and control and have 'orientation toward the market and toward maintaining or expanding the current market share. Competition is emphasized within the boundaries of stability and control as with the setting of ambitious, quantifiable goals.' As proposed by Hardcopf and Shah (2014), Ambidexterity culture type refers to a combination of high Clan and Adhocracy culture type levels. Paro and Gerolamo (2015) estimate of theoretical ideal Lean culture is based on their scoring of Liker (2004)`s Toyota Way 14 principles with Cameron and Quinn`s Competing Values Framework (CVF).

Note 2: 'n/a' refers to 'not applicable' or not discussed in the article. '?' indicates that no prediction made in the article

All these authors are probably right in their own way. Existing instruments, frameworks and models may just be too crude and are ill-fitted to describe and assess Lean in all its dimensions and nuances properly.

There seems to be consensus however that national culture of low assertiveness and high uncertainty avoidance are more conducive to Lean (Table 8). But conducive does not mean exclusive as the work of Netland *et al.* (2012) on subsidiaries on two large

multinational corporations elegantly show. Lean can and is implemented internationally and they and others authors have found that organizational culture weighs more than national culture in the balance of successful Lean mastership. As Hines *et al.* (2011) suggest, savvy global managers will adapt Lean implementation plan to take advantages and build on favorable features of national culture traits and work on mitigating those which are less Lean supportive. Interestingly, although many equate Lean to Japanese culture, as MacKenhauer (2016) justly noted, this is not the case. However, the emergence of TPS (Toyota Production System), Lean`s flagship, in Japan is not a coincidence. There are certain cultural elements (assumptions, values, artefacts) that are likely more influential than others in Lean and were present in Japan at the time with a twist that sparked and fueled the development of TPS and Lean. We agree with Padkil and Leonard (2015 and 2016) that a greater understanding of the relative interplay, relative importance and gradation of these cultural elements would be most useful.

As already pointed out, the bulk of the current literature on Lean culture remains very superficial. In fact, we could only find two papers who attempted to add more depth to their proposed Lean culture conceptualization beyond the classic Lean features such as continuous improvement or respect for people that are usually reported. Alpenberg and Scarbrough (2009) sought to describe a TPS cultural archetype classifying elements of five sources: 1- Liker`s 14 principles of Toyota Way (2004), 2- Liker`s TPS house (2004), 3- TMMC Public Display, 4- Womack *et al*.`s Lean Thinking (1990, 1996) and 5- those proposed by Magee (2007) in three categories: 1- basic assumptions/values, 2- behavioral norms and 3- rites and rituals. In their conclusion, they remark that level of basic assumption / values is not often observed; that there are a large number of behavioral norms and rites and rituals listed separately with only a few having explicit linkage. They however made no attempt to fill or explain these gaps and do not provide, unfortunately a unified TPS archetype at the end. Parkes (2014), using Hampden-Turner and Trompenaars national culture qualifiers and Schein`s popular three level cultural model summarized the characteristics of Lean culture as the following:

- ‘On the level of basic assumptions: particularism, synthesis, collectivism, outer direction, status assigned and synchrony.

- On the level of values: PDCA process, standardization, visual management, teamwork, paradox, intensity, kaizen, do concept.

- On the level of artefacts: Japanese terminology, rituals, uniforms, visual control management tools, etc.

She does not unfortunately provide much explanation on why and how these characteristics distinguish themselves and are truly and specifically Lean's basic assumptions, values or artefacts. Suggested values of paradox and intensity are particularly intriguing. She does not either illustrate how these levels and characteristics relate to each other as if they were independent and disconnected. This may be a distortion caused by the emblematic depiction of Schein`s model as a layered pyramid (Liker and Hoseus, 2008). In that regard, Hatch (1993)`s representation of her four organizational culture elements: assumptions, values, symbols, artefacts into an interconnected wheel may be a closer telling model of the phenomenon worth considering in further investigation about Lean culture.

### *1.3.3 Scope of Lean culture pragmatic ambiguity*

In addition to the above elements of its range, Lean culture's high level of pragmatic ambiguity is demonstrated also in its scope. Scope or extension of Lean culture pragmatic ambiguity is hereby shown as in the more general concept of organizational culture, formulation of a tentative Lean culture definition from source documents, the notion of cultural gap and amplification by four primary managerial issues.

Whereas this review finds Lean culture to be more often than not, treated superficially in the literature, it reveals that in the majority of documents, Lean culture relates to culture at an organizational level. However, even the notion of organizational culture appears to show immaturity. We were able to extract 103 different definitions of organizational culture in the 126 documents subset treating Lean culture substantially (Table 10). While this is evidence of pragmatic ambiguity at least in the discourse, content analysis of these definitions suggests a rather agreeing perception of organizational culture within Lean culture scholars based on 14 domains that are translated in this original, evidence-based definition of organizational culture as:

'the learned(n=22) and shared(n=38) collective(n=79) knowledge(n=70) including especially beliefs(n=35) and values(n=42) with related artefacts(n=20) guiding(n=45) daily(n=17) behaviors(n=84) of members(n=62) and is distinctive(n=53), contextual(n=14) and powerful(n=5).'

Table 10 Definitions of organizational culture

| **Definitions cited directly** |
|---|
| **Alvesson, M.**<br>(2002) a shared$_S$ and learned$_L$ world of experiences$_K$, meanings$_K$, values$_{K\text{-}V}$ and understandings$_K$ which inform people$_{ME}$ and which are expressed, reproduced, and communicated$_{CL}$ partly in symbolic form$_A$. (Snyder, 2016) |
| **Bunch, K.J.**<br>(2007) one of the most powerful$_{PO}$ and stable$_{DA}$ forces operating within an organization$_{CL}$. (Piccolo, 2010 *(thesis)*) |
| **Daft, R.**<br>(2001) the set$_{DC}$ of values$_V$, guiding$_G$ beliefs$_{K\text{-}B}$, understandings and ways of thinking$_K$ shared$_S$ by members$_{ME}$ of an organisation$_{CL}$ and taught$_L$ to new members$_{ME}$ as correct. (Bhasin, 2013; Bhasin, 2015 *(book)*) |
| **Detert, J.R. *et al.***<br>(2000) combination of artifacts$_A$ (also called practices, expressive symbols, or forms), values$_{K\text{-}V}$ and beliefs$_{K\text{-}B}$, and underlying assumptions$_K$ that organizational$_{CL}$ members$_{ME}$ share$_S$ about appropriate$_{DC}$ behavior$_B$. (Bortolotti, 2015)<br>(2000) artefacts$_A$, values$_{K\text{-}V}$ and beliefs$_{K\text{-}B}$ and the behaviours$_B$ which are commonly shared$_S$ and accepted by members$_{ME}$ in the organisation$_{CL}$ (Alkhoraif, 2016) |
| **Drennan, D.**<br>(1992) how things are done$_B$ around here$_{DC}$ (Hook, 2008 *(thesis)*) |
| **Greenberg, D. and Beyron, R.**<br>(2004) the cognitive structure$_K$ consisting of attitudes$_B$, values$_{K\text{-}V}$, behavioral$_B$ norms$_G$ and expectations shared$_S$ by all the members$_{ME}$ of the organization$_{CL}$ (Sadriev, 2016) |
| **Groseschl, S. and Doherty, L.**<br>(2000) metaphor of an onion's layers, where at least three layers exist: behavior$_B$, values$_{K\text{-}V}$ and basic assumptions$_K$ (Urban, 2015) |
| **Hofstede, G.**<br>(1980) the collective$_{CL}$ programming$_K$ of the mind which distinguishes$_{DC}$ the members$_{ME}$ of one human$_{ME}$ group from another. (Guimaraes, 2012; 2013 and *(thesis)*, Hook, 2008)<br>(1990) the collective$_{CL}$ programming$_K$ of the employees$_{ME}$' mind that distinguishes$_{DC}$ members$_{ME}$ of one organisation$_{CL}$ from others. (Wiengarten, 2015)<br>(1991) the collective$_{CL}$ programming$_K$ of the mind, which distinguishes$_{DC}$ the members$_{ME}$ of one category of people$_{ME}$ from another (Alkhoraif, 2016)<br>(1997) the collective$_{CL}$ programming$_K$ of the mind which distinguishes$_{DC}$ the members$_{ME}$ of one group$_{CL}$ or category of people$_{ME}$ from another. (Lacksonen, 2010)<br>(1999) the collective$_{CL}$ programming$_K$ of the mind that distinguishes$_{DC}$ the members$_{ME}$ of one group$_{CL}$ or category of people$_{ME}$ from another. (Mishra, 2010)<br>(2000) the collective$_{CL}$ ways of thinking$_K$, feeling$_B$ and acting$_B$. (Oudhuis, 2015)<br>(2010) the collective$_{CL}$ programming$_K$ of the mind that distinguishes$_{DC}$ the members$_{ME}$ of one group$_{CL}$ or category of people$_{ME}$ from others. (Martins, 2015)<br>(2010) relatively stable characteristic$_{DA}$, reflecting a shared$_S$ knowledge structure$_K$, values$_{K\text{-}V}$, behavioural norms$_G$ and patterns$_B$. (Guimaraes, 2013) |

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| **House *et al.***<br>(2004) shared$_{S}$ understanding$_{K}$ made manifest in act$_{B}$ and artifact$_{A}$. (Kull, 2014) |
| **Human Synergistics International**<br>The basic assumptions$_{K}$, shared$_{S}$ values$_{K\text{-}V}$ and beliefs$_{K\text{-}B}$ that guide$_{G}$ the way organizational$_{CL}$ members$_{ME}$ behave$_{B}$ toward each other$_{DC}$ and approach their work. (Testani, 2010; Testani, 2012) |
| **Korotkow, E.**<br>(2004) the system$_{CL}$ of formal and informal rules and norms$_{G}$ of activity$_{B}$, customs$_{A}$ and traditions$_{A}$, individual$_{ME}$ and group$_{CL}$ interests and values$_{K\text{-}V}$, features of behavior of the person$_{ME}$ in the organization$_{CL}$, the level of cooperation$_{B}$ and satisfaction with work, understanding$_{K}$ of purposes of the organization$_{CL}$ development and readiness for realization of these purposes$_{G}$ (Sadriev, 2016) |
| **Kuper, A., & Kuper, J.**<br>(1989) the way of life of a people$_{ME}$. It consists of conventional patterns$_{DC}$ of thought and behaviour$_{B}$, including values$_{K\text{-}V}$, beliefs$_{K\text{-}B}$, rules and conduct$_{G}$, political organizations$_{CL}$, economic activity, and the like$_{K}$, which are passed on from one generation to the next by learning$_{L}$—and not by biological inheritance. (Woehl, 2011 *(thesis)*) |
| **Kvale, S.**<br>(1996) the shared$_{S}$ motives, values$_{K\text{-}V}$, beliefs$_{K\text{-}V}$, identities, and interpretations or meanings of significant events$_{K}$ that result from common experiences of members$_{ME}$ of a collective$_{CL}$, and which are transmitted across age generations$_{L}$ (Sanda, 2011) |
| **Mann, D.**<br>(2010) the way work is being done$_{B}$ in an organization$_{CL}$ (Rymaszewska, 2013)<br>(2010) the sum$_{CL}$ of people$_{ME}$'s habits$_{B}$ in terms of how they get their work done (Donnelly, 2014) |
| **Merriam-Webster On-Line Dictionary**<br>(2006) the integrated pattern$_{DC}$ of human knowledge$_{K}$, belief$_{K\text{-}B}$, and behavior$_{B}$ that depends upon man$_{ME}$'s capacity for learning$_{L}$ and transmitting knowledge$_{K}$ to succeeding$_{DA}$ generations$_{CL}$. (Jackson, 2006 *(book)*) |
| **O'Reilly *et al.***<br>(1991) a shared$_{S}$ set$_{DC}$ of values$_{K\text{-}V}$ within the organization$_{CL}$. (Ingelsson and Martensson 2014, Martensson 2014)<br>(1996) a system$_{CL}$ of shared$_{S}$ values$_{K\text{-}V}$ defining what is important$_{G}$, and norms$_{G}$, defining appropriate$_{DC}$ attitudes$_{B}$ and behaviours$_{B}$, that guide$_{G}$ member$_{ME}$' attitudes$_{B}$ and behaviours$_{B}$. (Badurdeen, 2011; Padkil, 2016) |
| **Ravasi *et al.***<br>(2006) a set$_{DC}$ of shared$_{S}$ mental assumptions$_{K}$ that guide$_{G}$ interpretation and action$_{B}$ in organizations$_{CL}$ by defining appropriate$_{DC}$ behavior$_{B}$ for various situations$_{CX}$. (Maestas, 2014; Charron et al., 2015) |
| **Rizvi *et al.***<br>(2011) a system$_{CL}$ sharing$_{S}$ common beliefs$_{K\text{-}B}$, symbols$_{A}$, rituals$_{A}$ and practices$_{A}$ over time$_{DA}$ and is a reflection of their behaviors$_{B}$. (Raghavan, 2013) |
| **Schein, E.H.**<br>(1983 and 1984) The pattern$_{DC}$ of basic assumptions$_{K}$ that a given group$_{CL}$ has invented, discovered or developed in learning$_{L}$ to cope with its problems of external adaptation and internal integration$_{CX}$, and that have worked well enough to be considered valid$_{G}$, and therefore, to be taught to new members$_{ME}$ as the correct way$_{G}$ to perceive, think and feel$_{B}$ in relation to those problems$_{CX}$. (Jadhav, 2014; Liker, 2008 *(book)*; Parkes, 2015 *(book)* and 2016; Paro, 2015; Woehl, 2011 *(thesis)*)<br>(1984) a pattern$_{DC}$ of basic assumptions$_{K}$ – invented, discovered or developed by a given group$_{CL}$ as it learns$_{L}$ to cope with its problems of external adaptation and integral integration$_{CX}$ – that has |

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| worked well enough to be considered valid, and therefore to be taught to new members$_{ME}$ as the correct way$_{G}$ to perceive, think, and feel$_{B}$ in relation to those problems$_{CX}$ (Kuppers, 2016 *(thesis)*) |
| (1992) A pattern$_{DC}$ of shared$_{S}$ basic assumptions$_{K}$ that the group$_{CL}$ learned$_{L}$ as it solved its problems of external adaptation and internal integration$_{CX}$, that has worked well enough to be considered valid$_{G}$ and, therefore, to be taught to new members$_{ME}$ as the correct way$_{G}$ to perceive, think, and feel$_{B}$ in relation to those problems$_{CX}$. (Abrahamsson, 2012; Guimaraes, 2012 *(thesis)*; Jenei, 2014; Losonci, 2017; Testani, 2011; Urban, 2015) |
| (1996) ways of perceiving, thinking and reacting$_{B}$ that are taken for granted$_{L}$, shared$_{S}$ and tacit, is stated to be one of the most powerful$_{PO}$ and stable$_{DA}$ forces operating in organization$_{CL}$ (Renstrom, 2014) |
| (2004) a pattern$_{DC}$ of shared$_{S}$ basic assumptions$_{K}$ that has been learnt$_{L}$ whilst solving problems, that has worked well enough to be considered valid, and therefore, to be taught to new members$_{ME}$ as the correct way$_{G}$ to perceive, think, and feel$_{B}$ in relation to those problems$_{CX}$. (Al-Najem, 2012; Höök, 2008 *(thesis)*) |
| (2004) the personality$_{DC}$ of the organization$_{CL}$ and is comprised by the assumptions$_{K}$, values$_{K-V}$ and practices$_{B}$ of organization$_{CL}$ members$_{ME}$ (Höök, 2008 *(thesis)*) |
| (2009) a pattern$_{DC}$ of shared$_{S}$ tacit assumptions$_{K}$ that was learned$_{L}$ by a group$_{CL}$ as it solved its problems of external adaptation and internal integration$_{CX}$, that has worked well enough to be considered valid and, therefore, to be taught to new members$_{ME}$ as the correct way$_{G}$ to perceive, think, and feel$_{B}$ in relation to those problems$_{CX}$. (Vlachos, 2016) |
| (2009) the pattern$_{DC}$ of basic assumptions$_{K}$ that a given group$_{CL}$ has invented, discovered or developed in learning$_{L}$ to cope with its problems of external adaptation and internal integration$_{CX}$ and that have worked well enough to be considered valid, and, therefore, to be taught to new members$_{ME}$ as the correct way$_{G}$ to perceive, think, and feel$_{B}$ in relation to those problems$_{CX}$ (Guimaraes, 2013) |
| (2010) pattern$_{DC}$ of shared$_{S}$ basic assumptions$_{K}$ learned$_{L}$ by a group$_{CL}$ as it solved its problems of external adaptation and internal integration$_{CX}$, which has worked well enough to be considered valid$_{G}$ (Le, 2016) |
| **Schneiger, W.E.** |
| (1996) the reality, or genetic code$_{DC}$, which dictates$_{G}$ the organizational$_{CL}$ behaviors$_{B}$ (Haley, 2014) |
| **Scholtes, P.** |
| (1998) The day-to-day$_{DA}$ experience$_{K}$ of the ordinary worker$_{ME}$. (Bicheno and Holweg, 2009 *(book)*) |
| **Shermerorn, J. *et al.*** |
| (2004) The system$_{CL}$ of the general actions$_{B}$, values$_{K-V}$ and beliefs$_{K-B}$ which develop in the organization$_{CL}$ and by which members$_{ME}$ of the organization$_{CL}$ are guided$_{G}$ in their behavior$_{B}$ (Sadriev, 2016) |
| **Steel, R.** |
| (2004) emergent$_{L}$ result of the continuing$_{DA}$ interactions$_{S}$ and negotiations$_{B}$ about values$_{K-V}$, meanings$_{K}$, properties$_{K}$ between the members$_{ME}$ of the specific$_{DC}$ organization$_{CL}$ and with its environment$_{CX}$. (Salah, 2015) |
| **Sun, S. (citing Brown 1998)** |
| (2009) the pattern$_{DC}$ of beliefs$_{K-B}$, values$_{K-V}$ and learned$_{L}$ ways of coping with experience that have developed during the course of an organisations$_{CL}$ history$_{DA}$, and which tend to be manifested in its material arrangements$_{A}$ and in the behaviours$_{B}$ of its members$_{ME}$ (Alkhoraif, 2016) |
| **Sun, S. (citing Davis 1985)** |
| (2008) the pattern$_{DC}$ of shared$_{S}$ beliefs$_{K-B}$ and values$_{K-V}$ that give members$_{ME}$ of an institution$_{CL}$ meaning$_{K}$, and provide with the rules$_{G}$ for behaviour$_{B}$ in the organization$_{CL}$ (Alkhoraif, 2016) |
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| **Yukl, G. and Kaulio, M.**<br>(2011) the culture in an organization$_{CL}$ is formed by the organization$_{CL}$ members$_{ME}$' shared$_{S}$ norms$_{G}$, values$_{K\text{-}V}$ and beliefs$_{K\text{-}B}$ and it has an important function: it helps the employee$_{ME}$ to understand the surrounding environment$_{CX}$ and how to react to it$_{G}$ (Martensson, 2014) |
| **Weese, W.**<br>(1996) the values$_{K\text{-}V}$ and beliefs$_{K\text{-}B}$ that are practiced$_{B}$ by all employees$_{ME}$ in an organization$_{CL}$. (Asaad, 2013) |
| **Wincel, J. and Kull, T.**<br>(2013) the conventions, principles$_{K}$, norms$_{G}$, and noticeable artefacts$_{A}$ of its employees$_{ME}$ and their behaviours$_{B}$ (Bhasin, 2015) |
| **Womack, J.P. and Jones, D.T.**<br>(2011) shared$_{S}$ beliefs$_{K\text{-}B}$, values$_{K\text{-}V}$ and assumptions$_{K}$ among enterprise$_{CL}$ staff$_{ME}$ working for common$_{CL}$ goals$_{G}$ (Guang, 2017) |
| **Zbiegien-Maciag, L.**<br>(2002) group$_{CL}$ of rational$_{K}$ rules$_{G}$ of action$_{B}$, which are uncovered, set up and developed$_{L}$ by the group$_{CL}$ and they are used to deal with the problem of internal integration and external adjustment$_{CX}$ and because they act well$_{G}$, they can create the ways of thinking and feeling$_{B}$ for their members$_{ME}$ (Jakonis, 2012) |
| **Zhang, X. and Li, B.**<br>(2013) core competency$_{DC}$ for an organization$_{CL}$ to influence$_{G}$ organisational$_{CL}$ performance$_{B}$ (Kuppers, 2016 *(thesis)*) |
| **Zu *et al.***<br>(2010) pattern$_{DC}$ of values$_{K\text{-}V}$, beliefs$_{K\text{-}V}$ and assumptions$_{K}$ shared$_{S}$ among the employees$_{ME}$ in a business$_{CL}$. (Pedersen-Rise, 2016) |
| **Definitions composed from multiple references** |
| **Barney/Deal, T. and Kennedy, A./Ouchi/Pettigrew/Schein/Schockley-Zalabak, P. and Morley, D.D.**<br>The common$_{CL}$ underlying theme of culture definitions is based on organisation$_{CL}$'s values$_{K\text{-}V}$, beliefs$_{K\text{-}B}$, and their shared$_{S}$ philosophy$_{K}$. (Guimaraes, 2012 *(thesis)* and 2015) |
| **Calori, R. and Samin, P./Hofstede/Schein**<br>Belief$_{K\text{-}B}$ system$_{CL}$ that members$_{ME}$ of an organization$_{CL}$ share$_{S}$, including ways of working$_{B}$, traditions$_{A}$, stories$_{A}$, and acceptable methods$_{A}$ to achieve goals$_{G}$. (Pakdil, 2015) |
| **Deal, T. and Kennedy, A./Schein/Kotter J. and Heskett, J./Van der Post *et al.***<br>a set$_{DC}$ of deeply embedded$_{PO}$, commonly held values$_{K\text{-}V}$ and beliefs$_{K\text{-}B}$ that influence$_{PO}$ the behaviours$_{B}$ of the employees$_{ME}$ of the organisation$_{CL}$. (van der Merwe, 2015) |
| **Hallam, C.R.A. *et al.*/Womack, J.P.**<br>a set$_{DC}$ of organisational$_{CL}$ attitudes$_{B}$ (Pearce, 2013) |
| **Hines *et a*l./Achanga et *al.***<br>collective$_{CL}$ norms$_{G}$ and behaviors$_{B}$ which encompass trust, hierarchy, work environment$_{CX}$, communications$_{S}$, and fellow-feeling$_{DC}$. (Dora, 2016) |
| **Sopow/Hoogervorst *et al.***<br>the traditions$_{A}$, beliefs$_{K\text{-}B}$, values$_{K\text{-}V}$ and sense-of-self$_{K}$ of an organisation$_{CL}$, based on historical$_{DA}$ factors$_{CX}$, established notions$_{K}$, rituals$_{A}$ and leadership$_{B}$. (Canning, 2015) |
| **Authors' own definitions** |
| **Aij, K.H.** *(thesis)*<br>(2015) ways of working$_{B}$; motivated towards improvement philosophy$_{K}$; trust, transparency, honesty and respect$_{A}$ |
| **Alston, F.** *(book)*<br>(2017) a system$_{CL}$ of elements consisting of practices$_{B}$, behaviors$_{B}$, symbols$_{A}$, language$_{A}$, asssumptions$_{K}$, and perceptions shared$_{S}$ by its members$_{ME}$ |

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| **Alves, J.R.X. and Alves J.M.**<br>(2015) a set$_{DC}$ of values$_{K\text{-}V}$, norms$_{G}$, beliefs$_{K\text{-}B}$, habits$_{B}$ and customs$_{B}$ that are shared$_{S}$ collectively$_{CL}$. |
| **Anonymous** *(commercial)*<br>(2009) principles$_{K}$, values$_{K\text{-}V}$ and behaviors$_{B}$ into the organization$_{CL}$. |
| **Atkinson, P.** *(commercial)*<br>(2010) resides in the hands, the hearts$_{B}$ and the minds$_{K}$ of the staff$_{ME}$ of the business$_{CL}$. |
| **Bardurdeen, F. and Gregory, B.** *(commercial)*<br>(2012) the way we automatically$_{G}$ think and act$_{B}$ *every* day$_{DA}$. |
| **Bell, S.C. and Orzen, M.A.** *(book)*<br>(2011) organization$_{CL}$'s shared$_{S}$ beliefs$_{K\text{-}V}$ and values$_{K\text{-}V}$, manifested as attitude$_{B}$ and behavior$_{B}$. |
| **Bujak, A. *et al.*** *(book)*<br>(2012) value$_{K\text{-}V}$, norms$_{G}$ and assumptions$_{K}$ shared$_{S}$ by individuals$_{ME}$ of the organization$_{CL}$, which drive$_{G}$ the behaviour$_{B}$ of people$_{ME}$ working in the shop floor. |
| **Charron, R. *et al.*** *(book)*<br>(2015) the collective$_{CL}$ behavior$_{B}$ of humans$_{ME}$ who are part of an organization$_{CL}$ and the meanings$_{K}$ that the people$_{ME}$ attach to their actions$_{B}$. Culture includes the organization$_{CL}$ values$_{K\text{-}V}$, visions$_{K}$, norms$_{G}$, working language$_{A}$, systems$_{CL}$, symbols$_{A}$, beliefs$_{K\text{-}B}$, and habits$_{B}$. It is also the pattern$_{DC}$ of such collective$_{CL}$ behaviors$_{B}$ and assumptions$_{K}$ that are taught$_{L}$ to new organizational members$_{ME}$ as a way of perceiving, and even thinking and feeling$_{B}$. The organizational culture affects the way people$_{ME}$ and groups$_{CL}$ interact$_{B}$ with each other, with clients, and with stakeholders. |
| **Chestworth, B. *et al.***<br>(2010) behaviours$_{B}$ and relationships of individuals$_{ME}$ and groups$_{CL}$ which emerge during the process that evolve and mature$_{DA}$ culture.<br>(2010) an entity impacted by elements of the organization$_{CL}$, particularly attitudes or behaviours$_{B}$, structures$_{A}$ and relationships$_{B}$. |
| **Dennis, P.** *(book)*<br>(2016) the day-to-day$_{DA}$ experience of our team$_{CL}$ members$_{ME}$. Current behaviors$_{B}$ |
| **Emiliani, B.** *(book)*<br>(2007) leadership and behavioral$_{B}$ aspects of work and organization$_{CL}$. |
| **Fleidner, G.** *(book)*<br>(2016) set$_{DC}$ of assumptions$_{K}$ that are shared$_{S}$ over long-term horizon$_{DA}$. The assumptions$_{K}$ serve to guide$_{G}$ overt attitudes$_{B}$ and practices$_{B}$ of a group$_{CL}$ such as a team$_{CL}$. Culture manifests itself in the form of shared$_{S}$ elements including company documents$_{A}$, norms$_{G}$ of behavior$_{B}$, beliefs$_{K\text{-}B}$, values$_{K\text{-}V}$, metrics$_{A}$, and rewards$_{A}$. These shared$_{S}$ elements are causal$_{G}$ determinants of attitudes$_{B}$ and practices$_{B}$. Organizational culture refers to these shared$_{S}$ elements in a workplace environment$_{CX}$. It is the principled atmosphere of the system$_{DC}$. Simply put, it is the way things are done$_{B}$ in an organization$_{CL}$.<br>A set$_{DC}$ of workplace assumptions$_{K}$ that are learned$_{L}$ over a long-term time horizon$_{DA}$, which serve to guide$_{G}$ overt attitudes$_{B}$ and practices$_{B}$ of a group$_{CL}$. The culture of an organization$_{CL}$ consists of values$_{K\text{-}V}$, beliefs$_{K\text{-}B}$, attitudes$_{B}$, practices$_{B}$, behaviors$_{B}$, norms$_{G}$, and habits$_{B}$. Culture is simply the way things are done$_{B}$ in an organization$_{CL}$. |
| **Haley, M**<br>(2014) organizational$_{CL}$ dynamics$_{B}$ and synergy representative$_{DC}$ at every level |
| **Hegland *et al.*** *(commercial)*<br>(2010) what are and are not$_{G}$ acceptable$_{DC}$ behaviors$_{B}$ in an organization$_{CL}$. |
| **Hines *et al.*** *(book)* |

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| (2011) the social, moral, and behavioral$_{B}$ norms$_{G}$ of a group$_{CL}$ or organization$_{CL}$, which are based on the beliefs$_{K-B}$, attitudes$_{B}$, values$_{K-V}$, and priorities$_{DC}$ of the members$_{ME}$. (Hines, 2010 *(commercial)*) |
| **Jekiel, C.M. 2010** *(book)*<br>patterns$_{DC}$ of behaviors$_{B}$ and attitudes$_{B}$. |
| **Kavanagh, S.C. and Kenworthy, H.** *(commercial)*<br>(2016) system$_{CL}$ of shared$_{S}$ assumptions, values$_{K-V}$, and beliefs$_{K-B}$, and it exerts a powerful$_{PO}$ influence on how people$_{ME}$ behave$_{B}$ in an organization$_{CL}$. |
| **Koenigsaecker, G.** *(book)*<br>(2013) the behaviors$_{B}$ or habits$_{B}$ of its leaders$_{ME}$ |
| **Liker, J.K. and Hoseus, M.**<br>(2006) shared$_{S}$ language$_{A}$, symbols$_{A}$, beliefs$_{K-B}$, and values$_{K-V}$. |
| **Mann, D.** *(book)*<br>(2005, 2010) the sum$_{CL}$ of peoples$_{ME}$' habits$_{B}$ related to how they get their work done$_{G}$. (Nelson, 2011 *(book);* Charron, 2015)<br>(2008) the sum$_{CL}$ of many individuals$_{ME}$' habits$_{B}$ related to the work in the organization$_{CL}$. |
| **Manos, A. and Chad, V.** *(book)*<br>(2013) sum$_{CL}$ total of all behaviors$_{B}$, relationships$_{B}$, comprehension$_{K}$, and interactions$_{B}$ that fuel overall alignment$_{G}$ via collective$_{CL}$ thoughts$_{K}$, words$_{A}$ and actions$_{B}$ |
| **McCarthy, D. and Rich, N.** *(book)*<br>(2015) Culture, or 'the way we do things$_{B}$ around here$_{DC}$', is driven$_{G}$ by instinctive patterns$_{DC}$ of behaviour$_{B}$. |
| **Miller *et al.*** *(book)*<br>(2014) what a group$_{CL}$ of people$_{ME}$ or society would recognize as 'how we do things around here'$_{B\text{-}DC}$. |
| **Mustapha, A.**<br>(2015) the day-to-day$_{DA}$ experience$_{B}$ of the ordinary worker$_{ME}$ |
| **Ogunbiyi, O**<br>(2014) the process of the way things$_{B}$ are done |
| **Nahmens, I. *et al.***<br>(2012) practices$_{B}$ being followed$_{G}$ |
| **Perstal, J. *et al.***<br>(2013) a fairly stable$_{DA}$ set$_{DC}$ of assumptions$_{K}$ that are taken-for-granted$_{L}$, shared$_{S}$ beliefs$_{K-B}$, meanings$_{K}$, and values$_{K-V}$ in an organization$_{CL}$ that govern the members$_{ME}$' operations$_{B}$ |
| **Pradabwong, J. *et al.***<br>(2012) beliefs$_{K-B}$ and behavior$_{B}$ of employees$_{PE}$ |
| **Punnakitikashem, P. *et al.***<br>(2013) one group$_{CL}$ of people$_{PE}$'s behavior$_{B}$ and attitude$_{B}$. |
| **Santorella, G.**<br>(2017) comprised of three elements: espoused values$_{K-V}$, outcomes$_{B}$, and core beliefs$_{K-B}$ |
| **Schipper, T. and Swets, M.** *(book)*<br>(2010) sum$_{CL}$ of habits$_{B}$ among members$_{ME}$ of a work group$_{CL}$. The way things are done$_{B}$ around here$_{DC}$. |
| **Sehested, C. and Sonnenberg, H.** *(book)*<br>(2011) a pattern$_{DC}$ of shared$_{S}$ fundamental assumptions$_{K}$ about the correct way$_{G}$ to perceive, think and feel$_{B}$. |
| **Selvaraju, S. and Peterson, C.**<br>(2013) the basic assumptions$_{K}$, shared$_{S}$ values$_{K-V}$ and beliefs$_{K-B}$ that guide$_{G}$ the way organizational$_{CL}$ members$_{ME}$ behave$_{B}$ toward each other$_{DC}$ and approach their work. |

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| **Shook, J.** *(commercial)*<br>(2010) the way to change culture is to change cultural artifacts$_{A}$ — the observable data of an organization$_{CL}$, which include what people$_{ME}$ do and how they behave$_{B}$. Anyone wanting to change a culture needs to define the actions$_{B}$ and behaviors$_{B}$ they desire, then design$_{G}$ the work processes that are necessary to reinforce$_{L}$ those behaviors$_{B}$. |
| **Sisson, J. and Elshennawy, A.**<br>(2015) shared$_{S}$ set$_{DC}$ of beliefs$_{K\text{-}B}$ and practices$_{B}$. |
| **Stenzel, J.** *(book)*<br>(2007) The people$_{ME}$ in our company$_{CL}$ hold a set$_{DC}$ of values$_{K\text{-}V}$ and beliefs$_{K\text{-}B}$ that causes them to behave$_{B}$ in certain ways$_{G}$. When they behave$_{B}$ in accordance with their values$_{K\text{-}V}$ and beliefs$_{K\text{-}B}$ and get the results they expect, they reinforce the validity of those values$_{K\text{-}V}$ and beliefs$_{K\text{-}B}$ in their minds. This self-reinforcing cycle of values$_{K\text{-}V}$ and beliefs$_{K\text{-}B}$ driving behavior, behavior$_{B}$ yielding expected results, and results driving$_{G}$ values$_{V}$ and beliefs$_{K\text{-}B}$ is what we call culture. |
| **Stone, K.B.**<br>(2012) the way things are done$_{B}$ around here$_{DC}$; includes values$_{K\text{-}V}$, beliefs$_{K\text{-}B}$, and norms$_{G}$ that drive people$_{ME}$'s actions$_{B}$. |
| **Tortorella, G.L. and Fogliatto, F.S.**<br>(2013) the sum$_{CL}$ of people$_{ME}$ habits$_{B}$ in relation to the way they perform their activities$_{G}$ |
| **Urban, W.**<br>(2015) models and patterns$_{DC}$ of behaviour$_{B}$ typical in an organization$_{CL}$ |
| **Valero, G.** *(commercial)*<br>(2006) unique traits$_{DC}$ and characteristics of the people$_{ME}$ within the organization$_{CL}$. |
| **Van der Zee, H.** ***et al.*** *(book)*<br>(2015) shared$_{S}$ beliefs$_{K\text{-}B}$ and values$_{K\text{-}V}$ that manifest themselves as attitudes$_{B}$ and behavior$_{B}$. |
| **Wellman** ***et al.*** *(book)*<br>(2011) the way things are done$_{B}$ "around here"$_{DC}$. |
| **Zarbo, R.J.**<br>(2012) how people$_{ME}$ are incentivized$_{L}$ to behave$_{B}$ and the way people think$_{K}$, talk$_{A}$, work, and act every day$_{DA}$. |

Legend: A: artefacts (n=20), B: behaviors (n=84), CL: collective (n=79), CX: contextual (n=14), DA: daily (n=17), DC: distinctive (n=53), G: guiding (n=45), K: knowledge (n=70), K-B (beliefs=35) K-V: values (n=42), L: learned (n=22), ME: members (n=62), PO: powerful (n=5), S: shared (n=38).

Note: 1 count per definition – total # citation: 103

It is notable that none of the source definitions contained all above elements, which is by itself evidence of added value. Implications of this definition are that organizational culture is both an acquired and transmissible learning. It is deeply ingrained but modifiable as well and hence manageable. It involves a group of people and is characterized by all elements that make that group particular and standing out from other groups. Organizational culture accounts for the way a group of people behave among themselves and in interactions with their environment and with other people every day and for as long as this group choose to stay together. It suggests a constructivist nature in

which organizational culture needs to be continuously re-enacted to exist. Organizational culture contains features of peer-pressure amongst its members and distanciation from other people, although how it is actually performed (for example, whether people are more or less friendly or welcoming) becomes a cultural trait. Organizational culture is observable particularly in its artefacts but because its meanings reside mostly in the minds of members in both conscious and unconscious ways, it is not easily decipherable in its entire richness. However, consideration of even just a few key elements may be informative and productive in understanding and engaging in that culture.

### *1.3.4 Tentative Lean culture definition*

As for definition of Lean culture, 13 were found in this review (Table 11). They however all appear rather generic and superficial with variable emphasis on a large range of issues from membership (just employees or management as well) to goals (excellence? reduction or elimination of waste?) or means (reasonably free hand or scientifically based?). They do not provide much insights about which beliefs, values or artefacts are fundamental and necessary to Lean. Nevertheless, based on our aforementioned proposed organizational culture definition and Table 10 findings, this tentative Lean culture definition may be built, where c: refers to citation:

'An organizational culture(c:2A,7A,9B) in which all members(c:1A,3A,11C,13A), from CEO to employees(c:3B), are learning(c:3C,10C) together(c:5A,6A,9C,11A,12A) to continuously(c:4D,8C) improve their work(c:2B,5C,8D,10B,13B) scientifically(c:5B) and create value(C:9E,13C) to customers(c:6D,12C) by eliminating waste(c:1C,6C,9F,13E) and solving problems(c:10A) for long-term profit(c:6B,7B) while believing in teamwork(C:8B), participation(1B,9D) and purposeful(c:4A) autonomy(c:4C), highly valuing respect(c:3E,8A), humility(c:3D) and excellence(c:12B), and using Lean tools and techniques(c:4B,9A) every day(c:5D).'

Table 11 Lean Culture Definitions (Academics/Book authors/Commercial authors/PhD thesis)

| **Lean Culture Definitions by Academics/Book Authors/Commercial Authors/PhD thesis** |
|---|
| **1. Ahmad, S.A.S.**<br>(2013) where all employee$_{1A}$ participating$_{1B}$ in activities to reduce business waste$_{1C}$. |
| **2. Alston, F.** *(book)*<br>(2017) culture that has all of the elements and attributes$_{2A}$ required to implement and sustain Lean process improvement initiatives$_{2B}$. |

| |
|---|
| **3. Bicheno, J. and Holweg, M.** *(book)*<br>(2009) all people$_{3A}$, from CEO to junior$_{3B}$, share two related characteristics, both related to Learning$_{3C}$: humility$_{3D}$ and respect$_{3E}$. |
| **4. Charron, R. *et al.*** *(book)*<br>(2015) beliefs and behavior characteristics of employees that understand what their company's goals and objectives are, why they are important, understand the purposes$_{4A}$ of Lean improvements, have had the necessary Lean tools and techniques training$_{4B}$ to effect improvements, and are then given a reasonably free hand$_{4C}$ to do so on an ongoing basis$_{4D}$. |
| **5. Gaudet, J. and Bergeron F.**<br>(2016) shared$_{5A}$ language, values and practices of scientifically$_{5B}$ improving work$_{5C}$, every day$_{5D}$. |
| **6. Höök, M** *(thesis)*<br>(2008) shared$_{6A}$ assumptions that the common goal is increased long-term profit$_{6B}$, achieved by decreased costs and waste$_{6C}$ (performance), through a focus on customers and the people that create value$_{6D}$. |
| **7. Integris Performance Advisors in Salah *et al.*, 2015**<br>(2013) organizational environment$_{7A}$ in which the values and behaviors are aligned with the guiding principles of lean management$_{7B}$. |
| **8. Lotz, G. and Roodt, G.**<br>(2013) characterised by a deep respect for people$_{8A}$, teamwork$_{8B}$, and continuous$_{8C}$ improvement$_{8D}$. |
| **9. Manos, A. and Vincent, C.** *(book)*<br>(2013) sum total of all the lean tools, techniques$_{9A}$, and knowledge that exists within an organization$_{9B}$ at the root level and that fuel the overall organizational alignment via collective$_{9C}$ lean thoughts, words, and actions$_{9D}$ toward the elimination of waste$_{9E}$ and the creation of value$_{9F}$. |
| **10. Novac, C. and Mihalcea, A.**<br>(2014) We think at problem solving$_{10A}$ with continuous improvement$_{10B}$ and learning$_{10C}$. |
| **11. Schipper, T. and Swets, M.** *(book)*<br>(2010) an idea that is created in the mind, as an inference, consisting of the collective$_{11A}$ behaviors, practices, and habits of a community of people$_{11C}$ implementing a lean system. |
| **12. Stenzel, J.** *(book)*<br>(2007) shared$_{12A}$ mind-set that demands excellence$_{12B}$ in providing customer value$_{12C}$. |
| **13. Zitel, T. (2006) and Dennis, P. (2002)**<br>Everyone$_{13A}$ seeks improvement$_{13B}$, understands value$_{13C}$ and strives to attain it, and identifies waste and struggles to eliminate it$_{13E}$. (Ulhassan 2014 *(thesis)*) |

This definition appears to have some face validity and although it may not obtain absolute unanimity, it might perhaps get consensual support since it is built from dimensions brought up by authors in the field. Admittedly though, this definition contains arguable and ambiguous elements: for examples, in the use of the word 'scientifically', the notion of waste elimination and the nature of Lean tools and techniques.

Lean is indeed often described as a scientific method based on the Deming's Plan-Do-Check-Act wheel (Bicheno and Holweg, 2009; Rother, 2010) but Webster and Merriam

dictionary definitions of the term 'scientific' are: 1- 'of, relating to, or exhibiting the methods or principles of science' and 2- 'conducted in the manner of science or according to results of investigation by science : practicing or using thorough or systematic methods', which are processes that most academics will acknowledge to be arduous, slow, meticulous and requiring expertise: features that may be contributing for some not to consider Lean to be accessible. Perhaps the use of the word 'experimental', defined as 1- 'of, relating to, or based on experience or experiment, 2a- 'serving the ends of or used as a means of experimentation' and 2b- 'relating to or having the characteristics of experiment' (Webster & Merriam, 2018) may be more appropriate, representative, less intimidating and more in line with Lean's instruction of 'continuous (daily) improvement'.

Waste ('muda') elimination is undoubtedly Lean's predominant performance improvement key practice (Bicheno and Holweg, 2009; Womack and Jones, 2003). However, as Liker (2004) and Imai (2012) among others have been stressing, it must be counterbalanced by attention to 'muri', the overburden of people or equipment and smoothing of 'mura', or variation, to make Lean work to its full successful potential. These 3 "MUs" fit as a system and should be addressed concurrently.

Finally, more details are needed about what tools and techniques as Lean's artefacts should be considered, along with their related supporting beliefs and values with more specific information about their weight and ordering compared to the one stated in this definition, to form a comprehensive complete satisfying proposition. These findings provide even more evidence and justification for the high level of pragmatic ambiguity Lean culture currently has and much work needs to be done to bring together all these ideas.

Adding another aspect of pragmatic ambiguity scope, we noted in this literature review that several authors (Ahmed, 2013; Atkinson, 2013; Jenei *et al.*, 2014; Pedersen-Rise and Haddud, 2016; and others) refer to the notion of cultural gap described as the distance between the current organizational culture state to a future desired Lean culture one in the widely cited view that Lean transformation is an organizational change exercise. In that

regard, Testani and Ramkrishnan (2012) describes the most prescriptive and detailed plan to follow in their report relating the successful experience of IBM with the use of various proprietary assessment tools to monitor and to direct progress of their Lean journey over a period of 2 years. Development of Lean maturity instruments for the purpose of assessing cultural gap certainly appears to attract much scholarly interests. Our review has encountered over eleven: 1- Bashin (2011)'s Lean Audit tool, 2- Guimaraes and de Carvalho (2014)`s Lean assessment package (cultural enabler, continuous process improvement, enterprise alignment improvement, result improvement), 3- Ingelsson and Martensson (2014)'s Lean values questionnaire, 4- Jayamaha *et al.* (2014)'s Lean culture questionnaire, 5- Jenei *et al.* (2014) Lean Healthcare organizational culture questionnaire, 6- Jobin and Lagacé (2014)`s Lean Maturity model, 7- Mann (2015)`s Lean Management standards (for manufacturing and service), 8- Padkil and Leonard (2014)'s Lean assessment tool, 9- Salah *et al.* (2015) Critical lean Culture Criteria Model, 10-Urban (2015)'s Lean Management Maturity self-assessment tool and 11- van der Merwe (2015)'s Lean culture diagnostic tool, which are all more or less designed to assess Lean organizational culture change and likely many more questionnaires exist and would require a dedicated literature search to discover and meta-analysis to develop learnings.

Finally, this literature review finds four other amplifiers of Lean culture pragmatic ambiguity scope in the form of four primary managerial issues: 1- leadership, 2- human resources (HR) management, 3- sustainability and 4- innovation. Not as much based on any of the authors questioning their relevance in building a Lean culture but because these notions, having on their own some level of pragmatic ambiguity, add other layers of complexity to the concept. For example, if transformational leadership is usually considered to fit more Lean culture compared to transactional leadership, as works of Woehl (2011) suggest, it is not necessarily the case. Hence, further investigations are needed to determine which leadership practices are essential in Lean culture and which ones are facultative or even detrimental. In regard to HR management, its optimal position in Lean culture appears unclear: whether it should be more at a strategic level as Alagaraja and Egan (2013) suggest or it should serve better an organization's culture as a supportive function as described by Jorgensen *et al.* (2008)`s healthy Lean framework is yet to be determined. As for sustainability, Lean culture authors, more often than not, neglect to

specify which kind they refer to in their writing: specifically, sustainability at times appears to relate to maintenance of Lean mastership (such as project's gains over time, standardization, continuous improvement practices) and preservation of Lean culture; other times, it is about survival of the organization; and even other times, it is associated to issues of corporate social responsibility and long-term environmental safety and protection (green Lean) (Alves and Alves, 2015; Keiser, 2012).

## 1.4 Discussion

This literature review makes several notable contributions. From a methodological aspect, it proposes adaptation and extension of other recent systematic reviews that ensured broad coverage of the topic. Full disclosure of the citation selection process demonstrates the importance and utility of running literature search in several electronic databases, describing strengths and weaknesses of some of them as well. Although complete capture of all writings about Lean culture cannot be ascertained, the large sample size and efforts deployed decrease the risk that major contributions or a sufficient number of works have been missed that would affect significantly our findings. Two strategies were employed to decrease threat of validity and increase reliability: 1- Descriptive data were independently validated by a research assistant. Based on this exercise an over 95% inter-rater reliability can be estimated; 2- iterative data collection scheme meant that documents were read over several times, decreasing risk of missed information, bias and misclassification. We submit that use of the pragmatic ambiguity construct and inductive data collection and analysis plan were particularly suited for this first exploration on Lean culture. It allowed constructive generation of knowledge that would not have been as possible under a less flexible methodology.

This comprehensive systematic review of four segments of the literature (academic, books, thesis and grey articles) documents a high level of pragmatic ambiguity associated to Lean culture from three stand points: its international source, its wide range from strong advocates to intense objectors and in terms of its stance, its treatment and main bearer in the manufacturing and service sectors and its scope regarding the notions of organizational culture, cultural gap and its estimation, leadership, HR management, sustainability and innovation.

Unfortunately, this high level of pragmatic ambiguity is more related to a situation of omission and shallow understanding rather than exposure and constructive debate as the superficiality of documents reviewed and our analysis indicate. Differences noted in the literature between the manufacturing sector and the service sector appear more indicative of the relatively longer Lean experience in manufacturing than on fundamental differences in Lean nature in manufacturing and service.

The fact that European scholars have contributed more on the topic calls for Americans (North and South) and scholars from every other part of the world to increase their activity and share their knowledge and experiences for a greater and deeper understanding of Lean culture. The enigmatic silence of Japan on the matter begs for further inquiry and provision of valid explanations. Furthermore, even if further studies in healthcare, construction and automotive industries are needed, there is an opportunity to seek out Lean culture insights in other under-researched areas such as in retail, legal, entertainment, or tourism for likely valuable cross-learnings.

This review finds that a majority (80%) of Lean authors across disciplines and sectors view Lean culture as an organizational aim. The concept of culture appears hence less to be a pre-condition, a tool or a bonus from organizational change efforts and more about acting as a mirror or barometer of Lean transformation journey and mastership. This is consistent with the notion of cultural gap and the evidence-based definition of organizational culture we were able to build. Indeed, from a cultural perspective, there is less 'hard' or 'soft' sides of Lean. Lean culture is progressively built. Every Lean action or decision organization members make or not, and even more telling how these actions and decisions are made or not, are cultural artefacts. They become part of the organization`s knowledge base and reflect its values and assumptions.

A realization made during the conduct of this review and implied by our proposed organizational culture definition is that as Lean implementation lead to change in organizational culture and that organizational culture is a people manifestation, Lean transformation, from a cultural point of view, means fundamentally a change of people. If anyone is not ready or willing to change for good or not so good reasons, as teachings

of Hines (2011), Liker (2004), Rother (2010) and Womack *et al.* (1990, 1996) suggest, rapid actions need to be taken to either support and mentor these people or to re-assign them in a different work position. Otherwise, implementation of Lean is doomed.

Lean culture current high pragmatic ambiguity level may nevertheless have certain positive aspects. As everyone is entitled to keep its own interpretation of the concept, time and energy are not spent on debates and counter-argumentations on who's right and who's wrong about Lean culture. It maintains room for development and for constructive ideas. It may facilitate some collaboration between interest groups that may then focus their attention on Lean matters more important to them. However, there are several risks of maintaining Lean culture high pragmatic ambiguity level which includes: miscommunication, misunderstanding and missed opportunities that may lead to missteps, mistakes, errors and contribute to Lean's organizational change failure. Clarifying the nature of Lean culture can only mitigate these risks. The process of this clarification may also help uncover new Lean insights and managerial concepts that may contribute to improvements of organizations. By knowing more precisely what Lean culture is and what it is not, academics and practitioners could then spend their resources and creative drive toward other important aspects of Lean and its implementation for the ultimate goal of gaining lasting improved organizational performance.

## 1.5 Limitations

Several limitations of this review must be acknowledged.

The main one concerns its strict focus and restriction on the exploration of two key words: Lean culture (with and without brackets). Several other cultural labels of Lean can be found in the literature such as Toyota culture, kaizen culture, continuous improvement culture, Toyota kata culture, Japanese management culture and perhaps others. Further work is needed to determine to what extent all of them are similar and different between each other and how they make their own contribution to Lean knowledge. It is possible that some of them have been discussed in more depth compared to Lean culture in regards to related beliefs, values and artefacts.

A second limitation is that despite all care taken in the literature search, other databases exist such as Scopus, Engineering Village and other Journal - Publisher - Association specific databases and hence, no review could hardly ever be complete. This review appears nevertheless comprehensive and original in its large inclusion of records including commercial literature to give a sense of current state of knowledge on Lean culture.

A third limitation is the fact that searches were conducted on the same computer at two different dates. It is possible that hidden "cache" algorithms of databases have introduced some selection biases. Use of 'cited by' feature of Google Scholar in the final step of the search has, however, made missing of significant documents much less likely. It should be noted that, in order to overcome security features of Google Scholar, connection to several different internet access networks had to be done.

## 1.6 Further research and development

Based on this review`s findings, we suggest these seven areas of research and development:

1- Further work to decrease Lean culture's level of pragmatic ambiguity and refine its nature and improve understanding of its elements (artefacts, values, beliefs) is obviously needed.

2- Empirical studies in under-researched industries such as retail, legal, entertainment or tourism may support cross-learnings on Lean culture.

3- A general knowledge structure analysis from a bibliographical citations and co-citations matrix of Lean culture documents similar to one built by Plytiuk *et al.* (2012) for Healthcare Lean Thinking could be performed. This analysis may reveal knowledge cluster and help identify knowledge gaps to investigate further.

4- A meta-analysis of quantitative studies and Lean culture assessment instruments could be performed, which may eventually lead to the development and validation of a comprehensive Lean culture assessment tool or package.

5- Exploration on the issue of managerial paradox in Lean may deepen our understanding of the construct and help academics and practitioners to appreciate Lean and its nuances to develop more appropriate Lean mastership implementation and maintenance plans.

6- There is need to clarify how the concepts of Lean and its culture differentiate themselves as from each other a certain cultural perspective, everything about an organization becomes a manifestation of culture. To remain useful and relevant, Lean culture must mean something more than being the mere cultural expression of Lean. Considering Lean through lenses of other organizational change perspectives or theories such as the adaptation, the configurational, the political, the behavioral, or the complexity approaches may be helpful (Demers, 2007).

7- Finally, investigating further how Lean culture differentiates itself from other reported Lean conceptualization such as Lean philosophy, Lean thinking, Lean principles would be beneficial for academics and practitioners in enhancing our collective Lean understanding and in bolstering fresh ideas on how to make more organizations able to benefit from Lean's value-adding management system proposition.

## 1.7 Conclusion

This systematic review confirms Lean culture to currently have a high level of pragmatic ambiguity of a similar extent in four segments (academic, books, theses and commercial) of the management literature, irrespective of sector (manufacturing and service). Interest on Lean culture appears to be growing and further work that would increase knowledge on Lean and its culture may be inspired by our findings, in particular perhaps by our evidence-based definition of organizational culture.

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# Chapter 2
# Lean Healthcare: an Unexpected Journey


## Abstract

Purpose: This work seeks a greater understanding of Lean healthcare implementation challenges, from an operations management point of view, taking a situated cultural organizational change perspective.

Design/Methodology/Approach: A conceptual description of healthcare organizations Lean adoption trajectories is built using ripple and bridging modelization strategies from elements of three classic organizational change theories and relevant knowledge from Lean, organizational culture, service, healthcare, operations management and management literature.

Findings: The 'Contingent Lean Culture Adoption' (CLCA) model suggests 5 theoretical trajectories healthcare organizations may experience when conducting a Lean transformation. These trajectories evolve from a new concept of Lean Cultural Friction (LCF) which represents cultural friction a healthcare organization encounters toward an ultimate Lean culture mastership through time. From high to low initial LCF, a healthcare organization may in its Lean mastership course end up in three states: lower, similar or higher LCF situation.

Research implications: CLCA model demonstrates potential to be developed into a framework and even possibly a Lean cultural friction theory after further qualitative and quantitative validation.

Practical implications: The CLCA model may help healthcare managers to use more appropriate cultural change strategies during their organization`s Lean journey.

Originality/Value: This work enriches the concept of Lean cultural change which may not only apply to healthcare organizations but other ones as well. It suggests the existence of a healthcare organization Lean culture mastership archetype and introduces the notion of

Lean culture friction. It also provides propositions for pragmatic definitions of some original related organizational change terms: trajectory, path, route, course, track and journey in management.

Key Words: Lean, Healthcare, Operations Management, Organizational Culture, Organizational Change, Trajectory, Distance, Friction, Situation.

## 2.1 Introduction

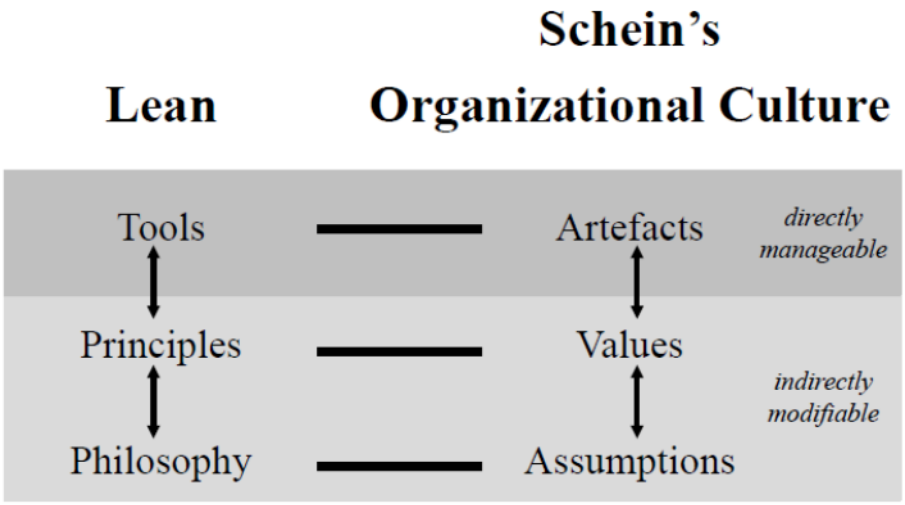
TPS, the Toyota Production System, still is today the most emblematic and celebrated realization of Lean. Really going from rags to riches, Toyota has been able to become and remain, with Lean, the largest car manufacturer in the world confounding conventional thinking that higher performance requires ever more resources, jostling entire supply chains, business models and management teaching (Holweg, 2007). But even Toyota stumbles at times with recalls and scandals despite learnings of its over 70-year Lean experience (Osono *et al.*, 2008; Gu, 2010). Lean is not easy, but its key elements: continuous improvement of operations and value creation by relentless removal of non-value-added activities from the stance of the ultimate end-customer through initiatives of trained motivated employees at all organizational levels are simple to grasp and very appealing for most, if not all organizations challenged to achieve ever greater performance (Womack *et al.*, 1990; Womack and Jones, 2003; Miina, 2013).

The earliest accounts of Lean application in healthcare date from 2001 with experiences of such pioneer organizations as Bolton Hospitals NHS Trust in the UK and Flinders Medical Centre in Australia (Radnor *et al.*, 2012). More than fifteen years later, only a few healthcare organizations, in particular Virginia Mason Medical Center and until recently, ThedaCare in the US, appears to have been able to obtain substantial sustained results with Lean and are advocate of Lean as a prime solution for the generally recognized subpar performance of healthcare services delivery everywhere (Kenney, 2015; Toussaint and Gerard, 2010; Imai, 2012). However, far too many organizations in healthcare and in other industries have failed in their attempt to lasting Lean

transformation; raising some doubts that Lean healthcare may not be worthy or achievable (Radnor *et al.,* 2012). Why Lean, a seemingly straight forward 'common sense' and evidenced successful business method is so hard to implement in healthcare which is full of highly educated dedicated people used to work in teams in high stakes, high performance, high costs and limited resources environments puzzle both much practitioners and academics (Spear, 2005; Toussaint and Berry, 2013). Numerous scholars such as Al-Balushi *et al.* (2014), Poksinska (2010), Radnor *et al.* (2012) and Sobek (2011) have listed various facilitators and barriers to Lean Healthcare implementation going from requirement for (or lack of) executive leadership, need for (or lack of) experts, champions and staff training, proper (or mis) identification of patients as the ultimate end-customer and to tradition legacy and professional silo thinking as the most important. These factors, albeit legitimate, are however very generic and leave to managers very little practical guidance on how to enhance or overcome them productively in their organization`s quest to gain Lean mastership.

Lean has been described as a toolbox, a set of principles and even more encompassing as a philosophy (Bhasin and Burcher, 2006). These complementary depictions show compelling analogy to the three fundamental features of Schein`s prominent conceptualization of organizational culture with its artefacts, values and assumptions model (Schein, 1984).

Figure 1 Comparison of Lean and Schein's organization culture conceptualization



Hence, if Lean represents a cultural proposition, it seems utterly suited to explore the rich body of knowledge of organizational change in management, particularly from a cultural perspective, to better understand Lean implementation and address its challenges. Although references to Lean culture are plentiful in the literature, this concept has been found to be treated and researched rather superficially in a substantial comprenhensive systematic litterature review of 1066 documents (academic papers, books, theses and commercial articles by Dorval *et al.* (accepted for publication, chapter 1 and appendix 1.1).

This paper seeks to offer a greater understanding of Lean healthcare implementation, from an operations management point of view, taking a situated cultural organizational change perspective.

For this purpose, a conceptual descriptive model of Lean adoption in healthcare organizations is built by first mobilizing elements of three classic organizational change theories: 1- a Lamarckian view of evolutionary theory (Van de ven and Poole, 1995), 2- Nadler and Tushman's contribution on contingency theory (1980) and 3- Greenwood and Hinings insights on configurational theory (1988) and then by rippling and bridging six models or conceptualization of organizational culture and change: first, Hatch`s cultural dynamics model (1993); second, Meyerson and Martin`s cultural change paradigm triad (1987); third, Trice and Beyer`s cultural leadership and forms (1993); fourth, Orlikowski`s situated change perspective (1996); fifth, Ghemawat`s CAGE framework (2001); and sixth, Shenkar *et al.*'s construct of cultural friction (2008), under a pragmatic Service Operations Management mindset (Spohrer & Maglio, 2008). An illustration of the proposed model is given by a case analysis of ThedaCare. A discussion about several implications of the model is then provided with proposed definitions of key related concepts and comparison to six reputable generic organizational change models and four other organizational change paradigms. This article ends with ideas on possible practical and theoretical impacts and on future development suggestions for this model.

## 2.2 Methodology

As reported by Jonassen *et al.* (2005), there is a long tradition of modelling for understanding scientific and mathematical phenomena and conceptual modelization is considered fundamental to human cognition and scientific inquiry. In their reviews on conceptual frameworks and theories, Imenda (2014) and Berman and Smyth (2015) demonstrate the range of diverging opinion among academics on the matter but they also underscore the importance and challenges that conceptualization represents. Meredith (1993) has usefully described seven types of conceptual research methodologies, classified in three sub-categories: 1- conceptual models, 2-conceptual frameworks and 3-theories in operations management. According to Meredith (1993), conceptual models attempt to represent or describe (but not explain) phenomenom. He identifies three types of conceptual models: 1- conceptual description, 2- taxonomies and typologies, and 3-philosophical conceptualization. Next developmental stage of models are frameworks, which can be inductively, deductively and systematically constructed. Meredith (1993) suggests that frameworks are used to explain phenomenom by means of propositions and testable hypotheses. The ultimate objective of modelization would be theories, which are meta-frameworks that form coherent groupings of concepts interrelated by principles of explanations and understanding. Theories distinguish themselves from elaborate frameworks in accordance to Dubin's five requirements: 1- a theory should allow prediction or increased understanding, 2- it is interesting (non-trivial), 3- it includes attributes or variables and their interactions, 4- it does not include composite variables and 5- a theory has boundary criteria (Meredith 1993). For means of conceptualization, Reisman, in 1988, offered a taxonomy of seven research strategies used in management and social sciences:1- a so-called ripple strategy or incremental approach is said to be the most commonly employed; 2- an embedding strategy has the ambition of generalizing several known models and theories into a more global formulation, 3- a bridging strategy involves connecting or re-purposing known models or theories to create new ones, 4- a transfer of technologies strategy consists of borrowing knowledge from one field to another one without typically making any novel contributions to the source discipline; 5-a creative application strategy is a variant of the previous fourth strategy and involves a new application of a known methodology to address an unrelated problem; 6- a structuring

strategy aims the exploration of a newly discovered field of inquiry, often approached by a grounded theory methodology and finally, 7- a empirical validation strategy is the least creative one but a critical step in rendering theoretical knowledge into practice. In this study, a conceptual description of healthcare organizations Lean culture adoption trajectories is built using rippling and bridging strategies from elements of three classic organizational change theories and relevant knowledge from Lean, organizational culture, service, healthcare, operations and management literature discretionally selected.

## 2.3 Findings

### *2.3.1 Lean organizational change: three helpful classic theories*

As Lean is a business method that changes organisation, delving into organizational change's body of knowledge seems indeed befitting. But this field is vast and intricate. It has gone through multiple rounds of incremental and breakthrough developments. Several perspectives (ecological, neo-institutional, political, among others) have been described and they can all be complementary (Demers, 2007). Some elements of organizational change's evolutionary, contingency and configurational theories appear though particularly helpful to better understand Lean implementation process.

Evolutionary theory suggests that change among and in organizations happens over continuous and mainly gradual cycles of variation, selection and retention. However, as pointed out by Van de ven and Poole (1995), if a strict Darwinian view on evolution were to be taken, it could only explain change over organizational generations. The alternative Lamarckian perspective recognizes that organizational traits may be acquired through learning and imitation within an organization's generation. Evolutionary theory also suggests that selected and retained traits and ultimately surviving organizations over time are those that best fit available resources and environment (DiMaggio and Powell, 1983).

This notion of fitness is also very important in contingency theory. This theory describes organizations as open systems requiring active management to balance internal needs and to adapt to their environment, assuming no best way of organizing and challenging

managers to be concerned about achieving alignment or goodness of fit between all organizational elements (Morgan 1998). Nadler and Tushman's congruence model for organization analysis (1980) illustrates well this theory by showing organizational inputs (environment, resources, history) strategically linked to an organizational transformation process that includes organizational tasks, formal and informal organisational arrangements and individual contributions toward outputs that are fed back continuously as new organizational inputs or learnings.

From these two basic theories, we retain the following points: 1- organizations change over time; 2- organizational change happens in planned and unplanned fashion; 3- many organizational elements influence change; 4- fitness or congruence among these elements influence change process and outcomes.

Configurational theory adds on that organizational change may nevertheless follow some patterns. Markedly, in their seminal paper 'Organizational designs, tracks and the dynamics of strategic change', Greenwood and Hinings (1988) have proposed existence of four organizational tracks (inertia, aborted excursions, re-orientations and unresolved excursions) defined as 'the temporal association of an organization with one or more design archetypes'. These tracks are theoretical predicted evolutionary course of organizations taken from a managerial interpretative scheme. The building blocks of these tracks, according to Greenwood and Hinings (1988), are five generic design archetypes: 1- archetype coherence (A), 2- embryonic archetype coherence (A), 3- schizoid incoherence, 4- embryonic archetype coherence (B) and 5- archetype coherence (B) for a simple organizational change from a condition A to B linked by processes of coupling and de-coupling. These design archetypes can be illustrated as wagons forming a train or track of variable length supporting variable organizational units of analysis and time frames.

Interestingly, configurational theory's concept of coherence finds consonance and consistency with concepts of fitness and congruence from the two previous theories. Moreover, the notions of patterns and archetypes appear inspiring to carry on a cultural approach of organizational change. On their own though, these theories remain broad and

generic. For the purpose of building a particular conceptual model, use of more specific theories or existing models related to the field of interests is needed and the following six were inspirational.

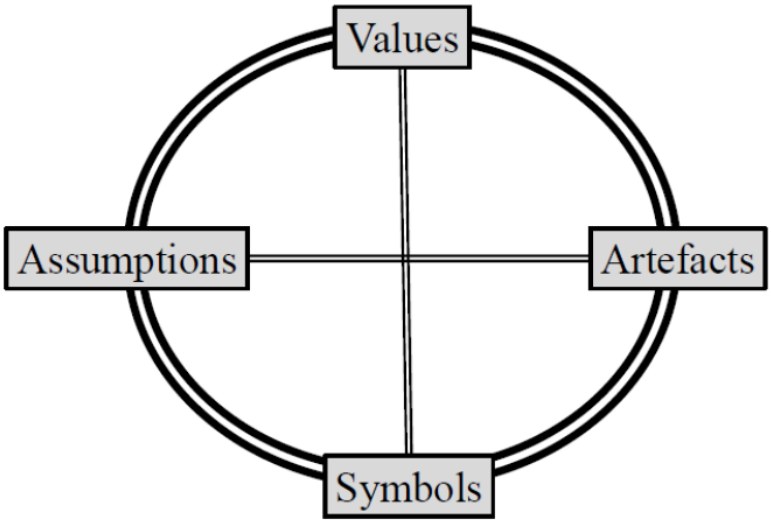
### *2.3.2 Cultural organizational change: a selected overview for rippling*

There are no formal theories that have emerged from the golden age of organizational change's cultural approach in the 1980-90`s era (Demers, 2007). The first edition of Schein`s organizational culture and leadership book was published in 1985 (Schein, 2010). His organizational culture framework suggesting that culture expresses itself through artefacts that are observable, manageable but 'peak of the iceberg' manifestations of abstract values which are reflections of transcendental assumptions remains one of the most referenced and enduring organizational culture models. His book is now in its fourth edition.

#### *2.3.2.1 Hatch`s cultural dynamics model*

Hatch`s significant incremental contribution was to bring a greater degree of sophistication to Schein`s model by including the element of symbols by specifying that artefacts by themselves may take different signification. It is when they reach a level of symbolic shared meaning that they can be more clearly linked to values and assumptions (1993). Hatch also challenge the hierarchical stacked or pyramidal representation of Schein`s organizational culture elements (Schein, 1984; Liker and Hoseus, 2008), arranging them in similar weight and circular fashion, suggesting that no element is more important than the other and that they are inseverable. However, there is agreement that culture can only be directly influenced through organizational change in artefacts and to a certain extent their symbolization through deliberate sense-making by management. According to this view, values and assumptions are not modifiable directly (see figure 1 and 2).

Figure 2 Hatch's organization culture conceptualization




simplified from Hatch (1993)

In her initial model, Hatch proposed a complex sequential relationship to these concepts but subsequently suggested that artefacts, symbols, values and assumptions are better conceptualized as being all interlinked and integrated (Hatch, 2011).

#### *2.3.2.2 Meyerson and Martin`s cultural change paradigm triad*

In general, management literature predominantly sees organizations through the eyes of various levels of managers, mainly of higher management and in particular, from those of the chief executive officer because of mutual interests and ease of access (Demers, 2007). This means that information is most commonly collected and interpreted from rather homogeneous and concerted sources. Particularly for organizational culture studies, this may be misleading and give a limited and incomplete image except when organizational culture is considered as a monolithic integrative element that is the glue that holds all pieces of an organization together (Meyerson and Martin, 1987). A major contribution of Meyerson and Martin was to highlight that imbedded in an 'integration' framework, other cultural paradigms co-exist providing a richer understanding of organizational culture and challenging researchers and other analysts to appreciate them. Their 'differentiation' paradigm recognizes that organizations are a collection of sub-groups that may each have their own sub-culture. These sub-cultures have features that are shared but they may be at times contradictory and inconsistent with those of the organization. The degrees of

contradiction and inconsistency and of its tolerance become in fact an organizational cultural artefact by itself that can be an asset or a burden for an organization during the course of its evolution. At a more granular level of observation, their 'ambiguity' paradigm recognizes that each individual in an organization has his or her own culture and is also part of several cultural sub-groups both from within and outside the organization. Care must be taken to decipher each cultural element appropriately for proper determination on what represents an organizational, sub-group or individual artefacts, symbols, values and assumptions. This can be done by multiple contacts of various members of an organization. This effort becomes particularly relevant and critical in pluralist organizations, such as healthcare organizations, where leadership is diffuse and shared (Denis *et al.*, 2001).

#### *2.3.2.3 Trice and Beyer`s cultural leadership*

Organizations are in constant membership flux at all levels. They gain members that bring baggage and need acculturation and lose members that hold valuable organizational knowledge that vanishes but creates opportunities for the organization. This phenomenon happens in planned and in unexpected fashion and represents a perpetual challenge for organizations and management, particularly when a programmed cultural change such as Lean wishes to be implemented. In that regard, the value of proactive human resource management for Lean mastership is more and more recognized (Algaraja and Egan, 2013). Strategic hiring, re-assigning, training and ultimately, if necessary, firing of individuals for the creation of optimal teams represent powerful means conducive to Lean culture internalisation as organizations and their managers are responsible and accountable for what they do and decide not to do (Hines, 2011). As for other managerial mean for organizational change, in 1993, Trice and Beyer elaborated on the concept of cultural leadership and proposed a model based on two archetypal basic strategies: 1-innovation when the organizational goal is to set an entirely different culture and 2-maintenance when the objective is to build on an already desired organizational culture. Their proposition becomes actionable and practical to managers when related to the particular cultural artefact of rites that can be used as tools to direct organizational change.

#### *2.3.2.4 Trice and Beyer`s cultural forms*

Rite, according to Trice and Beyer, are cultural practices that managers can deploy to impact on organizational social processes and hence culture. For them, rite 'amalgamates a number of discrete cultural forms into an integrated public performance' and is one of 'the most complex and elaborate of the cultural forms...' (1993). Trice and Beyer have identified through their field studies six generic types of cultural rites: rites of passage (1), of integration (2) and of degradation (3) which are to be used to change an organizational culture in need for innovation, whereas rites of enhancement (4), of renewal (5) and of conflict reduction (6) are conducive to a maintenance cultural strategy. They stress the importance of rites of creation, of transition and of parting in the sense-making process of any organizational change. They also indicate that they are likely many other types of rites that are still to be identified. Some could perhaps even be industry, such as healthcare, or Lean specific.

It is interesting to note that Trice and Beyer chose not to distinguish between artefacts and symbols in their description of possible culture forms. For them, physical objects and settings of an organization are all symbols. They put a lot of emphasis on the role of language and narratives such as jargon, gestures, humor, gossip, rumors, stories and several others as important bearer of organizational culture. They also suggest that managers dispose of many other practices than rites that can be utilized as powerful levers of change if and when used in coherent and constructive way. Trice and Breyer for example differentiate between rituals, described as simple combinations of repetitive behaviors; taboos, the negative counterpart of rituals for prohibited behaviors; and ceremonial which they define as an assemblage of rites in one occasion (1993). The challenge for managers who wishes to lead a Lean transformation is to identify and progressively implement appropriate Lean cultural artefacts and practices into their organization inspired by the particular circumstances or situation of the organization.

#### *2.3.2.5 Orlikowski`s situated change perspective*

Work organizations can be seen as a hierarchy of managers and front-line personnel working together to deliver products and render services to customers. How an organization is structured represents a strong cultural artefact, and so are how the work

load is distributed and shared and how communication and other social interactions are performed among its members and with outsiders. Moreover, beyond each organization`s member titles, job descriptions and responsibilities, there are individuals that carries those roles with all their talent, energy and capabilities. Sometimes the right mix of individuals and circumstances meet and outstanding organizational performance is achieved. Most times however, organizations have to deal with diverse strengths and weaknesses and attempt to get the most out of this situation. This is the essence of Orlikowski situated perspective on organizational change about the importance of paying attention to each individual input and contribution in the change or inertia of an organization. As she mentions in her landmark paper, a situated approach in the study of organizational change is a complement, not a substitute to other organizational change perspective (1996). Adopting a situated view enriches a cultural approach perspective, for example, by highlighting the unique contribution of individuality in organizational life and organizational change movements, an element that is often neglected or under appreciated. A situated view goes beyond a common contextual analysis as it recognizes the dynamic interactions between historical, political and environmental context of an organization and its unique membership who create or reproduce organizational routines that are objective cultural artefacts of a collective subjective interpretation of the organization`s operational purpose at a particular moment in time and in place (1996). The outcome may not be as what was planned and most likely result instead into transformed intentions but it is certainly not fortuitous or random, hence justifying the study of organizational change as a sense-making endeavor and a quest of learnings to help make more informed future managerial decisions. The study of the gap between any intended and achieved organizational change is challenging but greater insights may be obtained when approached from a cultural perspective.

### *2.3.3 Culture distance, gap and friction: bridging knowledge*

The notion of cultural distance is a staple for more than forty years in the economics, finance, international business and mergers and acquisitions studies (Shenkar, 2012). Year 2001 saw the publication of two significant contributions in the use of this concept:

namely, Ghemawat`s CAGE framework for practitioners and Shenkar`s Decade Award Winning article critique of the cultural distance construct for academics.

#### *2.3.3.1 Ghemawat`s CAGE framework*

The CAGE framework informs readers about four dimensions (1- Cultural, 2- Administrative and political, 3- Geographical and 4- Economic) of distance that may form a gap and therefore be a managerial challenge in a firm`s investments in another country. Cultural distance is plainly described though as differences in language, ethnicity, religion and social norms and as lack of connective ethnic or social networks between an investor organization and a recipient country, but are shown to have significant impacts on the success or failure of foreign investments in the article. Admittedly subjective, CAGE distance assessment is suggested to be a valuable complement to other tools managers may use to reduce costs of distance and support their actions (Ghemawat, 2001). Transposing this notion of cultural distance to an organization`s Lean adoption quest may appear odd at first but the issues regarding investing in Lean are not so dissimilar to all decisions and uncertainties an organization faces in foreign investments albeit Lean, in this view, represents a virtual country. There is still much face validity in the consideration that becoming Lean for almost all healthcare organizations is like moving to an entire foreign land with requirements to learn a new language, change habits and act differently.

#### *2.3.3.2 Shenkar et al.'s construct of cultural friction*

Shenkar challenged in 2001 the popular construct of cultural distance and use of its related quantitative index in international business by exposing numerous issues regarding questionable hidden assumptions weakening its theoretical and methodological validity (Shenkar, 2001). He convincingly demonstrated that cultural distance, contrary to its long-accepted construct premises, is not necessarily symmetric. It is also unstable, not linear, incomplete, severable with various effects and flawed in its implicitness of corporate homogeneity, spatial homogeneity and content equivalence. But his main contention about the cultural distance construct and cultural gap idea resides, at a more metaphoric level, in the fact that they both put emphasis on the relationship difference and void between two entities rather than approaching it from a more sophisticated and neutral stance on how these two entities may behave when in interaction allowing for both

positive and negative potentials (Shenkar, 2001). Hence, recalling a term originally used by Williamson (1975) in his transaction costs theory treaty and inspired by the disciplines of physics and mechanical engineering, Shenkar and colleagues strongly advocates for the use of the concept of cultural friction instead of cultural distance or gap (2008). They subsequently in 2011 published a cultural friction in international business model with 'drag parameters' or 'organizational equivalent conditions' that affects frictions such as load, surface, speed and stage and 'lubricants' or 'organizational equivalent prescriptions' that, they contend, alleviate friction such as communication, acculturation, socialization and staffing, that bare much resemblance with previously stated Lean implementation facilitator and barrier factors. They even proposed a mathematical formula measuring cultural friction quantitatively that is yet though requiring empirical validation (Luo and Shenkar, 2011). In a similar spirit of interdisciplinary collaboration that inspired the concept, it seems fit to borrow and adapt the construct of cultural friction in Lean healthcare. There is actually a precedent: already the concept of cultural friction has been extended to tourism by Cheok *et al.* (2005) in a study on cross-cultural service interactions.

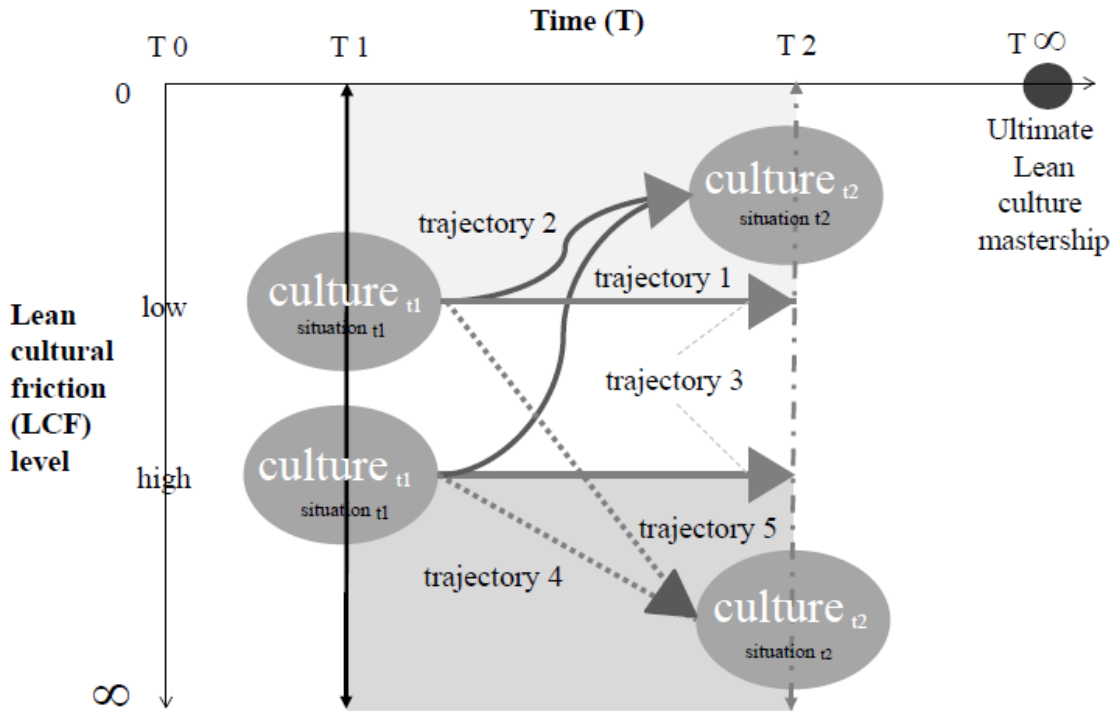
#### *2.3.4 The Contingent Lean Culture Adoption (CLCA) model*

Based on this knowledge and in an attempt to provide greater and more general explanations for differential Lean implementation experience of healthcare organizations, we conceptualized the following 'Contingent Lean Culture Adoption' (CLCA) model (figure 3). This model assumes that, from time $t_1$ to $t_2$, healthcare organizations manifest cultural artefacts and symbols expressing values and assumptions, shown as respectively, culture $t_1$ and culture $t_2$. The model postulates that, since Lean can be considered a cultural proposition, there is an ultimate Lean culture mastership state. The friction between the current organizational culture features and the ultimate Lean culture mastership state is referred to as the cultural friction at $t_1$ and $t_2$. A successful Lean adoption would reduce this friction level (trajectories 1- high to lower and 2- low to lower), whereas an unsuccessful one would maintain a similar baseline level of friction (trajectory 3- high to low and every level in between) and a failed one would be when friction level is increased (trajectories 4- high to higher and 5- low to higher). Situation $t_1$ and situation $t_2$ refer to

the fluctuating mix of individuals, including members of and others contacts with the organizations, and the entire varying organizational context (both within and outside) these organizations are at both times and they reflect the contingent nature of the model. Lean culture transformation seems additionally best conceptualized as an adoption process based on the Merriam-Webster web selected definitions of the transitive verb adopt: (1) to take by choice into a relationship; (2) to take up and practice or use; (3) to accept formally and put into effect; (5) to sponsor the care and maintenance of (2018).

Figure 3 The 'Contingent Lean Culture Adoption' (CLCA) model

for healthcare organizations cultural trajectories




***2.3.4.1 CLCA trajectories***

The CLCA model uses the term 'trajectory' specifically and intentionally. The meaning of term 'trajectory' is not well established in the management and organizational change literature and has been used liberally in many different ways (for examples: Fleck *et al*., 1990; Papadopoulos, 2008; Torres, 2007). The CLCA model proposes that an

organizational trajectory represents the theoretical predicted overall evolutionary course that an organization may follow from time 1 to time 2. This definition derives from the formal definition of a trajectory as being: (1) the curve that a body (such as a planet or comet in its orbit or a rocket) describes in space; (2) a path, progression, or line of development resembling a physical trajectory *<an upward career trajectory>'* (Merriam-Webster web dictionary, 2018).

#### *2.3.4.2 CLCA and implementation strategies*

The CLCA model informs managers and researchers that Lean implementation, despite all best efforts and intentions, may not achieve the desired goal at times. It implies however that a greater likelihood is obtained if the most appropriate strategic means to reduce cultural friction are used for each organization. The managerial decision in selecting the proper strategy would mainly depend on the following five factors inspired by Nadler and Tushman's congruence model for organization analysis (1980): 1- the managers` estimate of the Lean Cultural Friction (LCF) level which can be established subjectively and intuitively or more objectively and formally assessed by using one or several instruments that have been already developed to assess Lean maturity or Lean readiness (Guimaraes and de Carvalho, 2014; Jobin and Lagacé, 2014; Pakdil and Leonard, 2014). These instruments can only give an approximate estimate as they were not specifically designed to measure LCF level. There is certainly a need for development of such instrument; 2- the different components of LCF that are manageable; 3- the organization situation, i.e. the mix of individuals collaborating and the current context of the organization; 4- the organizational learnings and dependencies from past implementation successes or failures and the explanations for the obtained results; and 5- managerial preference.

Of note, the CLCA model is set applicable at an organization level. It could perhaps be applied to organizational sub-units or cells as long as these units or cells have enough power, influence, autonomy and control over their resources to implement Lean by themselves.

#### *2.3.4.3 CLCA conceptual paradigm*

The CLCA model is positioned in a pragmatic constructionist paradigm (Patton, 2002). It is pragmatic because of its functional definition of culture into four constituents (artefacts, symbols, values, assumptions) acting as anchors to facilitate longitudinal comparison at $t_1$ and $t_2$ and transversal interorganizational comparison qualitatively. In some future, it could become a positivist model when a validated instrument becomes available and permit quantitative analysis and test its implications. The model acknowledges that culture of an organization is an alive and fluid concept, in constant need of re-enactment and confirmation by its members, revealing its constructionist nature. It is illustrated in figure 2 by purposely having no line but an open border instead setting the elliptical margins of culture at $t_1$ and $t_2$. Concurrently, ultimate Lean mastership state is to be considered as a dynamic ever moving target in continuous improvement and re-invention.

#### *2.3.4.4 CLCA timeline*

The CLCA model does not assume any specific timeline between $t_1$ and $t_2$. As Lean aims at continuous daily improvement, the shortest period can hence be one working day and the longest, over the lifetime of the organization. Several Lean experts have however expressed opinions that if, after 18 to 24 months, an organization has not realized any significant gain in Lean mastership, a change in implementation strategy is desirable (Black, 2016; Testani and Ramakrishnan, 2010; Womack *et al.,* 1990). It could have been expected that as Lean mastership increases, the time period between $t_1$ and $t_2$ were to become exponentially shorter through the organization. However, recent evidence by Netland and Ferdow, (2016) suggests that successful Lean implementation, at least for manufacturing organizations, rather follows a sigmoidal pattern: slow at first, then showing rapid gain and finishes with a period of slow calibration as depicted in Figure 3. Patterns of unsuccessful Lean implementation are unknown and therefore shown as dotted lines.

#### *2.3.4.5 CLCA experience*

Additionally, the CLCA model allows for the notion of frictionless cultural elements and does not presume that at ultimate Lean mastership state, all organizations' culture would and could become exactly the same. An organization's culture reaching

ultimate Lean mastership is expected to have changed, but not necessarily in every and all its features. Some artefacts may very well remain the same but it is then for their symbols, values and assumptions attached to them that change would occur. Transversally, two organizations at similar LCF level are expected to appear very different but they would share a similar level of challenges in Lean culture mastership. Much further research is needed to determine which traits create more or less cultural friction and their relative importance. Taken to the extreme, it is understood that ultimate Lean culture can only be a singular experience since every organization's situation is unique.

#### *2.3.4.6 CLCA ethical implications*

The CLCA model does not pretend that ultimate Lean culture is desirable and suited for all organizations. This decision remains a strategic one made by the organization's leaders. The model informs organizations about five possible trajectories of Lean culture mastership over time while taking a neutral stance on performance and morals. An organization may still be very well-off despite experiencing an unsuccessful Lean culture adoption attempt and a successful Lean culture adoption does not guarantee an organization's prosperity but it certainly increases the chance of profiting from Lean's operational improvement promises. The CLCA model does not assume that Lean is right, good and best for all and consequently, organizations that use other management models should not be viewed as wrong, bad and doomed. They are just missing on the opportunity of Lean's value-adding propositions. The CLCA model highlights nevertheless that Lean cultural transformation may not be a risk-free endeavor.

## 2.4 An illustrative case analysis

The following analysis is an exploratory illustration of the CLCA model and its notions of cultural trajectories and cultural friction. This case example is built on secondary data as reported in writings of Kim Barnas (2011, 2014), Mark Graban (2019), Sylvain Landry (2016, 2018) and Dr John Toussaint (2010, 2015) on ThedaCare, an American healthcare organization which has one of the most documented recent Lean experience. Even though this exercise can only be considered speculative, preliminary and partial at this pre-

validation stage, it nevertheless demonstrates how the CLCA model could eventually be developed into a useful conceptual framework and may provide greater insights on the courses of healthcare organizations' Lean transformation from a cultural change perspective.

### *2.4.1 ThedaCare case*

ThedaCare, a community-based, non-profit healthcare organization, has grown from being a two-hospital system in 1994 to comprise in 2015 seven hospitals, three dozen specialized and generalist outpatient clinics, several nursing homes, assisted-living facilities, hospice care, rehabilitation centers and home health services under its wings. ThedaCare serves presently greater than 450 000 patients annually and is the largest employer in northeast Wisconsin with a staff count of over 7000 people (Barnas, 2011, 2014; Landry *et al.*, 2016). This impressive growth may have been stimulated by its board of trustees' decision in 1992 that 50 percent of management bonuses would be based on quality performance, which at the time was simply thought to depend on whether services were covered by board-certified physicians. It is reported that it is from this pivotal declaration that ThedaCare's still on-going quest for ever improving quality was launched and led to its experimentation with Lean (Toussaint and Berry, 2013). ThedaCare's trustees, who were then particularly engaged members, also had another fortunate influence on its fate. Since several of them were successful business leaders of local manufacturing firms with Lean experience, they demanded and facilitated investments in quality measurements and quality improvements (Toussaint and Berry, 2013). And, in 1996, ThedaCare was among the first healthcare providers in the world to acquire electronic medical records (EMR) as a pioneering mean to meet its performance and information needs and to support clinical care (Toussaint and Gerard, 2010). It is again the board of trustees who chose to elect Dr John Toussaint, an eager general internist with a passion for quality of care and 17-year experience within the organization, as ThedaCare's CEO in 2000 (Toussaint and Gerard, 2010; Toussaint with Adams, 2015).

While ThedaCare had consistently enjoyed high rankings in the 95$^{th}$ percentile on many hospital quality measures, its leaders' awareness that it could do and ought to do better

for patients' care has long been strong and a motivation to take responsible albeit frugal actions in search of excellence (Barnas, 2011, 2014). Indeed, financial stewardship appears to be a defining ThedaCare characteristic with leaders and managers taking pride in running their organization with business units and disciplined accountability, almost as if it were a for-profit enterprise. This is further supported by the fact that financial stewardship was eventually selected as one of ThedaCare's four core true north Lean metrics (Toussaint and Gerard 2010; Barnas, 2014).

Due, perhaps, to its location, in the upper middle part of their country, a land of a fairly homogenous population of dairy farmers, paper-mill and light industry workers, ThedaCare "value a sense of belonging", as stated by Barnas (2014), and it has always paid attention to and closely monitored employee satisfaction as an important organizational performance measure (Toussaint et Gerard, 2010). But, in the actual words of Toussaint and Gerard (2010), ThedaCare was also "a pretty typical, mid-sized, cradle-to-grave, not-for-profit healthcare provider" used to having a top-down, unquestioned-the-boss code of conduct and a hierarchical power distribution. ThedaCare practiced management by objectives with silos thinking and had firefighting attitudes, physician-centered operations and a traditional healthcare organizational culture of shame-and-blame resulting in all-too-common behaviors of fear to speak and hiding defects.

It is as a solution to improve quality of care at lower cost that ThedaCare's Lean journey started in 2003 (Toussaint and Gerard, 2010; Barnas, 2014). There were quick and encouraging results at first in several clinical processes in laboratories and a few medical clinics by running rapid improvement events (RIE) and PDSA (plan-do-study-act) cycles. There were however missteps such as this incident when a loyal senior medical clinic receptionist's position was judged wasteful and readily terminated. Despite offers to re-deploy her to another job, she felt so unconsidered that she quit angrily, a move that spread swiftly the rumor within the organization that 'Lean was mean'. But ThedaCare learned from that experience and instituted pre-emptive redeployment preparation work whenever a RIE at risk of causing job elimination was foreseen in collaboration to a human resource department re-assignment cell (Toussaint and Gerard, 2010). In 2004, Lean culture'

adoption was tested strongly when recently appointed ThedaCare's hospitals President, Kathryn Correia, ordered an immediate shut-down of all surgical suites to understand why there had been four events of wrong-site surgeries in 2 months. Process improvements including random quality audits were instituted. This experience exemplified to all the value of error reporting over silencing for the benefits of patients and clearly indicated to ThedaCare the expected path to follow.

2006 was a crucial turning point moment for ThedaCare. Although Lean's diffusion within the organization was becoming stagnant and employee's morale reached a record low that year, there were spectacular Lean successes in cardiac care from the Code STEMI project in which door-to-balloon coronary angioplasty target time of less than 90 min hit rate was improved from 65% achieved to almost 100% and in neurology care with ThedaCare obtaining a centre of excellence for stroke designation. Several physician groups and staff were nevertheless putting Dr Toussaint under a lot of pressure. An entire service of 8 orthopedic surgeons went as far as suddenly quit to form another competitive hospital nearby (Toussaint and Gerard, 2010). It took an unequivocal support from the board of trustees whose members were familiar with the growing pains of Lean culture adoption, for Lean's efforts to continue (Toussaint and Berry, 2013). Dr Toussaint realized then that he did not have what he felt were the right leadership skills to go on though and he announced his intention to step down as ThedaCare's CEO. He initiated a thoughtful succession plan through which potential internal candidates were mentored and challenged to demonstrate how much they were ready to lead ThedaCare into its next Lean development stage and Dr Toussaint rather became founding CEO of ThedaCare Center for Healthcare Value, ThedaCare's Lean promotion-education office. Concomitantly, key Lean patrons such as Kim Barnas, MaryJeanne Schaffmeyer, Roger Gerard and Nancy Gurnee among many others, formed a critical mass of or 'dream team' of Lean enthusiasts who pushed forward ThedaCare's Lean transformation. By the time Dr Dean Gruner took CEO office in 2008, the Collaborative Care unit project which developed a 'green field' Lean-designed model cell hospital ward was already operating and the original 12 full-time Lean facilitators group whose roles are to facilitate Lean activities, teach Lean concepts and develop future organisational leaders grew to a

membership of 30-35 members, each mandated for a two-year rotation. (Toussaint and Gerald, 2010; Barnas, 2011; Toussaint and Adams, 2015).

ThedaCare's Lean transformation appeared to flourish thereafter with apparent, progressive and appropriate use of Lean tools, enactment of Lean principles, appreciation of Lean values and understanding of Lean philosophy, earning to ThedaCare a reputation of world leader in Lean healthcare (Landry, 2018). Experimentation with daily team huddles, standard work, especially for its leaders, visual and process management was routinely put into practice. Education through various training programs, sensei assistance and several key reports (A3, status, scorecard) was abundant. ThedaCare applied hoshin kanri and established no-meeting daily zones to allow gemba information collection. ThedaCare central improvement system office was set up. ThedaCare improvement system was developed and they were integrated later through ThedaCare business performance system which solid results, even though they were under projected targets, were published in 2011 (Barnas). ThedaCare leaders outspokenly acknowledged that Lean adoption meant an arduous cultural organizational transformation and realized and secured early support from human resources and finance departments. In 2009, it was estimated that Lean efforts had spared 25 million $ to ThedaCare's bottom-line and by 2015, over 100 of its executives, managers and supervisors had gained Lean facilitator experience. Commitment to Lean was real. No efforts seemed indeed to have been spared for Lean to work and be sustained at ThedaCare (Barnas, 2011, 2014; Toussaint and Gerard, 2010; Toussaint and Adams, 2015).

Little has been written yet on events that happened at ThedaCare during 2011 and 2017 period, but noteworthy, in 2012, Kathryn Correia left the organization to become President and CEO of other health organizations. Followed by, in 2014, Kim Barnas and Roger Gerard who left ThedaCare to, respectively, work full-time at ThedaCare Center for Healthcare Value and start his own consulting firm. MaryJeanne Schaffmeyer joined back Kim Barnas and Dr Toussaint at ThedaCare Center for Healthcare Value when she retired in 2015 as ThedaCare's chief operating officer and Nancy Gurnee moved to Florida that same year to work on Lean at another health organization (sources: Linkedin profiles). ThedaCare Center for Healthcare Value was renamed Catalysis Inc. in

November 2016, an event that could be labeled a rite of renewal according to Trice and Beyer cultural forms (1993). And, in 2017, ThedaCare's board of trustees rather unexpectantly replaced retiring Dr Dean Gruner with an external nomination of Dr. Imran Andrabi without even involving the former in the process, as it was used to be done at ThedaCare in the past (Graban 2019; Landry, 2018).

Since then, ThedaCare's Lean facilitators group, which had already been gradually reduced to 20 members at some point and down to seven in 2018, was terminated and the use of the term 'Lean' was abandoned for the more generic expressions of continuous improvement, team member training, best practices application, leaders' empowerment and problem-solving in a ThedaCare public relation statement (Graban, 2019). Currently, on its website, ThedaCare appears to even have gone back to its original 2003 objective: to provide world-class quality care at lower cost, supported by a different business model: the Next Generation Accountable Care Organisation. There is no more reference to continuous improvement other than indirectly with intention to collaborate with Catalysis Inc. (2019).

The first warning signs of ThedaCare's Lean transformation potential issues may actually be detected and could perhaps have been appreciated as early as 2006 when Dr Toussaint remarked that only one fifth of ThedaCare's employees had been on even one Lean improvement team and later, when Kim Barnas indicated in 2011 that a little less than 60% of employees had been involved in ThedaCare's business performance system (Toussaint and Gerard, 2010; Barnas, 2011). In an interview after his retirement, Dr Gruner admitted to some of ThedaCare's problems: 1- a form of complacency toward their promoted Lean adoption methods; 2- a set back to hierarchical rigid decision-making; 3- misplaced dependency on Lean facilitators; 4- misdirected leadership and 5- lack of organizational self-reflection and learning. A commentator has also pointed out that ThedaCare's clinical quality rankings had fallen to 21th percentile and as low as 12$^{th}$ for serious complication rate in 2018 (Graban, 2019). Something certainly had to be done which may explain ThedaCare's board of trustees' actions whose change in membership since 2006 is unknown. When and how exactly ThedaCare's lost its way and its Lean

goals: to develop people, to solve problems, and to improve performance (Barnas with Adams, 2014)? Further research might eventually be able to tell. But the simplest answer may be because its leaders failed to put in practice their own PDSA cycle during Lean implementation.

### *2.4.2 CLCA model trajectories*

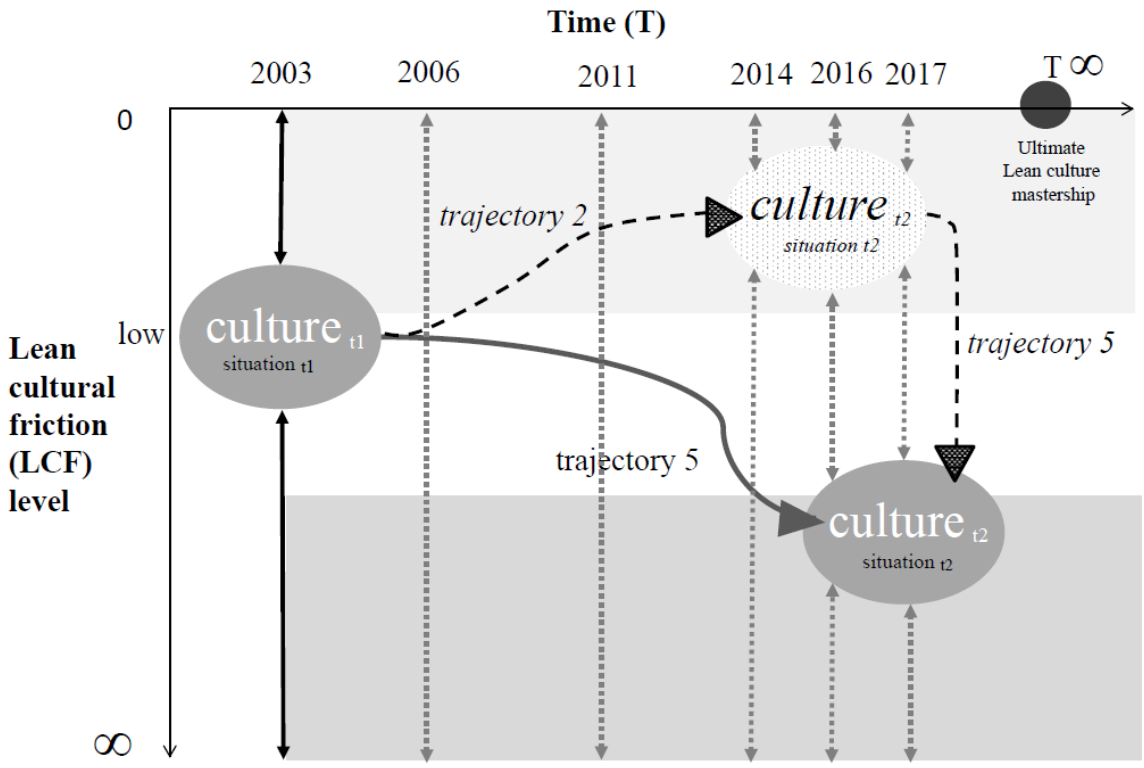
Certainly, if this analysis had been performed on and before 2016, ThedaCare's Lean culture adoption trajectory from publicly reported accounts could have been interpreted as a typical S-shape example, in accordance to Netland and Ferdows (2016), of trajectory 2 (low to lower) but subsequently followed in 2017 by a sharp sequential trajectory 5 (low to higher) (Figure 4).

Indeed, ThedaCare appears to start its Lean journey in 2003 as an organization with several Lean compatible features such as openness to innovation, eagerness to learn, attention to people (patients and employees) and to quality, engaged leadership with measure-driven and business-like practices. The case suggests that ThedaCare's progress in Lean culture adoption was slow and precarious from 2003 to 2006 followed by energetic advances from 2006 to 2011 peaking at the establishment of ThedaCare business performance system. Its rate of adoption gradually decreased towards 2014 to plateau for a while thereafter at a higher Lean culture mastery and lower Lean cultural friction levels. Events of 2017 and later demonstrate though a dramatic organizational culture trajectory 5 type turn around with apparent rejection of Lean and its culture.

The CLCA model allows however a different interpretation for ThedaCare's Lean journey to possibly be viewed as a general trajectory 5 all along. The explanation comes by rippling and bridging Luo and Shenkar (2011) model of cultural friction and their proposition of drag parameters (that increase friction) and lubricants (that decrease friction). From 2003 to 2011, it can be argued that ThedaCare, as a whole, had a prolonged period of love-hate relationship with Lean culture. As latent drag parameters such as its cultural legacy of top-down management and physician-centered care were gradually becoming manifest when confronted to Lean's culture of team-based management and

patient-centered care, proportionally greater use of lubricants had to be employed for ThedaCare Lean culture adoption to progress. The case suggests indeed that up to 2011, a lot of lubricants in the forms of experimentation, education, promotion and commitment were employed but these were likely facing strong, latent, passive, less accounted drag parameters which possibly never really reduced in intensity and were easily underestimated in an organization which had a baseline organizational cultural habit of silencing issues. When lubricants' forces gradually fell down, signaled by departures of key Lean patrons such as Kathryn Correia, Kim Barnas and Roger Gerard in 2012 and 2014, these drag parameters tilted the balance toward higher Lean cultural friction level. And, ThedaCare ends up at a lower Lean culture mastership level.

Figure 4 ThedaCare's contigent Lean culture adoption model trajectories




Note: (1) please refer to figure 5 for details about timeline.

(2) dotted line: possible interpretation of ThedaCare's trajectory;

full line: alternative interpretation

This interpretation suggests that CLCA model trajectories are conditioned by balancing forces of drag parameters and lubricants. Trajectories 1 and 2 demonstrate occurrences when lubricants are present in larger amount than drag parameters; trajectory 3 when lubricants are present proportionally at about the same degree as drag parameters and trajectory 4 and 5 when drag parameters are stronger than lubricants. It can be postulated that stronger lubricants may need to be used for organizations of trajectory 1 type which starts at higher level of Lean culture friction or possess less Lean culture favorable features than for organizations in trajectory type 2. But it can be easily imagined that forces of drag parameters are likely to be dynamic and largely variable and situation dependent.

S-shape trajectories type 1 and 2 of the CLCA model (Figure 3) could be explained by an initial action-reaction interplay between latent organizational drag parameters becoming manifest when confronted to Lean culture adoption process. As Lean-conducive lubricants are employed in proportionally higher degree than the organization's drag parameters, Lean culture mastership slowly increases; at a turning point moment, lubricants overwhelm all drag parameters and forces of the latter start to decrease. Lean culture mastership rapidly increases then and swift lower cultural friction ensues. The second plateau could be explained by a gradual lesser requirement of lubricants as drag parameters level decreases. It signals that a certain Lean culture mastership level has been achieved and lower Lean cultural friction level reached. Because an organization situation (people and context) always continues to change, this may be viewed as creating a persistent amount of drag and this provides an explanation for why Lean can only be sustained by constant use of some form and amount of lubrification.

This analysis suggests that Lean culture adoption can be now conceptualized as the process of mobilizing all latent organizational drag parameters to become manifest and overcoming them by proper lubrification. Ultimate Lean culture mastership would be the utopic situation when there would be no residual drag parameters creating Lean cultural friction and therefore no requirement for any lubricants.

Whether and how the CLCA model could have predicted earlier ThedaCare's trajectory 5 and enable its leaders and managers to employ corrective measures or better lubricants for a successful Lean adoption remains to be determined by further validation work.

Moreover, it is only when characteristics of Lean healthcare culture in its ultimate state will have been described that trajectory estimation may become more precise and informative. It is at this point conceivable that in ThedaCare's case, for example, its starting point may not be as low cultural friction level as initially postulated. Hence, its case would rather be a possible example of trajectory 1 and 4. Additionally, as more information is eventually obtained from ThedaCare's evolution and whether or not it has retained some Lean culture elements or returned back to its similar time 1 organizational culture, it is possible that trajectory 3 could be its most appropriate descriptor.

### *2.4.3 CLCA model and cultural friction, drag parameters and lubricants*

The above interpretation of the CLCA model suggests the existence of various types of drag parameters and lubricants. It also highlights the importance of using proper Lean-conducive lubricants in the process of Lean culture adoption. Lean-conducive lubricants may be defined as lubricants consistent and coherent with Lean's artefacts, symbols, values and assumptions. It can be imagined that use of other less Lean-coherent or inappropriate lubricants could provide some short-term relief to forceful drag parameters. But, inappropriate lubricants could become cultural drag parameters themselves, which would appear be even harder to recover. A ThedaCare example of this could be the angry receptionist departure – 'Lean is mean' incident in which elimination of waste should have been seen as a Lean-conducive cultural lubricant demonstrating a desirable cultural action. It however became a negative organizational story, another one of Trice and Beyer cultural forms (1993), that probably still haunts ThedaCare despite adoption of adequate Lean-conducive lubricating countermeasures. This suggests that they are no short-cuts in Lean culture adoption process. Consistency, coherence and responsiveness in application are paramount. It also can be hypothesized, if most effective cultural lubricants in Lean culture adoption are lean-conducive, that strongest drag parameters are likely revealers of baseline latent organizational culture values and assumptions that become manifest. However, all these statements will require further confirmatory investigation.

Additionally, this interpretation of the CLCA model allows for lubricants and drag parameters to both be active and passive factors with positive and negative impact on Lean culture adoption respectively. It is their summation that would dictate the organization's trajectory. Having access to information from different perspectives and organizational levels as proposed by Meyerson and Martin (1987) about drag parameters and lubricants effects would enhance precision in estimate and accuracy of interpretation. Finally, it may be postulated that intensity of drag parameters and lubricants may become stronger as they touch more profound cultural meanings such as values and assumptions rather than simply artefacts and their symbolism (Hatch, 1993).

Further rippling and bridging Luo and Shenkar (2011) model of cultural friction to discuss the possible nature of these factors, generic drag parameters (that increase friction) can be differentiated in terms of load, surface, speed and stage and the following generic lubricants (that decrease friction) have been proposed: communication, acculturation, socialization and staffing. Hence, the following comments can be made from the case.

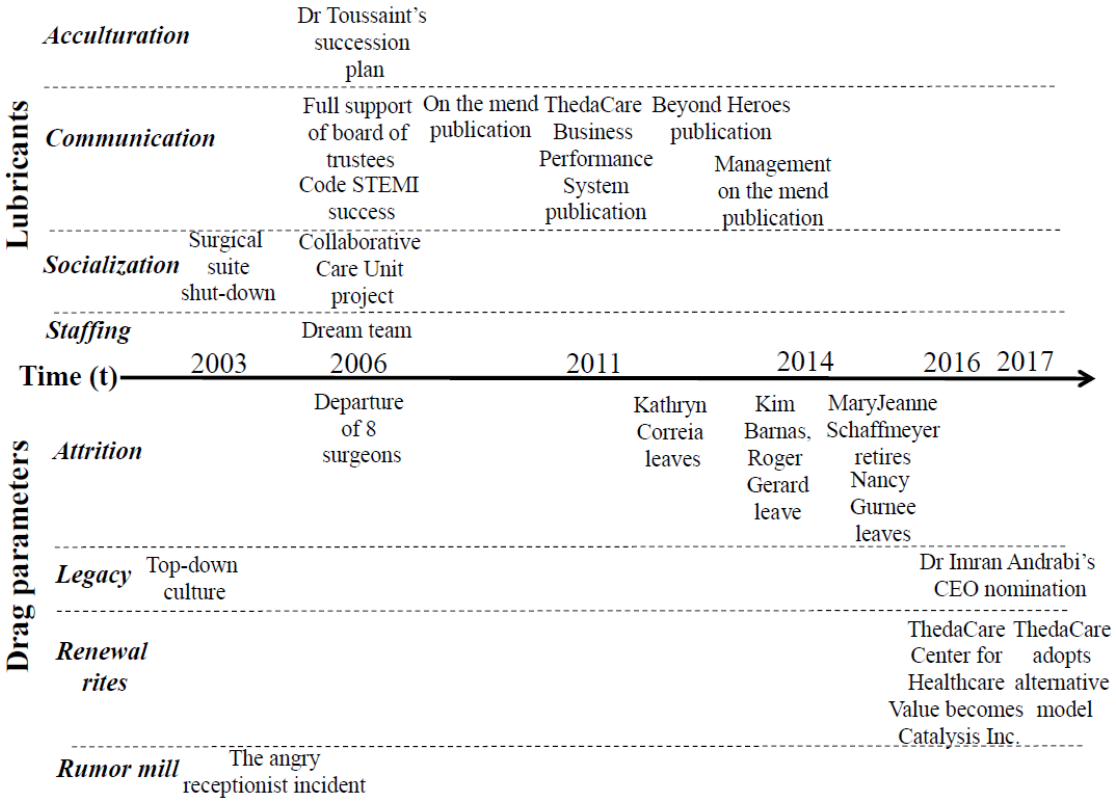
In terms of load and surface drag parameters, ThedaCare's Lean entry mode and number of contacts through runs of rapid improvement events and incremental settings of model cells may be seen as being cautious in its scope by limiting experimentation to small short-lived areas, permitting easier damage control if necessary. But load may have been perhaps at the same time overwhelming in its depth where a lot of resources were spent on a few projects at the expense of spreading superficial exposure to many others places. Those sectors that had been fortunate enough to be selected benefitted greatly from their Lean experience but the dream that Lean behaviors would then organically replicate by themselves in the organization did not happen and should not be surprising in consideration to the on-going levels of strong Lean-aversive cultural legacy drag. In term of the drag parameter speed, ThedaCare's Lean entrance rate and turnaround appear to have been too slow from the beginning. Several Lean authors seem to agree that notable Lean culture adoption features should be continually witnessed within a period of 3 to 18 months in the organization in a successful transformation (Black, 2016; Womack et al.

1990). If not, a change of implementation strategy and plan or application of cultural lubricants should be done. In terms of the drag parameter stage, ThedaCare appears to not have been able to gain and re-apply as many learnings from each of its rapid improvement events runs and model cells sets as it could have and may have lost opportunities of establishing a virtuous Lean culture adoption learning cycle.

All proposed generic lubricants by Luo and Shenkar (2011), communication, acculturation, socialization and staffing, appear to have been insufficiently employed by ThedaCare. Although there were certainly awareness and intentions, little is demonstrated on how communications were made truly open, transparent constructive, effective and widespread within ThedaCare during its Lean culture adoption attempt. There are rather several accounts on communication break-downs between physicians and leaders, employees and managers, leaders and suppliers in ThedaCare case. However, internal and external recognition of Code STEMI project and other ThedaCare's Lean successes may be seen as probable Lean culture lubricants. Training appears to have been too exclusive as evidenced by the proportion of more than 40% of employees still not involved in ThedaCare business performance system eight years after launch of ThedaCare's Lean initiative. Since features of Lean culture in its ultimate mastership state are still yet to be determined, ThedaCare's Lean patrons could not be really hold responsible for not being able to diffuse Lean culture in the organization through socialization. Lean culture current state of high pragmatic ambiguity was certainly not helping (Dorval *et al.*, accepted for publication). In term of staffing, although ThedaCare appear to have been well aware of the key importance of proper human resources management as a crucial Lean adoption lever, it is not clear what changes were made in ThedaCare's compensation and performance rewards plan to its personnel and in particular its leaders. ThedaCare has apparently been able to respect its no-lay off policy during its Lean adoption course and some information about the hiring process of new employees is found in Toussaint with Adams (2015) but little is said on how successful ThedaCare was in carrying its new hiring policies through.

Figure 5 presents a tentative account of some of cultural lubricants and drag parameters highlighted in ThedaCare case through time and categorized according to Luo and Shenkar (2011) proposed generic lubricants and case inspired types of drag parameters. Note how departure of prominent Lean figures seems to relate to crucial moments in ThedaCare's history. This suggests that ThedaCare has remained through the process a top-heavy organization.

Figure 5: ThedaCare Lean culture adoption factors timeline




### *2.4.4 Illustrative case conclusion*

All in all, this case analysis illustrates how ThedaCare during its Lean cultural adoption journey appears to have manifested persistent forceful drag parameters, particularly in terms of load, speed and stage, that were not compensated enough by sufficiently strong Lean-conducive lubricants resulting in higher level of cultural friction. It provides explanations for the proposed ThedaCare's trajectory 5 general course. Further research and deeper analyses during the CLCA model empirical validation will hopefully provide

further support for its flexibility in its sequential and global ability to assess healthcare organizations trajectories. Its future development may be able to identify other key factors, particularly for more Lean-specific drag parameters and Lean-conducive lubricants relating to the contact of Lean healthcare culture in its ultimate form and baseline healthcare organizational culture. This future work may increase understanding of Lean adoption process from a cultural change perspective, enhance the predictive value and demonstrate the usefulness of the CLCA model for academic and for practical purposes.

## 2.5 Discussion

As just illustrated, our CLCA model has the strengths of flexibility, clarity and simplicity. It does not pretend or intend to explain everything about the entire Lean healthcare implementation experience phenomenon, for example, it does not address issues of performance, marketing strategy, finance or organizational structure. But by using culture in a focused analytical lens, it may allow gaining new insights and deeper understanding of Lean healthcare and its implementation challenges.

### *2.5.1 Lean mastership*

The CLCA model suggests that all healthcare organizations have, at any time, a culture with constituents (artefacts, symbols, values, assumptions) that may or not be close to those of Lean. The model positions Lean as a cultural proposition that is demonstrated maximally by particular constituents (artefacts, symbols, values, assumptions) when an organization reaches an ultimate Lean mastership state. The variability of cultural strength is only hinted in figure 3 but included in the model, depicted by the surface area of the organization`s circle. Further studies will be needed to determine whether Lean culture can ever become too strong and tight (that could be depicted as a very small circle) and understand its implications. It seemed more appropriate introducing the concept of ultimate Lean mastership for the CLCA model rather than using the more commonly referred term of maturity in the literature to describe greater Lean adoption over time. Mastership suggests continual mindful efforts in sustaining and ever improving organizational capabilities in similarity to an artisan who is always getting better at his

craft with experience but at risk of losing abilities by failing to practice them whereas maturity fits more in a life cycle vision of organizational change (Van de Ven and Poole, 1995). Indeed, maturity suggests a rise with an implied inevitable eventual decay of organizational functions. There is as well in maturity a notion of passive effortless progression similar to the human experience in which time and change cannot be stopped and will happen any way which is not the case for Lean. Lean and its culture can only exist by concerted efforts in continuous pursuit of perfection (Womack and Jones, 2003).

### *2.5.2 Friction, drag factors and lubricants*

The CLCA model builds on the ideas of Shenkar and colleagues that the encounter of two cultures is best conceptualized by the notion of cultural friction rather than distance with a gap to fill. The friction metaphor certainly provides a richer conceptual framework. Since it derives from knowledge of the much more developed fields of physics and mechanical engineering, it inspires by analogy to find managerial equivalents to the drag factors and lubricants that condition friction and were previously mentioned. Additionally, practices and solutions that physicists and engineers have already found to reduce friction may find equivalent in management, which may then be eventually applicable to facilitate Lean transformation. This is an idea that would require further inquiry. The CLCA model and its findings during its validation process might actually also contribute to the field by identifying new constituents of cultural friction.

### *2.5.3 Path of least resistance*

The CLCA model and the cultural friction construct both allow for the potential to have numerous constituents, each carrying on a range of net effects (positive, neutral, negative). Culture and friction levels both result on the sums of their parts and how these parts interact with each other. The CLCA model does not however address directly important issues of Lean implementation in healthcare and other service organizations such as where and how efforts ought to be best spent (front office or back office functions first? Areas of greatest waste or areas of greatest buy-in? From top to middle management or front-line personnel? Or which professionals to train first? And so on). But this is where the notion of cultural friction might be particularly helpful. The path of least resistance of

each organization might be the one to follow but this statement needs further inquiry and validation.

### *2.5.4 Timing*

Embedded in the CLCA model and the cultural friction construct are several other important organizational change issues such as magnitude (large to small), pace (fast or slow) and rhythm (regular or punctuated) that several scholars have already explored (Klarner and Raisch, 2013; Langley *et al.*, 2013; Ligori, 2012). The question of timing of organizational change is perhaps the least discussed, but in the context of Lean`s continuous improvement spirit, now would always appear to be the best and appropriate answer.

### *2.5.5 Organizational Path, Route, Course, Journey and Track*

The choice of suggesting the notion of organizational trajectory in the CLCA model is based on consideration to differentiate itself from the other concept of organizational path in that the latter would better describe the actual step by step change experience of an organization, accounting for all its progress, interim states and set back it encounters along the way. This proposed definition of 'path' takes ground in its Merriam-Webster web dictionary formal one: 'a trodden way' (2018).

Similarly, other terms related to organizational change such as 'route', 'course', 'journey' and 'track' merit some semantic clarification since they point out to different meaningful aspects of organizational change.

We submit that organizational route should be preferably used to express a planned path that is managerially set but not necessarily followed, since it would then represent its path, based on Merriam- Webster web dictionary (2018)`s definitions of route: (1b) a means of access; (2) a line of travel and (3a) an established or selected course of travel or action.

We would like to suggest that, as path and route are not time bounded, 'organizational course' be used in this case drawing from its formal Merriam-Webster web dictionary definition (2018): the act or action of moving in a path from point to point.

Whereas, an organizational journey should be reserved to describe the entire life course of an organization from its beginning to its final desired destination or demise.

Finally, an organizational trajectory should be distinguished from an organizational track. Although they both refer to very similar conceptualization of an organization`s theoretical predicted evolutionary course, an organizational track, which has been exactly defined by Greenwood and Hinings as: 'the temporal association of an organization with one or more design archetypes' (1988) in their seminal paper 'Organizational designs, tracks and the dynamics of strategic change' is set in an interpretative conceptual paradigm whereas our CLCA model puts organizational trajectory into a pragmatic constructionist toward a positivist scheme, as previously specified (Greenwood and Hining, 1988).

### *2.5.6 CLCA and other organizational change models*

The CLCA model is compliant with and actually complement other generic organizational change models, such as Lewin's classic 3-stage model of change (unfreezing-moving-freezing) (Lewin, 1947), Gleicher's formula for change readiness (C= (abd) > x) where C stands for change, a for level of dissatisfaction with the status quo, b for clear and understood desired state, d for practical first steps toward a desired state and x for "costs" of changing) (Beckhard, 1975), Kotter's eight step process for leading change, Deal and Kennedy's 7 steps and 5 tips for organizational culture change (2000) or Cameron and Quinn's nine culture change steps based on their Competing Values Framework (2011) as the CLCA model not only includes the possibilities of success and failure but warns about possible harmful effects of organizational change efforts despite all best intentions. Since the CLCA model is still in basic development phase and approaches organizational change as a trajectory rather than a path perspective, it is not and cannot be as prescriptive in its Lean culture adoption process as these previous models are on organizational change. Nevertheless, during CLCA model's empirical validation, an array of strategic options and evidence for best practices in Lean cultural implementation will likely be uncovered.

For the notion of unfreezing (Lewin, 1947), level of dissatisfaction (Beckhard, 1975), Deal and Kennedy's second step: recognize a real threat from outside (2000) or

Kotter's first step: establishing a sense of urgency (1996), all these schemes suggest an underlying necessity to shake up an organization for change to occur in a paradigm of commonly perceived organisation inertia. Because the CLCA model is built on a constructionist paradigm of continuous change and constant re-enactment, it may stand closer to Weick and Quinn's suggested freeze-rebalance-unfreeze pattern of organizational change (Weick and Quinn, 1999). In their model, the first freeze stage describes efforts to bring everyone to work all together in a same new way, which find similarities in gaining consensus with Dean and Kennedy's and Cameron and Quinn's models and Kotter's forming a powerful coalition but this action raises resistance or friction as people need to give up old habits and lose some of their previous room for maneuvers, power and influence in their work place. Rebalance stands for the change and the unfreeze stage recognizes that people will, within the new organizational parameters, want and need to regain some room of maneuvers, power and influence in performing their duties. Further investigations are needed to determine which model is more applicable to healthcare organizations and whether a 'quiet' Lean culture revolution devoid of crisis and radical actions is possible.

The CLCA model takes into accounts the notion to build a new culture on the strengths of the existing culture put forward by Katzenbach *et al.* (2012) and (2014) by the relative level of cultural friction at T1. This does not mean that Lean culture adoption will be necessarily easier, faster or safer for an organization with a baseline culture close to Lean as trajectory 4 (or failed Lean adoption) illustrates. As Kotter's "planning for and creating short term wins" step and Cameron and Quinn's "identify a few key small wins to be implemented immediately" step suggest though, trajectory 4 may be less likely for those organizations following their advice but only empirical validation will be able to confirm this statement. Katzenbach *et al.*'s notions of critical few behaviors and critical informal leaders find echoes in Gleicher's perceived costs of the change, Dean and Kennedy's position a hero and Cameron and Quinn's identify key stories and incidents that characterize the preferred future culture steps. Which and how many critical behaviors, informal leaders, heroes, key stories and incidents are needed to decrease the perceived costs of change of healthcare organizations in their Lean culture adoption venture remains to be determined by future studies.

### *2.5.7 CLCA and other organizational change paradigms*

Managerial knowledge is frequently built on the exercise of considering a phenomenon from different theoretical perspectives. The CLCA model stands firmly grounded in an organizational cultural change's point of view. Other authors have taken different position and some have used combination of paradigms to make their point. Indeed, the issues of planned change and implementation of new managerial techniques have been addressed many times before but not necessarily regarding Lean but with other managerial methods such as total quality management (TQM) or Six-Sigma (SS). Four paradigms appear particularly relevant for this discussion: the political view, the learning view, the neoinstitutionalist view and the configurational view and their combinations.

#### *2.5.7.1 CLCA and the political point of view*

In their paper on corruption of managerial techniques, Lozeau *et al.* (2002) proposes four outcomes, which bare similarity with CLCA trajectories, based on analysis of health organizations' evolution in strategic change processes: 1- loose coupling, 2- transformation, 3- customization and 4- corruption and their findings suggest that corruption, the ill-piecemeal implementation of methods that consequently lead to sub-performance, is the most prominent. The power struggles and influence schemes that lead to corruption does not find direct equivalent in the CLCA model but may be possible explanatory mechanisms underlying the two negative trajectories that are directed away from Lean ultimate culture goal. Customization and transformation would be found in the positive trajectories where the first would eventually plateau and never reach ultimate lean culture as the latter would be assumed. Loose coupling finds equivalency in the neutral trajectories of the CLCA model.

#### *2.5.7.2 CLCA and the learning view*

More recently, Canato *et al.* (2013) in their study of SS implementation at 3M, provide support to some of CLCA model postulates: particularly that organizational culture change is possible but it may have unexpected and not necessarily desirable consequences. Set in an organizational practice change analysis framework, the coercive aspect of organizational change that these authors report is directly linked to the nature of SS which is a top-down approach for the improvement of operational performance using similar

tools as Lean but with little or no regard to front-line employees' inputs (Schroeder *et al.* 2008). Canato *et al.* suggest an onion-like layered organizational change model composed of core values at the heart, surrounded by internalized beliefs and behavioral norms, wrapped up in a cultural repertoire of different organizational practices. However, this conceptualization begs the questions: how and when organizational core values, which are often referred as source of organizational inertia, actually develop and how long does it take for members to learn and enact them? The CLCA model suggest a different paradigm in which each and all organizational artefacts are linked to some symbolization, a value set and assumptions that are socially constructed at every moment and therefore malleable by proper cultural leadership actions. The very notion of organizational culture as being a constraining force couldn't it be in fact culturally learned? This may represent actually one of the main challenges of Lean: invite all organizational members to live continual change through continuous improvement.

Canato *et al.* also mobilizes the concept of cultural fitness and practice diffusion first presented by Ansari *et al.* (2010). For them, based on the degree of extensiveness of practices used (from high to low) within an organization and the degree of fidelity to these practices (from high to low), a new practice will be consequently more or less difficult to diffuse and be sustained. Cultural fitness predicts that the more culturally close a new practice is to current organizational practices, the easier it would be to diffuse, presuming that dimensions that may create some residual cultural distance will take care of themselves. CLCA's consideration on cultural friction focuses on the problematic aspects regarding Lean methods' adoption and invites managers to address them directly which is certainly more in keeping with Lean mindset of identifying problems as continuous improvement opportunities and Lean culture definition (chapter 1). Moreover, as trajectory 5 warns, lower baseline LCF does not guarantee easier Lean adoption success.

#### *2.5.7.3 CLCA and the neoinstitutionalist view*

The CLCA model looks at organizational change one organization at a time. It appreciates though the reality that all organizations exist in a landscape of other organizations which attributes are included in the context of its situation. In that regard, the CLCA model is compatible with DiMaggio and Powell's conceptualization of isomorphic forces

(coercive, mimetic and normative) that shapes interorganizational life and outcomes in its situated positioning (1983).

#### *2.5.7.4 CLCA and the configurational view*

Because the CLCA model is flexible with no restriction in its timeline, it is also congruent with the configurational view on organizational change with its models of punctuated equilibrium introduced by Tushman and Romanelli (1985) and quantum organizational change by Miller and Friesen (1982). Nevertheless, since Lean represents a large cultural leap for most healthcare organizations, it remains, as already pointed out, to be demonstrated whether a Lean adoption process necessarily requires an organization to go through a high turbulence period or it is possible to happen in a slow and steady continuous improvement fashion, in greater concordance with its value proposition.

### *2.5.8 CLCA model towards a framework and a theory*

Meredith's typology of conceptual research methodologies suggests a step-wise gradual theoretical development sequence, beginning with a model, followed by a framework and leading possibly eventually to a theory. This view is not necessarily shared by other academics and, as acknowledged by Leshem and Trafford (2007), varied presentation of these notions can be found in the literature. Descriptive modeling does not appear to be a required step in theory building endeavors. From their review on conceptual framework development, for example, Leshem and Trafford (2007) do not discuss modeling. They rather content that conceptual frameworks are used to describe set of relationships between concepts and fulfill an integrative function between theories that offer explanations of investigated issues. According to them, conceptual frameworks help to ensure coherence in research work from theoretical perspectives to research design, data collection, analyses strategies and interpretation to presentation of results and are an essential component of academic work.

The following four criteria have been reported by Bergman and Smyth (2015) to ascertain credibility of a conceptual framework: 1- does the framework provide a common language to describe a situation and to report findings about it? 2- does the framework develop a set of guiding principles against which judgements and predictions could be made? 3-

does the framework propose a series of reference points helping to locate research questions within contemporary theories? 4- does the framework structure content of the intended research and enable contextualization of findings? As its stage of development, our CLCA model meets in parts several of these criteria but its empirical validation will enhance precision in language, accuracy in estimation and prediction and relevance of findings which will then elevate it to a proper conceptual framework level.

In her exploration on conceptual differences between theoretical and conceptual frameworks, Imenda (2014) offers the following definition of conceptual framework as 'an end result of bringing together a number of related concepts to explain or predict a given event, or give a broader understanding of the phenomenom of interest'. She suggests that conceptual frameworks are derived from concepts whereas theoretical frameworks derive from theories. She has found several definitions of the notion of concepts as being either symbolic representations of abstract ideas, components of theories and complex mental formulation of experiences. She also reports on several definitions of theories which she integrates in having three major characteristics: 1- being 'a set of interrelated propositions, concepts and definitions that present a systematic point of view'; 2- showing specific relationships between and among concepts; and 3- allowing explanations or predictions about 'occurrence of events, based on the specified relationship'. She cites Wacker (1998)'s proposed four components of a theory: the first being: a theory defines its terms, concepts or variables clearly; the second, a theory specifies its domain in which it is applicable; the third, a theory states a set of relationships amongst variables; and the fourth, a theory has specific predictive claim. Wacker (1998) further suggests the following eight key features of a 'good' theory in: 1- its uniqueness (the virtue of being different to other existing theories); 2- its conservatism (a new theory does not replace a current theory unless it has superior virtues); 3- its generalizability (a better theory has a wider scope of application); 4- its fecundity (a stronger theory generates more models and hypotheses than a weaker one); 5- its parsimony (the fewer assumptions a theory has the better it is assuming all other aspects are equal); 6- its internal consistency (a good theory identifies all relationships and gives valid explanations); 7- its empirical riskiness (refutation of propositions must be very possible); and 8- its abstraction (a good theory is independent of time and space).

Wacker (1998) also describes six types of theory-building research: 1- the analytical conceptual research is based on logical integration of concepts; 2- the analytical mathematical research is based on simulated data; 3- the analytical statistical research is based on explicit development of future testable empirical models; 4- empirical experimental research is based on field experiments; 5- empirical statistical research is based on quantitative real database analyses; and finally, 6- empirical case study allows in-depth qualitative investigations.

Following Wacker's typologies, development work of the CLCA model, thus far, has been of the analytical conceptual research type. Although the CLCA model already demonstrates promising features suggesting potential towards development to a 'good' theory, this will be confirmed only through its future validation and development (see section 2.6).

It remains that all these views are compatible with Meredith's typologies on theory conceptualization as noted in our methodology in section 2.2 and they support its validity and use in our work.

#### *2.5.9 Handle with care*

Finally, as for practical implications for healthcare managers and other practitioners, the CLCA model is useful in indicating that planned organizational change efforts such as Lean, may, hopefully more often than not, be successful but they may also fail and can actually be detrimental to their organization, therefore caution is warranted before proceeding. By first estimating Lean's organizational cultural friction level and appreciating the friction points, selecting appropriate lubricating strategies for their organization will be facilitated and lead to more effective Lean transformation. By reminding them to tap into individual talents of people surrounding them, the CLCA model invites healthcare managers and other practitioners to look beyond the obvious contextual hurdles for answers on how to make organizational change and in particular Lean, a reality. Pragmatically framing organizational culture into four constituents (artefacts, values, symbols and assumptions) in three (integrative, differentiated and ambiguous) levels, the CLCA model becomes a valuable tool on how to decipher Lean

culture implementation for practitioners and academics. The CLCA model provides naturally a framework for proper theoretical sampling in its future validation process. The notion of cultural friction productively breaks the glass ceiling of facilitator and barrier factors recurrently found in the Lean implementation literature and invites academics to dig further in identifying drag parameters and finding lubricants for greater understanding and more successful implementation of Lean in healthcare and other organizations. Analogous to Netland and Ferdows (2016) comment on the importance of appreciating where in the Lean implementation s-curve organizations are located for better understanding of their challenges, the descriptions of the five theoretical organizational Lean culture adoption trajectories may provide to academics firmer ground to start their studies or interpret their findings. For all these reasons, the CLCA model appears to be a valuable addition in the landscape of organizational change models.

## 2.6 Future developments

The next development steps of the CLCA model are obviously to undergo empirical qualitative and quantitative validation.

First, in order to be able to estimate LCF levels, features of the cultural constituents (artefacts, symbols, values and assumptions) of a healthcare organization in ultimate Lean mastership state need to be documented. Since such an organization does not, at least currently, exist, and consequently, this could only be a theoretical conceptual exercise. We are currently exploring diverse methodological options for this purpose.

Trajectories of CLCA model could then be tested empirically with a multiple case study, ideally using a theoretical sampling method of healthcare organizations.

From this knowledge, a LCF instrument could be created then validated quantitatively. This instrument could have multiple use for academics and practitioners to quantitatively assess healthcare Lean implementation and by managers to support their efforts toward Lean adoption.

Greater understanding on the natures, sources and forces of LCF, cultural lubricants and cultural drag parameters of healthcare organizations could potentially not only offer explanations but enable predictions of probable trajectories and perhaps eventually lead to propositions of solutions for changing organizational courses in Lean culture adoption journey to practitioners. The CLCA model would therefore become a conceptual framework, and may even be further developed thereafter into a full theory if and it were to meet Dubin's criteria (1969).

There are little theoretical ground and empirical evidence to prevent belief that learnings from Lean healthcare could not be extended and applicable to other service organizations or even to manufacturing. However, the reverse might not be true. Accepting that Lean is a cultural proposition, involvement of people is key and, by their nature, service organizations depend more on people`s activities than product organizations. Service organizations also rely more on customers' participation in providing them with quality inputs for rendering their services. This co-production issue becomes even more challenging for healthcare organizations since their customers are more often in impaired shape, sick and vulnerable, likely making Lean implementation in healthcare more hazardous and trickier than in other service organizations (Toussaint and Berry, 2013). The CLCA model may be helpful to investigate further this idea.

## 2.7 Conclusion

The conceptual exploration of Lean healthcare implementation by revisiting organizational change from a cultural perspective led to construction of the CLCA model, built with the notion of cultural friction and based on a situated view of organizational culture. Much further investigations are evidently needed and some avenues have been highlighted and, in that sense, the unexpected journey of Lean healthcare is likely to go through many more twists and turns.

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# Chapter 3
# Exploring Lean general and Lean healthcare cultural clusters


## Abstract

Purpose: This work investigates Lean's leading cultural clusters based on keywords exploration and qualitative analysis of preeminent Lean general and Lean healthcare reference books.

Design/Methodology/Approach: Content analysis on main text of 33 books, consolidated as three cases (Lean general, Lean Liker *et al.* and Lean healthcare), then re-consolidated as two other cases (Lean service and Lean manufacturing+) was performed.

Findings: Books contained on average 79000 words for a sum of over 2.5 million words analyzed. Ten top relevant keywords were identified, namely, in order of importance: work, time, process, Lean, system, improvement, production, patient, people and team. These top relevant keywords suggest the following four emergent Lean's leading cultural clusters: operations, change, collectivity and humanity. Cross-validation of these cultural clusters is demonstrated through sociotechnical systems theory.

Research implications: Content analysis is shown to be an effective research method in operations management enabling inductive analysis. Identification of four leading clusters may help further research on Lean culture.

Practical implications: Lean cultural transformation of healthcare and other domains organizations may be facilitated by focusing attention to what the organization actually does (operations), how change happens and how everything (collectivity) and everyone (humanity) work together in the organization.

Originality/Value: This work is the first application of content analysis on Lean reference books. It highlights the importance of time as a salient but underappreciated Lean culture element. It provides additional support for association between Lean and sociotechnical systems theory.

Keywords: Lean culture, healthcare, operations management, content analysis

## 3.1 Introduction

Lean, one of the most prominent current business methods to increase value and decrease waste in both manufacturing and service organizations` operations, may be seen as a cultural proposition (chapter 2). From that perspective, Lean transformation entails changing or narrowing the gap between an existing organization`s culture to a Lean one, which is much easier said than done (Ramakrishnan and Testani, 2012; Mann, 2015). A contributing factor may be that collective knowledge on Lean culture remains rather superficial and under-developed despite longstanding and growing interests in Lean culture from scholars and practitioners of all domains' management and, in particular, healthcare (Dorval *et al.*, accepted for publication).

Gaining a greater understanding of Lean culture in its ultimate ideal form might help to facilitate an organization's Lean transformation which is notoriously difficult to achieve but much desired, especially in healthcare (Radnor *et al.*, 2012). To do so, unfortunately, direct observation of organizations in ultimate Lean culture state is not possible. Indeed, even Toyota, Lean's most emblematic success, has not yet reached perfect Lean mastership as demonstrated by its deficiencies and failures from recurrent large-scale recalls and critical testimonies (Osono *et al.*, 2008; Mehri, 2006). Among alternative options then, since words and language are undeniably strong and powerful vectors of culture, a study of Lean experts' writings, using an organizational culture framework, appears well-suited.

From Sugimori *et al.*'s (1977) first account on Toyota Production System to Krafcik's paper labeling Lean in 1988, to Womack *et al.*'s 'The machine that changed the world' (1990), Liker's 'The Toyota Way' (2004), Graban's 'Lean Hospitals' (2016) books and to Spear's Harvard business review article, 'Fixing HealthCare from the Inside Today' (2005), Lean-related publications are now plentiful and diverse (Danese *et al.*, 2017). Making the right selection of source documents is key for validity of any research findings (Miles *et al.*, 2014). For the purpose of understanding better and describing features of

Lean healthcare culture at its ultimate ideal state, reference books may be one of the most appropriate and inspirational material to examine compared to academic papers, commercial articles, surveys or interviews.

Indeed, books as source documents have several strengths and advantages. They are committed expressions of their authors' knowledge and perspective, often based on years of personal and shared experience. Books have a more flexible format and provide greater and freer opportunities for content development than academic papers and commercial articles. More on this point, it follows that analysis of what the authors chose not to say or the emphasis, or not, they put on information may be as telling as the content itself. Books usually go through a more substantial revision process than commercial articles as they usually are expected to last longer and attract attention to a larger readership. This process ensures some quality in content proportional to the editors' reputation albeit books are not necessarily peer-reviewed unlike academic papers. Although this may be considered as a weakness for books, it could be seen as a strength as well. Since books are firm, set in time and approved accounts by their authors, books are arguably more reliable sources of information and better representative of the authors' point of view than interviews and surveys, as the latter may be more subject to multiple researcher`s and informant's biases (Miles *et al.*, 2014). Books are also readily available and fairly accessible. All can verify the information. Books are certainly very influential and impactful particularly on practitioners. Finally, books have always been regarded as legitimate reference sources for ages as early as the bible.

Applying an organizational culture framework to source documents analysis though is not as simple as it may appear since the field of organizational culture is vast (Giorgi *et al.*, 2015). Multiple definitions, models, frameworks and approaches have been proposed over the years and there is yet still no consensus on which one, if any, may be most effective and valid for conducting academic work. As case in point, in a recent Lean culture systematic review, 103 different organizational culture definitions were found out of 126 documents that were discussing culture with some substance (Dorval *et al.*, accepted for publication).

In this situation of high pragmatic ambiguity, taking an inductive analytic approach appears legitimate. An inductive qualitative research method let findings emerge from data analysis as opposed to a deductive approach which test validity of an existing or preconceived conceptual model or framework in source data. One way to conduct inductive analysis is to look subjectively for patterns and their frequencies within data (Patton, 2002). In this endeavor, content analysis represents a more objective adjunct technique to employ.

Content analysis is defined by Weber (1990) as "a research method that uses a set of procedures to make valid inferences from text" and it has been used for many purposes including, conveniently, investigation of cultural patterns. As reported by Duriau *et al.* (2007) in their review of content analysis literature in organization studies, content analysis acknowledges the importance of language in human cognition and may provide access to deep individual and collective structures such as values, intentions and attitudes which are cultural features. Content analysis may be performed through several sophisticated techniques such as key-word-in-context (KWIC), concordance, co-occurrence and theme analysis of idioms and sentences using complex statistical methods such as analysis of variance, structural equation models or confirmatory factor analysis (Weber, 1990). But even content analysis' most basic form, word frequency, is considered to be a legitimate indicator of construct centrality and importance. Content analysis assumes that differential use of words is meaningful, that change of words reflects change in attention and that these differences may be used to reveal understanding of underlying concepts (Duriau *et al.*, 2007). Content analysis has many advantages over many other research methods: 1- it is flexible, fitting to many levels of analysis and can be easily combined to other qualitative and quantitative analysis methods enabling data triangulation; 2- it is nonintrusive and less prone to diverse researcher and informant biases since there are no direct interactions between investigators and authors who are usually unaware that their text is being used for content analysis; 3- it is said to be safe because its procedures can be readily described, adjusted and replicated; 4- it allows for finding faster answers to longitudinal study questions since texts are rich time capsules; 5- it is relatively cost-effective and scalable, particularly with the development of

computer-aided text analysis (CATA); and 6- because the latter is nowadays readily available, at least in its simplest word frequency form as a common feature in most word processing software programs, collaborative work is possible (Weber, 1990; Duriau *et al.*, 2007). Similar to other research methods though, care must be taken in its conduct as it is susceptible to matters of reliability (stability, reproducibility and accuracy) and validity (face, construct, discriminant and generalizability). Moreover, as Weber (1990) shares, two specific additional methodological concerns apply to word frequency: first, since words in general have several meanings, word frequency may suggest a greater sense of uniformity than there actually is, overestimating effect and threatening validity of inferences. Secondly, effect underestimation may also occur simultaneously since words have synonyms and pronouns that may not be all accounted for by simple word frequency calculation. Unfortunately, no simple solution currently exists to address these issues but they can be expected with further IT development, especially, artificial intelligence. These caveats need to be considered in the design of any content analysis study and in interpretation of its results.

As the initial step of a quest to eventually being able to identify and describe features of Lean healthcare culture in its ultimate state, this article presents findings from CATA conducted on a selection of preeminent Lean reference books in the general domain and in healthcare. Main objective of this study was to determine leading Lean cultural clusters to guide further investigations on Lean healthcare culture. Secondary objectives were: 1- to investigate cultural pattern differences between Lean general, Lean healthcare, Lean service and Lean manufacturing+ reference books; 2- to investigate relevant keyword patterns over time; 3- to conduct additional emergent analyses as suited.

This paper contains a detailed methodology section. It presents its findings in five sections: the first describes the top relevant keywords determination process and results; the second demonstrates qualitative correlations between the identified top relevant keywords and eight organizational and cultural models culminating to a four leading cultural clusters proposal; the third section shows insights gained from within and cross-cases (Lean general, Lean *Liker et al.*, Lean healthcare, Lean service and Lean

manufacturing+) analysis; results of a relevant keyword patterns over time exploration is provided in section four and findings of other emergent analyses are presented in section five. A discussion follows which includes research implications, practical implications and limitations of this study. It ends with future research and development ideas and a conclusion.

## 3.2 Methods

This inductive exploration of Lean reference books for cultural clusters was done by CATA (computer-aided text analysis) using Atlas.ti version 8.2.32, Microsoft's Word 2016 and Excel 2016 software programs. Selection criteria of included books were: 1- notoriety of the book or of its first author, 2- the book's impact as estimated by number of Google Scholar citations and 3- link to Lean culture and/or Lean healthcare. A total sample of 33 books (21 Lean generic and 12 Lean healthcare from 16 different first authors (nine Lean generic and seven Lean healthcare) was hence elected. Only their most recent edition was considered for analysis (Table 1 and 2).

Table 1 Lean generic books

| Cases | Book - author(s), title, edition | Year | GSC# |
|---|---|---|---|
| LG-LM+ | Womack, J.P., Jones, D.T. and Roos, D., The machine that changed the world | 1990 | 15563 |
| LG-LM+ | Womack, J.P. and Jones, D.T., Lean Thinking: Banishing Waste and Create Wealth in Your Corporation | 1996 | 8668 |
| LG-LM+ | Ohno, T, Toyota Production System: Beyond Large-Scale Production | 1988 | 5868 |
| LG-LM+ | Ohno, T., Workplace Management (Special 100th Birthday ed.) | 2013 | 208 |
| LL-LM+ | Liker, J.K., The Toyota Way: 14 Management Principles from the World`s Greatest Manufacturer | 2004 | 5077 |
| LL-LM+ | Liker, J.K., Becoming Lean: inside stories of US manufacturers | 1997 | 444 |
| LL-LM+ | Liker, J.K., Hoseus, M, The Toyota Culture: The Heart and Soul of the Toyota Way | 2008 | 415 |
| LL-LM+ | Liker, J.K., Meier, D, The Toyota Talent: Developing Your People the Toyota Way | 2007 | 197 |
| LL-LM+ | Liker, J.K., Convis, G.L., The Toyota Way to Lean Leadership: Achieving And Sustaining Excellence through Leadership Development | 2012 | 121 |
| LL-LM+ | Liker, J.K., Franz, J.K., The Toyota Way to Continuous Improvement: Linking Strategy to Operational Excellence to Achieve Superior Performance | 2011 | 102 |
| LL-LM+ | Liker, J.K. Developing Lean Leaders at all levels: A Practical Guide | 2015 | 7 |
| LL-LS | Liker, J.K., Ross, K, The Toyota Way to Service Excellence: Lean Transformation for Service Organizations | 2017 | 0 |
| LG-LM+ | Monden, Y., Toyota Production System: An Integrated Approach to Just-in-Time (4th ed.) | 2012 | 2357 |
| LG-LM+ | Imai, M., Gemba Kaizen (2nd ed.) | 2012 | 704 |
| LG-LM+ | Imai, M., Kaizen: The Key to Japan's Competitive Success | 1986 | 210 |
| LG-LM+ | Dennis, P., Lean Production simplified: A plain-language guide to the world`s most powerful production system (3rd ed) | 2016 | 598 |
| LG-LM+ | Bicheno, J., Holweg, M., The Lean Toolbox (5th ed.) | 2017 | 549 |
| LG-LS | Bicheno, J., The Lean Toolbox for Service Systems | 2008 | 100 |
| LG-LM+ | Rother, M., Toyota Kata | 2010 | 452 |
| LG-LM+ | Rother, M., Aulinger, G, Toyota Kata Culture | 2017 | 0 |
| LG-LM+ | Mann, D., Creating a Lean Culture: Tools to Sustain Lean Conversions (3rd ed.) | 2015 | 412 |

Note 1: cases: LG: Lean general; LAP: Lean manufacturing+; LL; Lean Liker *et al.*; LS: Lean service

Note 2: GSC#: 'Google Scholar citation number' as of August 1st, 2017.

Note 3: Books are sorted according to GSC# from highest to lowest. Cases are determined by first author`s contributions.

Note 4: Books discarded because of having GSC# less than 300: Maskell, B.H., Practical Lean accounting: a proven system for measuring and managing the lean enterprise (GSC# 258); Forbes, L. H., Ahmed, S. M., Modern construction (GSC# 180); Conner, G., Lean manufacturing for the small shop (GSC# 135); Bell, S., Lean enterprise systems: using IT for continuous improvement (GSC# 116); Sayer, N. Lean for Dummies (GSC# 110); several others of less than 100 existed.

Table 2 Lean healthcare books

| Cases | Book author(s), title, edition | Year | GSC# |
|---|---|---|---|
| LH-LS | Graban, M., Lean Hospitals: Improving Quality, Patient Safety and Employee Engagement (2nd ed.) | 2016 | 160 |
| LH-LS | Graban, M., Swartz, J.E., Healthcare Kaizen: Engaging Front-Line Staff in Sustainable Continuous Improvements | 2012 | 30 |
| LH-LS | Graban, M. Swartz, J.E., The Executive Guide to Healthcare Kaizen: Leadership for a Continuously Learning and Improving Organization | 2013 | 9 |
| | Virginia Mason Experience | | |
| LH-LS | Kenney, C., Transforming Health Care: Virginia Mason Medical Center`s Pursuit of the Perfect Patient Excellence | 2011 | 141 |
| LH-LS | Plsek, P.E., Accelerating Health Care Transformation with Lean and Innovation: The Virginia Mason Experience | 2014 | 26 |
| LH-LS | Kenney, C., A Leadership Journey in Health Care: Virginia Mason`s Story | 2015 | 2 |
| | ThedaCare Experience | | |
| LH-LS | Toussaint, J., Gerard, R.A., Adams, E., On the Mend: Revolutionizing Healthcare | 2010 | 136 |
| LH-LS | Barnas, K., Toussaint, J., Beyond Heroes: A Lean Management System for Healthcare | 2014 | 10 |
| LH-LS | Toussaint, J., Management on the Mend: The Executive Guide to System Transformation | 2015 | 6 |
| LH-LS | Black, J., Miller, D., The Toyota Way to Healthcare Excellence (2nd ed.) | 2016 | 80 |
| LH-LS | Zidel, T.G., A Guide to Transforming Healthcare | 2006 | 67 |
| LH-LS | Zidel, T.G., Rethinking Lean in Healthcare A Business Novel on How a Hospital Restored Quality Patient Care and Obtained Financial Stability Using Lean | 2016 | 0 |

Note 1: cases: LH: Lean healthcare; LS: Lean service

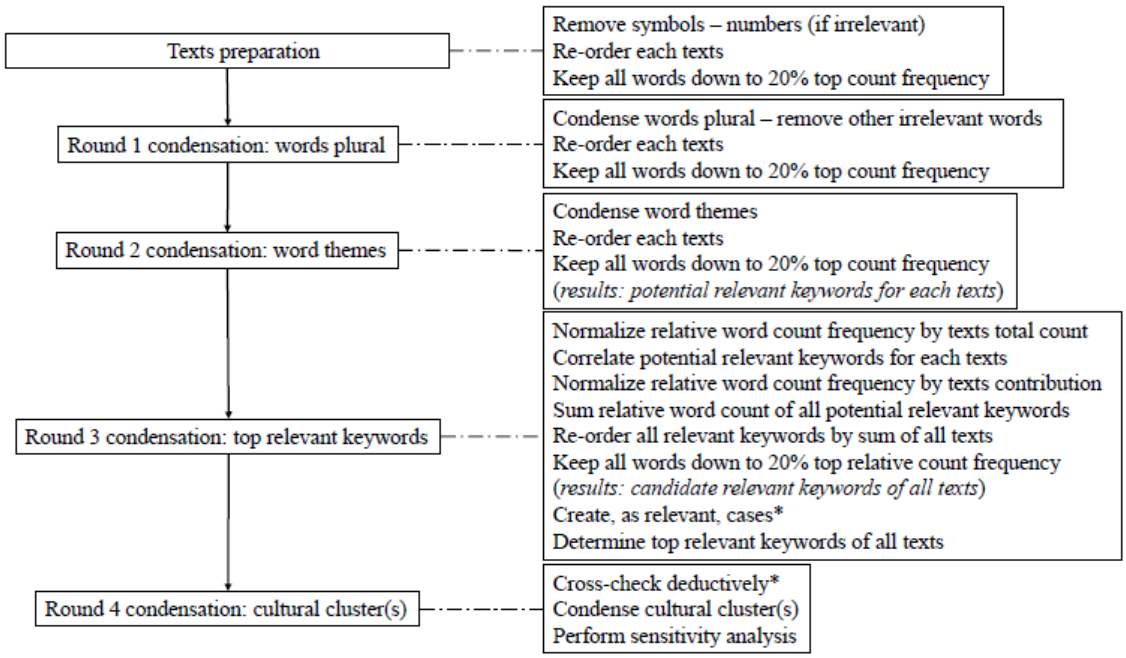
Note 2: GSC#: 'Google Scholar citation number' as of August 1st, 2017.

Note 3: Books are sorted out according to GSC# from highest to lowest. Cases for Lean Healthcare are determined by a mix of first authors' and organization experiences' contributions.

Note 4: Books discarded because of having GSC# less than 50: Wellman, J., Jeffries, H., Leading the Lean Healthcare Journey: Driving Culture Change to Increase Value (GSC# 47); Aherne, J., Whelton, J., Applying Lean in Healthcare: A Collection of International Case Studies (GSC # 33); Grunden, N., Pittsburg way to efficient healthcare: improving patient care using Toyota based methods (GSC# 28); Grunden, N., Hagood, C., Lean-led hospital design: Creating the efficient hospital of the future (GSC# 22); Gabow, P.A., Goodman, P.L., Lean Prescription: Powerful Medicine for our ailing healthcare system (GSC# 10); Bercaw, R.G., Taking Improvement from the Assembly Line to Healthcare (GSC# 5)

Consent for content transcription was obtained from all editors and took six months (August 2017 - January 2018). All books' main texts were transcribed integrally and went on for seven months (November 2017 - May 2018). Forewords, tables, figures, acknowledgements, footnotes, endnotes, glossaries, appendices, index, case studies, reference list and any other book content were disregarded as use of these supplementary sections differ from one book to another. This allowed for more consistent and fairer comparison.

Figure 1 Cultural cluster exploration – procedure




A cultural cluster exploration – computer-aided texts analysis (CCE-CATA) technique having four rounds of data condensation was developed and used as follows (Figure 1): First, it was quickly realized that texts needed some preparation. For example, Microsoft's Word word count calculator appeared more sensitive to spacing, symbols and tabs than Atlas.ti's, therefore, all symbols in texts were replaced by a tab. This procedure made word counts between Atlas.ti and Word 2016 programs similar by less than 3% difference (Findings-section 1: Table 3). As Atlas.ti is able to export word lists and counts in Excel spreadsheets facilitating data manipulation and condensation, total word count numbers for normalization of relative contribution book weights in this study are based on Atlas.ti's results as reference point. Note that Atlas.ti's feature enabling exportation of word lists with standard "stop and go" word exclusions (that ignores, for example, most prepositions and word contractions such as I'll, haven't, etc) has been used. Numbers and their counts were then removed from listing in Excel spreadsheet as they were irrelevant for the purpose of this study. After re-ordering remaining words according to their counts, words down to 20% of top count frequency were kept inspired by Pareto's 80-20 principle.

First round of condensation consisted of combining remaining words with their plural and removing any extra "stop and go" words (i.e. neutral, content-free or irrelevant words for

this study' objectives) and any too book-specific words such as Virginia Mason, Thedacare or Toyota to enhance validity of book comparison (see Supplemental Table 1 for more details). After re-ordering remaining words according to count, word frequency Pareto histograms (word exact) were created as an in-between step validation testing exercise (see Supplemental Figures 1.1 to 1.33).

Round 2 condensation stage involved combining further related words into themes, re-ordering them and creating word frequency Pareto histograms (word theme) (see Supplemental Figures 1.1 to 1.33 and Supplemental Table 2 for theme word content details). Interestingly, several top relevant keywords were already noticeable at this point but since this study sought to explore broad cultural clusters, it was considered more appropriate to pursue further consolidation using word theme listings rather than word exact. Top potential relevant keywords from each book were determined again by Pareto 80-20 principle, keeping top words down to 20% of peak count. A total of 182 potential relevant keywords were hence identified.

Round 3 condensation work started with normalization of each book's potential relevant keyword count in percentage (of each book's total relevant keyword count). Then a correlation table was created with 182 potential relevant keywords vertically and each book horizontally, filled by corresponding count percentage. These percentage counts were further normalized according to each book's relative contribution weight estimated by each book' total word count. The next step involved summing all potential relevant keyword relative counts, ordering them by frequency and again keeping all words down to 20% of max frequency, consequently identifying candidate relevant keywords. If felt relevant, case(s) creation is here suggested to be an optional but valuable step in CCE-CATA to help determining top relevant keywords. For this study, Lean general, Lean Liker *et al.*, Lean healthcare, Lean service and Lean manufacturing+ cases were devised by summing their respective potential relevant keyword relative counts. Lean Liker *et al.* case was singled out since Liker and colleagues' contributions to Lean literature were noted to be more substantial and outstanding enough to justify its own case after an initial Lean generic versus Lean healthcare assessment. Each cases' potential relevant keyword counts became candidate relevant keyword lists when keeping just words down to 20% of max relative frequency (Findings-section 4: Figures 2 and Supplemental tables 3).

Determination of top relevant keywords was then done by keeping all candidate relevant keywords showing consistency and stability within one ordering levels among total and all cases (Supplemental Table 4). For this study, cut-off was set at the word 'team' as prevalence of the word 'problem' was mainly driven by Liker *et al.*'s contributions.

Then, as an optional part of round 4 condensation, a deductive cross-check analysis was performed by qualitatively correlating (single rater) the ten top relevant keywords with dimensions of four renown organizational structure models (Galbraith's star model (2012), Leavitt's diamond model (1965), McKinsey's 7-S model (2004) and Mintzberg's basic parts of organizations model (1979)) in search of similarities and gaps (Findings-section 2: Table 4). It is followed by a similar exercise with four models of organizational culture dimensions as proposed by Cameron and Quinn (2011), Detert *et al.* (2000), Hofstede *et al.* (2010) and House *et al.* (2004), and Schein (1981) (Findings-section 2: Table 5).

CCE-CATA procedure culminates with an original condensation of the ten top relevant keywords into four leading cultural clusters (Findings-section 2: Table 6).

Sensitivity analyses were performed in multiple ways from round 3 condensation stage by: 1- using crude frequency of occurrence (presence or absence in the 33 books) rather than using potential relevant keywords' relative counts; 2- by performing potential relevant keywords normalization according to each book's relative potential relevant keyword counts rather than each book's total word count; 3- by doing potential relevant keywords normalization according to each book's Google Scholar citation counts, 4- by not normalizing potential keyword count.

These additional content explorations were performed.

Potential relevant keywords of all books (< 2000 n= 5; 2000-2010, n= 7; and > 2010 n= 21; total n= 33) and of books restricted to Lean generic (i.e. Lean general and Lean Liker *et al.)* (< 2000 n= 5; 2000-2010, n= 5; and > 2010 n= 11; total n= 21) were regrouped per

year of publication in decades without additional word condensation efforts to investigate evolution of potential relevant keywords over time (Findings-section 4: Figures 3).

A pronoun analysis was performed using Microsoft Word 2016's word count calculator on normalized text (Findings-section 5: Table 7). Microsoft Word 2016 software has the added capacity to identify and locate keywords in text which allow to appreciate conceptualization of the word of interest and increase accuracy of interpretation over Atlas.ti. Percentage counts per books were normalized according to each book' total word count for each pronoun. Then, a similar pronoun analysis was performed on a sample of texts from five other reference books (three on Six Sigma, a competing contemporary management method to Lean, and two on general management). Results are compared using chi-square statistical test of independence performed in Excel 2016. Statistical significance is set to $p<0.05$.

To further explore the word 'time' and better appreciate its contextual use, a single rater coding analysis was carried out on an arbitrarily selected book, Liker and Ross's Lean Service. Using Microsoft's Word 2016 program word calculator and word locator features, this analysis is based on Webster's and Merriam's 14 definitions of time framework (Supplemental table 5).

Finally, a qualitative cross-validation of the four cultural clusters with the tentative Lean culture definition elaborated in chapter 1, p. 34 was performed.

We submit that this research meets criteria and follows Yin (2009)'s proposed process (plan, design, prepare, collect, analyze, share) of a multi-case study, which validity is enhanced by the number of cases and multiple authors' contributions of diverse background expertise and fields (management, engineering, manufacturing, service, automobile, healthcare, etc) (Findings-section 1: Table 4).

## 3.3 Findings

### *3.3.1 Section 1: Top relevant keyword determination*

Selected books contained on average 79000 words (10000 to 147000) for a sum of over 2.5 million words analyzed. Liker *et al.*'s books are in general more voluminous (about 100000 words on average) than Lean healthcare (on average 65000 words) and Lean general (70000 words). All authors except one (Kenney) have managerial credentials and half (8/16) had background in engineering. Most (15/16) hold or have held successful Lean consultant positions (Table 3).

Table 3 Word frequencies information

| **Lean healthcare case** | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st Author | Graban | Graban | Graban | Kemcy | Plsek | Kemcy | Toussaint | Barnas | Toussaint | Black | Zidel | Zidel | | | | | | | | | | |
| Main Credentials | Engineering Management | Engineering Management | Engineering Management | Journalism | Engineering Management | Journalism | Physician Management | Management | Physician Management | Engineering Management | Management Engineering | Management Engineering | | | | | | | | | | |
| Book Title | Hospital | Kaizen | Executive | Transforming | Innovation | Leadership | On Mend | Heroes | Mngt Mend | Excellence | Transforming | Rethinking | | | | | | average | min | max | sum | |
| Year | 2016 | 2012 | 2013 | 2011 | 2014 | 2015 | 2010 | 2014 | 2015 | 2016 | 2006 | 2016 | | | | | | | | | | |
| #words* | 119564 | 87370 | 46180 | 81725 | 66938 | 53245 | 40222 | 44544 | 49162 | 94607 | 33838 | 51182 | | | | | | 64048 | 33838 | 119564 | | |
| # words | 121856 | 88696 | 47040 | 83229 | 67454 | 53794 | 40941 | 45223 | 49814 | 97162 | 34444 | 52541 | | | | | | 65183 | 34444 | 121856 | 782194 | |
| % difference | 2% | 1% | 2% | 2% | 1% | 1% | 2% | 2% | 1% | 3% | 2% | | | | | | | | | | | |
| # distinct | 7143 | 6506 | 4586 | 6536 | 5889 | 5000 | 4924 | 4549 | 5188 | 7116 | 3818 | 4357 | | | | | | 5468 | 3818 | 7143 | | |
| Top word | patient | kaizen | kaizen | patient | innovation | work | patient | work | Lean | Lean | time | said | | | | | | | | | | |
| # count | 1073 | 1433 | 1021 | 879 | 873 | 436 | 381 | 422 | 369 | 920 | 377 | 301 | | | | | | | | | | |
| 80%Pareto | 215 | 287 | 204 | 176 | 175 | 87 | 76 | 84 | 74 | 184 | 75 | 60 | | | | | | | | | | |
| # pKR | 29 | 11 | 9 | 17 | 16 | 19 | 22 | 19 | 32 | 19 | 18 | 35 | | | | | | 21 | 9 | 35 | | |
| **Lean general case** | | | | | | | | | | | | | | | | | | | | | | |
| 1st Author | Womack | Womack | Ohno | Ohno | Monden | Imai | Imai | Dennis | Bicheno | Bicheno | Rother | Rother | Mann | | | | | | | | | |
| Main Credentials | Political Sc Management | Political Sc Management | Engineering Management | Engineering Management | Accounting Management | Management | Management | Engineering Management | Engineering Management | Engineering Management | Management Engineering | Management Engineering | Management Psychology | | | | | | | | | |
| Book Title | Machine | Thinking | TPS | Workplace | TPS | Gemba | Kaizen | LP | Toolbox | Service | Kata | Culture | Culture | | | | | | | | | |
| Year | 1990 | 1996 | 1988 | 2013 | 2012 | 2012 | 1986 | 2016 | 2017 | 2008 | 2010 | 2017 | 2015 | | | | | | | | | |
| #words* | 87618 | 107420 | 35733 | 36501 | 107922 | 61413 | 46825 | 30408 | 163653 | 76640 | 58899 | 10711 | 69301 | 68696 | 10711 | 163653 | | | | | | |
| # words | 90109 | 110148 | 36412 | 36820 | 109971 | 62711 | 47947 | 30464 | 164723 | 77692 | 60102 | 10990 | 70249 | 69872 | 10990 | 164723 | 908338 | | | | | |
| % difference | 3% | 2% | 2% | 1% | 2% | 2% | 2% | 0% | 1% | 1% | 2% | 3% | 1% | | | | | | | | | |
| # distinct | 6793 | 7430 | 4023 | 2974 | 6049 | 5195 | 4896 | 4060 | 9353 | 6209 | 4501 | 1623 | 5004 | 5239 | 1623 | 9353 | | | | | | |
| Top word | production | product | production | work | production | kaizen | management | process | time | service | improvement | coaching | Lean | | | | | | | | | |
| # count | 952 | 634 | 580 | 265 | 1253 | 430 | 482 | 242 | 1225 | 690 | 591 | 280 | 1233 | | | | | | | | | |
| 80%Pareto | 190 | 127 | 116 | 53 | 251 | 86 | 96 | 48 | 245 | 138 | 118 | 56 | 247 | | | | | | | | | |
| # pKR | 19 | 38 | 10 | 31 | 19 | 35 | 25 | 30 | 34 | 16 | 19 | 10 | 11 | 23 | 10 | 38 | | | | | | |
| **Lean Liker *et al.* case** | | | | | | | | | | | | | | | | | | | | | | |
| Author | Liker | Liker | Liker | Liker | Liker | Liker | Liker | Liker | | | | | | | | | | | | | | |
| Main Credentials | Engineering Management | Engineering Management | Engineering Management | Engineering Management | Engineering Management | Engineering Management | Engineering Management | Engineering Management | | | | | | | | | | | | | | |
| Title | 14 | Becoming | Culture | Talent | Leadership | CI | Developing | Service | | | | | | | | | | | | | | |
| Year | 2004 | 1997 | 2008 | 2007 | 2012 | 2011 | 2015 | 2017 | | | | | | | | | | | | | | |
| #words* | 100674 | 65425 | 173259 | 89360 | 82190 | 48705 | 96998 | 144264 | | | | | | | | | | 100109 | 48705 | 173259 | | |
| # words | 102624 | 66476 | 175481 | 90322 | 83854 | 49383 | 97009 | 146756 | | | | | | | | | | 101488 | 49383 | 175481 | 811905 | |
| % difference | 2% | 2% | 1% | 1% | 2% | 1% | 0% | 2% | | | | | | | | | | | | | | |
| # distinct | 6965 | 5726 | 10177 | 5389 | 6020 | 4639 | 5334 | 7975 | | | | | | | | | | 6528 | 4639 | 10177 | | |
| Top | process | production | team(s) | job(s) | leader(s) | lean | work(s) | work(s) | | | | | | | | | | | | | | |
| # count | 568 | 448 | 1394 | 927 | 618 | 386 | 580 | 1001 | | | | | | | | | | | | | | |
| 80%Pareto | 114 | 90 | 279 | 185 | 124 | 77 | 116 | 200 | | | | | | | | | | | | | | |
| # pKR | 39 | 36 | 33 | 18 | 37 | 31 | 48 | 31 | | | | | | | | | | 34 | 18 | 48 | | |
| * by MsWord | | | | | | | | | | | | | | # words | 78848 | | 2502437 | | | | | |
| other: by Atlas.ti | | | | | | | | | | | | | | average | | | total sum | | | | | |
| | | | | | | | | | | | | | | # pKR | 26 | | | | | | | |

Legend: pKR: potential keyword

There were on average 26 potential relevant keywords (9-48) per book, 24 potential relevant keywords (18-31) per cases and 23 candidate relevant keywords (Supplemental figures 1, Supplemental Table 4 and Figures 2.1 and 2.2). Ten top relevant keywords were identified, in order of importance: 'work', 'time', 'process', 'Lean', 'system', 'improvement', 'production', 'patient', 'people' and 'team' (Supplemental Table 4).

Figure 2.1 Candidate relevant keywords Pareto histogram 1

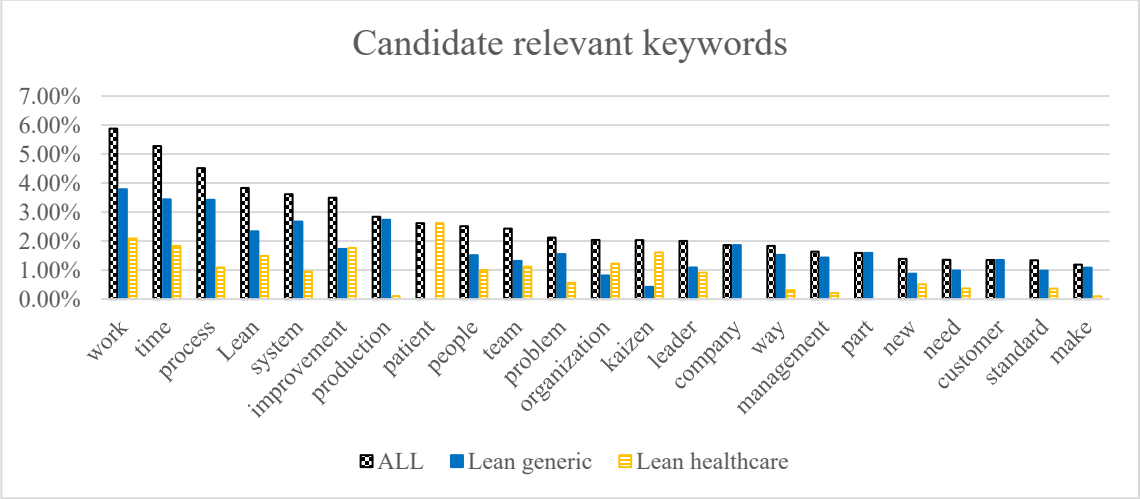
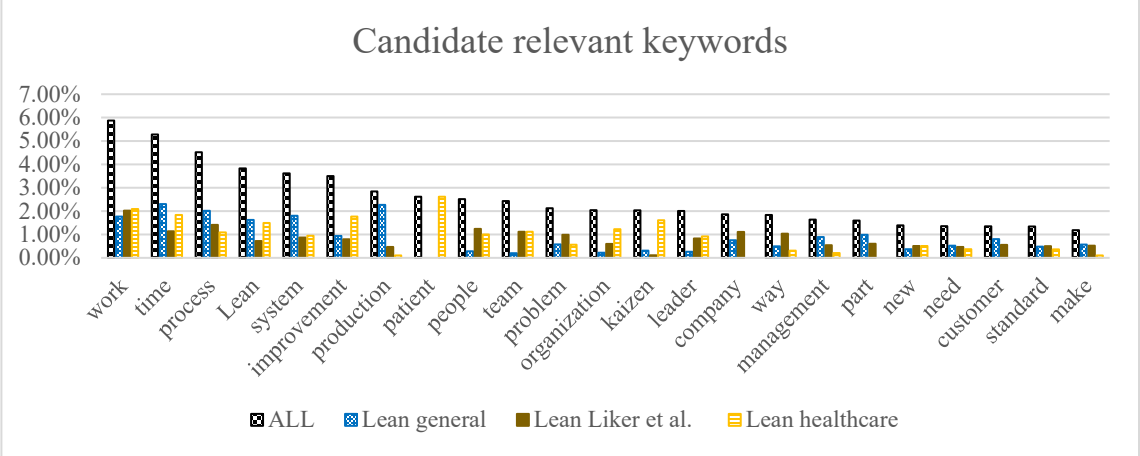



Figure 2.2 Candidate relevant keywords Pareto histogram 2



Sensitivity analyses suggest that the found ten top relevant keywords through our explicit detailed procedure are correct. If common popular sense would have kept either top three or top five most frequent words in the consolidation process, the variant use of the Pareto principle allowed for greater accountability and wider inclusion of words for enhanced exploration. It should be noted that the inverse exponential function of word counts as demonstrated in figures 2.1 and 2.2 and supplemental figures 1.1 to 1.33 have been observed at each condensation step. A more stringent and proper use of Pareto principle were 80% of variability is explained by 20% of frequency would have kept only the top four words in the final selection, whereas use of an inverse Pareto principle conservation rule (keep all words down to 20% of top word frequency) would have expanded the list of relevant keywords to 51 with the addition of the following words: 'problem', 'organization', 'kaizen', 'leader', 'company', 'way', 'management', 'part', 'new', 'need', 'customer', 'standard', 'make', 'get', 'see', 'value', 'plant', 'care', 'product', 'say', 'quality', 'develop', 'staff', 'job', 'line', 'service', 'change', 'worker', 'level', 'use', 'idea', 'training', 'member', 'culture', 'example', 'learning', 'manager', 'machine', 'go', 'flow', 'thinking'. We content that this list does not introduce significantly new, unaccounted cultural clusters that are not part of our proposed four (see findings section 2) except perhaps for "leadership" related to the words: 'leader', 'management', 'manager' and for "education" with appearance of the terms 'training' and 'learning'. These unaccounted clusters may however arguably be part of the proposed cultural clusters of "operations".

As it stands, the current selection of ten relevant keywords accounts for more than 50% of total variability of all cases (see Supplemental Table 3).

Use of different weighting rules does not significantly change the identified top relevant keywords but ordering is affected. For example, weighting by relative total relevant keyword count rather than total book count as selected leads to a Top 25 candidate relevant keyword rather than a Top 23 with the addition of the term "get" and "see" and ordering of relevant keywords changes up or down 3 spots for "company" for the top ten

relevant keywords to a maximum of five for “kaizen”. Use of no weighting or crude frequency rules do not significantly change findings.

### *3.3.2 Section 2: From top relevant keywords to leading Lean cultural clusters*

Although suggested to be optional in the fourth round of condensation of this study’s CCE-CATA procedure (figure 1), this deductive cross-check step serves two valuable purposes: 1- it verifies whether or not top relevant keywords determined by analysis could be representation of an already described respected model providing further validation for this model and 2- it may provide additional insights how to interpret results of the CCE-CATA procedures and to more solidly justify proposal of novel cultural clusters.

Table 4 illustrates qualitative correlations with four classic organizational design and structure models and the ten top relevant keywords.

Table 4. Qualitative correlation organizational models

| Model | Dimensions | work | time | process | Lean | system | improvement | production | patient | people | team |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Galbraith's star model** (2012) | people | | | | | | | | | | |
| | process | | | | | | | | | | |
| | rewards | | | | | | | | | | |
| | strategy | | | | | | | | | | |
| | structure | | | | | | | | | | |
| **Leavitt's diamond model** (1965) | managerial task | | | | | | | | | | |
| | people | | | | | | | | | | |
| | structure | | | | | | | | | | |
| | technology | | | | | | | | | | |
| **McKinsey's 7-S model** (2004) | shared values | | | | | | | | | | |
| | skills | | | | | | | | | | |
| | staff | | | | | | | | | | |
| | strategy | | | | | | | | | | |
| | structure | | | | | | | | | | |
| | style | | | | | | | | | | |
| | systems | | | | | | | | | | |
| **Mintzberg's basic parts of organizations model** (1979) | strategic apex | | | | | | | | | | |
| | middle line | | | | | | | | | | |
| | operating core | | | | | | | | | | |
| | technostructure | | | | | | | | | | |
| | support staff | | | | | | | | | | |

| Legend: | identical |
|---|---|
| | strong |
| | weak |
| | assumed |

If “patient” is shown to have a strong correlation with “people” in Galbraith’s star model (people, process, rewards, strategy and structure), this is in line with contemporary managerial thinking of acknowledging patients as co-producers and customers. However, when this model was conceived in 1977, “people” essentially referred to organizational staff from CEO to front-line employees and not to customers. “Process” appears to be the main dimension having the most and stronger links with relevant keywords, followed by “people” and “structure”. “Rewards” and “strategy” find little association except indirectly with “team”. Incidentally, “team” appears to be for all theses models a non-discriminating dimension as association, albeit weak may be conceivably related to almost all of them. All and all, Galbraith’s model appears to have a poor fit with the ten relevant keywords identified by this CCE-CATA. It is felt that the relevant keywords, “improvement’ does not even find equivalency in this model. This should be of little surprise since Galbraith’s model is proposed as an aid for designing organizations, a stage where organizational improvement issues are not usually conspicuous (Galbraith, 2012).

A similar rating is given to Leavitt’s diamond model (managerial task, people, structure and technology) who shares two dimensions with Galbraith’s – “people” and “structure”. Leavitt’s managerial contribution with this model is to remind that the four stated dimensions are interrelated critical success factors in organizational change (Leavitt, 1965; Smith *et al.*, 1992). It is felt that the relevant keyword “improvement” does not find direct association in this model similarly to Galbraith’s. Remarkably, although improvement is the usual intention of planned organizational change, it is not always the case and the outcome. Notably as well, by focusing on managerial tasks, Leavitt’s diamond leaves out operations and organizational performance off its equation.

The same can be said for McKinsey’s 7-S model (shared values, skills, staff, strategy, structure, style and systems). Although its development occurred concomitantly to works of Pascale and Athos (1981) on “The Art of Japanese Management”, Peters and Waterman’s presentation of this model in their book, “In Search of Excellence” is, similarly to Galbraith’s model, intended to be a generic organizational design assessment tool (2004, 1982). Relevant keywords “patient” and “time” are felt not to be addressed

adequately by this model and in overall, linkage to dimensions are considered weak except for systems, which is shared.

As for Mintzberg's basic parts of organizational model (strategic apex, middle line, operating core, technostructure and support staff) (1979), it appears, as the other previous models, internally focused with a large emphasis, however, on human resource. All parts in Mintzberg's model regard 'people': in "strategic apex", he refers to top managers and their staff; "Middle line" are other managers; "operating core" are all employees making products and rendering services; "technostructure" are organizational analysts such as accountants and long-term planners and "support staff" are other employees in charge of cafeteria or payroll, for examples (Mintzberg, 1980). Yet again, there appears to be a silence over the following constructs: "improvement" and "patient" and along its extension, customers. This should not be too surprising as this model was also conceived out of works on the structuration of organizations and not organizational change.

If the aforementioned models appear overall ill-fitted with the ten top relevant keywords identified in this study, other organizational models, more specifically oriented toward organizational culture, ought to be considered for a thorough deductive cross-check. For this matter, whereas the comprehensive literature review done on Lean culture (chapter 1) enabled to identify three influential models of organizational culture proposing specific dimensions: 1- Cameron and Quinn's Competing Value Framework (2011), 2-Hofstede *et al.* (2010) and 3- House *et al.* (Globe study) (2004) (please refer respectively to chapter 2, Table 9 and 8 for more details on each models) in addition to Schein's basic assumptions bases (1981), the model of Detert *et al.* (2000), appears to be another important model to include in this analysis.

Indeed, with the aim to describe Total Quality Management (TQM)'s specific underlying beliefs and values, Detert and colleagues have derived then, from an extensive literature synthesis, a framework of eight general organizational culture dimensions constructed with ideas around: 1- the basis of truth and rationality, 2- the nature of time and time horizon, 3- motivation, 4- stability versus change, 5- orientation to work and coworkers,

6- isolation versus collaboration, 7- control and responsibility and 8-internal or external orientation. Their work suggests that TQM, arguably a more generic form of Lean as it is based on the same operations management principles (Hackman and Wageman, 1995; Holweg, 2007; Parkes, 2015), is a factual scientifically based management method that requires long-term orientation and strategy in its strive for organizational continuous improvement. Issues of quality in a TQM environment, as in Lean, are considered to be due to poor system designs, not employees' fault. Quality issues are dealt with proactively in TQM by intrinsically motivated employees using existing resources. Customer-focus results are achieved by process improvement and defect prevention requiring internal and external cooperation and collaboration of all stakeholders. Everyone's participation in a TQM organization is solicited and united by shared vision and goals. Finally, there is a strong TQM belief that financial results follow optimal customer-driven operational performance. Detert and colleagues' impressive results were obtained from proceedings of a panel meeting held in December 1997. This panel was composed of fifteen distinguished educators, practitioners, consultants and/or researchers. A modified nominal group technique proposed by Van de Ven & Delbecq (1972) was used. This technique is described as a research process yielding quantifiable answers to, in this specific case, the problem of gaining greater understanding on TQM's underlying cultural values. Reproducing this work nowadays for Lean would be a monumental, next to impossible, task since Lean's expertise is international and access to these experts prohibitively limited. Moreover, sounder evidence beyond experts' one-day panel meeting opinions are currently available for Lean. Detert *et al.*'s contribution remains nevertheless very commendable and certainly inspirational for further understanding of Lean culture.

Compared to the previous model of organizational design and structure, greater fitness between models of organizational culture and Lean's relevant keyword appears to be found except perhaps for the Competing Value Framework of Cameron and Quinn (Table 5). This may be because this model aims at describing generic cultures of organizations linked to two strategic structuration axis (flexibility vs stability and internal vs external focus) which are not primary concerns in Lean.

Table 5 Qualitative correlation organizational culture models

| Model | Dimensions | work | time | process | Lean | system | improvement | production | patient | people | team |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cameron and Quinn's Competing Value Framework** (2011) | adhocracy | | | | | | | | | | |
| | clan | | | | | | | | | | |
| | hierarchy | | | | | | | | | | |
| | market | | | | | | | | | | |
| **Detert et al. TQM values (adapted)** (2000) | factual truth | | | | | | | | | | |
| | long-term strategic vision | | | | | | | | | | |
| | intrinsic motivation | | | | | | | | | | |
| | continuous improvement | | | | | | | | | | |
| | stakeholders-oriented results | | | | | | | | | | |
| | collaboration | | | | | | | | | | |
| | inclusive involvement | | | | | | | | | | |
| | customer-driven | | | | | | | | | | |
| **Hofstede et al.** (2010) **and House et al.** (2004) **cultural dimensions** | assertiveness | | | | | | | | | | |
| | future orientation | | | | | | | | | | |
| | human orientation | | | | | | | | | | |
| | in-group collectivism | | | | | | | | | | |
| | institutional collectivism | | | | | | | | | | |
| | performance orientation | | | | | | | | | | |
| | power distance | | | | | | | | | | |
| | uncertainty avoidance | | | | | | | | | | |
| **Schein's basic assumptions bases** (1981) | environment | | | | | | | | | | |
| | reality | | | | | | | | | | |
| | truth | | | | | | | | | | |
| | time | | | | | | | | | | |
| | space | | | | | | | | | | |
| | human nature | | | | | | | | | | |
| | human activities | | | | | | | | | | |
| | human relationships | | | | | | | | | | |

| Legend: | identical |
|---|---|
| | strong |
| | weak |
| | assumed |

Proposed dimensions of other models seem to have a lot of overlap between and among the ten top relevant keywords and they do not demonstrate much discrimination. All appears to be part of all. It is particularly striking for the model of Detert *et al.* on Total Quality Management (TQM) values. This is hardly surprising considering the similarities in origins, in principles, in tools and in expected outcomes that TQM and Lean share.

It is the cultural dimensions of Hofstede *et al.* and House *et al.* that show the most differentiating power among the ten top relevant keywords. The least addressed but the most important ones appear to be however 'work' and 'process'. These authors seem to pay more attention in their models to performance and results whereas Lean invites to focus more on operational improvements to obtain greater results. Their two types of collectivism (in-group and institutional) are not discernable within the ten top relevant keywords. Definition of human orientation as 'the degree to which a collective encourages and rewards individuals for being fair, altruistic, generous, caring, and kind to others' (Martins *et al.*, 2015) does not really relate to 'patient' and 'people' as customers, co-producers or workers in its Lean sense. Dimensions of assertiveness and power distance do not find analogs in the ten top relevant keywords.

As for Schein's basic assumptions bases, it is the natures of space and truth that do not seem to be represented in the ten top relevant keywords. No much discriminating power is brought by differentiating human nature, human activities and human relationships. The top relevant keyword 'improvement' is only weakly relating to Schein's model by its nature of time base.

Moreover, it should be noted that some dimensions proposed in these cultural models are vast and very challenging to operationalize. For examples: Schein's nature of reality or Detert *et al.*'s stakeholders-oriented results and even the deceptively simple yet complex construct of collaboration.

In front of these inadequacies and shortcomings of all these models, it seems appropriate to suggest better discerning grouping of top relevant keywords with an additional condensation step into novel cultural clusters.

It is therefore proposed that Lean's top relevant keywords 'work', 'time', 'process', 'system', 'production' be combined into a cultural cluster named "operations" (Table 6).

Table 6 Qualitative correlation leading cultural clusters

| Model | Dimensions | work | time | process | Lean | system | improvement | production | patient | people | team |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lean cultural clusters** | operations | | | | | | | | | | |
| | change | | | | | | | | | | |
| | collectivity | | | | | | | | | | |
| | humanity | | | | | | | | | | |

| Legend: | identical | |
|---|---|---|
| | strong | |
| | weak | |
| | assumed | |

The term operations refers to the basic definition of operations management as stated by Slack *et al.* (2007): 'the activity of managing the resources which are devoted to the production and delivery of products and services' (p.4). The strong predominance of the top relevant keywords forming this cluster suggests that Lean is a business method that focuses on what organizations and its members actually do as opposed to what they say and what they think they are doing. The methodological implications of this point for academics is to recognize that in order to best study and assess Lean implementation and sustainability, an ethnographic strategy with on-site visits would be the strongest and most accurate method whereas interviews would be a weaker way and surveys, the weakest mean of investigation. For practitioners, it suggests that Lean is a pragmatic fact-based business method. It reminds them that, under a Lean paradigm, organizational resources ought to be better spent on supporting the organization and all its members to work together to deliver products and services as best as they can and better every day rather than investing in the search for a better organizational structure, vision statement, business plan, marketing scheme, public relation stunt, etc.

Top relevant keywords of ‘time’, ‘process’ and to some extent ‘work’ but, particularly strongly ‘improvement’ find a key construct in a second proposed Lean cultural cluster of “change”.

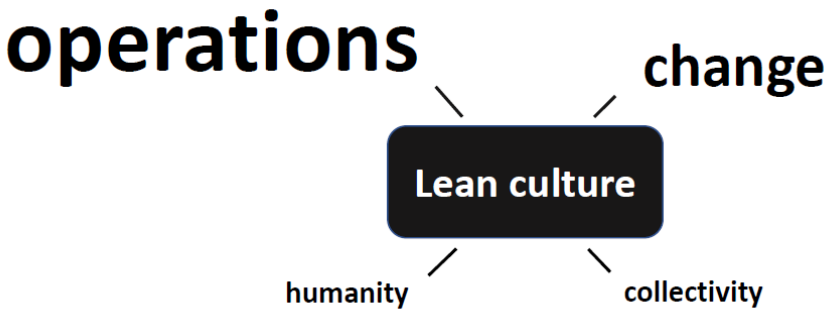
The word change certainly encompasses well and more generically one of Lean’s mantra, the lauded concept of ‘continuous improvement’, (Liker, 2004; Rother, 2010; Graban and Swartz, 2012). Lean, as a dynamic organizational system, assumes and much embraces change. Usual change management frameworks assume baseline organizational stability and describe different sequential steps to follow for planned organizational change to be customized every time as in Kotter (2012) or Cameron and Quinn (2011) and similarly for crisis management in unplanned changes as in Pearson and Clair (1998) or Diermeier *et al.* (2006). Lean, by rather assuming that organizations and its members continuously change, proposes structured ways of addressing effectively any and all changes, particularly through the practices of kata (Rother, 2010) and hoshin kanri (Liker, 2004). Lean organizations no longer need to increase readiness for change (Armenakis *et al.,* 1993; Weiner, 2009), they manage change continuously. By doing so, they increase their flexibility, agility and responsiveness (Ednilson and Hanna, 2009; Alves *et al.*, 2012; Qrunfleh and Tarafdar, 2013; Purvis *et al.,* 2014) and innovation capabilities (Sehested and Sonnenberg, 2011; Sawhney *et al.,* 2007).

‘System’ and ‘team’ appear appropriately associated with a third proposed cultural cluster of “collectivity” that echoes Hofstede *et al.* and Globe study (House *et al.*) dimensions of collectivism (see chapter 1, Table 8). Based on Merriam-Webster definitions (2018) of collectivity and collective, this cultural cluster refers to any grouping of cooperative units sharing similarities and interests. In case of Lean, it obviously starts at the aggregation of members into teams, then into organization, extending to a whole supply chain of organizations which have relationship with their communities, nations and the world. The notion of collectivity also recalls Lean’s moral organizational goal to act as ‘good citizen’ and its strong engagement to take positive corporate social responsibility actions and adopt proper green environmentally sustainable practices (Piercy and Rich, 2015; Wu *et al.*, 2015).

Finally, if there one aspect that numerous authors have reported on Lean is certainly to be a humane form of management. Lean is indeed geared toward "respect for people" and even "respect for humanity" among its pillars or its bases (Sugimori *et al.*,1977; Liker, 2004). "Humanity" therefore seems to be fitting for condensing top relevant keywords 'patient', 'people' and by weaker extension 'team' as a fourth proposed cultural cluster.

Hence, it is proposed that, from these analyses, Lean has four leading cultural clusters: operations, change, collectivity and humanity (Figures 3).

Figure 3 Lean cultural clusters




Note: figure illustrating clusters in size related to their relative word frequencies (operations (22.1 (45%)), change (14% (29%)), humanity (6.5% (13%)), collectivity (6% (12%)))

Further work on the characterization of Lean culture, supported by these clusters, is felt to be more likely fruitful although, as it will be discussed later, other important cultural elements of Lean culture may have been missed by this admittedly high-level content analysis.

### *3.3.3 Section 3: Lean multiple case reports*

Lean general case contains works of Bicheno *et al.* (n=2), Imai (n=2), Ohno (n=2), Rother (n=2), Womack *et al.* (n=2), Dennis (n=1), Mann (n=1) and Monden (n=1) for a total condensation of 13 books (a little more than 900 000 words) covering a time period from 1988 to 2017 (Tables 1, 4 and Supplemental Table 4 - for list of 22 candidate relevant keywords considered here). Note that except for Rother and Aulinger, Toyota Kata Culture published in 2017, other recent books are actually 2$^{nd}$ up to 5$^{th}$ edition.

Lean Liker *et al.* case comprises of eight books written by Liker and different co-authors during the time period of 1997 to 2017, condensing more than 800000 words (Tables 1, 4 and Supplemental Table 4 - for list of 31 candidate relevant keywords considered here).

Lean healthcare case includes works of Graban *et al.* (n=3), Kenney (n=2), Toussaint (n=2), Zidel (n=2), Barnas (n=1), Black (n=1) and Plsek (n=1) for a total condensation of 12 books (about 780 000 words) covering a time period from 2010-2016 (Tables 2, 4 and Supplemental Table 4 – for list of 18 candidate relevant keywords considered here).

Lean service case corresponds to the combination of all Lean healthcare books with the inclusion of one work from Bicheno and one work from Liker and Ross (14 books; total word count: about 1 million), whereas Lean manufacturing+ case includes all the other books (19 books; total word count: about 1.5 million) (Tables 1,2-4 and Supplemental Table 4 for list of 21 candidate relevant keywords for Lean service and list of 31 candidate keywords for Lean manufacturing+ case considered here).

Even though any inference made from single word frequency taken out of context is precarious and speculative, these observations can be made from the cases' top candidate relevant keywords lists. Note that since this work intends to help identifying Lean healthcare cultural features, greater attention is paid to Lean healthcare case.

*Lean general case*

The word 'time' is the dominant candidate relevant keyword in this case. This seems fitting when appreciating the heavy focus on operations management matters that its candidate relevant keyword list suggests with other words such as 'production', 'process', 'system', 'work', 'part', 'product', 'line', 'machine', 'problem', 'make', 'use', 'way' and 'standard' (14/22 or 63%). The eight other words seem to focus on change ('Lean', 'improvement'), people ('management', 'customer', 'worker') and strategy ('company', 'need', 'value'). Notably, 'team' is not found in Lean general case but is strong in Lean Liker *et al.* and Lean healthcare. 'Value' is only found in Lean general which suggests

that Lean general authors are taking a more classical Lean perspective [Womack and Jones 2003], which is also supported by the inclusion of the word 'standard'.

*Lean Liker et al. case*

'Standard' figures also in Lean Liker *et al.* case candidate relevant keywords in which 'work' and 'process' are as well dominant. A striking difference of this case listing is its inclusion of several human resource concerns with words such as: 'people', 'team', 'leader', 'job', 'training', 'learning', 'customer', 'management', 'member' and 'culture' (10/31 or 32%). This appears congruent with Liker and colleagues' interest on people as suggest by his books' title: "The Toyota Culture", "The Toyota Talent", "The Toyota Way to Lean Leadership", "Developing Lean Leaders at all levels" and "The Toyota Way to Service Excellence". There are a lot more action verbs in Liker *et al.*'s candidate relevant keywords books such as 'work', 'develop', 'get', 'see', 'make' and 'go' than in other cases which reveals a dynamic storytelling writing style.

*Lean healthcare case*

An outstanding but foreseeable Lean healthcare candidate relevant keyword feature is the prominence of the word 'patient'. More interestingly, its dominance seems to be proportional to the summation of the words 'part', 'product' and 'customer' contributions from Lean general case. This may suggest that 'patient' in Lean healthcare includes constructs of patients as not only service receiver- ie. 'customer' but also as service co-producer- ie. 'part' and service outcome- ie. 'product', which is concordant with service-centered dominant logic view proposed by Vargo and Lusch (2004).

The presence of 'kaizen' in the top five Lean healthcare candidate keywords appears also telling. Kaizen is a concept foremost promoted by Imai which he defines as "… on-going improvement involving everyone, including both managers and workers. The kaizen philosophy assumes that our way of life – be it our working life, our social life, or our home life – deserves to be constantly improved" p. 3 (1986). Kaizen, Lean's spirit of improvement, then evolved to represent a usually one week-long interdisciplinary teamwork special event dedicated to improve a specific process problem using PDCA

(plan-do-check-act) methodology (Graban, 2016). Kaizen events are sometimes considered by some authors complimentary to rapid improvement events (RIE), which by virtue of their smaller scale are more conducive to continuous process improvement (Graban, 2012). For Lean healthcare case authors to adopt kaizen seems fitting since interdisciplinary teamwork on projects is customary and necessary in healthcare high-stake, high-risk, quickly changing environment (Berry and Bendapudi, 2007).

As Mann (2015) and Liker (2015) among others suggest, for any organization to ever become Lean, there must be strong, proactive, supportive, committed, radically different leadership. Concordantly, it is apt that the word 'leader' figures in both Lean healthcare and Lean Liker *et al.* top candidate relevant keywords cases whereas, notably though, it is 'management' that is found in Lean general. This might be due to the fact that Lean healthcare and Lean Liker *et al.* books are overall more recent. And so is the recognition that Lean executive leadership plays a critical role in successful, lasting Lean transformation (Aij *et al.*, 2015; Mann, 2015). To find 'leader' in Lean healthcare top candidate relevant keywords is also in line with findings of a recent systematic literature review which noted leaders as the main barer of Lean culture (Dorval *et al.*, accepted for publication).

Where 'staff' is noted in the candidate relevant keywords Lean healthcare list, supporting the importance of humanity in Lean, it is relevant to point out that the words 'manager', 'physician' or any other healthcare professionals, are not. Equivalency is found in the word 'worker' in Lean general case and 'member' in Lean Liker *et al.* case. Again, perhaps because Lean healthcare and Lean Liker *et al.* cases are based on more recent books, word selection of 'staff' and 'member' appears more evocative of partnership compared to the more hierarchical distant words 'worker' (Lean general case) or 'employee' could be implying. This may reflect a trend toward the often-referred Lean cultural trait of flatter, agile, horizontal organization structure compared to traditional rigid vertical command and control organizations (Liker and Convis, 2012).

In all three cases, unit level appears to reside at the organization rather than other micro-level (personal or small-group) or macro-level (regional, national or international supply chain) matters. In terms of site, 'hospital' is found in Lean healthcare candidate relevant keywords, whereas it is 'company' in Lean general with the addition of 'plant' in Lean Liker cases. Taking a hospital-centric/dominant view of healthcare systems is all too common and may be undesirably nearsighted (Evans and Van Lerberghe, 2008). As argued by McKone-Sweet *et al.* (2005), taking a holistic supply chain management approach, particularly in healthcare, may allow for greater opportunities to find valuable Lean operational improvements (Aronsson *et al.*, 2011).

The word 'problem' figures in all three cases, albeit at different levels of importance: less and not reaching top candidate relevant keyword level for Lean healthcare and Lean general, whereas it is for Lean Liker *et al.* This is why cut-off of top relevant keyword was set before this word. It is fascinating that the word 'waste' is not found in any of the candidate relevant keyword cases. This might be because waste elimination is such a fundamental Lean characteristic that it is assumed and authors do not feel the need to discuss it at more length (Holweg, 2007).

Another noteworthy missing word is 'innovation' but this important concept of doing things differently, also a Lean staple, is hinted in the candidate relevant keywords 'new' of Lean Liker *et al.* case and 'idea' in Lean healthcare case (Plsek, 2014).

*Lean service and Lean manufacturing+ cases*

In an effort to investigate whether certain cultural themes had been buried within the grouping of the preceding cases and in recognition of the traditional dichotomy between the service and manufacturing traditions in operations management, books were re-grouped according to Lean service versus Lean manufacturing+ cases.

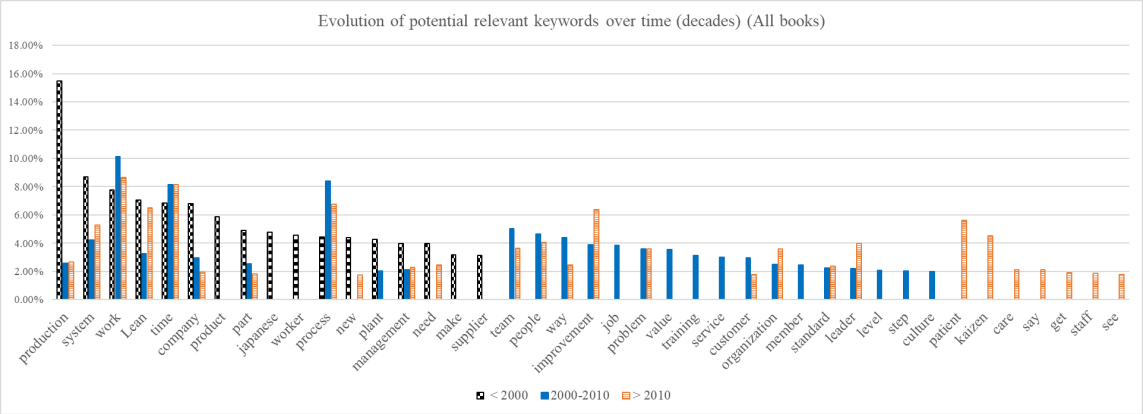
These new cases highlight how strong the word 'patient' is in Lean healthcare as 'patient' takes second place in Lean service top candidate relevant keywords after 'work'. 'Kaizen' is also uniquely found in Lean service which is also driven by Lean healthcare literature.

A stronger and more direct focus on human matters is appropriately found in Lean service with words such as: ‘patient’, ‘team’, ‘people’, ‘leader’, ‘staff’, ‘customer’ (6/21 or 28%) than in Lean manufacturing+ case which contains ‘people’, ‘management’, ‘team’, ‘leader’, ‘worker’ (5/31 or 16%). Notably, ‘quality’ another Lean basic feature and fundamental theme in operations management, become only apparent in Lean manufacturing+ candidate relevant keywords (Dorval and Jobin, 2018).

#### *3.3.4 Section 4: Relevant keywords evolution over time (decades)*

Figure 4.1 illustrates potential relevant keywords of all books grouped in decades of publication. Ordering procedure started by > 2010 (n=21 books) first, then secondly 2000-2010 (n=7 books) and lastly < 2000 (n=5 books) (Tables 1 and 2). There appears to be a strong focus on matters of operations management in the < 2000 books not only by the predominance of the word ‘production’ but with all of its other potential relevant keywords. This theme remains the leading one in all decades with three words: ‘work’, ‘time’ and ‘process’ demonstrating high presence to similar degree. A gradual shift and spread though is observed from operational to human, and then to more strategic issues in potential relevant keywords topics through time. As demonstrated by appearance of words such as ‘team’, ‘people’, ‘training’, ‘customer’, ‘culture’ in the second 2000-2010 decade and then, ‘improvement’, ‘leader’, ‘kaizen’ picking up strength or appearing in the > 2010 decade. Figure 4.1 also provide evidence for the younger Lean healthcare literature with words such as ‘patient’, ‘care’, ‘staff’ not mentioned earlier. These terms are more specific to Lean healthcare books. Notably, ‘product’, ‘Japanese’, ‘worker’, ‘make’ and ‘supplier’ are only found in potential relevant keywords of the < 2010 decade, whereas it is ‘job’, ‘value’, ‘training’, ‘service’, ‘member’, ‘level’, ‘step’ and ‘culture’ that are only observed in the second potential relevant keywords 2000-2010 decade.

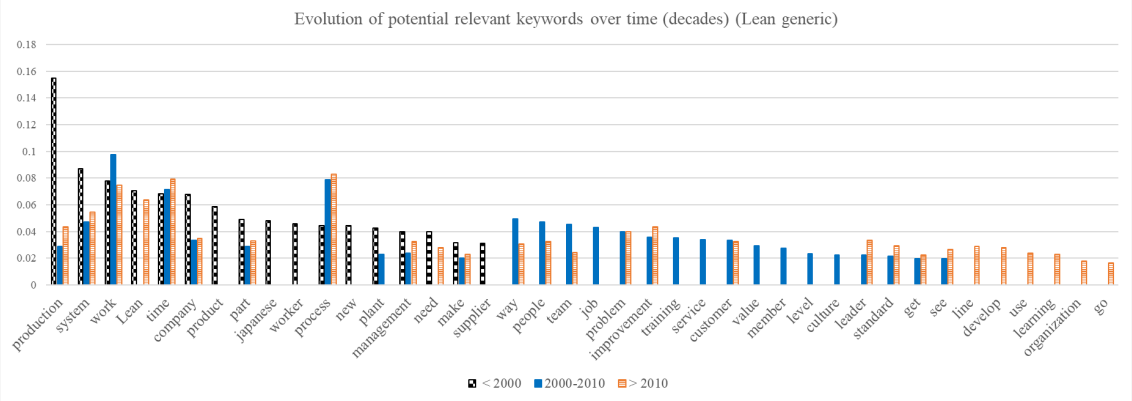
Figure 4.1 Evolution of potential relevant keywords over time (All)




Note: All books (relative % within each decade)

When Lean healthcare books are removed and the same ordering procedure technique is applied to the remaining Lean generic topic books (total n=21; < 2000 (n=5), 2000-2010 (n=6); > 2010 (n=10) (Table 1)), the same shift and spread from operational to human and then to strategic issues can be appreciated in figure 4.2. The word 'new' is additionally only present in the < 2000 decade. No word from the second 2000-2010 decade becomes singularly apparent but 'line', 'develop', 'use', 'learning', 'organization' and 'go' appear in the last > 2010 decade. The words 'Lean' and 'need' are the only two words present in the first < 2000 decade, that skip a decade and comes back as top potential relevant keywords in the last decade > 2010. This trend represents perhaps a period of uncertainty in the adoption of the Lean label in the second 2000-2010 decade. The words 'work', 'time', 'process' and to a lesser degree 'system' remains to strongest and consistent top potential relevant keywords through time.

Figure 4.2 Evolution of potential relevant keywords over time (Lean generic)




Note: Lean generic (relative % within each decade)

### *3.3.5 Section 5: other emergent complementary CATA explorations*

Five emergent CATA were undertaken while conducting this study: 1- a pronoun analysis, 2- a time content exploration, 3- a qualitative correlation between chapter 1's tentative Lean culture definition and this study's four cultural clusters, 4- a cross-validation exercise of the four Lean cultural with sociotechnical systems theory and 5- a working Lean healthcare culture definition proposal.

#### *3.3.5.1 Pronoun analysis*

To test the hypothesis that a cultural trait of the Lean literature is to use more often some pronoun over others, a pronoun analysis was performed. Using Atlas.ti software program, counts of all pronouns from the books' dataset were collected, normalized in percentage of total pronoun count of each book and then averaged, without weighing, by domain (Lean general, Lean Liker *et al.* and Lean healthcare). Then a similar pronoun CATA was performed on representative excerpt from five other reference books (three Six Sigma, two general management) (Table 7). Statistics were performed using Chi-squared test (in Excel 2016).

Table 7 Pronoun analysis

| *Pronoun* | **Lean general** | **Lean Liker *et al.*** | **Lean healthcare** | *average (Lean)* | *average** (Six Sigma-gen)* |
|---|---|---|---|---|---|
| I | 13% | 10% | 13% | 12% | 12% |
| You | 22% | 20% | 15% | 19% | 21% |
| She | 1% | 2% | 8% | 4% | 2% |
| He | 10% | 12% | 8% | 10% | 6% |
| We | **30%** | **29%** | **30%** | **29%** | **16%*** |
| They | 23% | 27% | 27% | **26%** | **43%*** |
| *sum* | 100% | 100% | 100% | 100% | 100% |

*P < 0.005

** estimated from excerpts of five reference books (3 six-sigma, 2 general)

Total word count: 6533


Reference Listing

Collins, J. C. (2005). *Good to great and the social sectors: Why business thinking is not the answer: a monograph to accompany Good to great: why some companies make the leap--and others don't*. J. Collins, Boulder, Colorado.

Eckes, G. (2001). *The Six Sigma Revolution: How General Electric and Others Turned Process Into Profits* John Wiley, New York.

Gygi, C., DeCarlo, N. and Williams, B. (2005). *Six Sigma for Dummies*, Wiley Publishing Inc., Indianapolis.

Harry, M. J., & Schroeder, R. (2000). *Six sigma: The breakthrough management strategy revolutionizing the world's top corporations*, New York.

Kotter, J. P., and J. L. Heskett. J.L. (1992). *Corporate Culture and Performance*, Free Press, New York.


The pronoun ‘we’ is predominantly used in the sample of Lean books, followed by ‘they’, ‘you’, ‘I’, ‘he’ and ‘she’. A finding that is consistent among all Lean books. It is interesting to remark though that the pronoun ‘he’ and ‘she’ are used in about the same proportion in Lean healthcare case where as ‘he’ is predominant over ‘she’ in Lean general and Lean Liker cases.

When these findings are compared to Six Sigma/General management books, in this literature, the pronoun ‘they’ is prominent, followed by ‘you’, ‘we’, ‘I’, ‘he’ and ‘she’. The differential use of the pronouns ‘we’ and ‘they’ between the Lean books and Six Sigma/General management books is statistically significant ($p < 0.005$), whereas uses of the other pronouns are not.

This provides even more support for the concept of collectivity to be a valid Lean cultural trait. This apparent shift in the use of the pronoun 'we' to 'they' in the Six Sigma/Lean general literature is coherent with the description of Six Sigma by Schroeder *et al.* (2008). They explain that even though Lean and Six Sigma essentially employ similar managerial techniques and tools, Six Sigma is as a top-down approach. Trained task forces are sent to front-lines and put in charge to resolve operational problems one after the other. Proposed solutions, once supported by higher management, are then implemented by front-line employees (Schroeder *et al.*, 2008). Lean adopt a different approach. Lean organizations educate all employees on continuous improvement techniques and tools. They are then enabled and supported to bring incremental change to their work every day by managers who act rather as coaches rather than gatekeepers (Rother, 2010). Optimal operations management becomes in Lean a 'we' team effort rather than a 'they' command-and-control endeavor (Womack *et al.*, 1990).

#### *3.3.5.2 Time content exploration*

To find words such as 'work' and 'process' at the top of a relevant keywords list of an operations management method such as Lean can easily be appreciated; however, to discover the word 'time' taking a more prominent position over other words such as 'system' or 'improvement' does not come as intuitively. Time has certainly several meanings. In fact, according to Merriam & Webster dictionary (2018), time has 14 definitions: 1- time as duration/measure; 2- time as occasion/occurrence; 3- time as opportunity/to change; 4- time as age/history; 5- time as period/term; 6- time as season; 7- time as tempo/rhythm; 8- time as moment/clock, 9- time as repetition/series, 10- time as finite moment/not infinite; 11- time as experience/good or bad; 12- time as pay rate/wages; 13- time as playing/game; 14- time as availability/computer or room (Supplemental Table 5).

With the aim to understand better the use, meanings and impact of 'time' in the Lean literature, a time content exploration was undertaken.

Based on this framework and Microsoft Word 2016 word locator features, coding of all 638 mentions of 'time' in Liker and Ross' The Toyota Way to Service Excellence was performed by 1 coder. This book was arbitrarily selected because its original publication is recent (2017). It links both Lean major domains (manufacturing vs service) and it is one of the most voluminous of the dataset with over 145 000 words (Table 1 and 4).

The most used definitions of time found in this exploration is the first one, time as duration/measure (25%), followed by occasion/occurrence (23%) tempo/rhythm (15%), availability (15%), period/term (9%), repetition/series (5%), moment/clock (4%), age/history (3%), opportunity/to change (1%), experience/good or bad (1%). No utilisation of time as season, as finite moment/not infinite, as pay rate/wages or playing/game was noted. These results suggest that the word 'time' is used in rather balanced and nuanced ways in Lean literature with a predominance on operational concerns such as measure and timing (Bicheno and Holweg, 2017).

These findings can only be considered preliminary as this time content analysis is certainly only at an exploratory stage. They seem however interesting enough to support a more definitive exploration that would require analysis of more than one book with at least two coder-investigators and another tie breaker referee to increase accuracy and reliability in results. Moreover, other Lean candidate relevant keywords such as 'patient', 'improvement' and 'team' and could also be considered for further clarification analysis.

#### *3.3.5.3 Lean culture definition and cultural clusters qualitative correlation*

In chapter 1, the following tentative definition of Lean culture, built from a consolidation effort of all 23 elements (here underlined) raised by 13 different definitions of Lean culture found in the literature, was constructed:

> 'an organizational culture in which all members, from CEO to employees, are learning together to continuously improve their work scientifically and create value to customers by eliminating waste and solving problems for long-term profit while believing in teamwork, participation and purposeful autonomy, highly

valuing respect, humility and excellence, and using Lean tools and techniques every day.'

These 23 elements are here correlated qualitatively with this study's four cultural clusters (Table 8):

Table 8 Qualitative correlation Lean culture definition and cultural clusters

| | operations | change | collectivity | humanity |
|---|---|---|---|---|
| organizational culture | | | identical | |
| all members | | | identical | weak |
| CEO | | | weak | identical |
| employees | | | weak | identical |
| learning | weak | identical | | |
| together | | | identical | |
| continuously | | identical | | |
| improve | weak | identical | | |
| work | identical | | | |
| scientifically | identical | | | |
| create value | identical | | weak | |
| customers | | | | identical |
| eliminating waste | identical | | | |
| solving problems | identical | | | |
| long-term profit | weak | weak | weak | |
| teamwork | | | identical | |
| participation | | | identical | weak |
| purposeful autonomy | | | | identical |
| respect | | | weak | identical |
| humility | | | | identical |
| excellence | identical | | | |
| Lean tools and techniques | identical | | | |
| every day | | identical | | |

| Legend: | identical |
|---|---|
| | strong |
| | weak |
| | assumed |

As it can be appreciated, the fact that almost all elements, with the exception of 'long-term profit', are accounted for by the four cultural clusters with not much strong thematic overlap supports the validity of this study findings.

This agreement between contributions originating from an academic source (Lean culture definition) and findings based on predominantly practitioner literature (Lean cultural clusters) suggest that the four cultural clusters may represent a legitimate bridge between these two bodies of knowledge and that the four cultural clusters could be used as sound scaffolder to build on further Lean culture knowledge.

Interestingly, the element of 'long-term profit' brought up by Höök (2008) raises a few important issues. First, it may be questioned whether this point is legitimate since search for profit is not commonly and explicitly associated with Lean. It is rather the notion of value that predominates Lean's discourse, as it may be appreciated from this study. The word 'value' figures in the top candidate relevant keywords listing and the word 'profit' does not (Supplemental Table 4). To her credit though, 'create value' is also part of her definition (chapter 1, Table 11) and her definition appears to be formed around a TQM's organizational objective to balance interests of three crucial stakeholders: shareholders, customers and organizational members (Kelada, 1999; Deschamps and Nayak, 1995) toward an optimal performance objective. The importance of profit for Lean organizations is also recognized by Ohno who describes it as 'a condition for a business to continued existence' (1988) and a mean for a company to fulfill its social responsibility (2013).

Höök's element of search for long-term profit in Lean culture gains though greater interest with its reference to the concept of long-term vision over short-term gains which is certainly very strong in Lean, as in TQM. Long-term vision is often expressed as the concept of hoshin kanri, a sophisticated form of strategic policy deployment in Lean. Several authors, such as Liker (2004), Bicheno and Holweg (2017), Nicholas (2016) and Barnabè and Giorgino (2017) have highlighted the importance of hoshin kanri in Lean's success and therefore its practice should probably be considered a key Lean culture artefact. The fact that this theme of long-term vision is not well accounted for by the four proposed cultural clusters brings up two crucial points: 1- the identified four cultural clusters only identifies dominant features of Lean culture and they should not be considered as the only components and 2- much more work is needed for greater understanding of Lean culture since there are likely other elements (artefacts, symbols, beliefs, values, assumptions) that are yet to be properly described.

#### *3.3.5.4 Lean cultural clusters and sociotechnical systems theory cross-validation*

The four Lean cultural clusters, operations, change, collectivity and humanity find also legitimacy by its consistency with the notion of sociotechnical systems and its theory, a linkage that has already been proposed by Shah and Ward (2007) through their definition of Lean.

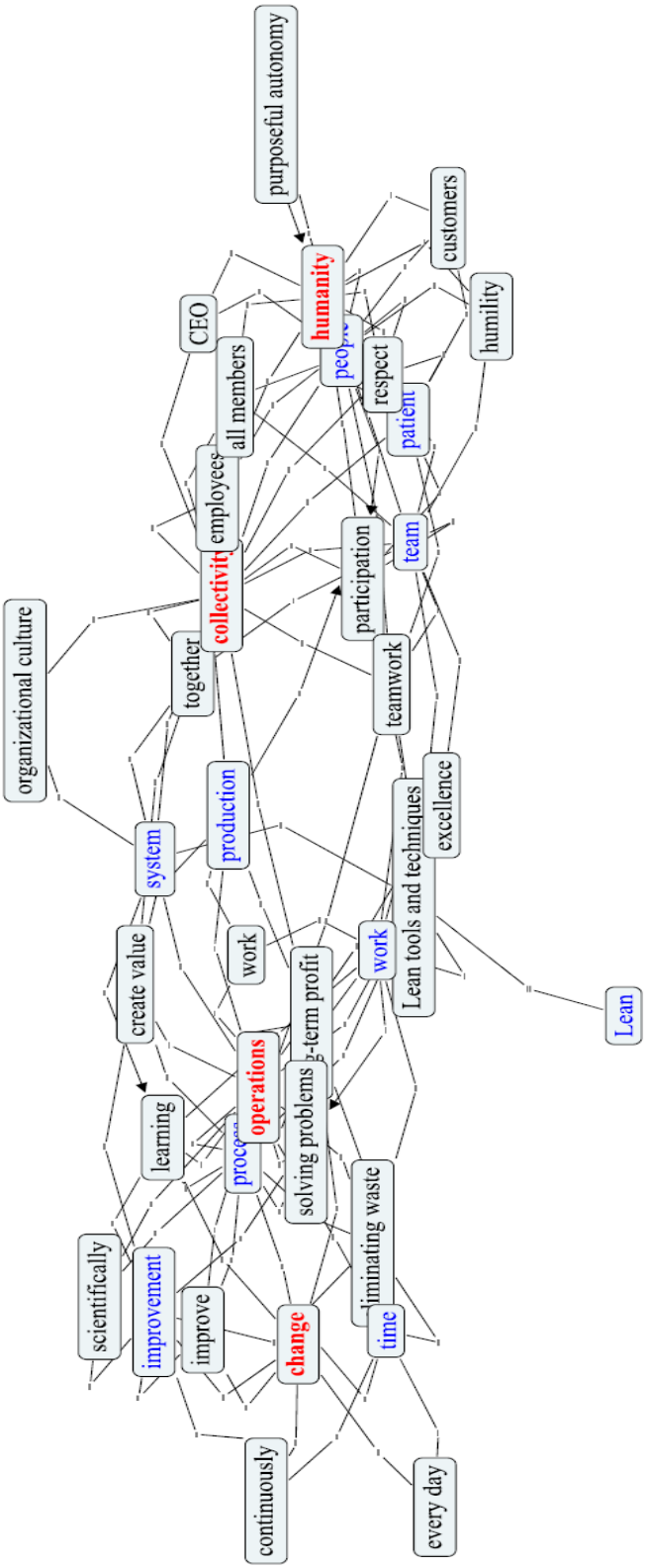
Elaborated in the 1950's and 60's by several contributors, in particular Eric Trist and Fred Emery, sociotechnical system theory contends that organizations, to get better performance, should seek optimal balance or joint optimization between their interdependent social components (people, members) (*humanity*) and technical components (tools, techniques, procedures, machines) (*operations*) as dynamic flexible open systems in continuous interactions (*change*) with their environment (*collectivity*). Sociotechnical system theory promotes non-bureaucratic organizational structuration (matrix, networks) formed by (semi-) autonomous groups (*collectivity*) composed of multiskilled operators who have quick access to necessary information and training for self-control (*humanity*). Team leaders replace managers (collectivity), efforts to eliminate status differentiation within organization and fair performance incentives and gainsharing to reward groups rather than individuals are instituted in an ideal sociotechnical view (humanity). This theory instructs to control organizational variances or irregularities as near as their sources to both enhance operational productivity and quality of work life as any deviations or disturbances affect one and the other (operations). Under its principle of equifinality, sociotechnical systems theory acknowledges that there are many ways and paths organizations may follow to structure and re-structure themselves in perpetual re-balancing efforts under ever changing conditions (change). There are also very specific statements regarding desirable human resource management (humanity-collectivity) in sociotechnical systems theory. For example, in order to get proper employee commitment and engagement, several suggestions on human needs to be fulfilled and rights to be respected are made as in a human need for work to be reasonably challenging, diverse (non-monotonous) and meaningful; rights for personal growth and continuing learning; needs for social support, recognition and constructive feedback on performance; rights for self-direction, self-realization and dignity; a need for appropriate job benefits and rights for job security,

safety and protection (van der Zwaan, 1975; Pasmore *et al.,* 1982; Miner, 2006). All these characteristics bare striking resemblance with Lean's teachings and as sound, find resonance with the four cultural clusters identified in this study.

#### *3.3.5.5 A working definition of Lean healthcare culture proposal*

Using CmapTools software (version 5.05.01) from the Institute for Human and Machine Cognition (http://cmap.IHMC.us) and its force directed automatic layout feature (up to 30 times or until stability of concept layout was achieved), the following cognitive map was generated. It represents efforts to link knowledge gained from analysis of practitioner literature, the ten relevant keword, the four Lean cultural clusters and the 23 elements of the tentative Lean culture definition which are based on academic evidence (Figure 5).

Figure 5 Cognitive map




Legend: top relevant keywords (blue), Lean cultural clusters (red), Lean culture definition elements (black)

Reading conventionally figure 5 from left to right, it is interesting to note that the "technico-social" dichotomy suggested in figure 3 (top to bottom) of the four Lean cultural clusters is preserved. Top relevant keywords 'production', 'system' and 'work' and the two cultural clusters: operations and collectivity occupy a central position and the notions of 'organizational culture', 'purposeful autonomy', 'Lean' and 'every day' take meaningful cardinal positions.

From all this work's findings, the following working definition of Lean healthcare culture can thusly be formulated:

> a proactive (change) pragmatic (operations) organizational culture in which all members (collectivity), from top leaders to front-line personnel (humanity), and stakeholders (collectivity) are learning (change) together (collectivity) to improve their work (operations) every day (change) systematically (operations) to create long term value (collectivity) to patients (operations / humanity) by eliminating waste and solving problems (operations), while believing in teamwork (collectivity), participation (collectivity) and purposeful autonomy (humanity) and highly valuing respect, humility (humanity) and excellence (operations), using Lean tools and techniques toward ever greater organizational (operations) continuous improvement (change).

## 3.4 Discussion

This work makes several contributions from a methodological perspective, from a Lean culture perspective and from a Lean general knowledge perspective, particularly regarding healthcare.

### *3.4.1 Methodological perspective*

Methodologically, this study provides evidence on the effectiveness, flexibility and scalability of content analysis for the exploration of cultural patterns in large documents. It demonstrates that even a rudimentary yet rigorous, relatively labor-intensive but widely available computer-aided text analysis (CATA) can uncover valuable insights. Selection

of proper source data and adoption of appropriate analytical approaches to answer the study questions remain critical.

The transparent step-by-step 4-round condensation technique procedure employed in this work increases reliability and replicability of results. This technique also appears generalizable and could be applied to or adapted for other related analysis in other fields or on other types of source documents. Internal validity of the work is enhanced by its meticulous and strict word condensation method, by use of an expanded Pareto 80-20 principle for more objective cut-off decisions and by performance of multiple sensitivity analyses showing consistency in findings. External validity is supported by inclusion of a large number of representative relevant Lean documents from different authors, domains and publication time periods.

While Neuendorf (2017) proposes this following broad definition of content analysis: 'a summarizing, quantitative analysis of messages that follows the standards of the scientific method (including attention to objectivity – intersubjectivity, a priori design, reliability, validity, generalizability, replicability, and hypothesis testing based on theory) and is not limited as to the types of variables that may be measured or the context in which the messages are created or presented', this work may represent what Miles *et al.* (2014) would label a mixed-methods research. It uses relative quantitative content analysis research strategies to make qualitative interpretation and to support qualitative findings. Neuendorf (2017) and Patton (2002) have recognized that the line between qualitative and quantitative research may be thin. We submit that the nature of this work remains qualitative since its source data are written documents.

This methodology for the investigation on Lean culture stands on the following assumptions that: first, textbooks, as written documents, are legitimate cultural artefacts; second, word choices are meaningful and culturally informative; third, relative frequency signals importance and significance of words and related constructs; fourth, in the process of linking word variants (for example: work, works, workable, worked, working, workings), there remains a significant and valid construct; and fifth, this latter construct

remains essentially the same whether the word is used as a noun, a verb, an adjective or an adverb and may be interpreted out of the word context. These last two assumptions stress an important point about this study: it is because its goal was to reveal broad clusters on Lean culture that this methodology becomes proper and suited. Other analytical schemes using more sophisticated analyses to permit deeper and more granular and detailed inferences would have been required otherwise.

Relative quantitative content analyses have been preferably used in this study because, as Atlas.ti word count outputs bluntly revealed, raw texts contain many challenging inconsistencies when they are not plainly mistakes. Attempting to resolve all wording issues in all books to enable quantitative analyses in absolute terms would have been an exhausting little value-adding exercise. It is possible that future IT development with artificial intelligence capabilities may allow precise data clean-up performance with detailed process rendition for proper interpretation of results. But, until then, relative quantitative content analyses, especially when applied consistently, appear not only adequate but justified as well for the aims of this study.

Based on findings of Duriau *et al.* (2007) systematic literature review and our own literature search, this work appears original and innovative in many ways. As content analysis source data, entire textbooks have hardly ever been used in management academic work. Reported source data are usually annual reports, trade magazines, scholarly journals or interviews and other field data. Where Strategic Management and Managerial and Organizational Cognition were the two main research themes to have used content analysis in the past, Duriau *et al.* (2007) did not identify any studies from Operations and Supply Chain Management or Health Care Management and consequently, none on the topics of Lean and more over, Lean healthcare. Finally, for the purpose of identifying keywords by an emerging inductive process rather than imposing some deductively, the use of an expanded Pareto 80-20 principle cut-off decision aid for word condensation proved to be useful and very effective in this study. Specialized content analysis software programs such as CATPAC II, T-Lab Pro and PolyAnalyst allowing for emergent coding exists but they use proprietary secret hidden algorithms that

make interpretation of results more difficult and are relatively expensive to use (Neuendorf, 2017).

### *3.4.2 Lean culture perspective*

The contributions that this work has on greater understanding of Lean culture reside as much as in what it shows and in what it does not show.

The four identified leading cultural clusters: operations, change, collectivity and humanity, suggest Lean to be a practical, proactive, dynamic, interdependent and humane business method, much aligned with sociotechnical systems theory as previously shown.

Lean is practical, proactive and dynamic as it is about enabling everyone involved in its organization to apply solutions and resolve all business problems right away as they present themselves and learning collectively from these experiences (Liker and Franz, 2011). It is not about complying to and sticking to any particular dogmatic, conceptual organizational designs, structures or models such as functional, divisional, matrix, centralized, decentralized, top-down, bottom-up, front-back, pillared, seeking horizontal or vertical integration (Galbraith, 2012). Organizational structure matters but Lean appears to be compatible with all and any of them to some extent as long as improvements in organizational performance toward its end-customers is achieved (Monden, 2012; Rother, 2010).

The first leading cultural cluster "operations", built from top relevant keywords 'work', 'time', 'process', 'system' and 'production' suggests that Lean is about what happens in organizations and what people are doing pragmatically, and not about what they say they are doing or what they think they are doing. All stakeholders (leaders, managers, employees, suppliers, and even customers, especially in service organizations) are called out to pay attention to what is going on in the organization. This is exemplified in the words of Mann (2015):

> "*The Lean management system consists of the discipline, daily practices, and tools you need to establish and maintain a persistent, intensive focus on process… The visual controls called for in a Lean management*

> *implementation represent Lean's emphasis on process. Timely maintenance of visuals provides physical evidence of leaders' discipline. Equally important, visuals are designed to capture abnormal process performance events, including information on misses, defects, interruptions, system failures, and abnormalities*." p. 8.

and these words of Liker and Convis (2012):

> *"... sustaining improvements requires a combination of top leadership commitment and a culture of continuous improvement. We have to change the culture from one in which people simply do their own job in their own function to make their own numbers look good (a vertical focus) to one in which people are focused horizontally on the customer and on improving value streams that deliver value across functions." p. 4.*

These points about pivotal focus on operations are further exemplified and supported by the notion of gemba or 'real place' – the place where real action occurs (Imai, 2012, p.13) and the key and crucial managerial practice of going to the gemba for Lean success, as repetitively instructed by several, if not all, Lean authors (Imai, 2012; Mann, 2015; Graban, 2016).

The second leading cultural cluster "change" taken directly from top relevant keywords 'time' and 'improvement' and indirectly from 'work' and 'process' reminds organizational stakeholders that Lean embraces the fact that change, similar to time, is inevitable but they create opportunities to make everything better (Imai, 1986). It may be hard and challenging but particularly when tested procedures such as PDCA (plan-do-check-act), value stream mapping and other Lean tools are applied with discipline, results follow. This is argued by Imai (2012) as followed:

> "*Kaizen* (as in Lean's concept of continuous improvement),…, *emphasizes human efforts, morale, communication, training, teamwork, involvement, and self-discipline—a commonsense, low-cost approach to improvement…. Kaizen fosters process-oriented thinking because processes must be improved for results to improve. Failure to achieve*

> *planned results indicates a failure in the process. Management must identify and correct such process-based errors. Kaizen focuses on human efforts—an orientation that contrasts sharply with the results-based thinking in the West." p. 3.*

The third leading cultural cluster "collectivity" based on top relevant keywords 'system', 'team' and 'organization', informs stakeholders that Lean requires and only works when all support it together interdependently. In the words of Ohno (1988):

> "*Teamwork is everything… one of my favorite stories (is) about a boat rowed by eight men, four on the left side and four on the right side. If they do not row correctly, the boat will zigzag erratically. One rower might feel he is stronger than the next and row twice as hard. But this extra effort upsets the boat's progress and moves it off course. The best way to propel the boat faster is for everyone to distribute force equally, rowing evenly and at the same depth*." *pp. 23-24.*

There is little place in Lean for individualistic, isolated in silo, protectionist attitudes which put everything at risk: behaviors with dire outcomes that are unfortunately seen too often in usual healthcare organizations (West and Lyubovnikova, 2013). Flow (of communication, cash, products and service), collaboration, cooperation, coordination are paramount in Lean, which, incidentally, are also themes very close to interests and best practices in supply chain management, a discipline that studies cross-disciplinary integration, networks and provision of collective sustainable value (Arlbjorn *et al.*, 2011; Chen and Paulraj, 2004; Frankel *et al.*, 2008; Landry and Beaulieu, 2003; Womack and Jones, 2003). Additionally, this study's pronoun analysis has found a statistically significant greater use of the pronoun 'we' in Lean literature. These points all support collectivity as being a significant Lean cultural cluster.

The fourth leading cultural cluster "humanity" derived from top relevant keywords 'patient', 'people' and by extension 'team', reminds stakeholders that, at its core, Lean achieve superior performance for people and by people. This is a central idea raised by all Lean authors. Lean recognizes that people have flaws and limitations but proposes ways to address and overcome them productively by extensive training and empathic human

resources management, focusing on systemic improvement rather than individual shame and blame (Liker, 2008). Examples are found in the words of Liker and Meier (2007):

> "*What Toyota has been able to do is gather competent and trainable people from around the world and, with considerable time and effort, develop high levels of talent within the masses. It is not a few star performers who make up a strong team. It is a collection of many players with good capability working in unison that makes an exceptional team. Toyota does not hope for the lucky draw of finding the natural talent—it is a rare find. Instead, Toyota leaders work on the known entity—the latent talent in each person who has the desire for personal growth*." *p. 3.*

and the words of Rother (2010):

> "*…the most important factor that makes Toyota successful is the skill and actions of all the people in the organization… this is the primary differentiator between Toyota and other companies. It is an issue of human behavior… Human possess an astounding capability to learn, create, and solve problem. Toyota's ability to continuously improve and adapt lies in the actions and reactions of the people in the firm, in their ability to effectively understand situations and develop smart solutions. Toyota considers the improvement capability of all the people in an organization the "strength" of a company*." *p. 13-14.*

Although these two testimonies are from Toyota and about its production system, they by extent apply to all Lean organizations.

The strategic importance of human resource development in Lean has also been discussed by Alagaraja and Egan (2013). But arguably the strongest evidence to support 'humanity' as a leading cultural focus comes from Sugimori *et al.* and their first account on the Toyota Production System (1977):

> "*It has built up a system of respect for human, putting emphasis on the points as follows: (1) elimination of waste by workers; (2) consideration*

*for workers' safety; and (3) self-display of workers' capabilities by entrusting them with greater responsibility and authority*." *p. 557.*

Lean's concerns for humanity and collectivity is also demonstrated with its links to corporate social responsibility and green operations (Piercy and Rich, 2015; Wu *et al.*, 2015).

All in all, collective understanding of Lean culture appears improved by this identification of four leading cultural clusters: operations, change, collectivity and humanity. They also show compatibility and consistency with many other Lean conceptualizations such as Toyota Production System (TPS) house schema, which exists in several variations, or Liker 4P's model (philosophy, process, people and partners, problem-solving) (see Supplemental figures 2 – illustrative purposes only).

In addition to the aforementioned word 'waste', a few other words are surprisingly missing from lists of top relevant keywords such as excellence, value, costs, discipline, leadership, strategy. Further work would need to be done to provide valid answers on this point.

Moreover, it is notable that very few, if any, top potential relevant keywords directly evoke, with the exception of perhaps 'Lean' and 'kaizen', either symbols, values or assumptions associated to Lean. This observation supports the facts that Lean is a pragmatic business method and that Lean culture is an under-developed concept.

#### *3.4.3 General Lean knowledge perspective*

A significant contribution of this work on general Lean knowledge is to recall how fundamental the concept of 'time' is in Lean and continuous improvement.

The first distinctive feature of Toyota Production System reported by Sugimori *et al.* (1977) says it almost all: 'just-in-time production' but even more telling is Ohno's discussion on the matter in his book, Workplace Management (2013):

"*I have realized this only recently, but apparently the phrase "just in time" is a created expression and not proper English…I heard from one person*

*that "exactly on time" is proper English. Although they say that "just in time" is not proper English, I think "just in time" is a very good expression.*
*The usage of "just in time" translated into Japanese is "to be just in time." It may be the "in time" that is not proper English. "Timing" is not the same as "time" but rather whether the timing is good or bad, as in whether it is on time or not on time, whether it is "in timing," although I don't know if that is proper English either. The word "just" was added so that enough to be on time would not be plenty in time. pp. 55-56.*

Clearly, time, its perception and its handling are very important in Lean, as confusing and difficult to figure out as it may be when there are as many as 14 definitions of time according to Merriam & Webster dictionary (2018).

The concept of time may be hidden in the notion of continuous improvement but it appears nevertheless determinant. Whereas many authors, in particular, Kotter (2012), speak about the need to create a sense of urgency for any organizational change to happen, this step, a significant cause of organizational inertia, disappears and no longer has to be overcome in Lean since change is taught and set up to take place continuously. In Lean, the time for improvement is always now and so is its timing.

One of the most striking testimony on the importance of time in Lean can be found in Liker and Ross (2017):

"*Toyoda had a very strict policy of not wasting people's time and felt that this was a case where the person was subservient to the machine when the machine should be serving the person. As Toyota president Eiji Toyoda later explained: "A person's life is an accumulation of time—just one hour is equivalent to a person's life. Employees provide their precious hours of life to the company, so we have to use it effectively; otherwise we are wasting their life*." *p. 226.*

We submit that this except also encapsulates the four leading cultural clusters identified by this study: operations, change, collectivity and humanity.

Another significant contribution of this work is to demonstrate how analysis of the content of Lean books, even though it predominantly is destined to practitioners, can fruitfully contribute to academic knowledge which in turn can be put to use back to practitioners.

Finally, it is also fascinating to recognize that referring back into 1988 Krafcik's words, the four leading Lean cultural clusters could have already be appreciated which further support their validity:

> *"The data presented here illustrates the power of an integrative (collectivity) approach to human resource management (collectivity and humanity), manufacturing strategy (operations) and the implementation (change) of new technology (operations)… It is clear, too, that Lean management policies have inherent risks (change) that must be managed with a great deal of discipline and skill (operations). From the experience of Japanese and Western producers, it appears that this risk can be largely neutralized by developing (change) a well-trained (operations), flexible (change) workforce (humanity and collectivity), product designs that are easy to build with high quality (operations) and a supportive (collectivity), high-performance (operations) supplier network (collectivity)." p 51.*

#### *3.4.4 Research implications*

This work shows how content analyses can be an effective research method in management. And although it seems yet under-utilized, especially in operations management, its flexibility, its scalability and its availability will likely attract more and more researcher to experiment with it. Content analysis is flexible in the nature of the allowable source data. They only appear to be limited by researchers' imagination. It is flexible by permitting to tailor its methodology to accommodate any analyses of a wide range of study questions. It is flexible on how it easily can be combined with other qualitative and quantitative research methods as it stands on the fringe of both approaches.

Content analysis become scalable with IT development and computer-aided text analysis (CATA). It is also readily available, in its simplest form, as word count is part of most word processor software programs. Multiple specialized CATA software programs exists with different capabilities for different purposes. Neuendorf (2017) discusses features of 18 of them in the latest edition of her book.

The other main implication for research of this study is the identification of four leading clusters that may help further research on Lean culture. Investigating organizational culture can easily become a daunting task as to simply determine where to most productively start. Everything and anything in an organization and its environment may indeed be viewed as an artefact with underlying associated symbolism, values, beliefs and assumptions that need interpretation. What Lean expert authors seem to be suggesting through the four identified leading clusters: operations, change, collectivity and humanity, is to start, for Lean, at the operational level or the gemba. This is actually what many instructions on Lean recommend (Bicheno, 2016; Imai, 2012; Graban, 2016). Then, examine how change, problem solving and improvement efforts happen at the gemba and throughout the organization to thereafter investigate how all organizational stakeholders organize themselves, are linked and work together. Efforts should also be directed to describe human relationships in the organization, how all stakeholders interact, communicate and support each other. The four leading cultural clusters do not imply there are no other important aspects of Lean culture to account but they suggest that these features are more likely to be the ones that are the most distinctive of Lean organizations.

### *3.4.5 Practical implications*

Until research provides greater understanding of Lean culture and how to adopt it, already a few practical implications, or take away messages, to healthcare and other domains leaders and managers are suggested by this study four leading cultural clusters: 1-operations, 2-change, 3-collectivity and 4-humanity.

1- ‘Operations’ take away: Lean is a pragmatic practical business method. Its culture instructs to address problems proactively swiftly; to apply PDCA (plan-do-check-act) with discipline; to focus on operations and results will follow.

2- ‘change’ take away: Lean and its culture encourages to not just be unafraid of change but to embrace it. Its practices provide means on how to consider change as opportunities to seize rather than crisis to manage. They also exemplify the common saying: slow and steady wins the race.

3- ‘collectivity’ take away: Lean culture stresses solidarity and togetherness. Whereas other common sayings tell all for one and one for all and chains are as strong as their weakest link, Lean success lies on all stakeholders playing their part and working together on continuous improvement of their organization.

4- Finally, ‘humanity’ take away: Lean is all about people. Lean culture seeks to strike the perfect balance between the requirements of the working life, social and personal life toward ever greater fulfillment and achievements collectively and individually.

If Lean transformation of healthcare or any other organizations is not easy, these pointers may prove to be helpful and inspiring to leaders and managers in their journey.

## 3.5 Limitations

This study contains several limitations that need to be acknowledged.

The first and main one regards its methodology. As pointed out in the introduction from Weber (1990), content analysis by single word frequency taken out of context may both over- and under-estimate construct effect. A situation for which no easy solution exists. However, since the purpose of the study was to unveil Lean’s main cultural clusters which necessarily requires broad data condensation, we believe validity of findings is not seriously threatened. Additionally, consistency of findings observed through the different sensitivity analyses and the general face validity of this study results increases our confidence.

A second limitation concerns the selection of source data. Although care was taken to include a large representative sample of respected Lean textbooks, there might be systematic yet unrecognized biases and blind spot in the content of these textbooks that

do not portray Lean in its entire nature. Repeating this study with others source data such as academic papers, commercial articles, interviews of other Lean experts who have not committed themselves in writing textbooks to triangulate our findings may increase generalizability.

A third limitation is linked also to source data selection. It is possible that direct observation of or immersive experience in organizations, particularly in the field of healthcare, are necessary to better elucidate and fully appreciate Lean culture features. The use of written documents, as official, convenient and reliable as they be, remains filtered account by their authors.

A fourth limitation is found in the specific framing of this study in a cultural paradigm. Approaching Lean from other organizational change perspective such as neo-institutional, configurational, political or behavioral among other (Demers, 2007) could enhance understanding of Lean from a cultural perspective by an interplay of similarities and differences. Nevertheless, when analyzing written documents, as they are proper artefacts, taking a cultural point of view appears coherent and legitimate.

A fifth limitation resides in the fact that many analyses could only be conducted by a single coder for academic reasons. Transparency of results at every step enable readers to appreciate and to verify by themselves accuracy of findings. Greater validity may and could have been achieved by a multiple coders research process.

## 3.6 Further research and development

In addition of conducting further research to solve issues just raised by this study limitations, seven other promising development paths that could be pursued are here presented:

1- from a methodological standpoint, it would be interesting to compare results of the same analysis performed by specialized software programs with emergent coding

capabilities such as CATPAT II, T-Lab pro and PolyAnalyst, which execute analyses according to proprietary and hidden algorithms.

2- results' refinement could be obtained from applying other CATA methodologies such as those described by Weber (1990): key-word-in-context (KWIC), concordance, co-occurrence and theme analysis of idioms and sentences and those described by Neuendorf (2017): psychometric content analysis, rhetorical analysis, discourse analysis, semiotic analysis or critical analysis among others to not only gain more knowledge on Lean but to decipher as well how authors' writing style may affect Lean understanding. This exercise could also aim to find out how authors' writing style changes over time and affect their conceptualization of Lean. This type of analysis may also clarify changes or evolution of words, formulae, and concepts among Lean authors and over time.

3- repeating these CATA on texts of other managerial methods and theories such as Six Sigma (Schroeder *et al.*, 2008), Total Quality Management (TQM) (Hackman and Wageman, 2005), Theory of constraints (TOC) (Goldratt and Cox, 2004), Business Process Re-engineering (BPR) (Hammer, 1990), sociotechnical systems theory (Trist and Bamforth, 1951; Emery and Trist, 1965; Emery, 1959; Trist *et al.,* 1963; Trist, 1978) would help to appreciate how much this study's results, particularly the four leading cultural clusters identified are Lean specific. It may also provide greater insights on how these approaches differ or could be complimentary.

4- as identified by the qualitative correlation analysis between the tentative Lean culture definition and the four cultural clusters, further investigations on Lean culture's symbols, values, beliefs and assumptions could be pursued in our textbook data set and potentially triangulated with other documentation sources using CATA and other qualitative analysis methods. This may eventually lead to characterization of Lean general and Lean healthcare culture at its ultimate state and allow formulation of an improved evidence-based definition of Lean culture. This ambitious work appears now to be facilitated with this study findings of four leading Lean cultural clusters.

5- once Lean healthcare culture in its ultimate state will have been characterized, validation work on Dorval and Jobin's contingent Lean culture adoption model (CLCA) could be enabled along the concomitant identification of Lean culture sources of cultural friction (chapter 2).

6- further investigation of the concept of time in Lean and how it is culturally similar or different than in TQM as proposed by Detert *et al.* (2000) and from one business sector to another, seems also warranted. This may prove to be a salient source of cultural friction between usual organizations and Lean organizations. To give a factual healthcare example, if Lean calls for elimination of all wait times, some of them may actually be value adding such as rest time, recovery time or reflection time. Determining how much and how many of those times patients and even healthcare professionals may need for optimal outcomes is challenging and perhaps culturally based.

7- Finally, further inquiries on the similarities and differences of Lean and best practices in the discipline of supply chain management, strategy, innovation, marketing and/or performance management to generate cross-learnings is likely to be insightful.

## 3.7 Conclusion

This work presents a first application of content analysis in Operations Management, in Lean and in Lean healthcare and describes an original methodology. Results are suggesting four leading Lean culture clusters: operations, change, collectivity and humanity. These findings may stimulate more productive research on Lean and its culture. They may also inspire leaders, managers and other stakeholders in their Lean organizational transformation journey to pay greater attention on operations, on how organizational change unfolds, on how organizational units work together in collectivity and on how human nature matters in this quest. This study also identifies the importance of time as a salient and under-appreciated focus in Lean culture that warrants further inquiries.

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# Conclusion

This conclusion highlights and synthetizes findings and contributions made by these three pieces of work with their limitations and includes a plan of future research and development.

The extensive comprehensive systematic literature review of chapter 1 provides evidence on worldwide growing general interests about Lean culture, especially in healthcare. The concept of Lean culture was found though to be mainly treated superficially by most authors and the review did not yield any very helpful framework to firmly base further studies on Lean culture which was one of the purposes of the review. High degree of pragmatic ambiguity about our collective understanding of Lean culture was demonstrated from various standpoints: 1- in its nature, as an aim rather than a pre-requisite, a mean or an outcome; 2- in its main bearer, predominantly leaders but also assigned to managers and personnel; 3- in inconsistency of findings from analysis by reputed organizational culture conceptualizations such as Schein's organizational culture model, Hofstede and Globe study cultural dimensions and Cameron and Quinn's Competing Value Framework and 4- in five amplifiers: the notion of cultural gap, issues of leadership, human resource management, sustainability and innovation. The review enabled proposition of two original meaningful evidence-based definitions of first, organizational culture and second, Lean culture. The work also illustrates the challenges that represent performance of a cumulative systematic literature review. The point that even with great efforts in thoroughness and rigor, such a review cannot ever claim to be complete is stressed. Findings may nevertheless be informative, valuable and pertinent.

Chapter 2's initial sparking insight was to relate commonly reported Lean descriptors of tools, principles and philosophy to Schein's organizational model of artefacts, values and assumptions which supports well the claim to consider Lean as a cultural proposition. Then, by using rippling and bridging conceptualization strategies, a contingent Lean culture adoption (CLCA) conceptual description model could be built based on three classic organizational change theories: evolutionary, contingency and configurational theories and six various conceptual models discretionarily selected: 1- Hatch`s cultural

dynamics model; 2- Meyerson and Martin`s cultural change paradigm triad; 3- Trice and Beyer`s cultural leadership and forms; 4- Orlikowski`s situated change perspective; 5- Ghemawat`s CAGE framework; and 6- Shenkar *et al.*'s construct of cultural friction. The CLCA model proposes five theoretical trajectories healthcare organizations may experience during their Lean transformation. The model suggests the existence of a Lean culture ultimate mastership archetype from which cultural frictions are generated when current culture of a healthcare organization is confronted to it. The CLCA model has promising features discussed in chapter 2 that could eventually lead to development of a Lean culture framework and possibly even to a cultural friction theory but much further validation and conceptualization works would need to be done.

As a first step in this regard and toward a goal to define and describe Lean healthcare culture in its ultimate mastership form, an exploratory computer-aided text analysis (CATA) of over 2.5 million words from 33 Lean generic and Lean healthcare reference books was undertaken. It revealed four emergent leading cultural clusters – operations, change, collectivity and humanity and highlighted the importance of the different definitions of time in Lean. Ties between Lean and the classic sociotechnical systems theory become clearer and better supported by these four cultural clusters. A working Lean healthcare culture definition could then be built by merging knowledge gained in chapter 1. A major contribution of this work is to demonstrate the utility of content analysis in generating academic knowledge from mainly practitioner-oriented literature even by using a fairly basic method.

Several methodological contributions are made in this work. In chapter 1, beyond a demonstration that content of a systematic literature review always represents a sample of all potential documents that could be included in a review, it shows that one of the first challenges in the conduct of a review is to select the most representative sample to answer the study question. Choosing the right keywords to use in the electronic search engine are crucial and it was shown that use or not of brakets has an impact on the listings of documents retrieved. The fact that similar results were obtained in the two samples analyzed in chapter 1 adds confidence in its findings. The power of current search engines is impressive and undeniable. They give access to a wealth of information from the entire

world in matters of seconds. Yet performance of a cumulative review is still yet a cumbersome, labor intensive and time-consuming activity which is likely to become easier in the future with new software development, greater interconnectivity and artificial intelligence (see appendix 4.1). An ideal tool would merge listings of various selected search engines and provide statistics on errors, repetitive entries and other inconsistent findings. To facilitate this, a call for standardization of information provided by academic search engine could be made. We were fortunate enough to have the support of an excellent team of librarians for documents retrieval but it remains a laborious task. This process could be probably be facilitated by greater networking between libraries and other document repositories. Futur development in artificial intelligence may enable conduct of systematic review much easier: after setting initial parameters, much of the tedious work could be automated with more reliable accounts and reproductibility. Analysis of content could also be performed more readily and faster. It would also be more realistic to perform sensitivity analysis of findings in performing analysis on extreme sample and key study parameters. A methodological learning made in chapter 2 was to recall and apply Meredith (1993)'s and Reisman (1988)'s typologies of conceptual modelization. The whole exercise actually exposes the merits of pluri- and interdisciplinarity where new knowledge is built from previous knowledge from within and among different disciplines. Utility of content analysis, particularly when assisted by computer, is illustrated in chapter 3. In similarity to chapter 1, there appear to be opportunities for artificial intelligence development to facilitate conduct of such analysis faster and in even larger scale. Benefits of methodological pluri- and interdisciplinarity are also exemplified in chapter 3 in which combination of various techniques enhanced depth, scope, validity and reliability of findings.

From an academic perspective, main contributions of chapter 1 may be resumed by a clear demonstration of growing international appeal in the study of Lean culture although still at a stage of high pragmatic ambiguity. The five identified amplifiers (cultural gap, leadership, human resources, sustainability and innovation) provide a spectrum of interesting future research and development cues. The evidence-based definitions of organizational culture and Lean culture may also help future studies on the topic by providing an initial frame of reference. Important insights made in chapter 2 include

demonstration of Lean as being a cultural proposition, framing conceptually organizational culture into four situated elements: artefacts, symbols, values and assumptions at three levels of interpretation: integrated, differentiated and granular as proposed by Hatch (1993, 2011), Meyerson and Martin (1987) and Orlikowski (1996) and development of the concept of trajectories, cultural frictions and Lean culture ultimate mastership. It remains to be demonstrated how useful and practical these notions will be to increase knowledge on Lean by the validation process. In the case of chapter 3, identification of operations, change, collectivity and humanity as Lean's leading cultural clusters and of time as a particularly important concept in Lean may help further investigational work of Lean to be more productive. Ties found between Lean and sociotechnical systems theory, which were developed during the same time period but in different academic fields suggest there is greater universal theory at play that is yet to be described.

Although all this work is essentially based on secondary knowledge and not primary empirical data, practical implications can nevertheless be stated. By being made more aware about the notion of pragmatic ambiguity, its advantages and risks and the different current interpretations of Lean culture from chapter 1, practitioners may more easily accept to live with the current level of uncertainty while probably having more productive negociations when discussing Lean issues with more or less experienced stakeholders. More importantly, practioners may be enabled to ask better questions and demand clearer answers to more experienced Lean colleagues or academia. From chapter 2, practioners may better understand Lean as being a strategical risk with high rewards but undeniable stakes. Practioners could also help to identify cultural friction points, drag parameters and their lubricants from their experience. But perhaps the greatest chapter 2's lesson for managerial practitioners would be to learn to better appreciate, trust, respect and support the talents of everyone around them, in particular front-line employees, in their collective efforts of continuous organizational improvements. Chapter 3 provides re-assurance to practitioners that Lean is a pragmatic business method focused on operations. It invites managers to view change more as an opportunity than a threat and encourage slow and steady improvements to win the race. Linking back to a point made in the introduction, Lean represents a change as it is not a natural organizational culture. Reasons for this may

be found by transposing knowledge from the field of physics into management. Physics has long observed that nature favor disorder over order. This provides explanations why when a glass is dropped, it shatters all over the floor rather than become a bigger container, why houses of cards do not spontaneously create themselves and why heat always travels toward cold. Entropy, a measure of randomness, from the second law of thermodynamics, is noted to always increase when two systems (and by extension in management, organizations and their culture) interact with each other. Once mixed, these systems cannot easily be returned back to their initial state either much like when milk blends in coffee unless much energy is spent and special tools and techniques are employed (Starzak, 2010). Lean challenges organizations to reduce their entropy and to become more orderly by removing wasteful practices and improving their operations with persistence, skills and discipline using Lean tools and techniques. A process that is indeed demanding and unnatural. No wonder then why Lean is so hard to implement. Considering the first law of thermodynamics which states the condition of conservation of energy, or that in all, nothing is created and nothing wasted, it can be speculated that it is by recycling and re-investing the energy gained by reducing its organizational entropy that Lean may become sustainable. Academic and practical implications of this fascinating analogy go beyond the scope of this work but may represent a fruitful field of further investigations.

Another practical lessons of chapter 3 for practioners is found in the reminder of the popular saying: a chain is as strong as its weakest link in stressing the fundamental importance in Lean and organizational success of solidarity and collaboration by the two cultural clusters – collectivity and humanity. Lean as in all organizations, particularly for healthcare and services, lives and dies by its people. In its adoption and in its ultimate cultural mastership state, Lean is a rich and intense experience.

Future development plan for this work involves detailed description of Lean healthcare culture in its ultimate state and eventually a proper evidence-based definition of Lean healthcare culture from further analysis of chapter 3 data. Then, validation of the CLCA model with identification of all relevant cultural friction points and their lubricants from empirical data could be performed. This validation could lead to identification of conditions to predict trajectories of healthcare organizations and to provide remedies if

another trajectory would be desired. The CLCA model would then become a proper framework which could then be possibly develop into a theory by meeting Dubin's criteria (Meredith, 1993) and Wacker's criteria (1998). This work will likely be done initially in healthcare by virtue of vertical exploration but it would gain more value, strength and generalizability if similar findings were to be made in other service and manufactural domains through horizontal exploration. Further horizontal exploration could be also be performed in comparing the cultural perspective with other organizational change perspective, in using other investigational methods such as content analysis of academic literature or meta-analysis of Lean assessment tools (see appendix 4.2), in further studying Lean in light to other business formula such as Total Quality Management or the Theory of constraints and of course further explore Lean's ties with sociotechnical systems theory and laws of thermodynamics.

The main limitation of chapter 1's findings resides in the fact that the literature review was strictly focused on two keywords: Lean culture, with or without brackets. Considering its current state, now documented, of pragmatic ambiguity, important insights may have been missed by not including related concepts such as Lean thinking, Lean philosophy or Toyota culture, kaizen culture, continuous improvement culture, for example in the search. This work would help to clarify nuances between these concepts but would likely represent a herculean task to be tackled by multiple investigators. Chapter 2's main limitation of course is its lack of proper empirical validation. But since its inspirational sources are anchored on practical experience, it nevertheless appears to retain much face validity. The strongest limitation of chapter 3 is found in its principal methodology and the over-/under estimated construct effect of single word frequency taken out of context content analysis. Findings conserve their validity through the extensive cross-validation process used and the multiple additional analytical analysis employed.

In conclusion, from an initial intention to explore the notion of healthcare organization Lean trajectories seven years ago, the notion of cultural friction was developed and four leading Lean cultural clusters were identified. Compelling ties between Lean and sociotechnical systems theory and Lean with the laws of thermodynamics (entropy and conservation of energy) were discerned and would likely be worth exploring further in

future research. An evidence-based definition of organizational culture enabled proposals of two working definition of Lean culture and Lean healthcare culture and further expected near future work will likely present the utility and validity of the postulated concept of Lean healthcare culture in ultimate mastership state. This work provides proof in the worth of pluri- /inter-disciplinarity and polyvalence in academic work and will hopefully stimulate greater collaboration and knowledge sharing between disciplines: operations management, healthcare, engineering, and so many others for the benefits and improvements of all organizations but ultimately, more specifically, of care of patients.

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# Appendices

Chapter 1

1.1 IJPPM eprint March 6th, 2019; https://doi.org/10.1108/IJPPM-03-2018-0087.

1.2 Supplemental Table 5a Extent and range elements of Lean culture ambiguity

1.3 Supplemental Table 5b Extent and range elements of Lean culture ambiguity

1.4 Supplemental Table 7a Range of Lean culture ambiguity (manufacturing vs service sectors)

1.5 Supplemental Table 7b Range of Lean culture ambiguity (manufacturing vs service sectors)

1.6 Source documents reference list– Lean culture systematic review

Chapter 2

2.1 IJQSS proof version as submitted 27-01-19

Chapter 3

3.1 IJPPM proof version as submitted 03-02-19

3.2 Supplemental Figures 1 – Pareto histogram (potential key words)

3.3 Supplemental table 1: Extra “stop and go” words list removed

3.4 Supplemental Table 2: Theme word content list of top relevant keywords

3.5 Supplemental Tables 3: Candidate relevant keywords (adjusted ordering by books)

3.6 Supplemental Table 4: Top relevant keywords selection process

3.7 Supplemental Table 5: Definition of TIME

Conclusion

4.1 Short report on artificial intelligence (AI) and content analysis

4.2 Lean assessment tools and Lean cultural clusters analysis

# Lean culture: a comprehensive systematic literature review

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## Abstract

**Purpose** – The purpose of this paper is to assess the level of pragmatic ambiguity (PA) lean culture has currently in the manufacturing and service literature.
**Design/methodology/approach** – A comprehensive systematic review of academic (journals, books and theses) and commercial literature was undertaken drawn from a six databases search of two keywords ("lean" and "culture") and related citations.
**Findings** – A total sample of 1,066 references (678 academic papers, 121 books, 103 theses and 164 commercial documents) were analyzed. The authors found contributions from 67 countries but oddly, only two came from Japan. In total, 89 percent of citations were directly about lean culture. However, for 86 percent of them, lean culture was only discussed superficially. All four literature segments show an over 85 percent agreement on lean culture being an organizational aim. The authors encountered 103 definitions of organizational culture and found 13 definitions of lean culture. Issues of culture gap, leadership, human resource management, sustainability and innovation are found to amplify lean culture's already high PA level.
**Research limitations/implications** – Further research and development are needed to decrease lean culture's PA level and improve understanding of lean from a cultural perspective.
**Practical implications** – Current lean culture's high PA level has positive and negative effects on lean implementation. Taking lean implementation from a cultural perspective may facilitate an organization's lean transformation journey.
**Originality/value** – This is the first systematic literature review on lean culture using a broad and inductive approach. An original evidence-based definition of organizational culture is proposed.

**Keywords** Review, Manufacturing, Culture, Service, Lean

**Paper type** Literature review

## 1. Introduction

With the ebbing of the total quality management (TQM) movement and the seminal publication of Womack *et al.*'s "The Machine that changed the world," lean has become one of the prominent contemporary performance enhancing business proposition for both manufacturing and service organizations (Gupta *et al.*, 2016; Hines *et al.*, 2004). Portrayed as a salutary solution by its numerous advocates, it is also described as a waning fad by perhaps as many detractors in the academic and practitioner world of all fields (Atkinson and Nicholls, 2013; Newman and Chaharbaghi, 1998; Seddon, 2011; Womack and Jones, 1996/2003). As controversial as TQM once was, lean finds its origins in the same principles and operation management master pioneers teachings of Shewhart, Deming, Juran and others (Bicheno and Holweg, 2009). But it took the ingenuity, the hard work and peculiar contextual circumstances of the Toyota car company to demonstrate the power of lean on operational effectiveness and lead the way (Liker, 2004). Lean instructs organizations to continuously improve all of their operation elements by relentlessly

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creating value and removing non-value added or waste activities from the stance of the ultimate end-customer through initiatives of an entire body of trained motivated personnel (Mann, 2015; Rother, 2010; Womack *et al.*, 1990). It is often labeled as a "common sense" approach that is very attractive and appears deceptively simple to master (Holweg, 2007; Radnor *et al.*, 2012).

Lean remains, however, notoriously difficult to implement with a reported adoption failure rate as high as 90 percent (Bhasin, 2012). Even though it has been more than 40 years since Sugimori *et al.* (1977) published the first English account on Toyota Production System (TPS), Toyota's foundational actualization and prime inspiration of lean, managers and scholars are still struggling to crack open its code and replicate similar success as Toyota. Amongst all reported possible factors of this enigma, culture has been repeatedly evoked to be as much an explanation, a cause and a key solution (Amhad, 2013; Bortolotti *et al.*, 2015; Wong, 2007). But which culture though?

Culture in management can indeed take several meanings. In their review, "The many faces of culture: making sense of 30 years of research on culture in organizations studies," Giorgi *et al.* (2015) present a framework in which, according to them, culture in management has been approached into five interrelated ways: as values, as stories, as frames, as toolkits and as categories. National culture, one of the earliest and longstanding hypotheses to explain lean's successful development in Japan (Schonberger, 2007) falls into their first form, culture as values. However, national culture is less and less considered to be the issue in lean. Although it took decades to demonstrate, lean has now been convincingly shown not to be exclusively "Japanese" as evidenced by the positive experience of the American Nummi (New United Motor Manufacturing, Inc.) project, the success of many other international lean organizations in all domains and the simple fact that not all organizations in Japan are lean (Krafcik, 1988; Kull *et al.*, 2014; Netland *et al.*, 2012).

In their paper, "Culture change: an integration of three different views," Meyerson and Martin (1987) further highlight that the analysis of culture in management needs to be interpreted in accordance to three paradigms: an integrative one, which acknowledges the existence of organization-wide culture; a differentiative one, which recognizes that, within any organization, there are sub-cultures that co-exist; and an ambiguous one, which stresses the fact that individuals in organization bring their own cultural contributions which are continuously influenced by other cultures outside the organization and are to be addressed appropriately by management for optimal organizational performance.

Determining what kind of culture (individual, team, organizational and communal) or whose culture (leaders, managers, employees, suppliers and customers) are more important in lean or which features of culture are relevant for lean success or, in fact, finding out what is exactly a lean culture does not come by easily with a rapid search of the manufacturing or service literature. The notion of lean culture appears to be rather used freely by all for all. Lean culture seems indeed to be in a state of convenient pragmatic ambiguity (PA).

PA is a construct developed by Giroux which she defines as: "the condition of admitting more than one course of action" in her analysis of the TQM movement and management fashions (Giroux, 2006). PA allows the co-existence of multiple, even possibly diametrically opposite, interpretations of the same concept leading to many different applications. It creates a situation in which concepts such as lean and its culture find sufficient recognition to exist but may be used in many different ways to support any argument liberally. When there is PA, everyone has sort of an idea of what the actual concepts are and mean. Everyone kind of agrees of what they are not or ultimately agrees to disagree but the concepts survive and may even thrive for a while. However, a condition of PA can only last for so long before flaws and inconsistencies are exposed, confusion sets and interest wanes. As TQM's faith demonstrates, what may have been in the limelight for a while is at risk of vanishing away unless the concepts are clarified and properly characterized.

For this purpose, systematic literature reviews can be very useful and effective. Templier and Paré (2015) have identified four different types of systematic literature reviews: the narrative, the developmental, the cumulative and the aggregative types. Each one has strengths and challenges which direct selecting the proper type to use. As brief examples, a narrative review aims to strictly summarize knowledge in a topic but does not include novel propositions or theory validation; a developmental review uses a selection of leading documents for the construction of new conceptual framework and theories; a cumulative review compiles evidence methodically to identify patterns and generate new knowledge, whereas aggregative review pools knowledge of similar documents for the performance of evidence-based meta-analyses.

This work intends to assess the level of PA lean culture currently has in the literature and describes its source, its range and its scope through a comprehensive systematic review of Templier and Paré's cumulative type. A discussion is provided highlighting the positive and negative implications of lean culture's current PA level and the paper concludes with its limitations and suggestions for further research and development on lean culture.



## 2. Methods

This systematic literature review emulates, adapts and extends methodology of other recent literature reviews on lean services (Gupta *et al.*, 2016), Lean Healthcare (Costa and Filho, 2016; D'Andreamatteo *et al.*, 2015) and Lean Six Sigma in manufacturing (Albliwi *et al.*, 2015). Findings of the latest one on lean research by Danese *et al.* (2017) are considered in the discussion. This review respects the three generic stages (planning, conducting and reporting) recommended by Tranfield *et al.* (2003) for systematic literature reviews and methods of the cumulative type as described by Templier and Paré (2015). Because the purpose of the study was to investigate the extent of lean culture PA which revealed itself during the conduct of the study, we purposely did not pre-determine a data collection plan and proceeded and coded information iteratively. A first literature search was performed October 30 and 31, 2016 on six electronic databases (ABI/inform (Proquest), Business Source Complete (EBSCO), Sage Journals, Science Direct (Elsevier), Web of Science (Reuters) and Google Scholar) in triplicate to confirm stability of listings, using simply two keywords: "lean" and "culture" to maximize findings without brackets and without a time frame limit. Six month later, April 30, 2017, a second literature search was then done with the same two keywords "lean culture" with brackets in all same six electronic databases in triplicate to enhance this work's comprehensiveness and validity. When permitted, filters were applied to restrict listing regarding management, which allowed avoidance of irrelevant entries relating, for examples, to basic and clinical research on obesity. Then, citation abstracts were screened for relevance to the purpose of investigating the lean culture concept in the literature. To maximize inclusiveness, we did not rate or restrict documents based on their quality but reviews, editorials, commentaries and abstracts were discarded. Figure 1 provides a records selection flowchart. Interestingly, although there was a certain amount of cross-detection between databases (12 percent or $n = 127$), no record was unanimously cited by all of them. ABI/inform (Proquest) and Business Source Complete (EBSCO) had the most similar search (48 shared citations or about 40 percent) in the first search (31-10-16). There were very few shared records in the second search (30-04-17) (6 percent or $n = 37$). Search in Business Source Complete (EBSCO) had the most repeat within its own listing citations followed by Google Scholar. Google Scholar had the highest number of erroneous citations. After eliminating these repeats and errors, citations from personal website or of promotional nature were discarded as they carry the heaviest bias load and have little or no review process for diffusion. Citations in foreign languages other the English or French were not considered. Note that only one record in French ended up in the review. As scientific knowledge is traditionally built incrementally, we took advantage

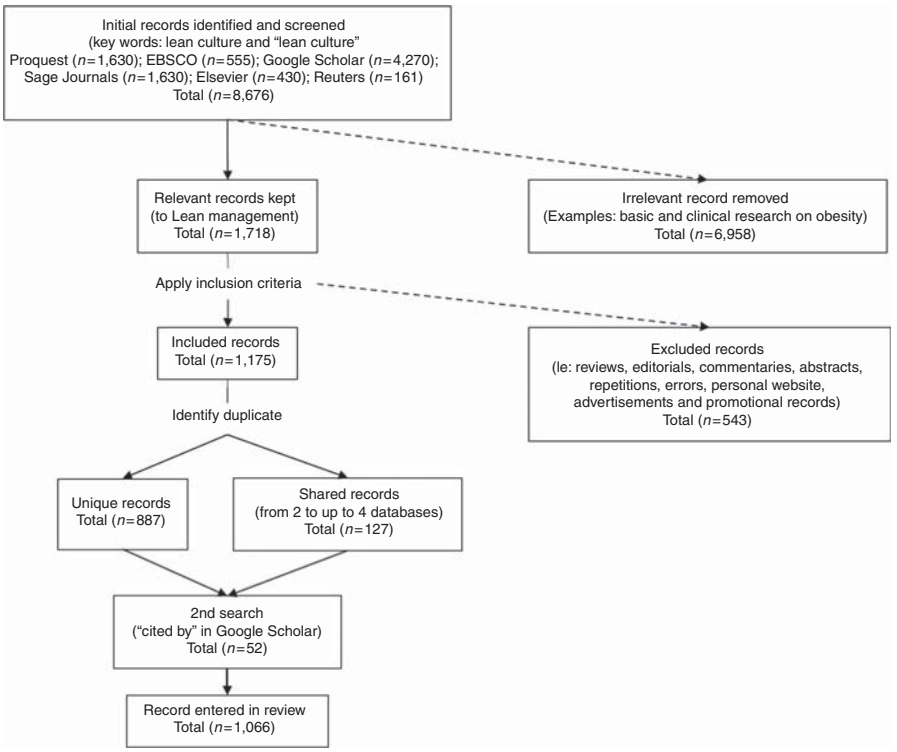


**Figure 1.**
Selection process of records

of the contemporary "cited by" feature enabled in Google Scholar to research all found citations for additional references. Many recurrent citations were encountered but 52 new entries were identified by this scheme (for more details, contact corresponding author). Retrieval of documents took 16 weeks (2 periods of 8 weeks) with a success rate of 98 percent (24 missing). Baseline information of each document (authors' name; country of first author; nature, methods and base industry of the document; publication title, subject and year; and publisher) was collected in an Excel spreadsheet and validated by a research assistant (agreement $>$ 95 percent). Discordances were settled by discussion and senior author decision. Then lean culture information was extracted from each document and processed in additional Excel spreadsheets. Coding was conducted by making as little inference as possible. Definitions to be considered had to be explicitly stated as well as any feature of lean culture; hence, records were determined superficial if lean culture was basically mentioned without any other precision or along with use of a plain synonym such as culture of continuous improvement (the most common). Substantial records include some form of construct development: either by details on organizational culture or on definition or description of lean and/or of lean culture. For the aim to indicate greater support in our results, when appropriate, statistical analyses ($\chi^2$ tests) were performed with Excel software v 16.0.9001.2080. Threshold for significance is set at standard $p < 0.05$.

## 3. Findings

### *3.1 Source documents of lean culture pragmatic ambiguity assessment*

This systematic literature review covers the content of a total sample of 1,066 documents including 678 academic journal papers, 121 books, 103 theses and 164 commercial

literature articles. No previous systematic review on lean culture was found in our search. Source documents of lean culture PA assessment's analysis cover information about countries of origin, authorship and timeline, publishers, fields of study, documents' method, academic contribution and by its extent.

The notion of lean culture is found to have a wide international appeal with contributions from 67 countries. The six most productive countries, as determined by affiliation of the first author, were: the USA ($n = 413$, 39 percent), the UK ($n = 129$, 12 percent), Sweden ($n = 52$, 5 percent), Malaysia ($n = 38$, 4 percent), Canada ($n = 33$, 3 percent) and India ($n = 30$, 3 percent). This finding that sourcing from the USA and UK represents greater than 50 percent of references is consistent among all recent systematic reviews (Danese *et al.*, 2017; Costa and Filho, 2016; Gupta *et al.*, 2016). By continent, 448 lean culture documents were hence from North America, 388 from Europe, 154 from Asia, 33 from Africa, 27 from South America and 16 from Australia. Remarkably, only two Japanese articles addressing lean accounting were found. They essentially though simply referred to the notion of lean culture without any development. Sparsity of Japanese communication on lean has been previously noted by Guimaraes and de Carvalho (2012) who did not find any publications from Japan in their Lean Healthcare literature review. This is also observed in the other three recent aforementioned systematic reviews. Japan's silence over lean is puzzling. Any explanation at this point would be speculative and requires further investigation, which is more likely to come from Europe as overall, this review findings suggest that European authors contribute to lean culture literature with more scientific contents than North American's, who write more books and commercial literature ($p < 0.0001$) (for more details, contact corresponding author).

With ten contributions, S. Bhasin is the most prolific author on the topic. However, seven of his papers are essentially re-analysis of the same data collection involving a detailed survey questionnaire of 68 UK manufacturing organizations followed by a comprehensive audit of a subset of 20 of these organizations. We also identified late in the analysis four academic articles published twice, word for word, in two distinct journals under different titles. These are two examples of the risk of conducting systematic reviews on discovering anomalies in the literature. In total, 63 percent entries had more than one author (670/1,066), suggesting greater validity through collaborative work. The earliest entry found in our review was published in 1991. In total, 61 percent (655/1,066) have been published in the last five years with a peak in 2015 ($n = 147$, 14 percent) (Figure 2).

Over the years, lean culture has caught the interest of 418 different publishers: the most important being the Emerald Group Publishing (106/1,066; 10 percent), closely followed by Taylor and Francis Group (82/1,066; 8 percent) and then Elsevier (71/1,066; 7 percent). This finding is very similar to Gupta *et al.* (2016) review. With 18 entries, *International*

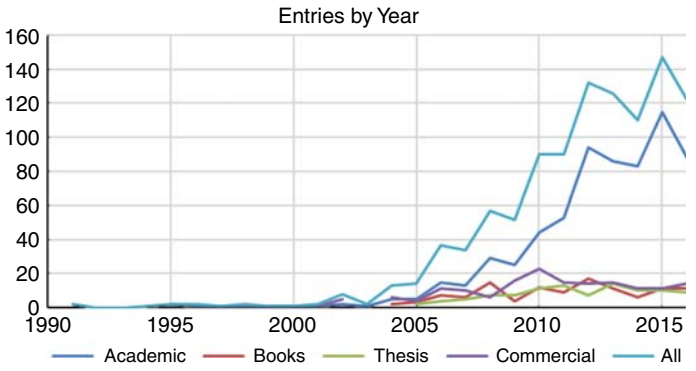


**Figure 2.**
Lean culture entries by year of publication

*Journal of Lean Six Sigma* is the main journal on the topic, followed by *Journal of Manufacturing Technology Management* ($n = 12$), *International Journal of Productivity and Performance* ($n = 12$), *International Journal of Production Research* ($n = 10$) and *International Journal of Operations & Production Management* ($n = 10$). In total, 16 records were from Proceedings of IIE Annual Conference (IISE) (Institute of Industrial and Systems Engineers). Overall, management publications (67 percent) predominate engineering (33 percent) one.

The majority of entries were clearly from the manufacturing world (598/1,066; 56 percent), 31 percent (330/1,066) came from the service domain and the remaining 138 (13 percent) were general. Authors were inspired from experiences from over 70 different industrial fields. Most of the documents reported on multiple fields. It is remarkable that Healthcare, a service, is the highest single field interest on lean culture (186/304; 61 percent) far ahead the next second one, and construction (86/321; 27 percent), which is surprisingly outnumbering motor vehicle (85/321; 26 percent), both from the manufacturing sector. Despite the large coverage, several important industries such as retail, legal, entertainment or tourism are missing (for more details, contact corresponding author).

Note that out of 103 theses retrieved in this literature search, 22 were at PhD level. Content of the other 81 has been thereafter excluded since the main purpose of baccalaureate and master degree's thesis is to demonstrate capability and conceptual understanding and not particularly to contribute to the literature. Moreover, thesis's gradings are not provided. Hence, a total of 985 documents were ultimately considered for further analysis.

In terms of methods, there is almost an even split with a predominance for qualitative analysis: single case (221/985; 22 percent) and multi-case (150/985; 15 percent), whereas quantitative analysis accounted for 21 percent (204/985); conceptual nature/modelization for 15 percent (148/985) and literature review for 7 percent (67/985). Ultimately, the remaining documents were based on expert opinion (195/985; 20 percent) (for more details, contact corresponding author).

In these records, 89 percent (879/985) of documents concerned directly lean culture, whereas the remaining 11 percent covered the topic indirectly either by discussing techniques related to lean such as Six Sigma, Lean Six Sigma, TQM or by making general comments about culture and organizational change not specifically associated to lean. Most of the former addressed the issue of lean culture superficially (753/879; 86 percent) and only 14 percent (126/879) treated the subject with some substance either by providing definitions or any depth in their discussion (for more details, contact corresponding author). A prime example can be found in David Mann's book, *Creating a Lean Culture*. It does not contain a lean culture definition but suggests a workplace culture definition such as "the way we do things here" and it explains: "As lean management, with its closed-loop focus on process, becomes habitual, little by little – almost unnoticeably at first – a Lean culture begins to grow. The new Lean culture emerges as leaders replace the mindset to work around problems today […]."

### *3.2 Range of lean culture pragmatic ambiguity*

Our findings indicate the range of lean culture PA to be demonstrated in terms of nature and bearer of lean culture, publication bias, manufacturing vs service lean culture treatment, quantitative method survey instruments, competing value framework (CVF) vs lean culture and deeper exploration. Table I provide an overview of the range of PA found in the 879 direct lean culture records.

For the large majority (786/879; 89 percent), lean culture was presented as: first, an organizational aim, a status to aspire, as opposed to, second, a pre-requisite or a condition precedent to lean (19/879; 2 percent); third, a mean or a tool used to master lean (57/879; 6 percent); fourth, an outcome (17/879; 2 percent), i.e. a by-product of lean. The role and responsibility of primary lean culture bearer was allocated to the organization leaders

| | Academic | Books | Theses (PhD) | Commercial | Total |
|---|---|---|---|---|---|
| *By culture nature* | | | | | |
| Pre-requisite | 16 (3%\84%) | 1 (1%\5%) | 0 | 2 (1%\11%) | 19 (2%\) |
| Mean | 47 (8%\82%) | 3 (3%/5%) | 2 (10%\4%) | 5 (3%\9%) | 57 (6%\) |
| Aim | 525 (88%\67%) | 102 (94%\13%) | 18 (90%\2%) | 141(93%\18%) | 786 (89%\) |
| Outcome | 12 (2%\ 71%) | 2 (2%\12%) | 0 | 3 (2%\18%) | 17 (2%\) |
| Total | 600 ( \68%) | 108 ( \12%) | 20 ( \2%) | 151 ( \17%) | 879 |
| *By main bearer* | | | | | |
| Leaders | 156 (26%\64%) | 36 (33%\15%) | 9 (45%\4%) | 43 (28%\18%) | 244 (28%\) |
| Managers | 30 (5%\65%) | 4 (4%\9%) | 0 | 12 (8%\26%) | 46 (5%\) |
| Personnel | 19 (3%\59%) | 4 (4%\13%) | 1 (5%\3%) | 8 (5%\25%) | 32 (4%\) |
| Other | 6 (1%\60%) | 1 (1%\10%) | 1 (5%\10%) | 2 (1%\10%) | 10 (1%\) |
| Not specified | 389 (65%\71%) | 63 (58%\12%) | 9 (45%\2%) | 86 (57%\16%) | 547 (62%\) |
| Total | 600 (\68%) | 108 (\12%) | 20 (\2%) | 151 (\17%) | 879 |

**Table I.**
Range of pragmatic ambiguity



(CEO or upper management team) in 244 articles (28 percent) as opposed to middle managers (46/879; 5 percent) or front-line personnel (32/879; 4 percent). Other includes all and government (10/879; 1 percent). For 547 (62 percent), no one in particular was mentioned to be responsible for upholding lean culture.

The relative similar distribution of all these proportions amongst each literature segment (academic, books, thesis and commercial) suggests that these findings legitimately represent the current lean culture situation. It supports their validity and the quality and relevance of this literature search.

There is, however, suggestion of probable publication bias in the review sample records since most authors but three documents state positive aspects of lean culture for organizations. We found the earliest dissenter in Newman and Chaharbaghi (1998). In their paper "The corporate cultural myth," they stand strongly against any use for the notion of organizational culture. Their virulent argumentation even compares culture to a cancer that may destroy defenseless organizations despite the fact that they paradoxically define culture as "the by-product of a technology that has been developed in exploiting an opportunity." The second negative view on the concept of lean culture comes from Bicheno and Holweg (2009). In their book *The Lean ToolBox*, they share (Peter) Scholtes' skepticism about culture and claim that it is a greatly misused word and a too easy fallback excuse for lean's failure. Finally, the third and last counter argument against lean culture we found resides in Seddon (2011). For him, lean and its culture can only be a fad since it essentially only "solves problems managers think they have" and "is as far as from (Taiichi) Ohno's philosophy as it is possible to get." He, however, does not provide much more explanation to support his position.

Our analysis reveals several statistically significant differences between contributions from the manufacturing and the service sectors. Manufacturing lean culture literature (61 percent or $n = 414/678$) appears to be of more scientific content than for service's (28 percent or $n = 191/678$) with a greater relative number of academic papers and lesser proportion of books and commercial articles (20 percent or $n = 106/530$) than service and general domains (38 percent or $n = 124/325$; and 42 percent or $n = 55/130$, respectively ). General domains authors tend to write more books (32 percent or $n = 41/130$) compared to those in manufacturing (8 percent or $n = 43/530$) and service activities (11 percent or $n = 37/325$) ($p < 0.0001$) (for more details, contact corresponding author).

From Table II, service and general sectors seem to have less direct lean content predominance than manufacturing, which suggests more exploration on other forms of business performance improvement model such as Six Sigma. Authors from the general domain seem to discuss lean culture more substantially. There is no difference

| | Manufacturing | Service | General | Total |
|---|---|---|---|---|
| *By point* | | | | |
| Direct | 510 (94%\58%) | 262 (85%\30%) | 107 (82%/12%) | 879 (89%\) |
| Indirect | 34 (6%\32%) | 48 (15%\45%) | 24 (18%/23%) | 106 (11%\) |
| Total | 544 ( \55%) | 310 ( \31%) | 131 ( \13%) | 985 |
| *By coverage* | | | | |
| Superficial | 447 (88%\59%) | 231 (88%\31%) | 75 (70%\10%) | 753 (86%\) |
| Substantial | 63 (12%\50%) | 31 (12%\25%) | 32 (30%\26%) | 126 (14%\) |
| Total | 510 (\58%) | 262 (\30%) | 107 (\12%) | 879 |
| *By culture nature* | | | | |
| Aim | 449 (88%\57%) | 240 (92%\31%) | 97 (91%\12%) | 786 (89%\) |
| Other | 61 (12%\66%) | 22 (8%\24%) | 10 (9%\11%) | 93 (11%\) |
| Total | 510 (\58%) | 262 (\30%) | 107 (\12%) | 879 |
| *By main bearer* | | | | |
| Leaders | 111 (67%\47%) | 92 (77%\39%) | 35 (81%\15%) | 238 (73%\) |
| Other | 54 (33%\61%) | 27 (23%\30%) | 8 (19%\9%) | 89 (27%\) |
| Total | 165 (\50%) | 119 (\36%) | 43 (\13%) | 327 |

**Table II.**
Range of lean culture ambiguity (manufacturing vs service sectors)

among manufacturing, service and general documents in regard to their vision of lean culture which is seen by over 89 percent to be an organizational aim as opposed to a pre-requisite, a mean or an outcome ($p = 0.28$ ns). All segments (manufacturing, service and general) put leaders as the main bearer of lean culture in concordance with all growing evidence supporting the crucial impact of leadership on lean mastership ($p = 0.07$ ns) (Al-Najem *et al.*, 2012; Mann, 2009; Schein, 2010).

Additional evidence of the large range of lean culture PA level is demonstrated by methodology analysis of the 185 direct quantitative academic papers retrieved in our literature search. There appears to be little consensus on the proper survey instrument to use as 81 percent (150/185) developed their own original questionnaire. Main stated sources of inspiration for the construction of these surveys were Liker's Toyota Way, Hofstede's and the Globe study cultural dimensions, Cameron and Quinn's CVF and Shah and Ward's Lean performance indicators. Table III illustrates predicted impact and, whenever actually performed, study findings related to cultural dimensions proposed by Hofstede and the Globe study.

The most glaring discordance is seen in the dimension of future orientation, which relates to long-term planning and working relationships (Wincel and Kull, 2013; Martins *et al.*, 2015). The majority predicted lean to culturally make organizations to have long-term outlook in accordance to the famed Hoshin Kanri tool and to discourage a mentality of short-term gains at any mean and any costs. But Kull *et al.* (2014) actually found the opposite in their analysis with lean manufacturing organizations showing lower future orientation than non-lean organizations, a result which they could hardly explain. Wincel and Kull (2013) had a similar observation but they offer the following explanation: long future-oriented organizations lack drive to improve their processes based on the western view that their future is predictable and manageable. There is hence no rush and perhaps even harm in changing anything rapidly whereas lean organizations with short future orientation stay restless and more agile, discontent by the status quo and eager to change every day. This duality and peculiar mix of long- and short-term orientation reveal some of the paradoxical features of lean's nature. Lean seems to contain many nuances that are not well accounted for in prominent management models and frameworks assessment tools such as the cultural dimensions of Hofstede and the Globe study or the CVF of Cameron and Quinn. This may explain the discordant findings reported.

**Table III.**
Hofstede and Globe study cultural dimensions lean culture comparison

| Cultural dimensions | Bortolotti *et al.* (2015) Predicted | Bortolotti *et al.* (2015) Found | Kull *et al.* (2014) Predicted | Kull *et al.* (2014) Found | Wincel and Kull (2013) Predicted | Wincel and Kull (2013) Found | Martins *et al.* (2015) Predicted | Lacksonen *et al.* (2010) Predicted | Abrahamsson and Isaksson (2012) Predicted |
|---|---|---|---|---|---|---|---|---|---|
| Assertiveness | Lower | Lower | Lower | Lower | Lower | Lower | Low | | |
| Future orientation | Higher | Higher | Higher | Lower | Lower | Lower | High | High | High |
| Humane orientation | Higher | Higher | Higher | No effect | Neutral | Higher | High | | |
| In-group collectivism | Higher | No effect | Higher | No effect | Neutral | Neutral | Moderate | High | |
| Institutional collectivism | Higher | Higher | Higher | No effect | Higher | No effect | Moderate | High | |
| Performance orientation | Higher | No effect | Higher | No effect | Lower | No effect | High | | |
| Power distance | Lower | No effect | Lower | No effect | Neutral | Neutral | Moderate | Low | Low |
| Uncertainty avoidance | Higher | No effect | Higher | Higher | Higher | Higher | High | High | High |

**Notes:** As reported by Martins *et al.* (2015): assertiveness refers to "the degree to which organizations or societies are assertive, confrontational, and aggressive in social relationships"; future orientation refers to "the degree to which individuals in organizations or societies engage in future-oriented behaviors such as planning, investing in the future, and delaying gratification"; humane orientation refers to "the degree to which individuals in organizations or societies encourage and reward individuals for being fair, altruistic, friendly, generous, caring, and kind to others"; in-group collectivism refers to "the degree to which individuals express pride, loyalty, and cohesiveness in their organizations or families"; institutional collectivism refers to "the degree to which organizational and societal institutional practices encourage and reward collective distribution of resources and collective action"; performance orientation refers to "the extent to which an organization or society encourages and rewards group members for performance improvement and excellence"; power distance refers to "the degree to which members of an organization or society expect and agree that power should be unequally shared" and uncertainty avoidance refers to "the extent to which members of an organization or society strive to avoid uncertainty by reliance on social norms, rituals, and bureaucratic practices to alleviate the unpredictability of future events." Bortolotti *et al.* (2015), Kull *et al.* (2014) and Wincel and Kull (2013) compared lean manufacturing organizations to non-lean manufacturing organizations which explain why higher and lower estimation are indicated; whereas for Martins *et al.* (2015), Lacksonen *et al.* (2010) and Abrahamsson and Isaksson (2012) only provide their predictions about what lean culture should be, hence use of high, moderate and low estimate

Further evidence of wide PA range and common management models' inadequacy can indeed be found in the works of Hardcopf and Shah (2014), Losonci *et al.* (2017) and Paro and Gerolamo (2015) using Cameron and Quinn's CVF (Table IV). Hardcopf and Shah hypothesized that ambidextry and adhocracy models of organizations would be more favorable to lean but could only find partial support for adhocracy in their study. Results of Losonci *et al.* suggest lean to be closer to clan and adhocracy organizational types and Paro *et al.*, based on an analysis of the 14 principles of the Toyota way show that lean has predominantly a hierarchy nature.

All these authors are probably right in their own way. Existing instruments, frameworks and models may just be too crude and are ill-fitted to describe and assess lean in all its dimensions and nuances properly.

As already pointed out, the bulk of the current literature on lean culture remains very superficial. In fact, we could only find two papers who attempted to add more depth to their proposed lean culture conceptualization beyond the classic lean features such as continuous improvement or respect for people that are commonly reported. Alpenberg and Scarbrough (2009) sought to describe a TPS cultural archetype from a small meta-analysis. They remarked that TPS basic assumptions/values are not often described and that a large number of TPS behavioral norms, rites and rituals exist but only a few having explicit linkage. No attempt to fill gaps of knowledge was done and no unified TPS archetype is described in the end. In her paper, Parkes (2014) summarized the following characteristics of lean culture:

- On the level of basic assumptions: particularism, synthesis, collectivism, outer direction, status assigned and synchrony.
- On the level of values: PDCA process, standardization, visual management, teamwork, paradox, intensity, kaizen and do concept.
- On the level of artefacts: Japanese terminology, rituals, uniforms, visual control management tools, etc.

| | Hardcopf and Shah (2014) | | Losonci *et al.* (2017) | | Paro and Gerolamo (2015) |
|---|---|---|---|---|---|
| Culture types | Predicted | Found | Predicted | Found | Predicted (%) |
| Adhocracy | Positive | Partial | None made | Positive | 4 |
| Ambidexterity | Positive | Neutral | n/a | n/a | n/a |
| Clan | Neutral | Neutral | Non made | Positive | 25 |
| Hierarchy | Negative | Neutral | None made | Neutral | 46 |
| Market | Neutral | Negative | n/a | n/a | 25 |

**Notes:** n/a, not applicable. As reported by Losonci *et al.* (2017): adhocracy culture type refers to an organization that has external focus and flexibility and "uses *ad hoc* approaches to solve problems incurred from the surrounding environment with flexibility and discretion. This, combined with the external focus and differentiation, indicates a willingness to take risks, creativity and innovation. Independence and freedom are highly respected" in these organizations; clan culture type refers to organizations that have internal focus and flexibility and is "characterized by internal cohesiveness with shared values, participation and collectivism." They focus "on internal problems and concerns of individuals and perpetual employment with an informal approach to work characterized by flexibility and discretion"; hierarchy culture type refers to organizations that have internal focus and control with "centralized decision-making and attention to stability and control through formalized structures, standardization and rigidity with policies, instructions and procedures" and where "conformity is encouraged"; market culture type refers to organizations that have external focus and control and have "orientation toward the market and toward maintaining or expanding the current market share. Competition is emphasized within the boundaries of stability and control as with the setting of ambitious, quantifiable goals." As proposed by Hardcopf and Shah (2014): ambidexterity culture type refers to a combination of high clan and adhocracy culture type levels. Paro and Gerolamo (2015) estimate of theoretical ideal lean culture is based on their scoring of Liker's (2004) Toyota Way 14 principles with Cameron and Quinn's competing values framework (CVF)

**Table IV.**
Cameron and Quinn's competing value framework and lean culture

She does not unfortunately provide much explanation on why and how these characteristics distinguish themselves and are truly and specifically lean's basic assumptions, values or artefacts. Suggested values of paradox and intensity are particularly intriguing. She does not either illustrate how these levels and characteristics relate to each other as if they were independent and disconnected.

### *3.3 Scope of lean culture pragmatic ambiguity*

In addition to the aforementioned elements of its range, lean culture's high level of PA is demonstrated also in its scope. Scope or extension of lean culture PA is hereby delineated in the more general concept of organizational culture, a listing of lean culture definitions, the notion of cultural gap and amplification by four primary managerial issues.

Whereas this review finds lean culture to be more often than not treated superficially in the literature, it reveals that in the majority of documents, lean culture relates to culture at an organizational level. However, even the notion of organizational culture appears to show immaturity. We were able to extract 103 different definitions of organizational culture in the 126 documents subset treating lean culture substantially (for more details, contact corresponding author). While this is evidence of PA at least in the discourse, content analysis of these definitions suggests a rather agreeing perception of organizational culture within lean culture scholars based on 14 domains that are translated in this original, evidence-based definition of organizational culture as:

> […] the learned$_{(n=22)}$ and shared$_{(n=38)}$ collective$_{(n=79)}$ knowledge$_{(n=70)}$ including especially beliefs$_{(n=35)}$ and values$_{(n=42)}$ with related artefacts$_{(n=20)}$ guiding$_{(n=45)}$ daily$_{(n=17)}$ behaviors$_{(n=84)}$ of members$_{(n=62)}$ and is distinctive$_{(n=53)}$, contextual$_{(n=14)}$ and powerful$_{(n=5)}$.

It is notable that none of the source definitions contained all above elements, which is by itself evidence of added value. Implications of this definition are that organizational culture is both an acquired and transmissible learning. It is deeply ingrained but modifiable as well and hence manageable. It involves a group of people and is characterized by all elements that make that group particular and standing out from other groups. Organizational culture accounts for the way a group of people behave among themselves and in interactions with their environment and with other people every day and for as long as the group choose to stay together. It suggests a constructivist nature in which organizational culture needs to be continuously re-enacted to exist. Organizational culture contains features of peer-pressure amongst its members and distanciation from other people, although how it is actually performed (e.g. whether people are more or less friendly or welcoming) becomes a cultural trait. Organizational culture is observable particularly in its artefacts but because its meanings reside mostly in the minds of members in both conscious and unconscious ways, it is not easily decipherable in its entire richness. However, consideration of even just a few key elements may be informative and productive in understanding and engaging in that culture.

As for a definition of lean culture, 13 were found in the following list. They, however, all appear rather generic and superficial with variable emphasis on a large range of issues from membership (just employees or management as well) to goals (excellence? Reduction or elimination of waste?) or means (reasonably free hand or scientifically based?). They do not provide insights about which beliefs, values or artefacts are specific to lean. These findings certainly contribute to the level of PA lean culture currently has and much work needs to be done to reconcile all these ideas.

Lean culture definitions (academics/book authors/commercial authors/PhD theses):

(1) Ahmad (2013): where all employee participating in activities to reduce business waste.

(2) Alston (2017): culture that has all of the elements and attributes required to implement and sustain lean process improvement initiatives.

(3) Bicheno and Holweg (2009): all people, from CEO to junior, share two related characteristics, both related to learning: humility and respect.

(4) Charron *et al.* (2015): beliefs and behavior characteristics of employees that understand what their company's goals and objectives are, why they are important, understand the purposes of lean improvements, have had the necessary lean tools and techniques training to effect improvements, and are then given a reasonably free hand to do so on an ongoing basis.

(5) Gaudet and Bergeron (2016): shared language, values and practices of scientifically improving work, every day.

(6) Höök (2008): shared assumptions that the common goal is increased long-term profit, achieved by decreased costs and waste (performance), through a focus on customers and the people that create value.

(7) Integris performance advisors in Salah *et al.* (2015) organizational environment in which the values and behaviors are aligned with the guiding principles of lean management.

(8) Lotz and Roodt (2014): characterized by a deep respect for people, teamwork and continuous improvement.

(9) Manos and Vincent (2012): sum total of all the lean tools, techniques and knowledge that exist within an organization at the root level and that fuel the overall organizational alignment via collective lean thoughts, words and actions toward the elimination of waste and the creation of value.

(10) Novac and Mihalcea (2014): we think at problem solving with continuous improvement and learning.

(11) Schipper and Swets (2012): an idea that is created in the mind, as an inference, consisting of the collective behaviors, practices and habits of a community of people implementing a lean system.

(12) Stenzel (2007): shared mindset that demands excellence in providing customer value

(13) Zidel (2006) and Dennis (2016): everyone seeks improvement, understands value and strives to attain it, and identifies waste and struggles to eliminate it (Ulhassan, 2014).

Adding another aspect of PA scope, we noted in this literature review that several authors (Ahmed, 2013; Atkinson, 2013; Jenei *et al.*, 2014; Pedersen-Rise and Haddud, 2016, and others) refer to the notion of cultural gap described as the distance between the current organizational culture state to a future desired lean culture one in the widely cited view that lean transformation is an organizational change exercise. In that regard, Testani and Ramakrishnan (2012) describe the most prescriptive and detailed plan to follow in their report relating the successful experience of IBM with the use of various proprietary assessment tools to monitor and to direct progress of their lean journey over a period of two years. Development of lean maturity instruments for the purpose of assessing cultural gap certainly appears to attract much scholarly interests. Our review has encountered over 11, all more or less designed to assess lean organizational culture change and likely many more questionnaires exist and would require a dedicated literature search to discover and meta-analysis to develop learnings.

Finally, this literature review finds four other amplifiers of lean culture PA scope: leadership, human resources (HR) management, sustainability and innovation. Not as much based on any of the authors questioning their relevance in building a lean culture but because these notions, having on their own some level of PA, add other layers of complexity to the concept. For example, if transformational leadership is usually considered to fit more lean

culture compared to transactional leadership, as works of Woehl (2011) suggest, it is not necessarily the case. Hence, further investigations are needed to determine which leadership practices are essential in lean culture and which ones are facultative or even detrimental. In regard to HR management, its optimal position in lean culture appears unclear: whether it should be more at a strategic level as Alagaraja and Egan (2013) suggest or it should serve better an organization's culture as a supportive function as described by Jorgensen's (2008) healthy lean framework is yet to be determined. As for sustainability, lean culture authors, more often than not, neglect to specify which kind they refer to in their writing: specifically, sustainability at times appears to relate to maintenance of lean mastership (such as project's gains over time, standardization and continuous improvement practices) and preservation of lean culture; other times, it is about survival of the organization; and even other times, it is associated with the issues of corporate social responsibility and long-term environmental safety and protection (green lean) (Alves and Alves, 2015).

## 4. Discussion

This literature review makes several notable contributions. From a methodological aspect, it proposes adaptation and extension of other recent systematic reviews that ensured broad coverage of the topic. Full disclosure of the citation selection process demonstrates the importance and utility of running literature search in several electronic databases, describing strengths and weaknesses of some of them as well. Although complete capture of all writings about lean culture cannot be ascertained, the large sample size and efforts deployed decrease the risk that major contributions or a sufficient number of works have been missed that would affect significantly our findings. Two strategies were employed to decrease threat of validity and increase reliability: descriptive data were independently validated by a research assistant; iterative data collection scheme meant that documents were read over several times, decreasing risk of missed information, bias and misclassification. We submit that use of the PA construct and inductive data collection and analysis plan were particularly suited for this first exploration on lean culture. It allowed constructive generation of knowledge that would not have been as possible under a less flexible methodology.

This comprehensive systematic review of four segments of the literature (academic, books, thesis and gray articles) documents a high level of PA associated to lean culture from three stand points: its international source, its wide range from strong advocates to intense objectors and in terms of its stance, its treatment and main bearer in the manufacturing and service sectors and its scope regarding the notions of organizational culture, cultural gap and its estimation, leadership, HR management, sustainability and innovation.

Unfortunately, this high level of PA is more related to a situation of omission and shallow understanding rather than exposure and constructive debate as the superficiality of documents reviewed and our analysis indicate. Differences noted in the literature between the manufacturing sector and the service sector appear more indicative of the relatively longer lean experience in manufacturing than on fundamental differences in lean nature in manufacturing and service.

The fact that European scholars have contributed more on the topic calls for Americans (North and South) and scholars from every other part of the world to increase their activity and share their knowledge and experiences for a greater and deeper understanding of lean culture. The enigmatic silence of Japan on the matter begs for further inquiry and provision of valid explanations. Furthermore, even if further studies in healthcare, construction and automotive industries are needed, there is an opportunity to seek out lean culture insights in other under-researched areas such as in retail, legal, entertainment or tourism for likely valuable cross-learnings.

This review finds that a majority (80 percent) of lean authors across disciplines and sectors view lean culture as an organizational aim. The concept of culture appears hence less

to be a pre-condition, a tool or a bonus from organizational change efforts and more about acting as a mirror or barometer of lean transformation journey and mastership. This is consistent with the notion of cultural gap and the evidence-based definition of organizational culture we were able to build. Indeed, from a cultural perspective, there is less "hard" or "soft" sides of lean. Lean culture is progressively built. Every lean action or decision organization members make or not, and even more telling how these actions and decisions are made or not, are cultural artefacts. They become part of the organization's knowledge base and reflect its values and assumptions.

Lean culture current high PA level may nevertheless have certain positive aspects. As everyone is entitled to keep its own interpretation of the concept, time and energy are not spent on debates and counter-argumentations on who's right and who's wrong about lean culture. It maintains room for development and for constructive ideas. It may facilitate some collaboration between interest groups that may then focus their attention on lean matters more important to them. However, there are several risks of maintaining lean culture high PA level which includes: miscommunication, misunderstanding and missed opportunities that may lead to missteps, mistakes, errors and contribute to lean's organizational change failure. Clarifying the nature of lean culture can only mitigate these risks. The process of this clarification may also help to uncover new lean insights and managerial concepts that may contribute to the improvements of organizations. By knowing more precisely what lean culture is and what it is not, academics and practitioners could then spend their resources and creative drive toward other important aspects of lean and its implementation for the ultimate goal of gaining lasting improved organizational performance.



## 5. Limitations

Several limitations of this review must be acknowledged.

The main one concerns its strict focus and restriction on the exploration of two keywords: lean culture (with and without brackets). Several other cultural labels of lean can be found in the literature such as Toyota culture, kaizen culture, continuous improvement culture, kata culture, Japanese management culture and perhaps others. Further work is needed to determine to what extent all of them are similar and different between each other and how they make their own contribution to lean knowledge. It is possible that some of them have been discussed in more depth compared to lean culture in regards to related beliefs, values and artefacts.

A second limitation is that despite all care taken in the literature search, other databases exist such as Scopus, Engineering Village and other Journal–Publisher–Association specific databases and hence, no review could hardly ever be complete. This review appears nevertheless comprehensive and original in its large inclusion of records including commercial literature to give a sense of current state of knowledge on lean culture.

A third limitation is the fact that searches were conducted on the same computer at two different dates. It is possible that hidden "cache" algorithms of databases have introduced some selection biases. Use of "cited by" feature of Google Scholar in the final step of the search has, however, made missing of significant documents much less likely. It should be noted that, in order to overcome security features of Google Scholar, connection to several different internet access networks had to be done.

## 6. Further research and development

Based on this review's findings, we suggest these six areas of research and development:

(1) Further work to decrease lean culture's level of PA and refine its nature and improve understanding of its elements (artefacts, values and beliefs) is obviously needed.

(2) Empirical studies in under-researched industries such as retail, legal, entertainment or tourism may support cross-learnings on lean culture.

(3) A meta-analysis of quantitative studies and lean culture assessment instruments could be performed, which may eventually lead to the development and validation of a comprehensive lean culture assessment tool or package.

(4) Exploration on lean managerial paradox may deepen our understanding of the construct and help academics and practitioners to appreciate lean and its nuances to develop more appropriate lean mastership implementation and maintenance plans.

(5) There is need to clarify how the concepts of lean and its culture differentiate themselves from each other as from a certain cultural perspective, everything about an organization becomes a manifestation of culture. To remain useful and relevant, lean culture must mean something more than being the mere cultural expression of lean. Considering lean through lenses of other organizational change perspectives or theories such as the adaptation, the configurational, the political, the behavioral or the complexity approaches may be fruitful (Demers, 2007).

(6) Finally, investigating further how lean culture differentiates itself from other lean conceptualization such as lean philosophy, lean thinking and lean principles would enhance our collective lean understanding.

## 7. Conclusion

This first systematic literature review on lean culture shows that it currently has a high level of PA of a similar extent in four segments (academic, books, theses and commercial) of the management literature, irrespective of sector (manufacturing and service). Interest on lean culture appears to be growing and further work that would increase knowledge on lean and its culture may be inspired by our findings, in particular perhaps by our evidence-based definition of organizational culture.



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Appendix 1.2 Supplemental Table 5a Extent and range elements of Lean culture ambiguity

| 31-10-16 | | Academic | Books | Thesis (PhD) | Commercial | total |
|---|---|---|---|---|---|---|
| | | | | | | |
| by point | Direct | 225 (77%\67%) | 34 (87%\10%) | 5 (83%\1%) | 70 (84%\21%) | 334 (80%\ ) |
| | Indirect | 67 (23%\78%) | 5 (13%\6%) | 1 (17%\1%) | 13 (16%\15%) | 86 (20%\ ) |
| total | | 292 ( \70%) | 39 ( \9%) | 6 ( \1%) | 83 ( \20%) | 420 |
| | | | | | | |
| by coverage | Superficial | 174 (77%\67%) | 20 (59%\8%) | 3 (60%\3%) | 62 (89%\24%) | 259 (78%\ ) |
| | Substantial | 51 (23%\68%) | 14 (41%\19%) | 2 (40%\1%) | 8 (11%\11%) | 75 (22%\ ) |
| total | | 225 ( \67%) | 34 ( \10%) | 5 ( \1%) | 70 ( \21%) | 334 |
| | | | | | | |
| by culture nature | Pre-requisite | 8 (4%\73%) | 1 (3%\9%) | 0 | 2 (3%\18%) | 11 (3%\ ) |
| | Mean | 16 (7%\73%) | 0 | 1 (20%\5%) | 5 (7%\23%) | 22 (7%\ ) |
| | Aim | 190 (84%\67%) | 31 (91%\11%) | 4 (80%\1%) | 60 (86%\21%) | 285 (85%\ ) |
| | Outcome | 11 (5%\69%) | 2 (6%\13%) | 0 | 3 (4%\19%) | 16 (5%\ ) |
| total | | 225 ( \67%) | 34 ( \10%) | 5 ( \1%) | 70 ( \21%) | 334 |
| | | | | | | |
| by main bearer | Leaders | 121 (54%\68%) | 19 (56%\11%) | 3 (60%\2%) | 35 (50%\20%) | 178 (53%\ ) |
| | Managers | 20 (9%\67%) | 1 (3%\3%) | 0 | 9 (13%\30%) | 30 (9%\ ) |
| | Personnel | 10 (4%\67%) | 0 | 0 | 5 (7%\33%) | 15 (4%\ ) |
| | Other | 4 (2%\57%) | 0 | 1 (20%\14%) | 2 (3%\29%) | 7 (2%\ ) |
| | Not specified | 70 (31%\67%) | 14 (41%\13%) | 1 (20%\1%) | 19 (27%\28%) | 104 (31%\ ) |
| total | | 225 ( \67%) | 34 ( \10%) | 5 ( \1%) | 70 ( \21%) | 334 |

Appendix 1.3 Supplemental Table 5b Extent and range elements of Lean culture ambiguity

| 30-04-17 | | Academic | Books | Thesis (PhD) | Commercial | total |
|---|---|---|---|---|---|---|
| | | | | | | |
| by point | Direct | 375 (97%\69%) | 74 (91%\14%) | 15 (94%\3%) | 81 (99%\15%) | 545 (96%\ ) |
| | Indirect | 11 (3%\55%) | 7 (9%\35%) | 1 (6%\5%) | 1 (1%\5%) | 20 (4%\ ) |
| total | | 386 ( \68%) | 81 ( \14%) | 16 ( \3%) | 82 ( \14%) | 565 |
| | | | | | | |
| by coverage | Superficial | 347 (93%\70%) | 54 (73%\11%) | 12 (80%\2%) | 81 ( \16%) | 494 (91%\ ) |
| | Substantial | 28 (7%\55%) | 20 (27%\39%) | 3 (20%\6%) | 0 | 51 (9%\ ) |
| total | | 375 ( \69%) | 74 ( \14%) | 15 ( \3%) | 81 ( \15%) | 545 |
| | | | | | | |
| by culture nature | Pre-requisite | 8 (2%\ ) | 0 | 0 | 0 | 8 (2%\ ) |
| | Mean | 31 (8%\89%) | 3 (4%/9%) | 1 (7%\3%) | 0 | 35 (6%\ ) |
| | Aim | 335 (89%\67%) | 71 (96%\14%) | 14 (93%\3%) | 81 ( \16%) | 501 (92%\ ) |
| | Outcome | 1 (0%\ ) | 0 | 0 | 0 | 1 (0%\ ) |
| total | | 375 ( \69%) | 74 ( \14%) | 15 ( \3%) | 80 ( \15%) | 545 |
| | | | | | | |
| by main bearer | Leaders | 35 (9%\53%) | 17 (23%\26%) | 6 (40%\9%) | 8 (10%\12%) | 66 (12%\ ) |
| | Managers | 10 (3%\63%) | 3 (4%\19%) | 0 | 3 (4%\19%) | 16 (3%\ ) |
| | Personnel | 9 (2%\53%) | 4 (5%\24%) | 1 (7%\6%) | 3 (4%\19%) | 17 (3%\ ) |
| | Other | 2 (1%\67%) | 1 (1%\33%) | 0 | 0 | 3 (1%\ ) |
| | Not specified | 319 (85%\72%) | 49 (66%\11%) | 8 (53%\2%) | 67 (83%\15%) | 443 (81%\ ) |
| total | | 375 ( \69%) | 74 ( \14%) | 15 ( \3%) | 81 ( \15%) | 545 |

Appendix 1.4 Supplemental Table 7a Range of Lean culture ambiguity (manufacturing vs service sectors)

| 31-10-16 | | Manufacturing | Service | General | Total |
|---|---|---|---|---|---|
| | | | | | |
| by point | Direct | 175 (88%\52%) | 113 (74%\34%) | 46 (68%/14%) | 334 (80%\ ) |
| | Indirect | 25 (13%\29%) | 41 (26%\48%) | 20 (30%/23%) | 86 (20%\ ) |
| total | | 200 ( \48%) | 154 ( \37%) | 66 ( \16%) | 420 |
| | | | | | |
| by coverage | Superficial | 137 (78%\53%) | 94 (83%\36%) | 28 (61%\11%) | 259 (78%\ ) |
| | Substantial | 38 (22%\51%) | 19 (17%\25%) | 18 (39%\24%) | 75 (22%\ ) |
| total | | 175 ( \52%) | 113 ( \34%) | 46 ( \14%) | 334 |
| | | | | | |
| by culture nature | Aim | 143 (82%\50%) | 98 (87%\34%) | 44 (96%\15%) | 285 (85%\ ) |
| | Other | 32 (18%\65%) | 15 (13%\31%) | 2 (4%\4%) | 49 (15%\ ) |
| total | | 175 ( \52%) | 113 ( \34%) | 46 ( \14%) | 334 |
| | | | | | |
| by main bearer | Leaders | 80 (78%\53%) | 72 (82%\40%) | 26 (81%\15%) | 178 (77%\ ) |
| | Other | 30 (23%\35%) | 16 (18%\31%) | 6 (19%\12%) | 52 (23%\ ) |
| Total | | 110 ( \48%) | 88 ( \38%) | 32 ( \14%) | 230 |

Note: Culture nature and main bearer had to be dichotomized since there was not enough spread of data to allow statistical analysis, which could not be performed either by literature segment for the same reason.

Appendix 1.5 Supplemental Table 7b Range of Lean culture ambiguity (manufacturing vs service sectors)

| 30-04-17 | | Manufacturing | Service | General | Total |
|---|---|---|---|---|---|
| | | | | | |
| by point | Direct | 335 (97%\61%) | 149 (96%\27%) | 61 (94%/11%) | 545 (96%\ ) |
| | Indirect | 9 (3%\45%) | 7 (4%\35%) | 4 (6%/20%) | 20 (4%\ ) |
| total | | 344 ( \61%) | 156 ( \28%) | 65 ( \12%) | 565 |
| | | | | | |
| by coverage | Superficial | 310 (93%\63%) | 137 (92%\28%) | 47 (77%\10%) | 494 (9%\ ) |
| | Substantial | 25 (7%\49%) | 12 (8%\24%) | 14 (23%\27%) | 50 (91%\ ) |
| total | | 335 ( \61%) | 149 ( \27%) | 61 ( \11%) | 545 |
| | | | | | |
| by culture nature | Aim | 306 (91%\61%) | 142 (95%\28%) | 53 (87%\11%) | 501 (92%\ ) |
| | Other | 29 (9%\66%) | 7 (5%\16%) | 8 (13%\18%) | 44 (8%\ ) |
| total | | 335 ( \61%) | 149 ( \27%) | 61 ( \11%) | 545 |
| | | | | | |
| by main bearer | Leaders | 31 (56%\52%) | 20 (65%\33%) | 9 (82%\15%) | 60 (62%\ ) |
| | Other | 24 (44%\65%) | 11 (35%\30%) | 2 (18%\5%) | 37 (32%\ ) |
| Total | | 55 ( \57%) | 31 ( \32%) | 11 ( \11%) | 97 |

Note: Culture nature and main bearer had to be dichotomized since there was not enough spread of data to allow statistical analysis, which could not be performed either by literature segment for the same reason.

Appendix 1.6 Source documents reference list – Lean culture systematic review


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# Lean Healthcare: Modelling cultural trajectories and cultural frictions



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## Introduction

TPS, the Toyota Production System, still is today the most emblematic and celebrated realization of Lean. Really going from rags to riches, Toyota has been able to become and remain, with Lean, the largest car manufacturer in the world confounding conventional thinking that higher performance requires ever more resources, jostling entire supply chains, business models and management teaching (Holweg, 2007). But even Toyota stumbles at times with recalls and scandals despite learnings of its over 70-year Lean experience (Osono *et al.*, 2008). Lean is not easy but its key elements: continuous improvement of operations and value creation by relentless removal of non-value-added activities from the stance of the ultimate end-customer through initiatives of trained motivated employees at all organizational levels are simple to grasp and very appealing for most, if not all organizations challenged to achieve ever greater performance (Womack *et al.*, 1990).

The earliest accounts of Lean application in healthcare date from 2001 with experiences of such pioneer organizations as Bolton Hospitals NHS Trust in the UK and Flinders Medical Centre in Australia (Radnor *et al.*, 2012). More than fifteen years later, only a few healthcare organizations, in particular Virginia Mason and until recently, ThedaCare in the US, appears to have been able to obtain substantial sustained results with Lean. However, far too many organizations in healthcare and in other industries have failed in their attempt to lasting Lean transformation; raising some doubts that Lean healthcare may not be worthy or achievable (Radnor *et al.*, 2012). Why Lean, a seemingly straight forward 'common sense' and evidenced successful business approach is so hard to implement in healthcare which is full of highly educated dedicated people used to work in teams in high stakes, high performance, high costs and limited resources environments puzzle both much practitioners and academics (Spear, 2005; Toussaint and Berry, 2013). Numerous scholars such as Al-Balushi *et al.* (2014) and Poksinska (2010) have listed various facilitators and barriers to Lean healthcare implementation going from requirement for (or lack of) executive leadership, need for (or lack of) experts, champions and staff training, proper (or mis) identification of patients as the ultimate end-customer and to tradition legacy and professional silo thinking as the most important. These factors, albeit legitimate, are however very generic and leave to managers very little practical guidance on how to enhance or overcome them productively in their organization`s quest to gain Lean mastership.

Lean has been described as a toolbox, a set of principles and even more encompassing as a philosophy (Bhasin and Burcher, 2006). These complementary depictions show compelling

analogy to the three fundamental features of Schein`s prominent conceptualization of organizational culture with its artefacts, values and assumptions model (Schein, 1984).

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Insert Figure 1 about here

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Hence, if Lean represents a cultural proposition, it seems utterly suited to explore the rich body of knowledge of organizational change (OC) in management, particularly from a cultural perspective, to better understand Lean implementation and address its challenges. Although references to Lean culture are plentiful in the literature, this concept has been found to be treated and researched rather superficially in a substantial comprehensive systematic literature review of 1066 documents (academic papers, books, theses and commercial articles) by XXXX (accepted for publication).

This paper seeks to offer a greater understanding of Lean healthcare implementation, from an operations management point of view, taking a situated cultural OC perspective.

For this purpose, a conceptual descriptive model of Lean adoption in healthcare organizations is built by first mobilizing elements of three classic organizational change theories: 1- a Lamarckian view of evolutionary theory (Van de ven and Poole, 1995), 2- Nadler and Tushman's contribution on contingency theory (1980) and 3- Greenwood and Hinings insights on configurational theory (1988) and then by rippling and bridging six models or conceptualization of organizational culture and change: 1- Hatch`s cultural dynamics model (1993); 2- Meyerson and Martin`s cultural change paradigm triad (1987); 3- Trice and Beyer`s cultural leadership and forms (1993); 4- Orlikowski`s situated change perspective (1996); 5- Ghemawat`s CAGE framework (2001); and 6- Shenkar *et al.*'s construct of cultural friction (2008). A discussion about several implications of the model is provided with comparison to two generic OC models and two other OC paradigms. This article ends with future development suggestions for this model.

**Methodology**

As reported by Jonassen *et al.* (2005), conceptual modelization is considered fundamental to human cognition and scientific inquiry. Meredith (1993) has described seven types of conceptual research methodologies, classified in three sub-categories: 1- conceptual models, 2-conceptual frameworks and 3- theories. Conceptual models attempt to represent or describe (but not explain) phenomenon. Three types of conceptual models have been further identified: 1- conceptual

description, 2- taxonomies and typologies, and 3- philosophical conceptualization (Meredith, 1993). The next developmental stage of models are frameworks, which can be inductively, deductively and systematically constructed. Frameworks are used to explain phenomenon by means of propositions and testable hypotheses. The ultimate objective of modelization are theories, which are meta-frameworks that form coherent groupings of concepts interrelated by principles of explanations and understanding. As means for exploratory conceptualization in this work, two of the seven research strategies used in management and social sciences and described in Reisman's taxonomy (1988) were employed: 1- the so-called ripple strategy or incremental approach, which consists of building new models from recognized related models from the same field of interest; and 2- the bridging strategy which involves connecting or re-purposing known models or theories from other domains to create new ones. In this study, a conceptual description of healthcare organizations Lean culture adoption trajectories is hence built from elements of three classic organizational change theories and relevant knowledge from Lean, organizational culture, service, healthcare, operations and management literature discretionally selected.

## Findings

### LEAN ORGANIZATIONAL CHANGE: THREE HELPFUL CLASSIC THEORIES

As Lean is a business method that changes organisation, delving into OC's body of knowledge seems indeed befitting. But this field is vast and intricate. It has gone through multiple rounds of incremental and breakthrough developments. Several perspectives (ecological, neo-institutional, political, among others) have been described and they can all be complementary (Demers, 2007). Some elements of OC's evolutionary, contingency and configurational theories appear though particularly helpful to better understand Lean implementation process.

Evolutionary theory suggests that change among and in organizations happens over continuous and mainly gradual cycles of variation, selection and retention. However, as pointed out by Van de ven and Poole (1995), if a strict Darwinian view on evolution were to be taken, it could only explain change over organizational generations. The alternative Lamarckian perspective recognizes that organizational traits may be acquired through learning and imitation within an organization's generation. Evolutionary theory also suggests that selected and retained traits and ultimately surviving organizations over time are those that best fit available resources and environment (DiMaggio and Powell, 1983).

This notion of fitness is also very important in contingency theory. This theory describes organizations as open systems requiring active management to balance internal needs and to adapt to their environment, assuming no best way of organizing and challenging managers to be concerned about achieving alignment or goodness of fit between all organizational elements (Morgan, 1998). Nadler and Tushman's congruence model for organization analysis (1980) illustrates well this theory by showing organizational inputs (environment, resources, history) linked to an organizational transformation process that includes organizational tasks, formal and informal organisational arrangements and individual contributions toward outputs that are fed back continuously as new organizational inputs or learnings.

From these two basic theories, we retain the following points: 1- organizations change over time; 2- OC happens in planned and unplanned fashion; 3- many organizational elements influence change; 4- fitness or congruence among these elements influence change process and outcomes.

Configurational theory adds on that OC may nevertheless follow some patterns. Markedly, in their seminal paper 'Organizational designs, tracks and the dynamics of strategic change', Greenwood and Hinings (1988) have proposed existence of four organizational tracks (inertia, aborted excursions, re-orientations and unresolved excursions) defined as 'the temporal association of an organization with one or more design archetypes'. These tracks are theoretical predicted evolutionary course of organizations taken from a managerial interpretative scheme. The building blocks of these tracks, according to Greenwood and Hinings (1988), are five generic design archetypes: 1- archetype coherence (A), 2- embryonic archetype coherence (A), 3- schizoid incoherence, 4- embryonic archetype coherence (B) and 5- archetype coherence (B) for a simple OC from a condition A to B linked by processes of coupling and de-coupling. These design archetypes can be illustrated as wagons forming a train or track of variable length supporting variable organizational units of analysis and time frames.

## ORGANIZATIONAL CULTURE AND CHANGE: A SELECTED OVERVIEW FOR RIPPLING

There are no formal theories that have emerged from the golden age of OC's cultural approach in the 1980-90`s era (Demers, 2007). However, Schein's organizational culture framework suggesting that culture expresses itself through artefacts that are observable, manageable but 'peak of the iceberg' manifestations of abstract values which are reflections of transcendental assumptions, remains one of the most referenced and enduring organizational culture models (1984, 2010).

*Hatch`s cultural dynamics model*

Hatch`s significant incremental contribution was to bring a greater degree of sophistication to Schein`s model by including the element of symbols by specifying that artefacts by themselves may take different signification. It is when they reach a level of symbolic shared meaning that they can be more clearly linked to values and assumptions (1993). Hatch also challenged the hierarchical stacked or pyramidal representation of Schein`s organizational culture elements (Schein, 1984; Liker and Hoseus, 2008), arranging them in similar weight and circular fashion, suggesting that no element is more important than the other and that they are inseverable. However, there is agreement that culture can only be directly influenced through OC in artefacts and to a certain extent their symbolization through deliberate sense-making by management. In her initial model, Hatch proposed a complex sequential relationship to these concepts but subsequently suggested that artefacts, symbols, values and assumptions are better conceptualized as being all interlinked and integrated (Hatch, 2011).

*Meyerson and Martin`s cultural change paradigm triad*

Whereas organizational culture is generally considered as a monolithic integrative force that is the glue that holds all pieces of an organization together, a significant contribution of Meyerson and Martin (1987) was to highlight that imbedded in this 'integration' framework, two other cultural paradigms co-exist. Their 'differentiation' paradigm takes note that organizations are as well a collection of sub-groups that may each have their own sub-culture. These sub-cultures have features that are shared but they may be at times contradictory and inconsistent with those of the organization. The degrees of contradiction and inconsistency and of their tolerance become in fact an organizational cultural artefact by itself that can be an asset or a burden for an organization during the course of its evolution. At a more granular level of observation, their 'ambiguity' paradigm recognizes that each individual in an organization has his or her own culture and is also part of several cultural sub-groups both within and outside the organization. Care must be taken to decipher each cultural element appropriately for proper determination on what represent organizational, sub-groups or individual artefacts, symbols, values and assumptions. This can be done by multiple contacts of various members of an organization. This method becomes particularly relevant and critical in pluralist organizations, such as healthcare organizations, where leadership is diffuse and shared (Denis *et al.*, 2001).

*Trice and Beyer`s cultural leadership*

In regards to managerial mean for organizational culture change, in 1993, Trice and Beyer elaborated on the concept of cultural leadership and proposed a model based on two archetypal basic strategies: 1- innovation when the organizational goal is to set an entirely different culture and 2- maintenance when the objective is to build on an already desired organizational culture. Their proposition becomes actionable and practical to managers when related to the particular artefact of rites that can be used as tools to direct cultural change.

*Trice and Beyer`s cultural forms*

Rite, according to Trice and Beyer, are cultural practices that managers can deploy to impact on organizational social processes and hence culture. For them, rite 'amalgamates a number of discrete cultural forms into an integrated public performance' and is one of 'the most complex and elaborate of the cultural forms...' (1993). Trice and Beyer have identified through their field studies six generic types of cultural rites: rites of passage (1), of integration (2) and of degradation (3) which are to be used to change an organizational culture in need for innovation, whereas rites of enhancement (4), of renewal (5) and of conflict reduction (6) are conducive to a maintenance cultural strategy. They stress the importance of rites of creation, of transition and of parting in the sense-making process of any OC. They also indicate that they are likely many other types of rites that are still to be identified. Some could perhaps even be industry, such as healthcare, or Lean specific.

It is interesting to note that Trice and Beyer chose not to distinguish between artefacts and symbols in their description of possible culture forms. For them, physical objects and settings of an organization are all symbols. They put a lot of emphasis on the role of language and narratives such as jargon, rumors and several others as important bearer of organizational culture. They also suggest that managers dispose of many other practices than rites that can be utilized as powerful levers of change if and when used in coherent and constructive way. The challenge for managers who wishes to lead a Lean transformation appears to identify and progressively implement appropriate Lean cultural artefacts and practices into their organization inspired by the particular circumstances or situation of the organization.

*Orlikowski`s situated change perspective*

Work organizations can be seen as a hierarchy of managers and front-line personnel working together to deliver products and render services to customers. Sometimes the right mix of individuals and circumstances meet and outstanding organizational performance is achieved.

Most times however, organizations have to deal with diverse strengths and weaknesses and attempt to get the most out of this situation. This is the essence of Orlikowski situated perspective on OC about the importance of paying attention to each individual input and contribution in the change or inertia of an organization. As she mentions in her landmark paper, a situated approach in the study of OC is a complement, not a substitute to other OC perspective (1996). Adopting a situated view enriches a cultural approach perspective, for example, by highlighting the unique contribution of individuality in organizational life and OC movements. A situated view goes beyond a common contextual analysis as it recognizes the dynamic interactions between historical, political and environmental context of an organization and its unique membership who create or reproduce organizational routines that are objective cultural artefacts of a collective subjective interpretation of the organization`s operational purpose at a particular moment in time and in place (1996). The outcome may not be as what was planned and most likely result instead into transformed intentions but it is certainly not fortuitous or random, hence justifying the study of OC as a learnings quest to help make more informed future managerial decisions. The study of the gap between any intended and achieved OC is challenging but greater insights may be obtained when approached from a cultural perspective.

## CULTURAL DISTANCE, GAP AND FRICTION: BRIDGING KNOWLEDGE

The notion of cultural distance (CD) is a staple for more than forty years in the economics, finance, international business and mergers and acquisitions studies (Shenkar, 2011). Year 2001 saw the publication of two significant contributions in the use of this concept: namely, Ghemawat`s CAGE framework for practitioners and Shenkar`s Decade Award Winning article critique of the CD construct for academics.

### *Ghemawat`s CAGE framework*

The CAGE framework informs readers about four dimensions (1- Cultural, 2- Administrative and political, 3- Geographical and 4- Economic) of distance that may form a gap and therefore be a managerial challenge in a firm`s investments in another country. Cultural distance is plainly described though as differences in language, ethnicity, religion and social norms and as lack of connective ethnic or social networks between an investor organization and a recipient country but are shown to have significant impacts on the success or failure of foreign investments in the article. Admittedly subjective, CAGE distance assessment is suggested to be a valuable complement to other tools managers may use to reduce costs of distance and support their actions (Ghemawat, 2001). Transposing this notion of CD to an organization`s Lean adoption

quest may seem odd at first but the issues regarding investing in Lean are not so dissimilar to all decisions and uncertainties an organization faces in foreign investments albeit Lean, in this case, represents a virtual country. There is still much face validity in the consideration that becoming Lean for almost all healthcare organizations is like moving to an entire foreign land with requirements to learn a new language, change habits and act differently.

*Shenkar et al.'s construct of cultural friction*

Shenkar challenged in 2001 the popular construct of CD and use of its related quantitative index in international business by exposing numerous issues regarding questionable hidden assumptions weakening its theoretical and methodological validity (Shenkar, 2001). He convincingly demonstrated that CD, contrary to its long-accepted construct premises, is not necessarily symmetric. It is also unstable, not linear, incomplete, severable with various effects and flawed in its implicitness of corporate homogeneity, spatial homogeneity and content equivalence. But his main contention about the CD construct and cultural gap idea resides, at a more metaphoric level, in the fact that they both put emphasis on the relationship difference and void between two entities rather than approaching it from a more sophisticated and neutral stance on how these two entities may behave when in interaction allowing for both positive and negative potentials (Shenkar, 2001). Hence, recalling a term originally used by Williamson (1975) in his transaction costs theory treaty, Shenkar and colleagues strongly advocates for the use of the concept of cultural friction instead of CD or gap (2008). They subsequently in 2011 published a cultural friction in international business model with 'drag parameters' or 'organizational equivalent conditions' that affects frictions such as load, surface, speed and stage and 'lubricants' or 'organizational equivalent prescriptions' that, they contend, alleviate friction such as communication, acculturation, socialization and staffing, that bare much resemblance with previously stated Lean implementation facilitator and barrier factors. They even proposed a mathematical formula measuring cultural friction quantitatively that is yet though requiring empirical validation (Luo and Shenkar, 2011). In a similar spirit of interdisciplinary collaboration that inspired the concept, it seems fit to transpose the construct of cultural friction in Lean healthcare.

## THE CONTINGENT LEAN CULTURE ADOPTION (CLCA) MODEL

Based on this knowledge, we conceptualized the following 'Contingent Lean Culture Adoption' (CLCA) model (figure 2). This model assumes that, from time $t_1$ to $t_2$, healthcare organizations manifest cultural artefacts and symbols expressing values and assumptions, shown

as respectively, culture $t_1$ and culture $t_2$. The model postulates that, since Lean can be considered a cultural proposition, there is an ultimate Lean culture mastership state. The friction between the current organizational culture features and the ultimate Lean culture mastership state is referred to as the cultural friction at $t_1$ and $t_2$. A successful Lean adoption would reduce this friction level (trajectories 1- high to lower and 2- low to lower), whereas an unsuccessful one would maintain a similar baseline level of friction (trajectory 3- high to low and every level in between) and a failed one would be when friction level is increased (trajectories 4- high to higher and 5- low to higher). Situation $t_1$ and situation $t_2$ refer to the fluctuating mix of individuals, including members of and others contacts with the organizations, and the entire varying organizational context (both within and outside) these organizations are at both times and they reflect the contingent nature of the model. Lean culture transformation seems additionally best conceptualized as an adoption process based on the Merriam-Webster selected definitions of the transitive verb adopt: (1) to take by choice into a relationship; (2) to take up and practice or use; (5) to sponsor the care and maintenance of (2018).

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Insert Figure 2 about here

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*CLCA trajectories*

The CLCA model uses the term 'trajectory' specifically and intentionally. It proposes that an organizational trajectory represents the theoretical predicted overall evolutionary course that an organization may follow from time 1 to time 2. This definition derives from the formal definition of a trajectory as being: (1) the curve that a body describes in space; (2) a path, progression, or line of development resembling a physical trajectory *<an upward career trajectory>'* (2018).

*CLCA and implementation strategies*

The CLCA model informs managers and researchers that Lean implementation, despite all best efforts and intentions, may not achieve the desired goal at times. It implies however that a greater likelihood is obtained if the most appropriate strategic means to reduce cultural friction are used for each organization. The managerial decision in selecting the proper strategy would mainly depend on the following five factors inspired by Nadler and Tushman's congruence model for organization analysis (1980): 1- the managers` estimate of the Lean Cultural Friction (LCF) level which can be established subjectively or more objectively assessed by using one or several

instruments that have been already developed to assess Lean maturity or Lean readiness (Guimaraes and de Carvalho, 2014; Pakdil and Leonard, 2014). These instruments can only give an approximate estimate as they were not specifically designed to measure LCF level; 2- the different components of LCF that are manageable; 3- the organization situation, i.e. the mix of individuals collaborating and the current context of the organization; 4- the organizational learnings and dependencies from past implementation successes or failures and the explanations for the obtained results; and 5- managerial preference.

*CLCA conceptual paradigm*

The CLCA model is positioned in a pragmatic constructionist paradigm (Patton, 2002). It is pragmatic because of its functional definition of culture into four constituents (artefacts, symbols, values, assumptions) acting as anchors to facilitate longitudinal comparison at $t_1$ and $t_2$ and transversal interorganizational comparison qualitatively. The model acknowledges that culture of an organization is an alive and fluid concept, in constant need of re-enactment and confirmation by its members, revealing its constructionist nature.

*CLCA timeline*

The CLCA model does not assume any specific timeline between $t_1$ and $t_2$. As Lean aims at continuous daily improvement, the shortest period can hence be one working day and the longest, over the lifetime of the organization. It could have been expected that as Lean mastership increases, the time period between $t_1$ and $t_2$ were to become exponentially shorter through the organization. However, recent evidence by Netland and Ferdow, (2016) suggests that successful Lean implementation, at least for manufacturing organizations, rather follows a sigmoidal pattern: slow at first, then showing rapid gain and finishes with a period of slow calibration as depicted in Figure 2. Patterns of unsuccessful Lean implementation are unknown and therefore drawn as dotted lines.

*CLCA experience*

Additionally, the CLCA model allows for the notion of frictionless cultural elements and does not presume that at ultimate Lean mastership state, all organizations' culture would and could become exactly the same. An organization's culture reaching ultimate Lean mastership is expected to have changed, but not necessarily in every and all its features. Some artefacts may very well remain the same but it is then for their symbols, values and assumptions attached to them that change would occur. Transversally, two organizations at similar LCF level are expected

to appear very different but they would share a similar level of challenges in Lean culture mastership. Much further research is needed to determine which traits create more or less cultural friction and their relative importance. Taken to the extreme, it is understood that ultimate Lean culture can only be a singular experience since every organization's situation is unique.

*CLCA ethical implications*

The CLCA model does not pretend that ultimate Lean culture is desirable and suited for all organizations. This decision remains a strategic one made by the organization's leaders. The model informs organizations about five possible trajectories of Lean culture mastership over time while taking a neutral stance on performance and morals. An organization may still be very well-off despite experiencing an unsuccessful Lean culture adoption attempt and a successful Lean culture adoption does not guarantee an organization's prosperity but it certainly increases the chance of profiting from Lean's operational improvement promises. The CLCA model highlights nevertheless that Lean cultural transformation may not be a risk-free endeavor.

## Discussion

Our CLCA model has the strengths of clarity, simplicity and flexibility. It does not pretend or intend to explain everything about the entire Lean healthcare implementation experience phenomenon. But by using culture in a focused analytical lens, it may allow gaining new insights and deeper understanding of Lean healthcare and its implementation challenges.

*Lean mastership*

The CLCA model suggests that all healthcare organizations have, at any time, a culture with constituents (artefacts, symbols, values, assumptions) that may or not be close to those of Lean. The model positions Lean as a cultural proposition that is demonstrated maximally when an organization reaches an ultimate Lean mastership state. Whereas maturity is more commonly used in the literature to describe Lean adoption over time, introduction of the concept of mastership appears more suited for the CLCA model. Mastership suggests continual mindful efforts in sustaining and ever improving organizational capabilities in similarity to an artisan who is always getting better at his craft with experience but at risk of losing abilities by failing to practice them whereas maturity refers more to a life cycle vision of OC (Van de Ven and Poole, 1995). Indeed, maturity suggests a rise with an implied inevitable eventual decay of organizational functions. There is as well in maturity a notion of passive effortless progression similar to the human experience in which time and change cannot be stopped and will happen any way which

is not the case for Lean. Lean and its culture can only exist by concerted efforts in continuous pursuit of perfection (Womack and Jones, 2003).

*Friction, drag factors and lubricants*

The CLCA model builds on the ideas of Shenkar and colleagues that the encounter of two cultures is best conceptualized by the notion of cultural friction rather than distance with a gap to fill. The friction metaphor certainly provides a richer conceptual framework. Since it derives from knowledge of the much more developed fields of physics and mechanical engineering, it inspires by analogy to find managerial equivalents to the drag factors and lubricants that condition friction and were previously mentioned.

*Path of least resistance*

The CLCA model and the cultural friction construct both allow for the potential to have numerous constituents, each carrying on a range of net effects (positive, neutral, negative). Culture and friction levels both result on the sums of their parts and how these parts interact with each other. The CLCA model does not however address directly important issues of Lean implementation in healthcare and other service organizations such as where and how efforts ought to be best spent (front office or back office functions first? Areas of greatest waste or areas of greatest buy-in? And so on). But this is where the notion of cultural friction might be particularly helpful. The path of least resistance of each organization might be the one to follow but this statement needs further inquiry and validation.

*Timing*

Embedded in the CLCA model and the cultural friction construct are several other important OC issues such as magnitude (large to small), pace (fast or slow) and rhythm (regular or punctuated) that several scholars have already explored (Klarner and Raisch, 2013; Ligori, 2012). The question of timing of OC is perhaps the least discussed, but in the context of Lean`s continuous improvement spirit, now would always appear to be the best and appropriate answer.

*CLCA and other OC models*

The CLCA model is compliant with and actually complement other generic OC models, such as Lewin's classic 3-stage model of change (unfreezing-moving-freezing) (Lewin, 1947) or Kotter's eight step process for leading change as the CLCA model not only includes the

possibilities of success and failure but warns about possible harmful effects of OC efforts despite all best intentions.

For the notion of unfreezing (Lewin, 1947) or Kotter's first step: establishing a sense of urgency (1996), these schemes suggest an underlying necessity to shake up an organization for change to occur in a paradigm of commonly perceived organisation inertia. Because the CLCA model is built on a constructionist paradigm of continuous change and constant re-enactment, it stands closer to Weick and Quinn's suggested freeze-rebalance-unfreeze pattern of OC (Weick and Quinn, 1999). In their model, the first freeze stage describes efforts to bring everyone to work all together in a same new way, which find similarities in Kotter's forming a powerful coalition but this action raises resistance or friction as people need to give up old habits and lose some of their previous room for maneuvers, power and influence in their work place. Rebalance stands for the change and the unfreeze stage recognizes that people will, within the new organizational parameters, want and need to regain some room of maneuvers, power and influence in performing their duties. Further investigations are needed to determine which model is more applicable to healthcare organizations and whether a 'quiet' Lean culture revolution devoid of crisis and radical actions is possible.

*CLCA and other OC paradigms*

Managerial knowledge is built on the exercise of considering a phenomenon from different theoretical perspectives. The CLCA model stands firmly grounded in an organizational cultural change's point of view. Other authors have taken different position and some have used combination of paradigms to make their point. Indeed, the issues of planned change and implementation of new managerial techniques have been addressed plentifully with other managerial methods such as total quality management or Six Sigma (SS). Two paradigms appear particularly relevant for this discussion: the political view and the learning view.

*CLCA and the political view*

In their paper on corruption of managerial techniques, Lozeau *et al.* (2002) proposes four outcomes, which CLCA trajectories share similarities, based on analysis of health organizations' evolution in strategic change processes: 1- loose coupling, 2- transformation, 3- customization and 4- corruption and their findings suggest that corruption, the ill-piecemeal implementation of managerial methods, is the most likely when there is a large compatibility gap. The power struggles and influence schemes that lead to corruption does not find direct equivalent in the

CLCA model but may be possible explanatory mechanisms underlying the two negative trajectories that are directed away from Lean ultimate culture goal. Customization and transformation would be found in the positive trajectories where the first would eventually plateau and never reach ultimate Lean culture as the latter would be assumed. Loose coupling finds equivalency in the neutral trajectories of the CLCA model.

*CLCA and the learning view*

More recently, Canato *et al.* (2013) in their study of SS implementation at 3M, provide support to some of CLCA model postulates: particularly that organizational culture change is possible but it may have unexpected and not necessarily desirable consequences. Set in an organizational practice change analysis framework, the coercive aspect of OC that these authors report is directly linked to the nature of SS which is a top-down approach for the improvement of operational performance using similar tools as Lean but with little or no regard to front-line employees' inputs (Schroeder *et al.*, 2008). Canato *et al.* suggest an onion-like layered OC model composed of core values at the heart, surrounded by internalized beliefs and behavioral norms, wrapped up in a cultural repertoire of different organizational practices. However, this conceptualization begs the questions: how and when organizational core values, which are often referred as basis of organizational inertia, actually develop and how long does it take for members to learn and enact them? The CLCA model suggest a different paradigm in which each and all organizational artefacts are linked to some symbolization, a value set and assumptions that are socially constructed at every moment and therefore malleable by proper cultural leadership actions.

Canato *et al.* also mobilizes the concept of cultural fitness and practice diffusion first presented by Ansari *et al.* (2010). For them, based on the degree of extensiveness of practices used (from high to low) within an organization and the degree of fidelity to these practices (from high to low), a new practice will be consequently more or less difficult to diffuse and be sustained. Cultural fitness predicts that the more culturally close a new practice is to current organizational practices, the easier it would be to diffuse, presuming that dimensions that may create some residual cultural distance will take care of themselves. CLCA's consideration on cultural friction focuses on the problematic aspects regarding Lean methods' adoption and invites managers to address them directly which is certainly more in keeping with Lean mindset of identifying problems as continuous improvement opportunities. Moreover, as trajectory 5 warns, lower baseline LCF does not guarantee easier Lean adoption success.

*Handle with care*

Finally, as for practical implications for healthcare managers and other practitioners, the CLCA model is useful in indicating that planned OC efforts such as Lean, may, hopefully more often than not, be successful but they may also fail and can actually be detrimental to their organization. Caution is certainly warranted before proceeding. By first estimating Lean's organizational cultural friction level and appreciating friction points, selecting appropriate lubricating strategies for their organization will be facilitated and lead to more effective Lean transformation. By reminding them to tap into individual talents of people surrounding them, the CLCA model invites healthcare managers and other practitioners to look beyond the obvious contextual hurdles for answers on how to make OC and in particular Lean, a reality. Pragmatically framing organizational culture into four constituents (artefacts, values, symbols and assumptions) in three (integrative, differentiated and ambiguous) levels, the CLCA model becomes a valuable tool on how to decipher Lean culture implementation for practitioners and academics. The CLCA model provides a framework for proper theoretical sampling in its future validation process. The notion of cultural friction productively breaks the glass ceiling of facilitator and barrier factors recurrently found in the Lean implementation literature and invites academics to dig further in identifying drag parameters and finding lubricants for greater understanding and more successful implementation of Lean in healthcare and other organizations. Analogous to Netland and Ferdows (2016) comment on the importance of appreciating where in the Lean implementation s-curve organizations are located for better understanding of their challenges, the descriptions of the five theoretical organizational Lean culture adoption trajectories may provide to academics firmer ground to start their studies or interpret their findings. For all these reasons, the CLCA model appears to be a valuable addition in the landscape of OC models.

**Future developments**

The next development steps of the CLCA model are obviously to undergo empirical qualitative and quantitative validation.

First, in order to be able to estimate LCF levels, features of the cultural constituents (artefacts, symbols, values and assumptions) of a healthcare organization in ultimate Lean mastership state need to be documented. Trajectories of CLCA model could then be tested empirically with a multiple case study.

Greater understanding on the natures, sources and forces of LCF of healthcare organizations could potentially not only offer explanations but enable predictions of probable trajectories and perhaps eventually lead to propositions of solutions for changing organizational courses in Lean culture adoption journey to practitioners. The CLCA model would therefore become a framework, and may even be further developed thereafter into a full theory.

There are little theoretical grounds and empirical evidence to prevent belief that learnings from Lean healthcare could not be extended and applicable to other service organizations or even to manufacturing. However, the reverse might not be true. Service organizations rely more on customers' participation in providing them with quality inputs for rendering their services. This co-production issue becomes even more challenging for healthcare organizations since their customers are more often in impaired shape, sick and vulnerable, likely making Lean implementation in healthcare more hazardous and trickier than in other service organizations (Toussaint and Berry, 2013). The CLCA model may be helpful to investigate further this idea.

## Conclusion

The conceptual exploration of Lean healthcare implementation by revisiting OC from a cultural perspective led to construction of the CLCA model, built with the notion of cultural friction and based on a situated view of organizational culture. Further investigations are needed and some avenues have been highlighted.

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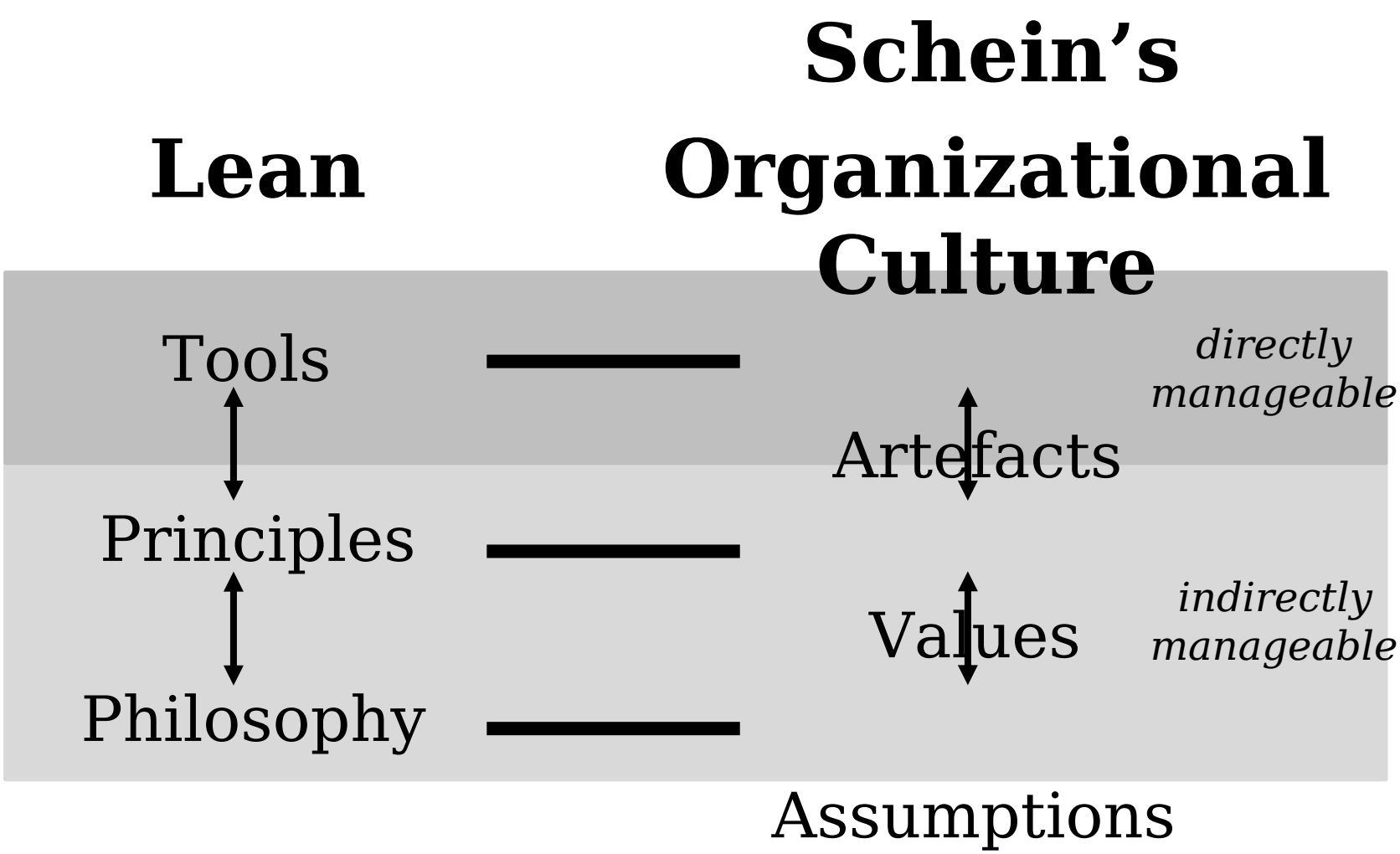
Lean
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Philosophy
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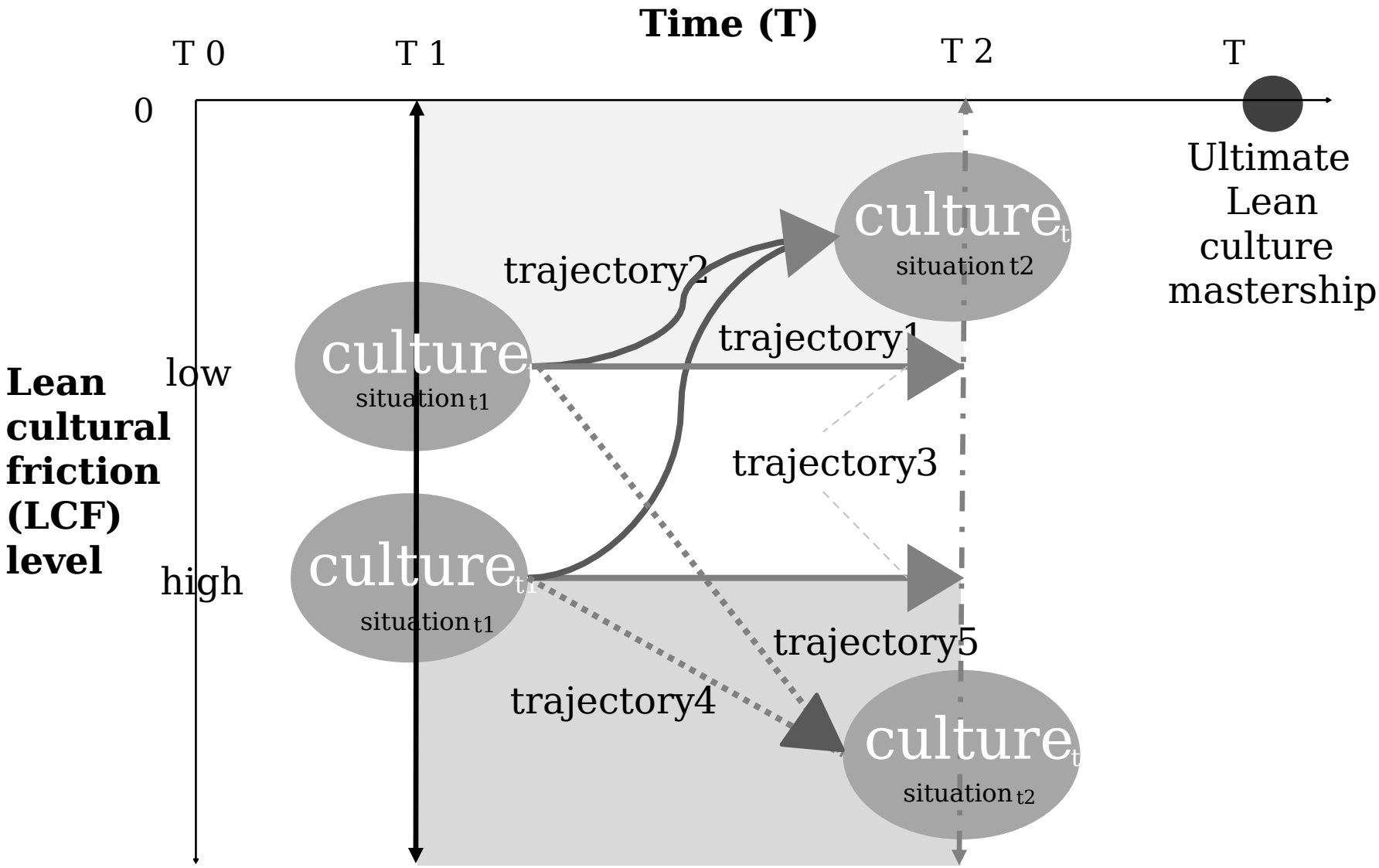
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Appendix 3.1 IJPPM proof version as submitted 03-02-19

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# Exploring Lean generic and Lean healthcare cultural clusters



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|---|---|
| Journal: | *International Journal of Productivity and Performance Management* |
| Manuscript ID | Draft |
| Manuscript Type: | Standard Paper |
| Keywords: | Lean Production, Organizational Culture, Health care, Operations management |
| | |

**Title:** Exploring Lean generic and Lean healthcare cultural clusters

**Structured Abstract:**

**Purpose:** This work investigates Lean culture by searching for leading cultural clusters through keywords exploration and qualitative analysis of preeminent Lean generic and Lean healthcare reference books.

**Design/Methodology/Approach:** Content analysis on main text of 33 books, consolidated as three cases (Lean general, Lean Liker *et al.* and Lean healthcare) was performed.

**Findings:** Books contained on average 79000 words for a sum of over 2.5 million words analyzed. Ten top relevant keywords were identified, namely, in order of importance: work, time, process, Lean, system, improvement, production, patient, people and team. These top relevant keywords suggest the following four emergent Lean's leading cultural clusters: operations, change, collectivity and humanity. Cross-validation of these cultural clusters is demonstrated through sociotechnical systems theory.

**Research implications:** Content analysis is shown to be an effective research method in operations management enabling inductive analysis. Identification of four leading clusters may help further research on Lean culture.

**Practical implications:** Lean cultural transformation of healthcare and other domains organizations may be facilitated by focusing attention to what the organization actually does (operations), to how change happens (change) and to how everything (collectivity) and everyone (humanity) work together in the organization.

**Originality/Value:** This work is the first application of content analysis on Lean reference books. It highlights the importance of time as a salient but underappreciated Lean culture element. It provides evidence and additional support for association between Lean and sociotechnical systems theory.

## 1.0 Introduction

Lean, arguably one of the most prominent current business methods to increase value and decrease waste in both manufacturing and service organizations` operations, may be seen as a

cultural proposition (xxx, in submission). From that perspective, Lean transformation entails changing or narrowing the gap between an existing organization`s culture to a Lean one, which is much easier said than done (Ramakrishnan and Testani, 2012; Mann, 2015). A contributing factor may be that collective knowledge on Lean culture remains rather superficial and under-developed despite longstanding and growing interests in Lean culture from scholars and practitioners of all domains' management and, in particular, healthcare (xxx, accepted for publication).

Gaining a greater understanding of Lean culture in its ultimate ideal form might help to facilitate an organization's Lean transformation which is notoriously difficult to achieve but much desired, especially in healthcare (Radnor *et al.*, 2012). To do so, unfortunately, direct observation of organizations in ultimate Lean culture state is not, at least yet, possible. Indeed, even Toyota, Lean's most emblematic success, has not yet reached perfect Lean mastership as demonstrated by its deficiencies and failures from recurrent large-scale recalls and critical testimonies (Osono *et al.*, 2008; Mehri, 2006). Among alternative options then, a study of Lean experts' writings, using an organizational culture framework, appears well-suited since words and language are undeniably strong and powerful vectors of culture (Schein, 1981, 1984).

From Sugimori *et al.*'s (1977) first account on Toyota Production System to Krafcik's paper labeling Lean in 1988, to Womack *et al.*'s 'The machine that changed the world' (1990), Liker's 'The Toyota Way' (2004), Graban's 'Lean Hospitals' (2016) books and to Spear's Harvard business review article, 'Fixing HealthCare from the Inside Today' (2005), Lean-related publications are now plentiful and diverse (Danese *et al.*, 2017). Making the right selection of source documents is key for validity of any research findings (Miles *et al.*, 2014). For the purpose of understanding better and describing features of Lean healthcare culture at its ultimate ideal state, reference books may be one of the most appropriate and inspirational material to examine compared to academic papers, commercial articles, surveys or interviews.

Indeed, books as source documents have several strengths and advantages. They are committed expressions of their authors' knowledge and perspective, often based on years of personal and shared experience. Books have a more flexible format and provide greater and freer opportunities for content development than academic papers and commercial articles. More on this point, it follows that analysis of what the authors chose not to say or the emphasis, or not, they put on information may be as telling as the content itself. Books usually go through a more substantial revision process than commercial articles. This process insures some quality in content proportional to the editors' reputation albeit books are not necessarily peer-reviewed unlike

academic papers. Since books are firm, set in time and approved accounts by their authors, books are arguably more reliable sources of information and better representative of the authors' point of view than interviews and surveys, as the latter may be more subject to multiple researcher`s and informant's biases (Miles *et al.*, 2014). Books are also readily available and fairly accessible. Books are certainly very influential and impactful particularly on practitioners. Finally, books have always been regarded as legitimate reference sources for ages as early as the bible.

Applying an organizational culture framework to source documents analysis though is not as simple as it may appear since the field of organizational culture is vast (Giorgi, 2015). Multiple definitions, models, frameworks and approaches have been proposed over the years and there is yet still no consensus on which one, if any, may be most effective and valid for conducting academic work. As case in point, in a recent Lean culture systematic review, 103 different organizational culture definitions were found out of 126 documents that were discussing culture with some substance (xxx, accepted for publication).

In this situation of high pragmatic ambiguity, taking an inductive analytic approach appears legitimate. An inductive qualitative research method let findings emerge from data analysis as opposed to a deductive approach which test validity of an existing or preconceived conceptual model or framework in source data. One way to conduct inductive analysis is to look subjectively for patterns and their frequencies within data (Dalton, 2002). In this endeavor, content analysis represents a more objective adjunct technique to employ.

Content analysis is defined by Weber (1990) as "a research method that uses a set of procedures to make valid inferences from text" and it has been used for many purposes including investigation of cultural patterns. As reported by Duriau *et al.* (2007) in their review of content analysis literature in organization studies, content analysis acknowledges the importance of language in human cognition and may provide access to deep individual and collective structures such as values, intentions and attitudes which are cultural features. Content analysis may be performed through several sophisticated techniques such as key-word-in-context (KWIC), concordance, co-occurrence and theme analysis of idioms and sentences using complex statistical methods such as analysis of variance, structural equation models or confirmatory factor analysis (Weber 1990). But even content analysis' most basic form, word frequency, is considered to be a legitimate indicator of construct centrality and importance. Content analysis assumes that differential use of words is meaningful, that change of words reflects change in attention and that these differences may be used to reveal understanding of underlying concepts (Duriau *et al.*, 2007). Content analysis has many advantages over many other research methods: 1- it is flexible, fitting to many

levels of analysis and can be easily combined to other qualitative and quantitative analysis methods enabling data triangulation; 2- it is nonintrusive and less prone to diverse researcher and informant biases since there are no direct interactions between investigators and authors who are usually unaware that their text is being used for content analysis; 3- it is said to be safe because its procedures can be readily described, adjusted and replicated; 4- it allows for finding faster answers to longitudinal study questions since texts are rich time capsules; 5- it is relatively cost-effective and scalable, particularly with the development of computer-aided text analysis (CATA); and 6- because the latter is nowadays readily available, at least in its simplest word frequency form as a common feature in most word processing software programs, collaborative work is possible (Weber, 1990; Duriau *et al.*, 2007). Similar to other research methods though, care must be taken in its conduct as it is susceptible to matters of reliability (stability, reproducibility and accuracy) and validity (face, construct, discriminant and generalizability). Moreover, as Weber (1990) shares, two specific additional methodological concerns apply to word frequency: first, since words in general have several meanings, word frequency may suggest a greater sense of uniformity than there actually is, overestimating effect and threatening validity of inferences. Secondly, effect underestimation may also occur simultaneously since words have synonyms and pronouns that may not be all accounted for by simple word frequency calculation. Unfortunately, no simple solution currently exists to address these issues but they can be expected with further IT development, especially, artificial intelligence. These caveats need to be considered in the design of any content analysis study and in interpretation of its results.

As the initial step of a quest to eventually being able to identify and describe features of Lean healthcare culture in its ultimate state, this article presents findings from CATA conducted on a selection of preeminent Lean reference books in the generic domain and in healthcare. Main objective of this study was to determine leading Lean cultural clusters to guide further investigations on Lean healthcare culture. Secondary objective was to investigate cultural pattern differences between Lean generic and Lean healthcare reference books.

This paper contains a detailed methodology section. It presents its findings in three sections: the first describes the top relevant keywords determination process and results; the second demonstrates qualitative correlations between the identified top relevant keywords and proposal of four leading cultural clusters and the third section cross-validates the four Lean cultural clusters with sociotechnical systems theory. A discussion follows which includes research implications, practical implications and limitations of this study. It ends with ideas for future research and development and a conclusion.

## 2.0 Methodology

This inductive exploration of Lean reference books for cultural clusters was done by CATA (computer-aided text analysis) using Atlas.ti version 8.2.32, Microsoft's Word 2016 and Excel 2016 software programs. Selection criteria of included books were: 1- notoriety of the book or of its first author, 2- the book's impact as estimated by number of Google Scholar citations and 3- link to Lean culture and/or Lean healthcare. A total sample of 33 books (21 Lean generic and 12 Lean healthcare from 16 different first authors (nine Lean generic and seven Lean healthcare) was hence elected. Only their most recent edition was considered for analysis (Table 1 and 2).

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Insert Table 1 and Table 2 about here

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Consent for content transcription was obtained from all editors and took six months (August 2017 - January 2018). All books' main texts were transcribed integrally and went on for seven months (November 2017 - May 2018). Forewords, tables, figures, acknowledgements, footnotes, endnotes, glossaries, appendices, index, case studies, reference list and any other book content were disregarded as use of these supplementary sections differ from one book to another. This allowed for more consistent and fairer comparison.

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Insert Figure 1 about here

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A cultural cluster exploration – computer-aided texts analysis (CCE-CATA) technique having four rounds of data condensation was developed and used as follows (Figure 1): First, it was quickly realized that texts needed some preparation. For example, Microsoft's Word word count calculator appeared more sensitive to spacing, symbols and tabs than Atlas.ti's; therefore, all symbols in texts were replaced by a tab. This procedure made word counts between Atlas.ti and Word 2016 programs similar by less than 3% difference (Findings-section 1: Table 3). As Atlas.ti is able to export word lists and counts in Excel spreadsheets facilitating data manipulation and condensation, total word count numbers for normalization of relative contribution book weights in this study are based on Atlas.ti's results as reference point. Note that Atlas.ti's feature enabling exportation of word lists with standard "stop and go" word exclusions (that ignores, for example,

most prepositions and word contractions such as I'll, haven't, etc) has been used. Numbers and their counts were then removed from listing in Excel spreadsheet as they were irrelevant for the purpose of this study. After re-ordering remaining words according to their counts, words down to 20% of top count frequency were kept justified by Pareto's 80-20 principle.

First round of condensation consisted of combining remaining words with their plural and removing any extra "stop and go" words (i.e. neutral, content-free or irrelevant words for this study' objectives) and any too book-specific words such as Virginia Mason, Thedacare or Toyota to enhance validity of book comparison (Supplemental Table 1). After re-ordering remaining words according to count, word frequency Pareto histograms (word exact) were created as an in-between step validation testing exercise (Supplemental Figures 1.1 to 1.33).

Round 2 condensation stage involved combining further related words into themes, re-ordering them and creating word frequency Pareto histograms (word theme) (Supplemental Figures 1.1 to 1.33 and Supplemental Table 2). Interestingly, several top relevant keywords were already noticeable at this point but since this study sought to explore broad cultural clusters, it was considered more appropriate to pursue further consolidation using word theme listings rather than word exact. Top potential relevant keywords from each book were determined again by Pareto 80-20 principle, keeping top words down to 20% of peak count. A total of 182 potential relevant keywords were hence identified.

Round 3 condensation work started with normalization of each book's potential relevant keyword count in percentage (of each book's total relevant keyword count). Then a correlation table was created with 182 potential relevant keywords vertically and each book horizontally, filled by corresponding count percentage. These percentage counts were further normalized according to each book's relative contribution weight estimated by each book' total word count. The next step involved summing all potential relevant keyword relative counts, ordering them by frequency and again keeping all words down to 20% of max frequency, consequently identifying candidate relevant keywords. If felt relevant, case(s) creation is here suggested to be an optional but valuable step in CCE-CATA to help determining top relevant keywords. For this study, Lean general, Lean Liker *et al.* and Lean healthcare cases were devised by summing their respective potential relevant keyword relative counts. Lean Liker *et al.* case was singled out since Liker and his collaborators' contributions to Lean literature are noted to be more substantial and outstanding enough to justify its own case. Each cases' potential relevant keyword counts became candidate relevant keyword lists when keeping just words down to 20% of max relative frequency (Findings: Figure 2 and Supplemental tables 3). Determination of top relevant keywords was then done by

keeping all candidate relevant keywords showing consistency and stability within one ordering levels among total and all cases (Supplemental Table 4). For this study, cut-off was set at the word 'team' as prevalence of the word 'problem' was mainly driven by Liker *et al.*'s contributions.

CCE-CATA procedure culminates with an original condensation of the ten top relevant keywords into four leading cultural clusters at round 4 (Findings: Table 4).

Sensitivity analyses were performed in multiple ways from round 3 condensation stage by: 1- using crude frequency of occurrence (presence or absence in the 33 books) rather than using potential relevant keywords' relative counts; 2- by performing potential relevant keywords normalization according to each book's relative potential relevant keyword counts rather than each book's total word count; 3- by doing potential relevant keywords normalization according to each book's Google Scholar citation counts, 4- by not normalizing potential keyword count.

We submit that this research meets criteria and follows Yin (2009)'s proposed process (plan, design, prepare, collect, analyze, share) of a multi-case study, which validity is enhanced by the number of cases and multiple authors' contributions of diverse background expertise and fields (management, engineering, manufacturing, service, automobile, healthcare, etc) (Findings-section 1: Table 4).

## 3.0 Findings

### *3.1 Top relevant keyword determination*

Selected books contained on average 79000 words (10000 to 147000) for a sum of over 2.5 million words analyzed. Liker *et al.*'s books are in general more voluminous (about 100000 words on average) than Lean general (70000 words) and Lean healthcare (on average 65000 words). All authors except one (Kenney) have managerial credentials and about half (9/16) had background in engineering. Most (15/16) hold or have held successful Lean consultant positions (Table 3).

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Insert Table 3 about here

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There were on average 26 potential relevant keywords (9-48) per book, 24 potential relevant keywords (18-31) per cases and 23 candidate relevant keywords (Supplemental figures 1, Supplemental Table 4 and Figure 2). Ten top relevant keywords were identified, in order of

importance: 'work', 'time', 'process', 'Lean', 'system', 'improvement', 'production', 'patient', 'people' and 'team' (Supplemental Table 4).

---

Insert Figure 2 about here

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Sensitivity analyses suggest that the found ten top relevant keywords through our explicit detailed procedure are sound. Use of different weighting rules does not significantly change the identified top relevant keywords, essentially their ordering was affected.

### *3.2 From top relevant keywords to leading Lean cultural clusters*

A fourth and last round of condensation was conducted inductively to transform the list of ten top relevant keywords into four better discerning cultural clusters.

The first grouping proposed combines Lean's top relevant keywords 'work', 'time', 'process', 'system', 'production' into a cultural cluster named "operations" (Table 4).

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Insert Table 4 about here

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The term operations refers to the basic definition of operations management as stated by Slack *et al.* (2007): 'the activity of managing the resources which are devoted to the production and delivery of products and services' (p.4). The strong predominance of the top relevant keywords forming this cluster suggests that Lean is a business method that focuses on what organizations and its members actually do as opposed to what they say and what they think they are doing. The methodological implications of this point for academics is to recognize that in order to best study and assess Lean implementation and sustainability, an ethnographic strategy with on-site visits would be the strongest and most accurate method whereas interviews would be a weaker way and surveys, the weakest mean of investigation. For practitioners, it suggests that Lean is a pragmatic fact-based business method. It reminds them that, under a Lean paradigm, organizational resources ought to be better spent on supporting the organization and all its members to work together to deliver products and services as best as they can and better every

day rather than investing in the search for a novel organizational structure, vision statement, business plan, marketing scheme, public relation stunt, etc.

Top relevant keywords of 'time', 'process' and to some extent 'work' but, particularly strongly, 'improvement' find a key construct in a second proposed Lean cultural cluster of "change".

The word change certainly encompasses well and more generically one of Lean's mantra, the lauded concept of 'continuous improvement', (Liker, 2004; Rother, 2010; Graban, 2012). Lean, as a dynamic organizational system, assumes and much embraces change structuring it through the practices of kata (Rother, 2010) and hoshin kanri (Liker, 2004). Lean organizations no longer need to increase readiness for change (Armenakis *et al.,* 1993; Weiner, 2009), they manage change proactively continuously.

'System' and 'team' appear appropriately associated with a third proposed cultural cluster of "collectivity" that echoes Hofstede *et al.* (2010) and Globe study (House *et al.,* 2004) dimensions of collectivism. Based on Merriam-Webster definitions (2018) of collectivity and collective, this cultural cluster refers to any grouping of cooperative units sharing similarities and interests. In case of Lean, it obviously starts at the aggregation of members into teams, then into organization, extending to a whole supply chain of organizations which have relationship with their communities, nations and the world. The notion of collectivity also recalls Lean's moral organizational goal to act as 'good citizen' and its strong engagement to take positive corporate social responsibility actions and adopt proper green environmentally sustainable practices (Piercy and Rich, 2015; Wu *et al.*, 2015).

Finally, if there one aspect that numerous authors have reported on Lean is certainly to be a humane form of management. Lean is indeed geared toward "respect for people" and even "respect for humanity" among its pillars or its bases (Sugimori *et al.*,1977; Liker, 2004). "Humanity" therefore seems to be fitting for condensing top relevant keywords 'patient', 'people' and by weaker extension 'team' as a fourth proposed cultural cluster.

Hence, it is proposed that, from these analyses, Lean has four leading cultural clusters: operations, change, collectivity and humanity (Figures 3).

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Insert Figure 3 about here

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Further work on the characterization of Lean culture, supported by these clusters, is felt to be more likely fruitful although, as it will be discussed later, other important cultural elements of Lean culture may have been missed by this admittedly high-level content analysis.

### *3.3 Lean cultural clusters and sociotechnical systems theory*

The four Lean cultural clusters, operations, change, collectivity and humanity find also legitimacy by consistency with the notion of sociotechnical systems and its theory, a linkage that has already been proposed by Shah and Ward (2007) in their definition of Lean.

Elaborated in the 1950's and 60's by several contributors, in particular Eric Trist and Fred Emery, sociotechnical systems theory contends that organizations, to get better performance, should seek optimal balance or joint optimization between their interdependent social components (people, members) (*humanity*) and technical components (tools, techniques, procedures, machines) (*operations*) as dynamic flexible open systems in continuous interactions (*change*) with their environment (*collectivity*). Sociotechnical system theory promotes non-bureaucratic organizational structuration (matrix, networks) formed by (semi-) autonomous groups (*collectivity*) composed of multiskilled operators who have quick access to necessary information and training for self-control (*humanity*). Team leaders replace managers (collectivity), efforts to eliminate status differentiation within organization and fair performance incentives and gainsharing to reward groups rather than individuals are instituted in an ideal sociotechnical view (humanity). This theory instructs to control organizational variances or irregularities as near as their sources to both enhance operational productivity and quality of work life as any deviations or disturbances affect one and the other (operations). Under its principle of equifinality, sociotechnical systems theory acknowledges that there are many ways and paths organizations may follow to structure and re-structure themselves in perpetual re-balancing efforts under ever changing conditions (change). There are also very specific statements regarding desirable human resource management (humanity-collectivity) in sociotechnical systems theory. For example, in order to get proper employee commitment and engagement, several suggestions on human needs to be fulfilled and rights to be respected are made as in a human need for work to be reasonably challenging, diverse (non-monotonous) and meaningful; rights for personal growth and continuing learning; needs for social support, recognition and constructive feedback on performance; rights for self-direction, self-realization and dignity; a need for appropriate job benefits and rights for job security, safety and protection (van der Zwaan, 1975; Passmore *et al.,* 1982; Miner, 2006). All these characteristics bare striking resemblance with Lean's teachings and find resonance with the four cultural clusters identified in this study.

## 4.0 Discussion

This work makes several contributions from a methodological perspective, from a Lean culture perspective and from a Lean general knowledge perspective, particularly regarding healthcare.

### *4.1 Methodological perspective*

Methodologically, this study provides evidence on the effectiveness, flexibility and scalability of content analysis for the exploration of cultural patterns in large documents. It demonstrates that even a rudimentary yet rigorous, relatively labor-intensive but widely available computer-aided text analysis (CATA) can uncover valuable insights. Selection of proper source data and adoption of appropriate analytical approaches to answer the study questions remain critical.

The transparent step-by-step 4-round condensation technique procedure employed in this work increases reliability and replicability of results. This technique also appears generalizable and could be applied to or adapted for other related analysis in other fields or on other types of source documents. Internal validity of the work is enhanced by its meticulous and strict word condensation method, by use of an expanded Pareto 80-20 principle for more objective cut-off decisions and by performance of multiple sensitivity analyses showing consistency in findings. External validity is supported by inclusion of a large number of representative relevant Lean documents from different authors, domains and publication time periods.

This methodology for the investigation on Lean culture stands on the following assumptions that: first, textbooks, as written documents, are legitimate cultural artefacts; second, word choices are meaningful and culturally informative; third, relative frequency signals importance and significance of words and related constructs; fourth, in the process of linking word variants (for example: work, works, workable, worked, working, workings), there remains a significant and valid construct; and fifth, this latter construct remains essentially the same whether the word is used as a noun, a verb, an adjective or an adverb and may be interpreted out of the word context. These last two assumptions stress an important point about this study: it is because its goal was to reveal broad clusters on Lean culture that this methodology becomes proper and suited. Other analytical schemes using more sophisticated analyses to permit deeper and more granular and detailed inferences would have been required otherwise.

### *4.2 Lean culture perspective*

The contributions that this work has on greater understanding of Lean culture reside as much as in what it shows and in what it does not show.

The four identified leading cultural clusters: operations, change, collectivity and humanity, suggest Lean to be a practical, dynamic, interdependent and humane business method, much aligned with sociotechnical systems theory as previously shown.

Lean is practical and dynamic as it is about enabling everyone involved in its organization to apply solutions and resolve all business problems right away as they present themselves and learning collectively from these experiences (Liker and Franz, 2011).

The first leading cultural cluster "operations", built from top relevant keywords 'work', 'time', 'process', 'system' and 'production' suggests that Lean is about what happens in organizations and what people are doing pragmatically. All stakeholders (leaders, managers, employees, suppliers, and even customers, especially in service organizations) are called out to pay attention to what is going on in the organization. These points about pivotal focus on operations are further exemplified and supported by the notion of gemba or 'real place' – the place where real action occurs (Imai, 2012) and the key and crucial managerial practice of going to the gemba for Lean success, as repetitively instructed by several, if not all, Lean authors (Imai, 2012; Mann, 2015; Graban, 2016).

The second leading cultural cluster "change" taken directly from top relevant keywords 'time' and 'improvement' and indirectly from 'work' and 'process' reminds organizational stakeholders that Lean embraces the fact that change, similar to time, is inevitable but they create opportunities to make everything better (Imai, 1986). Change may be hard and challenging but particularly when tested procedures such as PDCA (plan-do-check-act), value stream mapping and other Lean tools are applied with discipline, under a Lean paradigm, results follow.

The third leading cultural cluster "collectivity" based on top relevant keywords 'system', 'team' and 'organization', informs stakeholders that Lean requires and only works when all support it together interdependently. There is little place in Lean for individualistic, isolated in silo, protectionist attitudes which put everything at risk: behaviors with dire outcomes that are unfortunately seen too often in usual healthcare organizations (West and Lyubovnikova, 2013). Flow of information, collaboration, cooperation and coordination are paramount in Lean, which, incidentally, are also themes very close to interests and best practices in supply chain management, a discipline that studies cross-disciplinary integration, networks and provision of collective sustainable value

(Chen and Paulraj, 2004). These points all support collectivity as being a relevant Lean cultural cluster.

The fourth leading cultural cluster "humanity" derived from top relevant keywords 'patient', 'people' and by extension 'team', reminds stakeholders that, at its core, Lean achieve superior performance for people and by people. Lean recognizes that people have flaws and limitations but proposes ways to address and overcome them productively by extensive training and empathic human resources management, focusing on systemic improvement rather than individual shame and blame (Liker and Hoseus, 2008). But arguably the strongest evidence to support 'humanity' as a leading cultural focus comes from Sugimori *et al.* and their account on the Toyota Production System (1977):

> "*It has built up a system of respect for human, putting emphasis on the points as follows: (1) elimination of waste by workers; (2) consideration for workers' safety; and (3) self-display of workers' capabilities by entrusting them with greater responsibility and authority*." *p. 557.*

Lean's concerns for humanity and collectivity is also demonstrated with its links to corporate social responsibility and green operations (Piercy and Rich, 2015; Wu *et al.*, 2015).

All in all, collective understanding of Lean culture appears to be enhanced by this identification of four leading cultural clusters: operations, change, collectivity and humanity.

Interestingly though, in addition to the aforementioned quoted word 'waste', a few other words are surprisingly missing from lists of top relevant keywords such as excellence, value, costs, discipline, leadership, strategy. Further work would need to be done to provide valid answers on this point.

Moreover, it is notable that very few, if any, top potential relevant keywords directly evoke, with the exception of perhaps 'Lean' and 'kaizen', either symbols, values or assumptions associated to Lean. This observation supports the facts that Lean is a pragmatic business method and that Lean culture remain an under-developed concept warranting further investigations.

### *4.3 General Lean knowledge perspective*

A significant contribution of this work on general Lean knowledge is to remind how prominent and determinant the construct of 'time' is in Lean and continuous improvement.

The first distinctive feature of Toyota Production System reported by Sugimori *et al.* (1977) says it almost all: 'just-in-time production' but even more telling is Ohno's discussion on the matter in his book, Workplace Management (2013):

> *"I have realized this only recently, but apparently the phrase "just in time" is a created expression and not proper English…I heard from one person that "exactly on time" is proper English. Although they say that "just in time" is not proper English, I think "just in time" is a very good expression.*
>
> *The usage of "just in time" translated into Japanese is "to be just in time." It may be the "in time" that is not proper English. "Timing" is not the same as "time" but rather whether the timing is good or bad, as in whether it is on time or not on time, whether it is "in timing," although I don't know if that is proper English either. The word "just" was added so that enough to be on time would not be plenty in time. pp. 55-56.*

One of the most striking testimony on the importance of time in Lean can additionally be found in Liker and Ross (2017):

> "*Toyoda had a very strict policy of not wasting people's time and felt that this was a case where the person was subservient to the machine when the machine should be serving the person. As Toyota president Eiji Toyoda later explained: "A person's life is an accumulation of time—just one hour is equivalent to a person's life. Employees provide their precious hours of life to the company, so we have to use it effectively; otherwise we are wasting their life*." *p. 226.*

We submit that this excerpt also encapsulates the four leading cultural clusters identified by this study: operations, change, collectivity and humanity.

Finally, another significant contribution of this work is to demonstrate how analysis of content of Lean books, even though they are predominantly destined to practitioners, can fruitfully contribute to academic knowledge which in turn can be put to use back to practitioners.

## 5.0 Research implications

This work shows how content analyses can be an effective research method in management. And although it appears under-utilized, especially in operations management, its flexibility, its

scalability and its availability are likely to attract more and more researcher to experiment with it. Content analysis is flexible in the nature of the allowable source data. They only appear to be limited by researchers' imagination. It is flexible by permitting to tailor its methodology to accommodate any analyses of a wide range of study questions. It is flexible on how it easily can be combined with other qualitative and quantitative research methods as it stands on the fringe of both approaches. Content analysis become scalable with IT development and computer-aided text analysis (CATA). It is also readily available, in its simplest form, as word count is part of most word processor software programs. Multiple specialized CATA software programs exists with different capabilities for different purposes. Neuendorf (2017) discusses features of 18 of them in the latest edition of her book.

The other main implication for research of this study is the identification of four leading clusters that may help further research on Lean culture. Investigating organizational culture can easily become a daunting task as to simply determine where to most productively start. What Lean expert authors seem to be suggesting through the four identified leading clusters: operations, change, collectivity and humanity, is to start, for Lean, at the operational level or the gemba. Then, to examine how change, problem solving and improvement efforts happen at the gemba and throughout the organization to thereafter investigate how all organizational stakeholders organize themselves, are linked and work together. Efforts should also be directed to describe human relationships in the organization, how all stakeholders interact, communicate and support each other. The four leading cultural clusters do not imply there are no other important aspects of Lean culture to account but they suggest that these features are more likely to be the ones that are the most distinctive of Lean organizations.

## 6.0 Practical implications

Until research provides greater understanding of Lean culture and how to adopt it, already a few practical implications, or take away messages, to healthcare and other domains leaders and managers are suggested by this study four leading cultural clusters: 1-operations, 2-change, 3-collectivity and 4-humanity.

1- 'Operations' take away: Lean is a pragmatic practical business method. Its culture instructs to address problems proactively swiftly; to apply PDCA (plan-do-check-act) with discipline; to focus on operations and results will follow.

2- 'change' take away: Lean and its culture encourages to not just be unafraid of change but to embrace it. Its practices provide means on how to consider change as opportunities to seize

rather than crisis to manage. They also exemplify the common saying: slow and steady wins the race.

3- 'collectivity' take away: Lean culture stresses solidarity and togetherness. Whereas other common sayings tell all for one and one for all and chains are as strong as their weakest link, Lean success lies on all stakeholders playing their part and working together on continuous improvement of their organization.

4- Finally, 'humanity' take away: Lean is all about people. Lean culture seeks to strike the perfect balance between the requirements of the working life, social and personal life toward ever greater fulfillment and achievements collectively and individually.

If Lean transformation of healthcare or any other organizations is not easy, these pointers may prove to be helpful and inspiring to leaders and managers in their journey.

## 7.0 Limitations

This study contains several limitations that need to be acknowledged.

The first and main one regards its methodology. As pointed out in the introduction from Weber (1990), content analysis by single word frequency taken out of context may both over- and under-estimate construct effect. A situation for which no easy solution exists. However, since the purpose of the study was to unveil Lean's main cultural clusters which necessarily requires broad data condensation, we believe validity of findings is not seriously threatened. Additionally, consistency of findings observed through the different sensitivity analyses and the general face validity of this study results increases confidence.

A second limitation concerns the selection of source data. Although care was taken to include a large representative sample of respected Lean textbooks, there might be systematic yet unrecognized biases and blind spot in the content of these textbooks that do not portray Lean in its entire nature. Repeating this study with others source data such as academic papers, commercial articles, interviews of other Lean experts who have not committed themselves in writing textbooks to triangulate findings may increase generalizability.

A third limitation is linked also to source data selection. It is possible that direct observation or immersive experience in organizations, particularly in the field of healthcare, are necessary to better elucidate and fully appreciate Lean culture features. The use of written documents, as official, convenient and reliable as they are, remains filtered account by their authors.

A fourth limitation is found in the specific framing of this study in a cultural paradigm. Approaching Lean from other organizational change perspective such as neo-institutional, configurational, political or behavioral among other (Demers, 2007) could enhance understanding of Lean from a cultural perspective by an interplay of similarities and differences.

## 8.0 Further research and development

In addition of conducting further research to solve issues just raised by this study limitations, here are some other promising development paths that could be pursued:

1- from a methodological standpoint, it would be interesting to compare results of the same analysis performed by specialized software programs with emergent coding capabilities such as CATPAT II, T-Lab pro and PolyAnalyst, which execute analyses according to proprietary and hidden algorithms.

3- results' refinement could be obtained from applying other CATA methodologies such as key-word-in-context (KWIC) (Weber (1990)) or semiotic analysis (Neuendorf (2017) to not only gain more knowledge on Lean but to decipher as well how authors' writing style may affect Lean understanding.

4- repeating these CATA on texts of other managerial methods and theories such as Six Sigma (Schroeder *et al.*, 2008) or Total Quality Management (TQM) (Hackman and Wageman, 2005) would help to appreciate how much this study's results, particularly the four leading cultural clusters identified are Lean specific. It may also provide greater insights on how these approaches differ or are complimentary.

5- further investigations on Lean culture's symbols, values, beliefs and assumptions could be pursued in our textbook data set and potentially triangulated with other documentation sources using CATA and other qualitative analysis methods. This may eventually lead to characterization of Lean generic and Lean healthcare culture at its ultimate state and allow formulation of an evidence-based definition of Lean culture.

6- Finally, further inquiries on the similarities and differences of Lean and best practices in the discipline of supply chain management, strategy, innovation, marketing and/or performance management to generate cross-learnings are likely to be insightful.

## 9.0 Conclusion

This work presents a first application of content analysis in operations management, in Lean and in Lean healthcare and describes an original methodology. Results are suggesting four leading Lean culture clusters: operations, change, collectivity and humanity. These findings may stimulate more productive research on Lean, its culture and their association with sociotechnical systems theory. They may also inspire healthcare and other domains' leaders, managers and other stakeholders in their Lean organizational transformation journey to pay greater attention on operations, on how organizational change unfolds, on how organizational units work together in collectivity and on how human nature matters in this quest. This study also identifies the importance of time as a salient and under-appreciated focus in Lean culture that warrants further inquiries.

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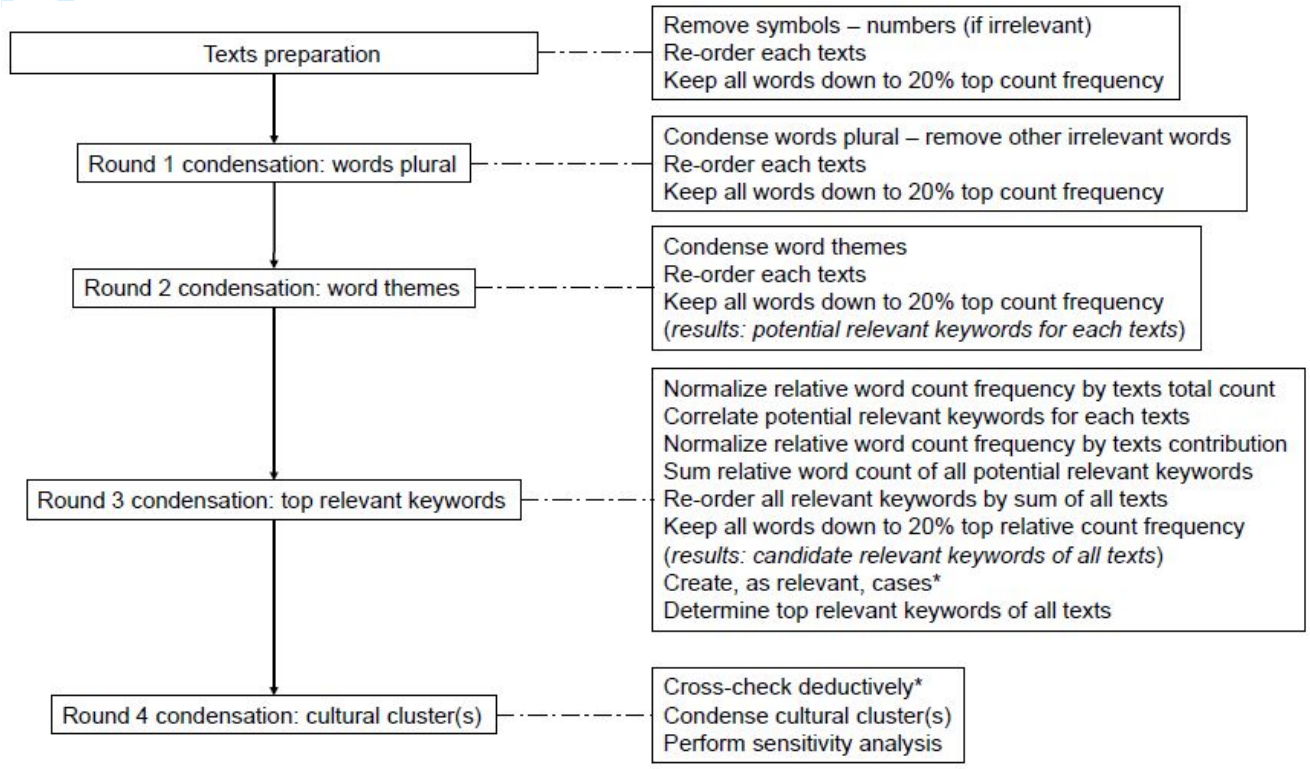
Figure 1 Cultural cluster exploration – computer-aided texts analysis (CCE-CATA) procedure




Legend: * optional steps

Figure 2 Candidate relevant keywords (and break-down by cases)

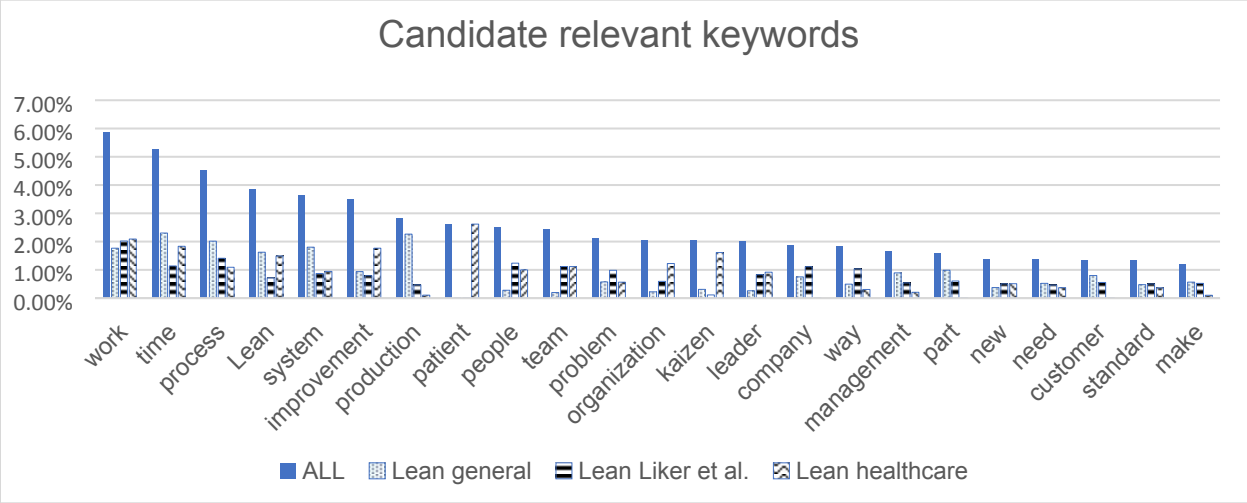
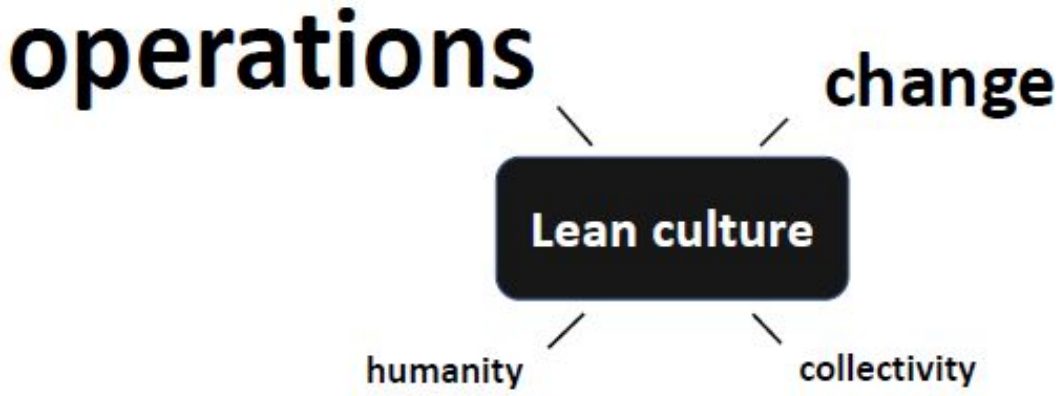


Figure 3 Lean cultural clusters diagram




Legend: figure illustrates clusters in size related to their relative word frequencies weight (operations (22.1 (45%)), change (14% (29%)), humanity (6.5% (13%)), collectivity (6% (12%)))

Table 1 Lean generic books

| Cases | Book - author(s), title, edition | Year | GSC# |
|---|---|---|---|
| LG-LM+ | Womack, J.P., Jones, D.T. and Roos, D., The machine that changed the world | 1990 | 15563 |
| LG-LM+ | Womack, J.P. and Jones, D.T., Lean Thinking: Banishing Waste and Create Wealth in Your Corporation | 1996 | 8668 |
| LG-LM+ | Ohno, T., Toyota Production System: Beyond Large-Scale Production | 1988 | 5868 |
| LG-LM+ | Ohno, T., Workplace Management (Special 100th Birthday ed.) | 2013 | 208 |
| LL-LM+ | Liker, J.K., The Toyota Way: 14 Management Principles from the World`s Greatest Manufacturer | 2004 | 5077 |
| LL-LM+ | Liker, J.K., Becoming Lean: inside stories of US manufacturers | 1997 | 444 |
| LL-LM+ | Liker, J.K., Hoseus, M, The Toyota Culture: The Heart and Soul of the Toyota Way | 2008 | 415 |
| LL-LM+ | Liker, J.K., Meier, D, The Toyota Talent: Developing Your People the Toyota Way | 2007 | 197 |
| LL-LM+ | Liker, J.K., Convis, G.L., The Toyota Way to Lean Leadership: Achieving And Sustaining Excellence through Leadership Development | 2012 | 121 |
| LL-LM+ | Liker, J.K., Franz, J.K., The Toyota Way to Continuous Improvement: Linking Strategy to Operational Excellence to Achieve Superior Performance | 2011 | 102 |
| LL-LM+ | Liker, J.K. Developing Lean Leaders at all levels: A Practical Guide | 2015 | 7 |
| LL-LS | Liker, J.K., Ross, K, The Toyota Way to Service Excellence: Lean Transformation for Service Organizations | 2017 | 0 |
| LG-LM+ | Monden, Y., Toyota Production System: An Integrated Approach to Just-in-Time (4th ed.) | 2012 | 2357 |
| LG-LM+ | Imai, M., Gemba Kaizen (2nd ed.) | 2012 | 704 |
| LG-LM+ | Imai, M., Kaizen: The Key to Japan's Competitive Success | 1986 | 210 |
| LG-LM+ | Dennis, P., Lean Production simplified: A plain-language guide to the world`s most powerful production system (3rd ed) | 2016 | 598 |
| LG-LM+ | Bicheno, J., Holweg, M., The Lean Toolbox (5th ed.) | 2017 | 549 |
| LG-LS | Bicheno, J., The Lean Toolbox for Service Systems | 2008 | 100 |
| LG-LM+ | Rother, M., Toyota Kata | 2010 | 452 |
| LG-LM+ | Rother, M., Aulinger, G, Toyota Kata Culture | 2017 | 0 |
| LG-LM+ | Mann, D., Creating a Lean Culture: Tools to Sustain Lean Conversions (3rd ed.) | 2015 | 412 |

Note 1: cases: LG: Lean general; LAP: Lean manufacturing+; LL; Lean Liker *et al*.; LS: Lean service

Note 2: GSC#: 'Google Scholar citation number' as of August 1st, 2017.

Note 3: Books are sorted according to GSC# from highest to lowest. Cases are determined by first author`s contributions.

Note 4: Books discarded because of having GSC# less than 300: Maskell, B.H., Practical Lean accounting: a proven system for measuring and managing the lean enterprise (GSC# 258); Forbes, L. H., Ahmed, S. M., Modern construction (GSC# 180); Conner, G., Lean manufacturing for the small shop (GSC# 135); Bell, S., Lean enterprise systems: using IT for continuous improvement (GSC# 116); Sayer, N. Lean for Dummies (GSC# 110); several others of less than 100 existed.

Table 3 Lean healthcare books

| Cases | Book author(s), title, edition | Year | GSC# |
|---|---|---|---|
| LH-LS | Graban, M., Lean Hospitals: Improving Quality, Patient Safety and Employee Engagement (2nd ed.) | 2016 | 160 |
| LH-LS | Graban, M., Swartz, J.E., Healthcare Kaizen: Engaging Front-Line Staff in Sustainable Continuous Improvements | 2012 | 30 |
| LH-LS | Graban, M. Swartz, J.E., The Executive Guide to Healthcare Kaizen: Leadership for a Continuously Learning and Improving Organization | 2013 | 9 |
| | Virginia Mason Experience | | |
| LH-LS | Kenney, C., Transforming Health Care: Virginia Mason Medical Center`s Pursuit of the Perfect Patient Excellence | 2011 | 141 |
| LH-LS | Plsek, P.E., Accelerating Health Care Transformation with Lean and Innovation: The Virginia Mason Experience | 2014 | 26 |
| LH-LS | Kenney, C., A Leadership Journey in Health Care: Virginia Mason`s Story | 2015 | 2 |
| | ThedaCare Experience | | |
| LH-LS | Toussaint, J., Gerard, R.A., Adams, E., On the Mend: Revolutionizing Healthcare | 2010 | 136 |
| LH-LS | Barnas, K., Toussaint, J., Beyond Heroes: A Lean Management System for Healthcare | 2014 | 10 |
| LH-LS | Toussaint, J., Management on the Mend: The Executive Guide to System Transformation | 2015 | 6 |
| LH-LS | Black, J., Miller, D., The Toyota Way to Healthcare Excellence (2nd ed.) | 2016 | 80 |
| LH-LS | Zidel, T.G., A Guide to Transforming Healthcare | 2006 | 67 |
| LH-LS | Zidel, T.G., Rethinking Lean in Healthcare A Business Novel on How a Hospital Restored Quality Patient Care and Obtained Financial Stability Using Lean | 2016 | 0 |

Note 1: cases: LH: Lean healthcare; LS: Lean service

Note 2: GSC#: 'Google Scholar citation number' as of August 1st, 2017.

Note 3: Books are sorted out according to GSC# from highest to lowest. Cases for Lean Healthcare are determined by a mix of first authors' and organization experiences' contributions.

Note 4: Books discarded because of having GSC# less than 50: Wellman, J., Jeffries, H., Leading the Lean Healthcare Journey: Driving Culture Change to Increase Value (GSC# 47); Aherne, J., Whelton, J., Applying Lean in Healthcare: A Collection of International Case Studies (GSC # 33); Grunden, N., Pittsburg way to efficient healthcare: improving patient care using Toyota based methods (GSC# 28); Grunden, N., Hagood, C., Lean-led hospital design: Creating the efficient hospital of the future (GSC# 22); Gabow, P.A., Goodman, P.L., Lean Prescription: Powerful Medicine for our ailing healthcare system (GSC# 10); Bercaw, R.G., Taking Improvement from the Assembly Line to Healthcare (GSC# 5)

## Table 3 Word frequencies

| **Lean healthcare case** | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1st Author | Graban | Graban | Graban | Kenney | Plsek | Kenney | Toussaint | Barnas | Toussaint | Black | Zidel | Zidel | | | | | |
| Main Credentials | Engineering Management | Engineering Management | Engineering Management | Journalism | Engineering Management | Journalism | Physician Management | Management | Physician Management | Engineering Management | Management Engineering | Management Engineering | | | | | |
| Book Title | Hospital | Kaizen | Executive | Transforming | Innovation | Leadership | On Mend | Heroes | Mngt Mend | Excellence | Transforming | Rethinking | | average | min | max | sum |
| Year | 2016 | 2012 | 2013 | 2011 | 2014 | 2015 | 2010 | 2014 | 2015 | 2016 | 2006 | 2016 | | | | | |
| #words* | 119564 | 87370 | 46180 | 81725 | 66938 | 53245 | 40222 | 44544 | 49162 | 94607 | 33838 | 51182 | | 64048 | 33838 | 119564 | |
| # words | 121856 | 88696 | 47040 | 83229 | 67454 | 53794 | 40941 | 45223 | 49814 | 97162 | 34444 | 52541 | | 65183 | 34444 | 121856 | 782194 |
| % difference | 2% | 1% | 2% | 2% | 1% | 1% | 2% | 2% | 1% | 3% | 2% | | | | | | |
| # distinct | 7143 | 6506 | 4586 | 6536 | 5889 | 5000 | 4924 | 4549 | 5188 | 7116 | 3818 | 4357 | | 5468 | 3818 | 7143 | |
| Top word | patient | kaizen | kaizen | patient | innovation | work | patient | work | Lean | Lean | time | said | | | | | |
| # count | 1073 | 1433 | 1021 | 879 | 873 | 436 | 381 | 422 | 369 | 920 | 377 | 301 | | | | | |
| 80%Pareto | 215 | 287 | 204 | 176 | 175 | 87 | 76 | 84 | 74 | 184 | 75 | 60 | | | | | |
| # pKR | 29 | 11 | 9 | 17 | 16 | 19 | 22 | 19 | 32 | 19 | 18 | 35 | | 21 | 9 | 35 | |
| | | | | | | | | | | | | | | | | | |
| **Lean general case** | | | | | | | | | | | | | | | | | |
| 1st Author | Womack | Womack | Ohno | Ohno | Monden | Imai | Imai | Dennis | Bicheno | Bicheno | Rother | Rother | Mann | | | | |
| Main Credentials | Political Sc Management | Political Sc Management | Engineering Management | Engineering Management | Accounting Management | Management | Management | Engineering Management | Engineering Management | Engineering Management | Management Engineering | Management Engineering | Management Psychology | | | | |
| Book Title | Machine | Thinking | TPS | Workplace | TPS | Gemba | Kaizen | LP | Toolbox | Service | Kata | Culture | Culture | | | | |
| Year | 1990 | 1996 | 1988 | 2013 | 2012 | 2012 | 1986 | 2016 | 2017 | 2008 | 2010 | 2017 | 2015 | | | | |
| #words* | 87618 | 107420 | 35733 | 36501 | 107922 | 61413 | 46825 | 30408 | 163653 | 76640 | 58899 | 10711 | 69301 | 68696 | 10711 | 163653 | |
| # words | 90109 | 110148 | 36412 | 36820 | 109971 | 62711 | 47947 | 30464 | 164723 | 77692 | 60102 | 10990 | 70249 | 69872 | 10990 | 164723 | 908338 |
| % difference | 3% | 2% | 2% | 1% | 2% | 2% | 2% | 0% | 1% | 1% | 2% | 3% | 1% | | | | |
| # distinct | 6793 | 7430 | 4023 | 2974 | 6049 | 5195 | 4896 | 4060 | 9353 | 6209 | 4501 | 1623 | 5004 | 5239 | 1623 | 9353 | |
| Top word | production | product | production | work | production | kaizen | management | process | time | service | improvement | coaching | Lean | | | | |
| # count | 952 | 634 | 580 | 265 | 1253 | 430 | 482 | 242 | 1225 | 690 | 591 | 280 | 1233 | | | | |
| 80%Pareto | 190 | 127 | 116 | 53 | 251 | 86 | 96 | 48 | 245 | 138 | 118 | 56 | 247 | | | | |
| # pKR | 19 | 38 | 10 | 31 | 19 | 35 | 25 | 30 | 34 | 16 | 19 | 10 | 11 | 23 | 10 | 38 | |
| | | | | | | | | | | | | | | | | | |
| **Lean Liker *et al.* case** | | | | | | | | | | | | | | | | | |
| Author | Liker | Liker | Liker | Liker | Liker | Liker | Liker | Liker | | | | | | | | | |
| Main Credentials | Engineering Management | Engineering Management | Engineering Management | Engineering Management | Engineering Management | Engineering Management | Engineering Management | Engineering Management | | | | | | | | | |
| Title | 14 | Becoming | Culture | Talent | Leadership | CI | Developing | Service | | | | | | | | | |
| Year | 2004 | 1997 | 2008 | 2007 | 2012 | 2011 | 2015 | 2017 | | | | | | | | | |
| #words* | 100674 | 65425 | 173259 | 89360 | 82190 | 48705 | 96998 | 144264 | | | | | | 100109 | 48705 | 173259 | |
| # words | 102624 | 66476 | 175481 | 90322 | 83854 | 49383 | 97009 | 146756 | | | | | | 101488 | 49383 | 175481 | 811905 |
| % difference | 2% | 2% | 1% | 1% | 2% | 1% | 0% | 2% | | | | | | | | | |
| # distinct | 6965 | 5726 | 10177 | 5389 | 6020 | 4639 | 5334 | 7975 | | | | | | 6528 | 4639 | 10177 | |
| Top | process | production | team(s) | job(s) | leader(s) | lean | work(s) | work(s) | | | | | | | | | |
| # count | 568 | 448 | 1394 | 927 | 618 | 386 | 580 | 1001 | | | | | | | | | |
| 80%Pareto | 114 | 90 | 279 | 185 | 124 | 77 | 116 | 200 | | | | | | | | | |
| # pKR | 39 | 36 | 33 | 18 | 37 | 31 | 48 | 31 | | | | | | 34 | 18 | 48 | |
| | | | | | | | | | | | | | # words | 78848 | | | 2502437 |
| * by MsWord | | | | | | | | | | | | | average | | | | total sum |
| other: by Atlas.ti | | | | | | | | | | | | | # pKR | 26 | | | |

Legend: pKR: potential keyword

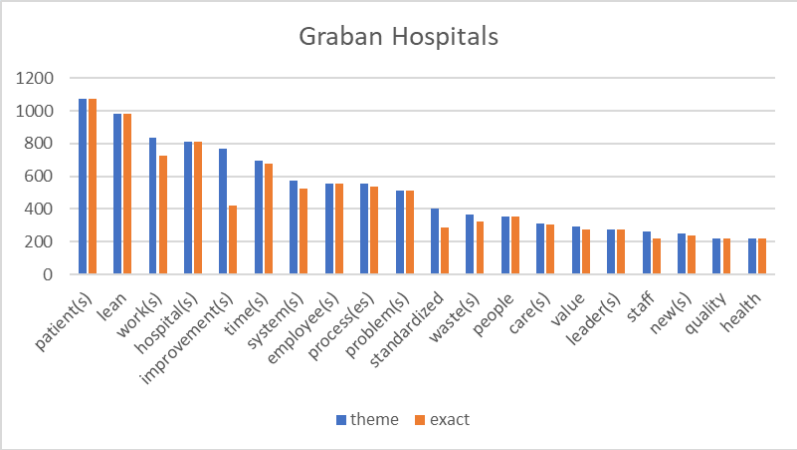
Table 4: Qualitative correlation table of top relevant keywords (Top RK) and Lean cultural clusters

| Top RK | Operations | Change | Collectivity | Humanity |
|---|---|---|---|---|
| work | | | | |
| time | | | | |
| process | | | | |
| Lean | | | | |
| system | | | | |
| improvement | | | | |
| production | | | | |
| patient | | | | |
| people | | | | |
| team | | | | |

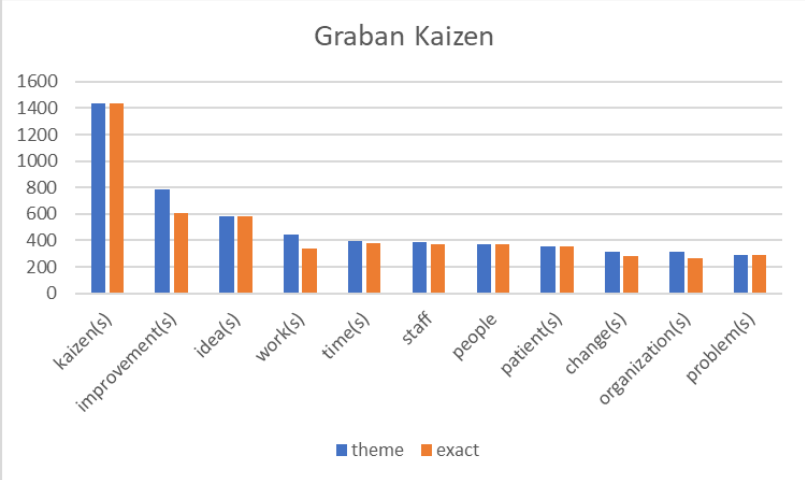
| Legend: | strong | |
|---|---|---|
| | weak | |
| | assumed | |

## Supplemental Figures 1 – Pareto histogram (potential key words)

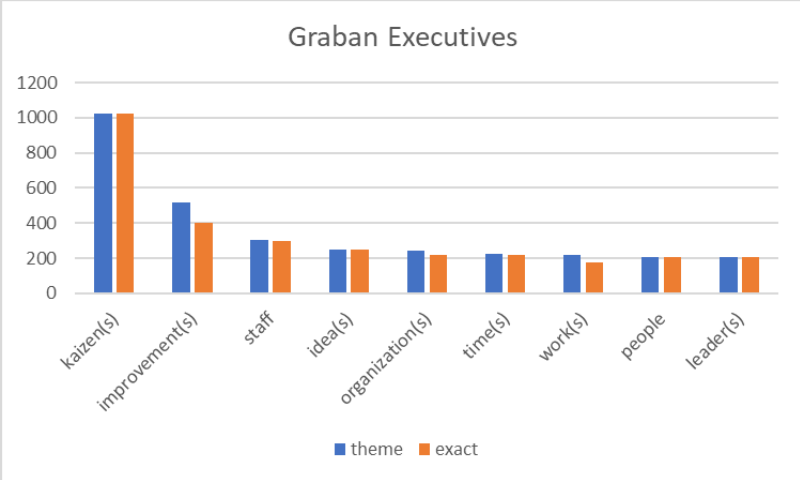
### Supplemental Figure 1.1



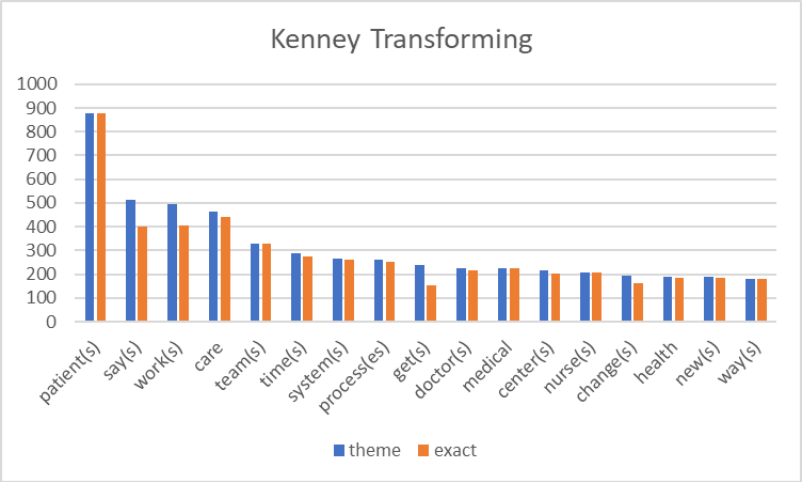

### Supplemental Figure 1.2



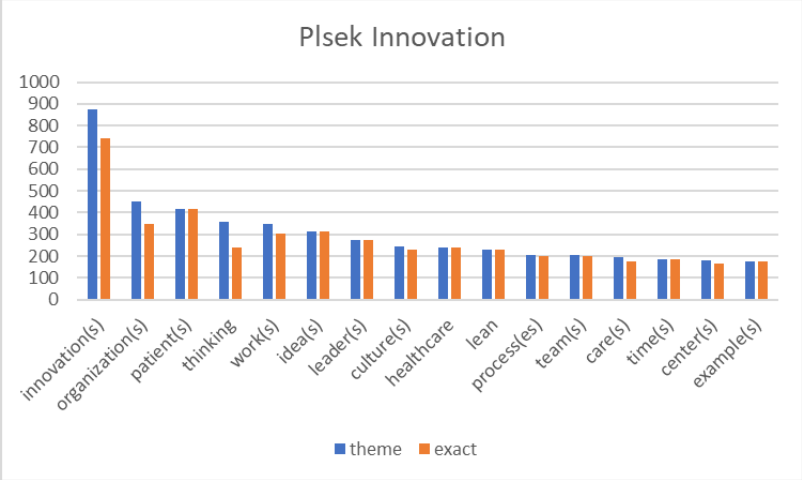

### Supplemental Figure 1.3



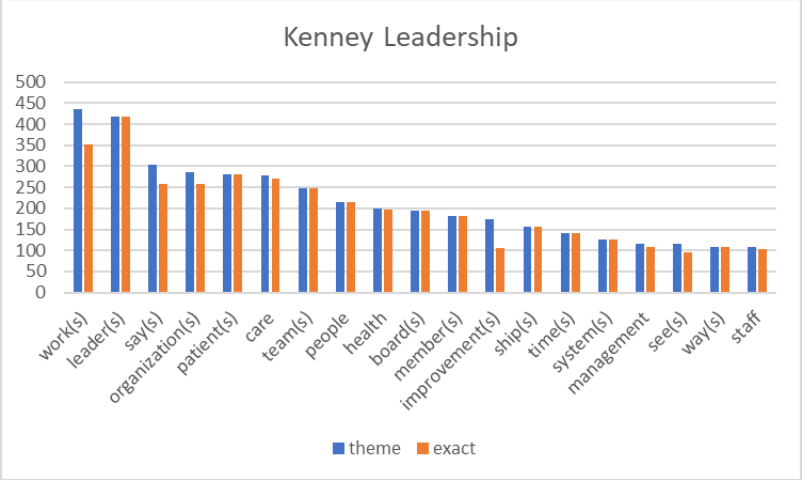
Supplemental Figure 1.4



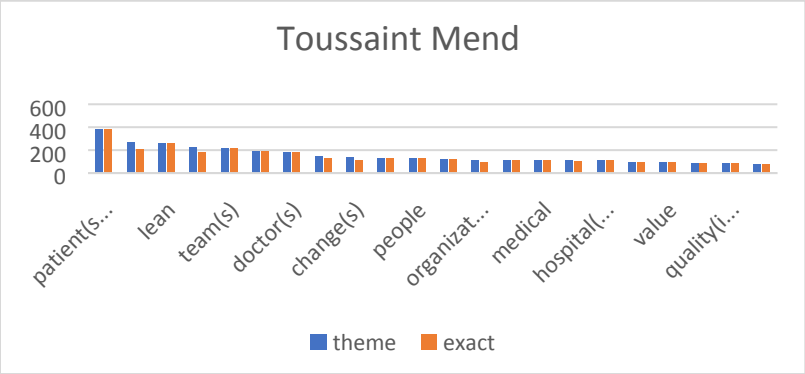

Supplemental Figure 1.5



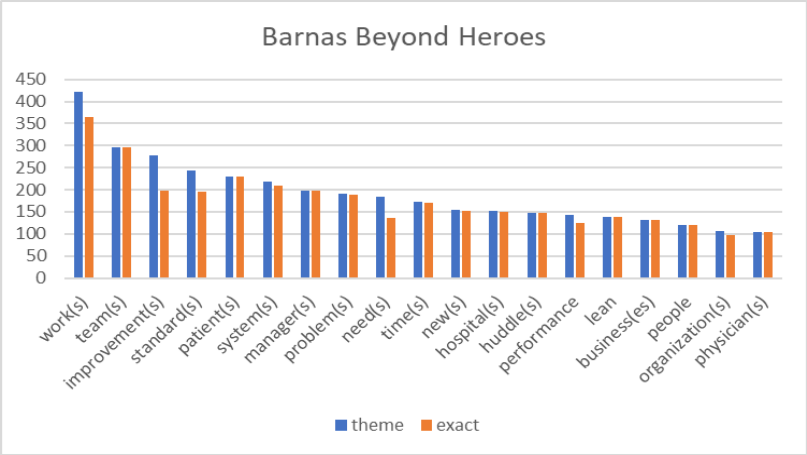

Supplemental Figure 1.6



Supplemental Figure 1.7




Supplemental Figure 1.8

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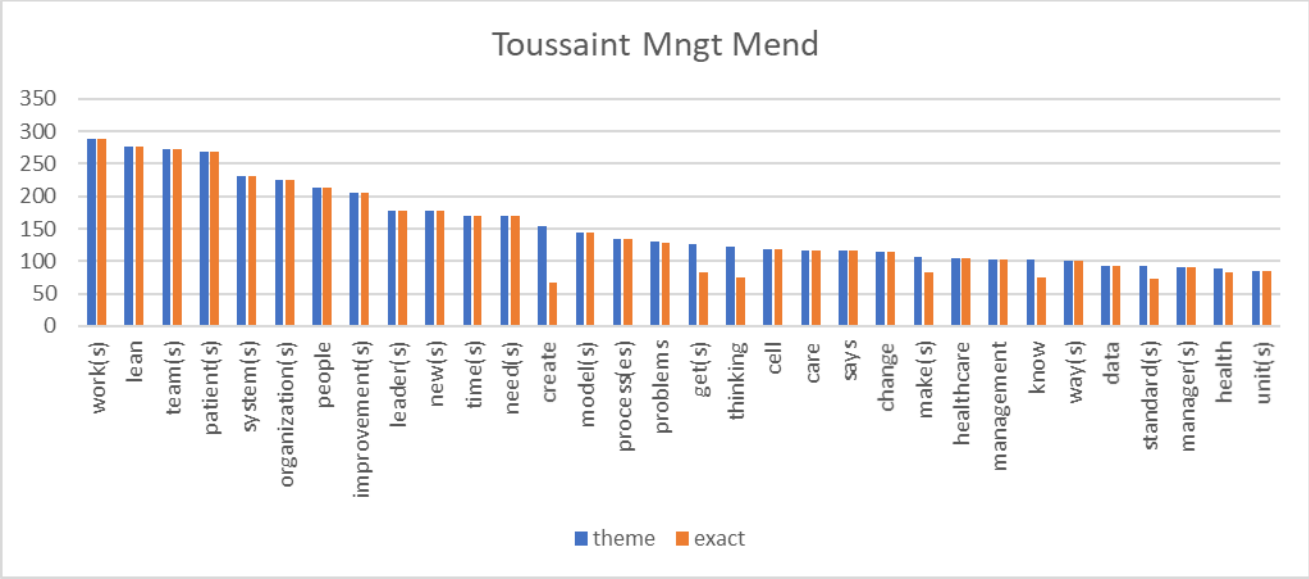

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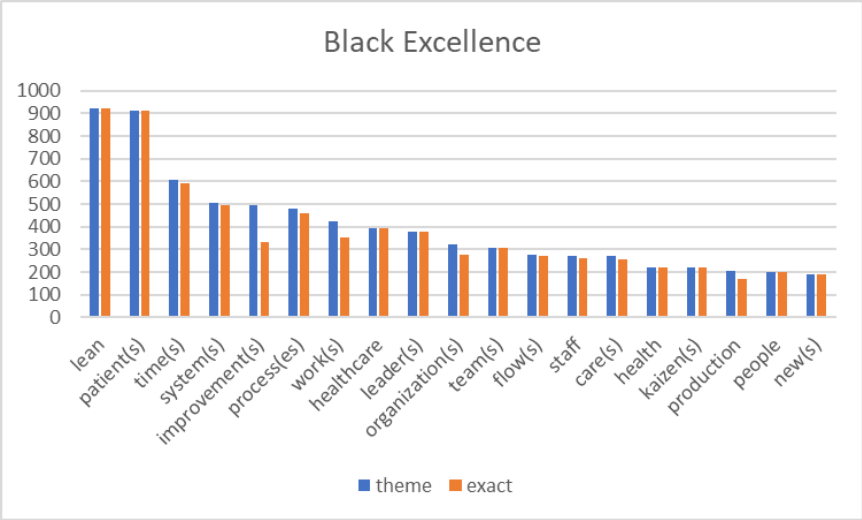


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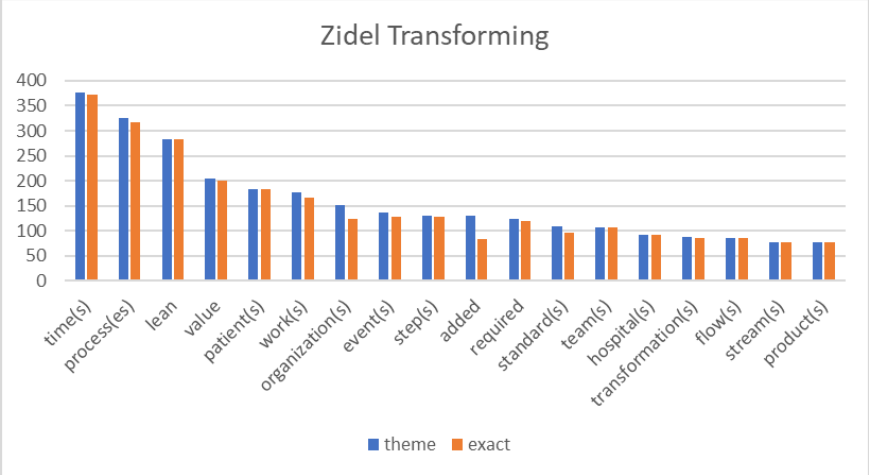


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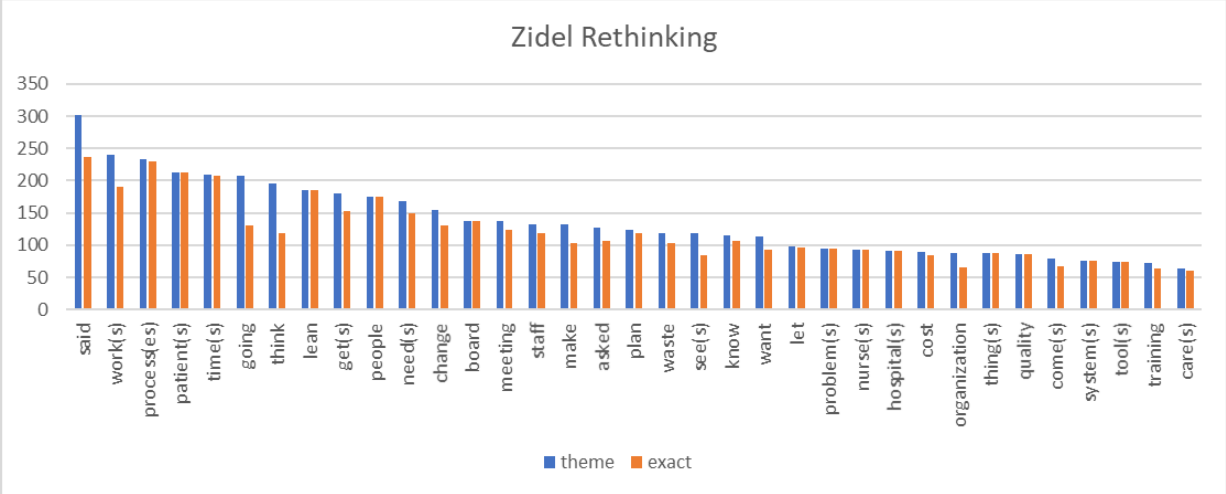
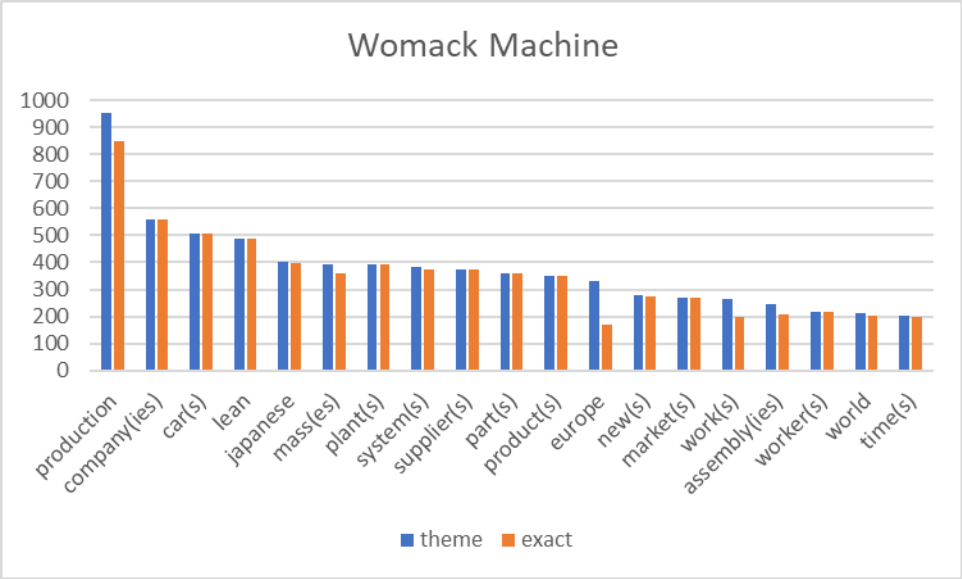
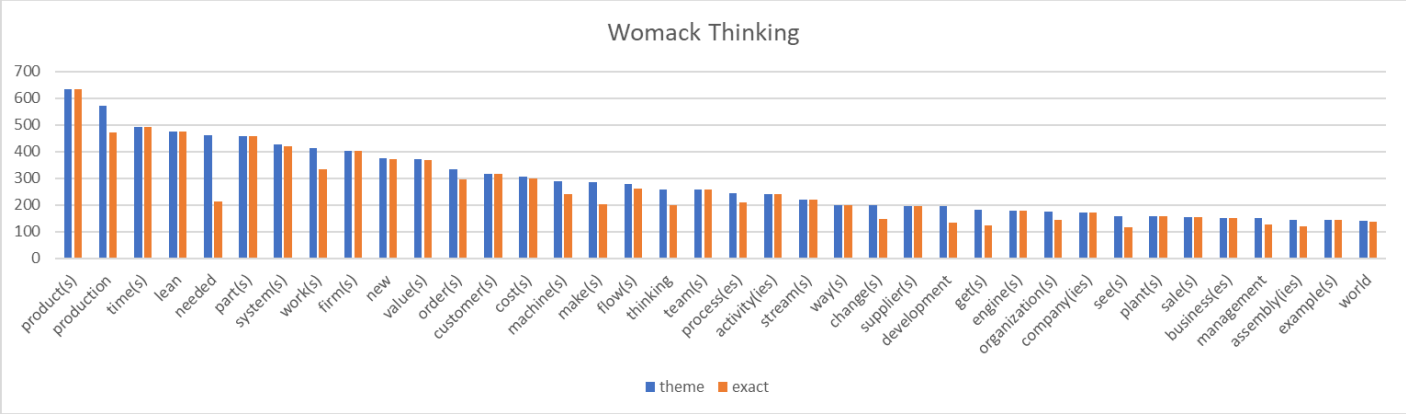


Supplemental Figure 1.13




Supplemental Figure 1.14

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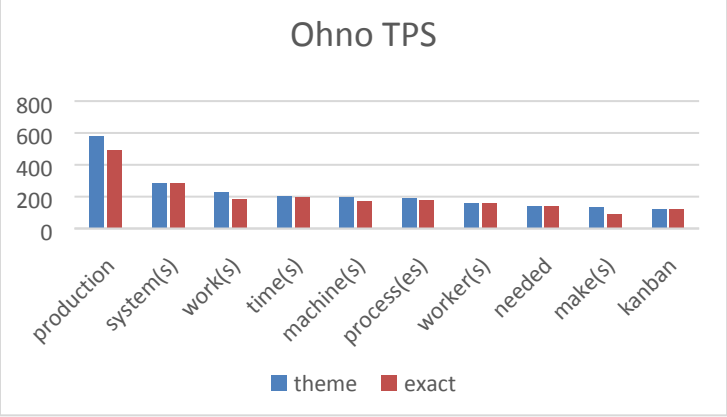

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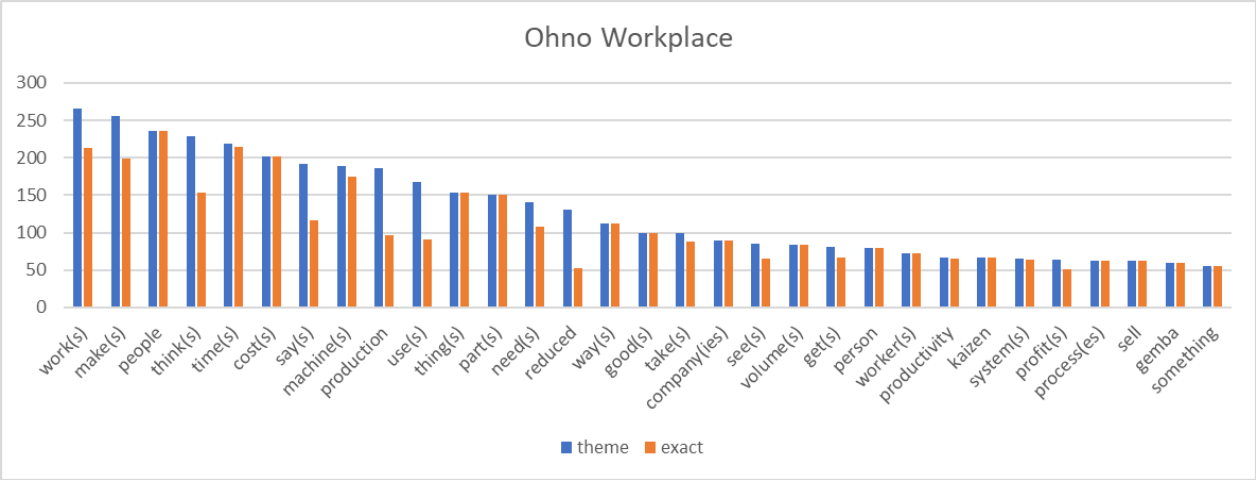


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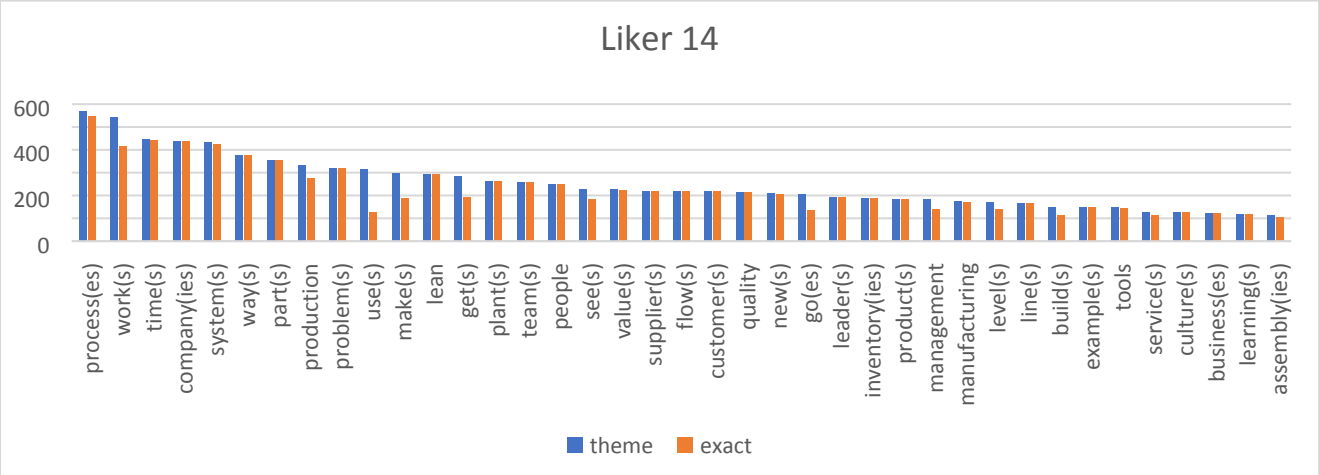
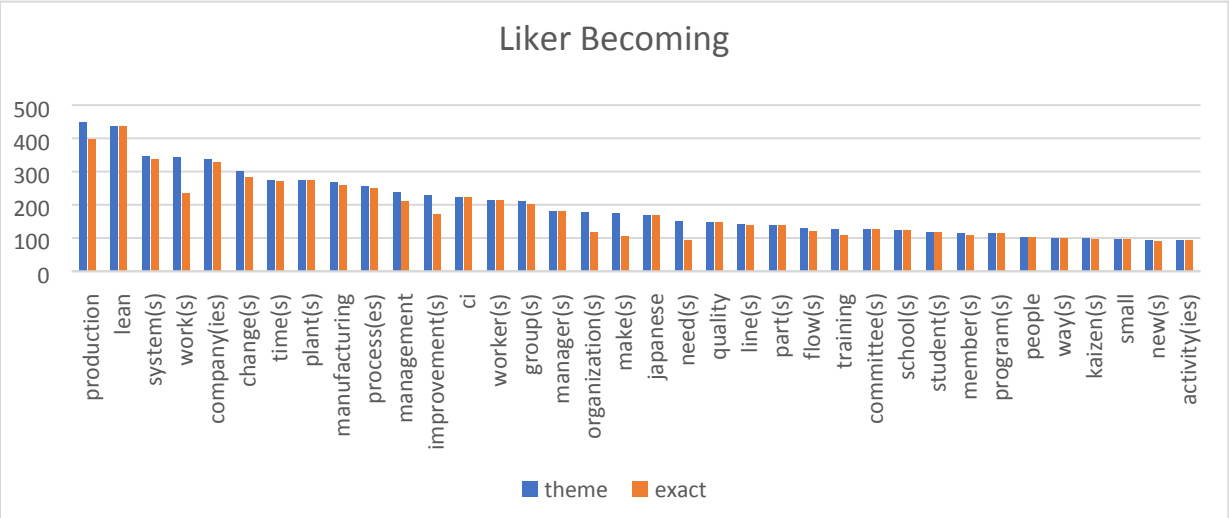



Supplemental Figure 1.18



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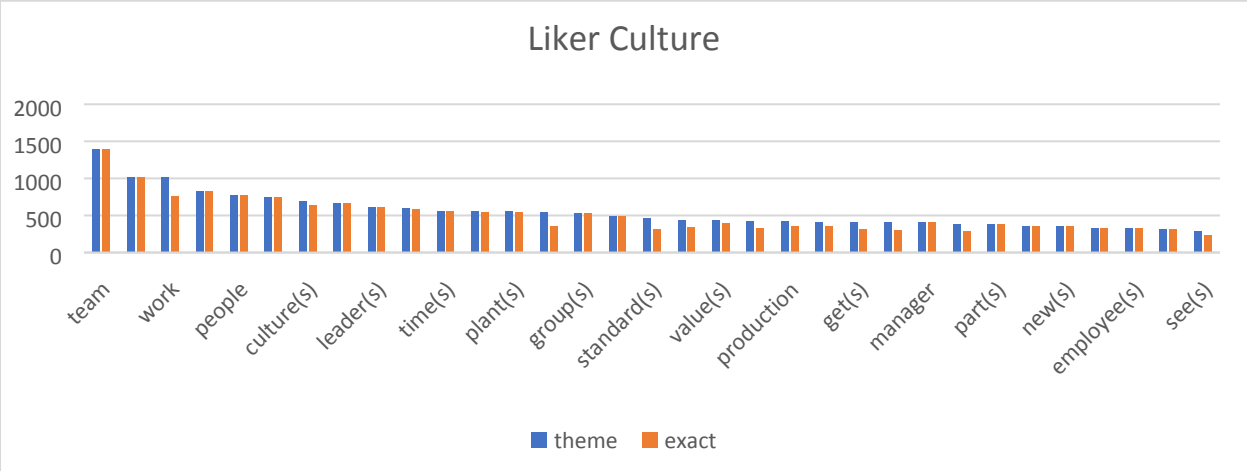


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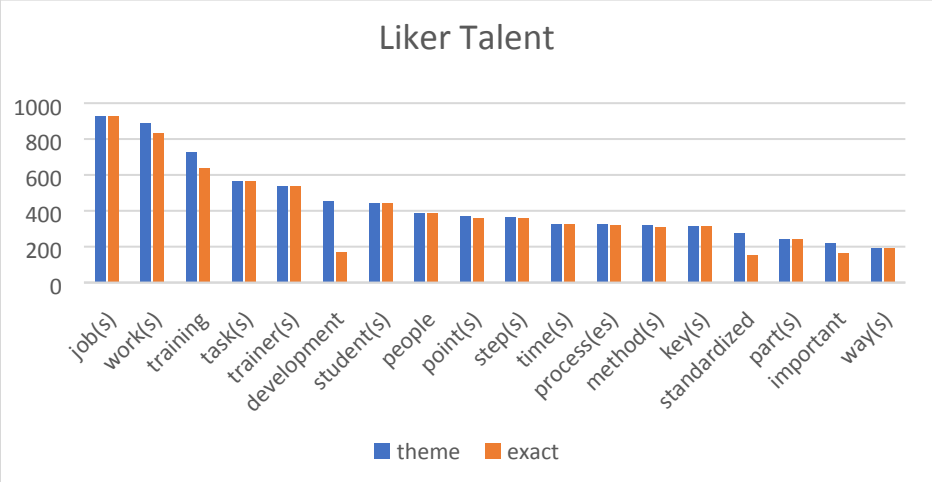


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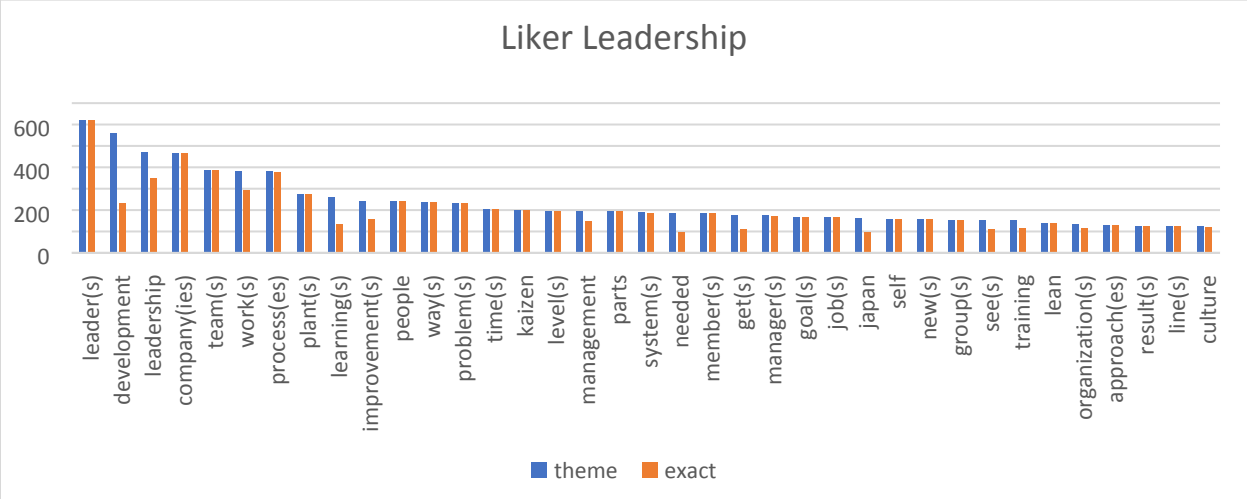

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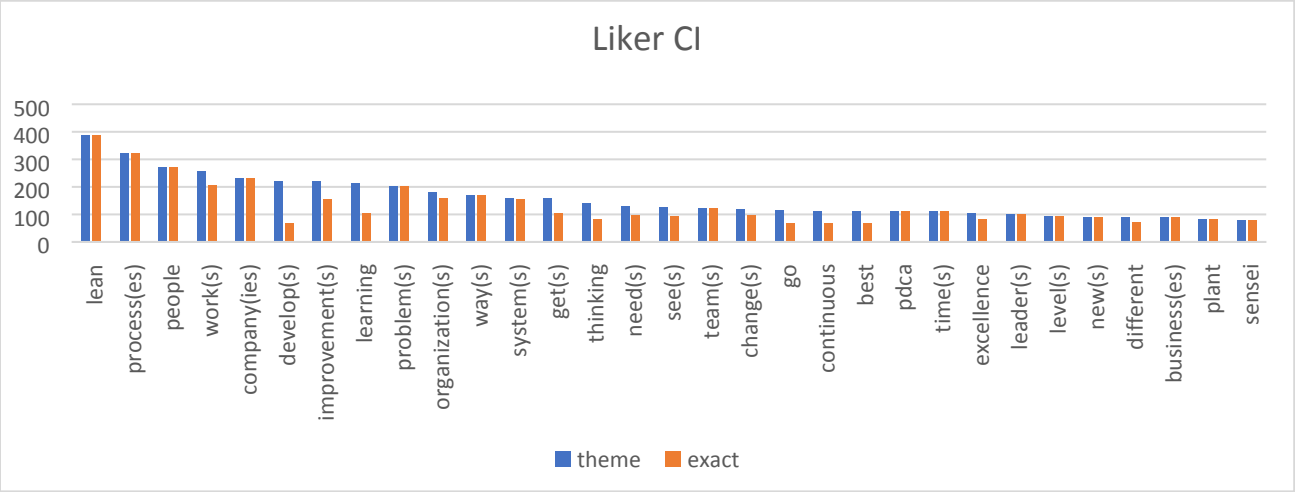


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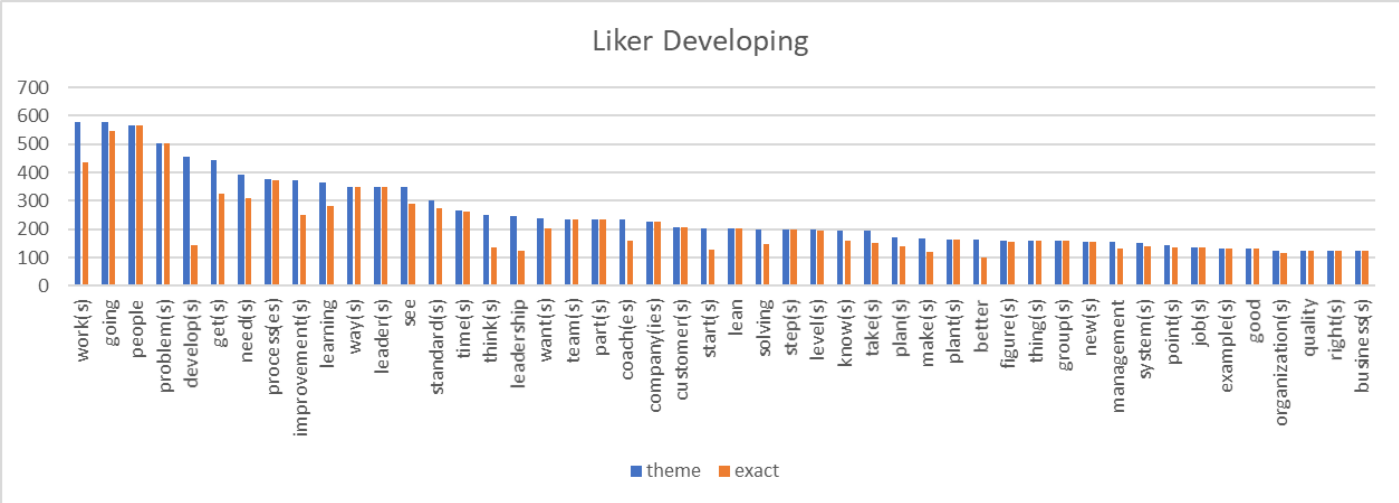


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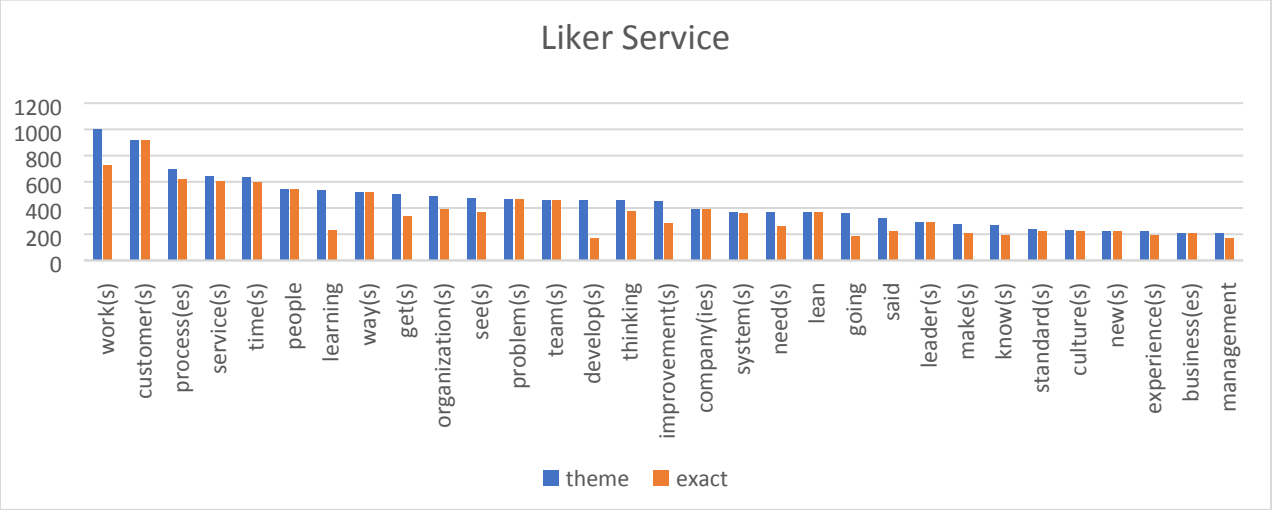
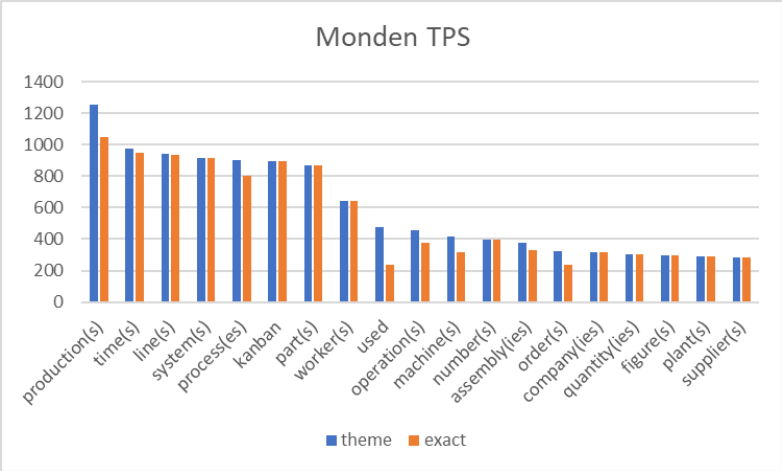
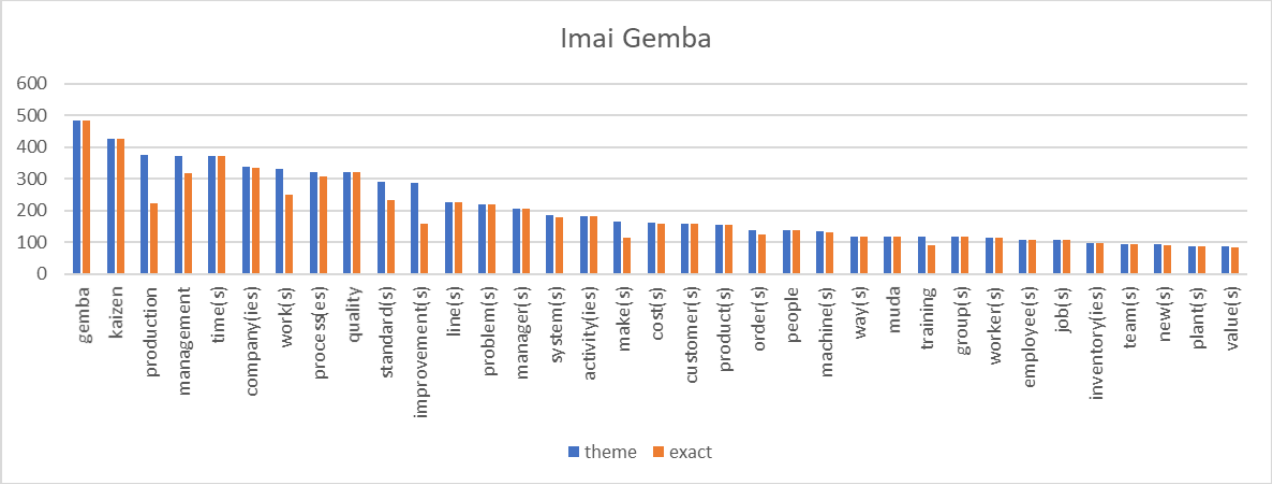


Supplemental Figure 1.25




Supplemental Figure 1.26

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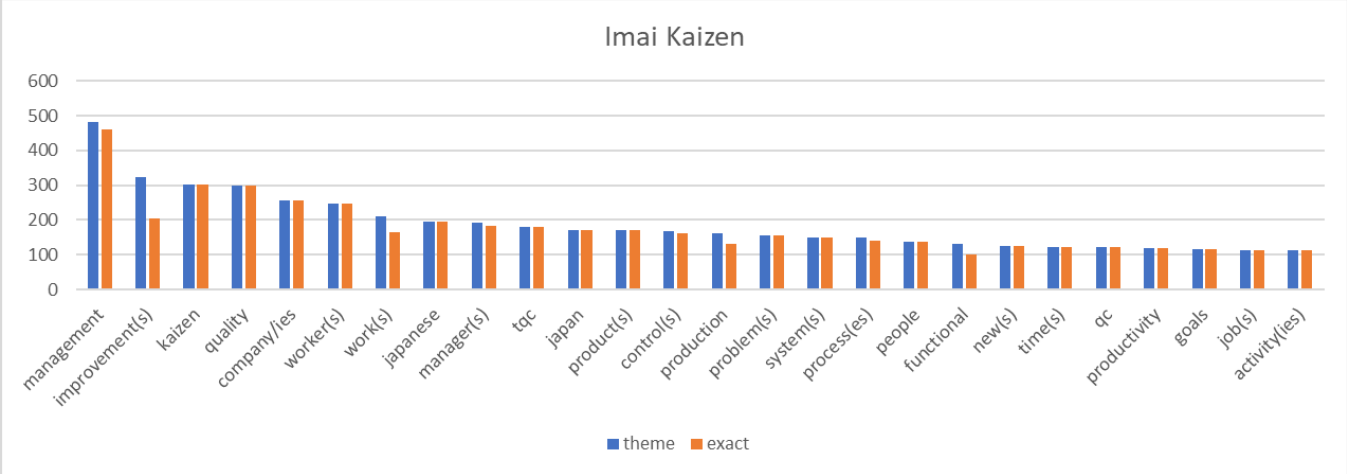

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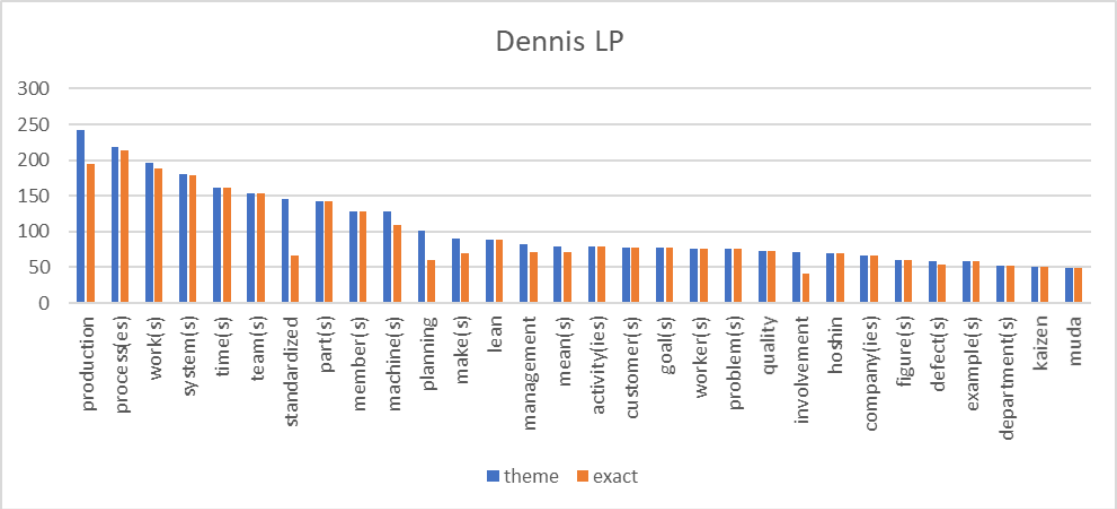


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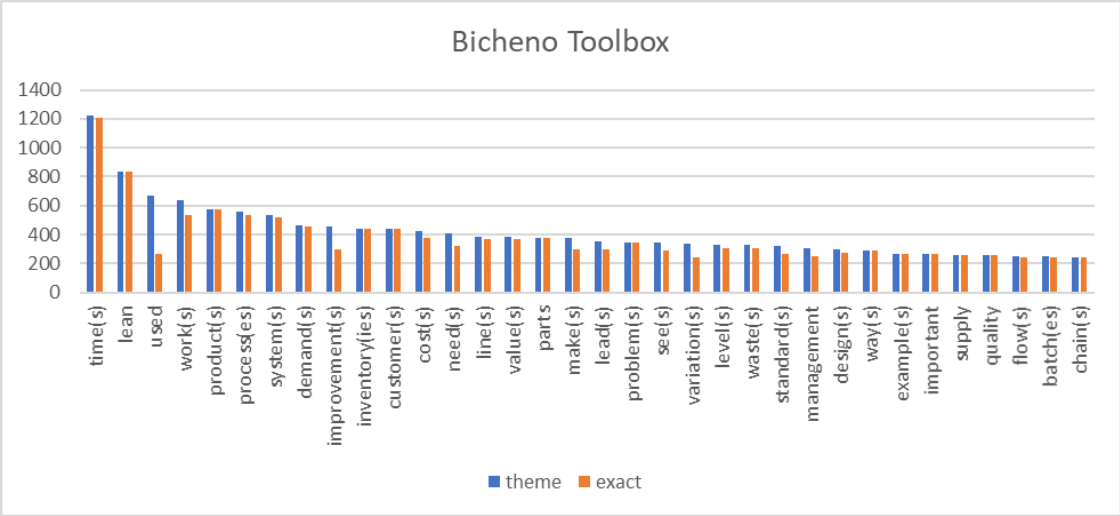
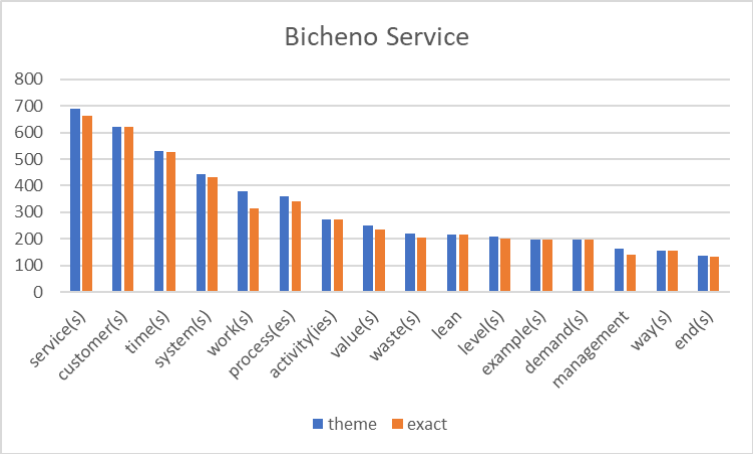
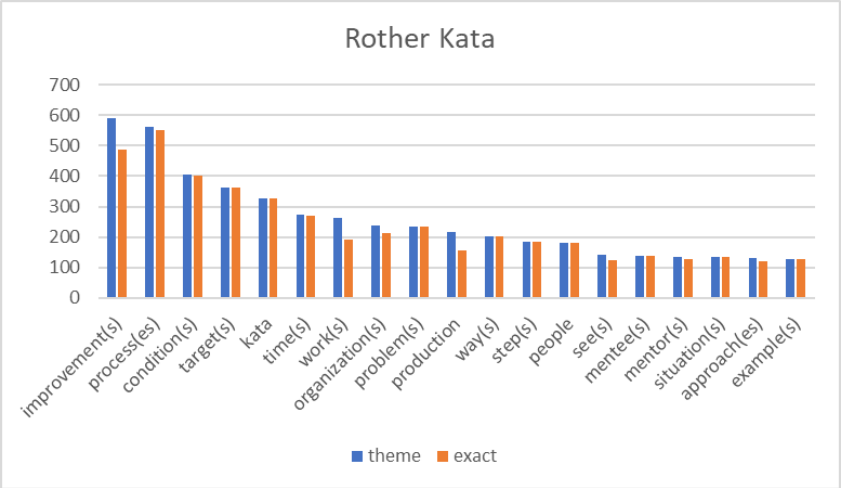


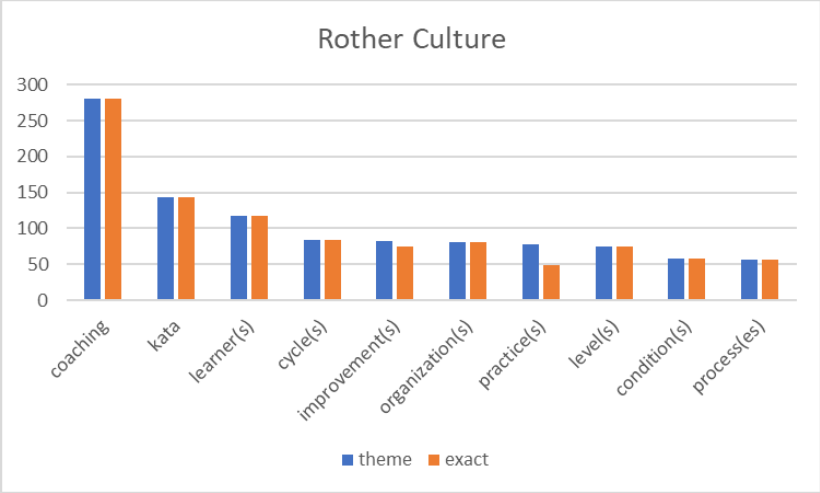

Supplemental Figure 1.30



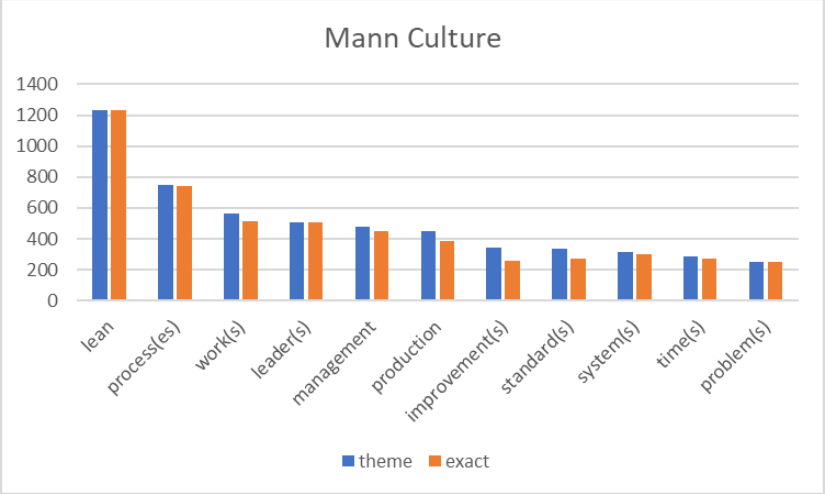
Supplemental Figure 1.31




Supplemental Figure 1.32




Supplemental Figure 1.33



Supplemental table 1: Extra "stop and go" words list removed

| First author/Title | Extra "stop and go" words removed in step four |
|---|---|
| Graban Hospitals: | can, s, might, one, often, just, also, many |
| Graban Kaizen: | can, s, one, Franciscan, will, might |
| Graban Executives: | s, Franciscan, can, one, small, will, better |
| Kenney Transforming: | Virginia, Mason, s, t, one, Kaplan, many, re, can, day |
| Plsek Innovation: | virginia, mason, s, one, can, also, vmps |
| Kenney Leadership: | Virginia, Mason, s, t, can, one, every, many, years, Kaplan |
| Toussaint Mend: | s, thedacare, one, every, can, will, also, years, john |
| Barnas Beyond Heroes: | s, will, one, every, unit, can, like, day, also |
| Toussaint Mngt Mend: | will, s, every, one, can, thedacare, also, everyone, first, year, like, two, many, now, must, instead, just, better |
| Black Excellence: | s, one, percent, can, first, also, Saskatchewan, t |
| Zidel Transforming: | will, must, s, one, may, can, non, first |
| Zidel Rethinking: | Nick, s, t, can, will, one, don, just, re, megan, everyone, joe, first, m, two, like, back, donna, well, three, next, good, also, il, must, however, another, now, okay, morning, ron, didn, even, ve, asha, day |
| Womack Machine: | s, ford, one, will, many, can, Toyota |
| Womack Thinking: | s, one, can, Toyota, will, pratt, many, every, first, porshe, percent, even, just, next, t, two, much, three, years, large, however, wiremold, also |
| Ohno TPS: | Toyota, s, can, one, must, toyoda, however, ford, will, just, even, many |
| Ohno Workplace: | will, can, just, one, even, Toyota, may, must, many, s, t, like, percent |
| Liker 14: | Toyota, s, one, will, can, tps, like, many, even, first, just, every, also, day, ford |
| Liker Becoming: | s, one, Toyota, will, ford, first, can, tps, two, also, just, three, many, day, percent, u, year, t, years |
| Liker Culture: | toyota, will, s, one, can, many, also, first, two, even |
| Liker Talent: | will, Toyota, can, may, must, one, s, also |

| | |
|---|---|
| Liker Leadership: | Toyota, s, gary, one, can, many, first, dana, t, even, will, every, also, like |
| Liker CI : | toyota, will, can, one, s, like, many |
| Liker Developing: | Toyota, will, can, one, like, s, might, first, also, now, just, many, even, every, really, may, actually, year, next, gary |
| Liker Service: | s, one, Toyota, can, will, t, like, leslie, first, day, many, even, sam, every, us, just, Joe |
| Monden TPS: | toyota, will, can, s, one, must, also, two |
| Imai Gemba: | s, one, can, must, many, first, also, will, day, two, daily, just, every, well, t, often, Percent |
| Imai Kaizen: | s, one, can, often, may, must, will, also, many, years, three, u |
| Dennis LP: | can, Toyota, s, will, must, also, one, us |
| Bicheno Toolbox: | can, will, one, may, s, also, many, often |
| Bicheno Service: | may, can, will, one, also, s, many, good |
| Rother Kata: | toyota, s, one, can, will, many, may, next |
| Rother Culture: | s, steve, can, Nancy, will, next, one, roger, five |
| Mann Culture: | s, can, one, will, day |

Supplemental Table 2: Theme word content list of top relevant keywords

**Work**: works, workable, worked, working, workings

**Time**: times, timed, timeliness, timely, timing

**Process**: processes, processed, processing

**Lean**

**System**: systems, systematic, systematically, systematize, systemized, systemic

**Improvement**: improvements, improve, improved, improves, improving

**Production**: produce, produced, produces, producing

**Patient**: patients

**People**

**Team**: teams, teaming

**Problem**: problems, problematic

**Organization**: organizations, organizational, organizationally, organize, organized, organizing

Supplemental Tables 3: Candidate relevant keywords

Supplemental Table 3.1 All, Lean general, Lean Liker *et al.* and Lean healthcare.

| Candidate relevant keywords | ALL | Lean general | Lean Liker *et al.* | Lean healthcare |
|---|---|---|---|---|
| work | 5.88% | 1.77% | 2.02% | 2.09% |
| time | 5.27% | 2.30% | 1.14% | 1.83% |
| process | 4.52% | 2.01% | 1.41% | 1.09% |
| Lean | 3.83% | 1.62% | 0.72% | 1.49% |
| system | 3.62% | 1.80% | 0.87% | 0.95% |
| improvement | 3.50% | 0.94% | 0.79% | 1.77% |
| production | 2.84% | 2.26% | 0.47% | 0.11% |
| patient | 2.62% | 0.00% | 0.00% | 2.62% |
| people | 2.52% | 0.28% | 1.24% | 1.00% |
| team | 2.43% | 0.20% | 1.12% | 1.12% |
| problem | 2.12% | 0.57% | 0.98% | 0.56% |
| organization | 2.04% | 0.22% | 0.59% | 1.22% |
| kaizen | 2.03% | 0.31% | 0.11% | 1.61% |
| leader | 2.00% | 0.26% | 0.83% | 0.92% |
| company | 1.86% | 0.75% | 1.11% | 0.00% |
| way | 1.83% | 0.49% | 1.03% | 0.31% |
| management | 1.64% | 0.89% | 0.54% | 0.21% |
| part | 1.59% | 0.99% | 0.61% | 0.00% |
| new | 1.39% | 0.37% | 0.50% | 0.51% |
| need | 1.36% | 0.52% | 0.46% | 0.37% |
| customer | 1.35% | 0.80% | 0.55% | 0.00% |
| standard | 1.34% | 0.48% | 0.50% | 0.36% |
| make | 1.19% | 0.57% | 0.52% | 0.10% |

Supplemental Table 3.2 All, Lean service and Lean manufacturing+

| Candidate relevant keywords | ALL | Lean service | Lean manufacturing+ |
|---|---|---|---|
| work | 5.88% | 2.75% | 3.12% |
| time | 5.27% | 2.43% | 2.84% |
| process | 4.52% | 1.61% | 2.90% |
| Lean | 3.83% | 1.78% | 2.05% |
| system | 3.62% | 1.38% | 2.24% |
| improvement | 3.50% | 1.96% | 1.54% |
| production | 2.84% | 0.11% | 2.73% |
| patient | 2.62% | 2.62% | 0.00% |
| people | 2.52% | 1.24% | 1.28% |
| team | 2.43% | 1.31% | 1.12% |
| problem | 2.12% | 0.77% | 1.35% |
| organization | 2.04% | 1.44% | 0.60% |
| kaizen | 2.03% | 1.61% | 0.42% |
| leader | 2.00% | 1.04% | 0.96% |
| company | 1.86% | 0.17% | 1.69% |
| way | 1.83% | 0.63% | 1.21% |
| management | 1.64% | 0.40% | 1.24% |
| part | 1.59% | 0.00% | 1.59% |
| new | 1.39% | 0.61% | 0.78% |
| need | 1.36% | 0.53% | 0.83% |
| customer | 1.35% | 0.78% | 0.57% |
| standard | 1.34% | 0.47% | 0.88% |
| make | 1.19% | 0.22% | 0.97% |

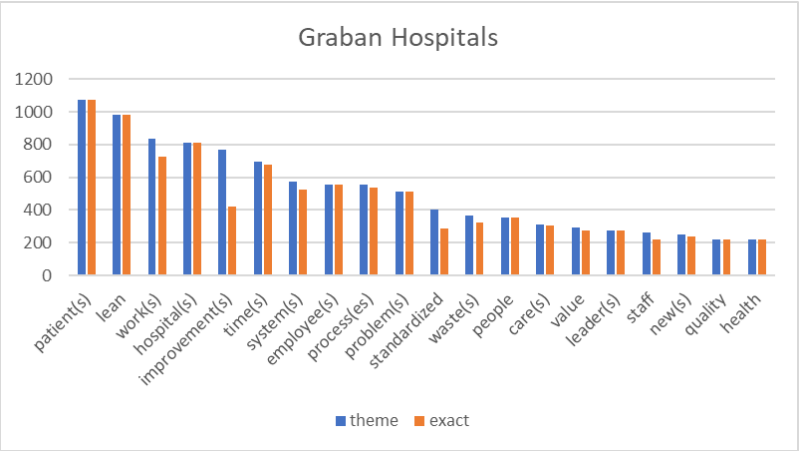
## Supplemental Table 4: Top relevant keywords selection process

| Top23 cRK | LG-all cRK | LG-Top23 cRK | LL-all cRK | LL-Top23 cRK | LH-all cRK | LH-Top23 cRK | LS - all cRK | LS - Top23 cRK | LAP - all cRK | LAP-Top23 cRK | **Top RK** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| work | time | time | work | work | patient | patient | work | work | work | work | **work** |
| time | production | production | process | process | work | work | patient | patient | process | process | **time** |
| process | process | process | people | people | time | time | time | time | time | time | **process** |
| Lean | system | system | time | time | improvement | improvement | improvement | improvement | production | production | **Lean** |
| system | work | work | team | team | kaizen | kaizen | Lean | Lean | system | system | **system** |
| improvement | Lean | Lean | company | company | Lean | Lean | process | process | Lean | Lean | **improvement** |
| production | part | part | way | way | organization | organization | kaizen | kaizen | company | company | **production** |
| patient | improvement | improvement | problem | problem | team | team | organization | organization | part | part | **patient** |
| people | management | management | system | system | process | process | system | system | improvement | improvement | **people** |
| team | product | customer | develop | leader | people | people | team | team | problem | problem | **team** |
| problem | customer | company | leader | improvement | care | system | people | people | people | people | |
| organization | company | problem | improvement | Lean | system | leader | leader | leader | management | management | |
| kaizen | worker | make | get | part | leader | problem | care | customer | way | way | |
| leader | line | need | job | organization | staff | new | staff | problem | team | team | |
| company | machine | way | Lean | customer | idea | need | say | way | plant | make | |
| way | problem | standard | see | management | say | standard | customer | new | make | leader | |
| management | make | new | plant | make | problem | way | problem | need | leader | standard | |
| part | use | kaizen | part | new | hospital | management | service | standard | product | need | |
| new | need | people | training | standard | | production | idea | management | standard | new | |
| need | value | leader | organization | production | | make | way | make | need | organization | |
| customer | way | organization | learning | need | | company | new | company | job | customer | |
| standard | standard | team | customer | kaizen | | part | | production | line | kaizen | |
| make | | patient | management | patient | | customer | | part | new | patient | |
| | | | make | | | | | | see | | |
| | | | member | | | | | | worker | | |
| | | | new | | | | | | quality | | |
| | | | standard | | | | | | use | | |
| | | | go | | | | | | develop | | |
| | | | production | | | | | | get | | |
| | | | culture | | | | | | training | | |
| | | | need | | | | | | value | | |

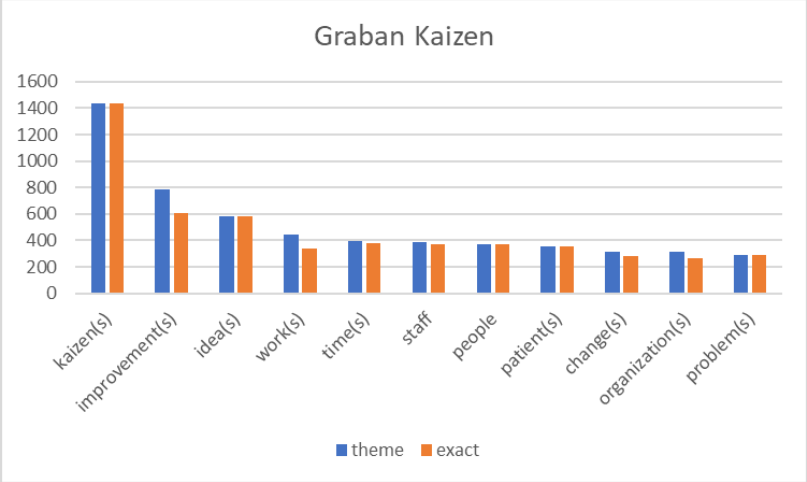
Legend: Top23 cRK: all books condensed top 23 candidate relevant keywords; LH-all cRK: Lean healthcare case all candidate relevant keywords; LH-Top23 cRK: Lean healthcare case ordering from condensed Top 23 candidate relevant keywords; LG-all cRK: Lean general case all candidate relevant keywords; LG-Top23 cRK: Lean general case ordering from condensed Top 23 candidate relevant keywords; LL-all cRK: Lean Liker case all candidate relevant keywords; LL-Top23 cRK: Lean Liker case ordering from condensed Top 23 candidate relevant keywords; LS-all cRK: Lean service case all candidate relevant keywords; LS-Top23 cRK: Lean service case ordering from condensed Top 23 candidate relevant keywords; LAP-all cRK: Lean all-purpose case all candidate relevant keywords; LAP-Top23 cRK: Lean all-purpose case ordering from condensed Top 23 candidate relevant keywords; Top RK: Top relevant keywords.

Appendix 3.2 Supplemental Figures 1 – Pareto histogram (potential key words)

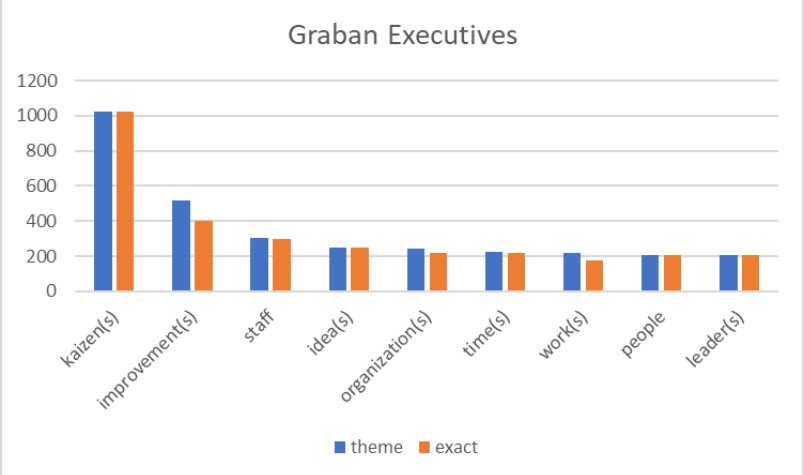
Supplemental Figure 1.1



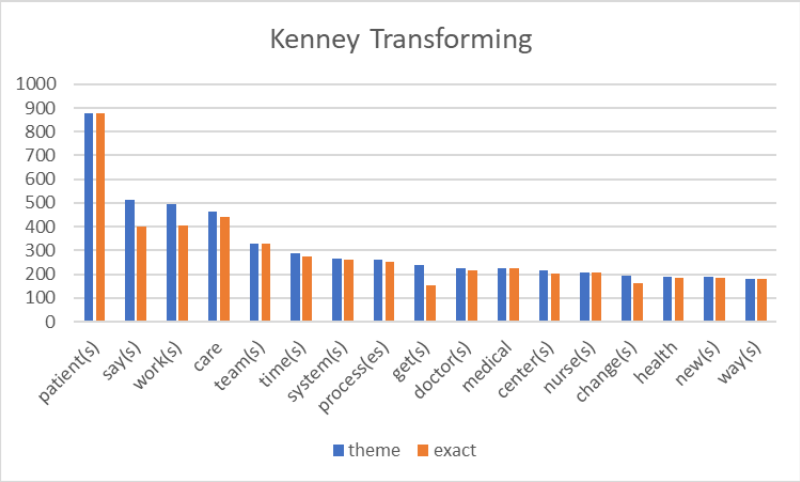

Supplemental Figure 1.2



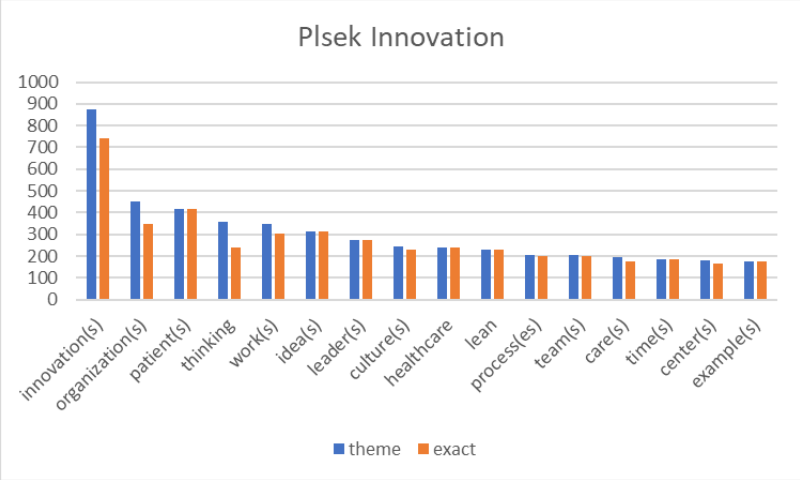

Supplemental Figure 1.3



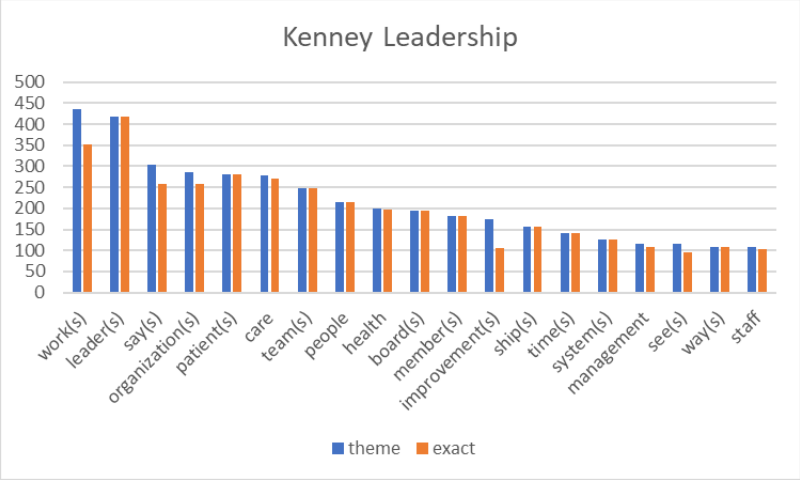
Supplemental Figure 1.4



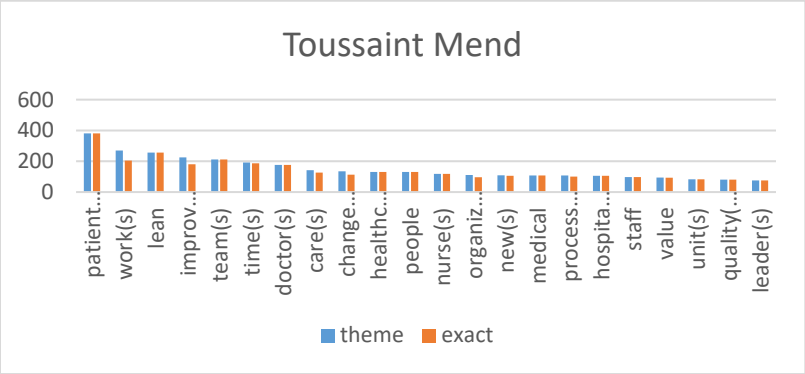

Supplemental Figure 1.5



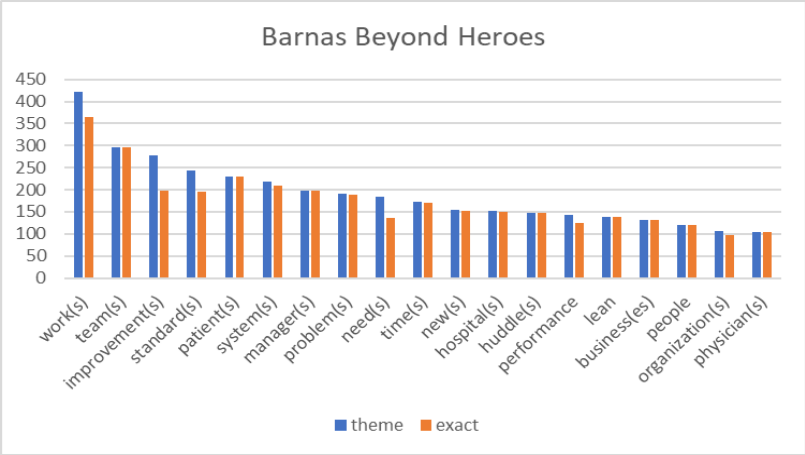

Supplemental Figure 1.6



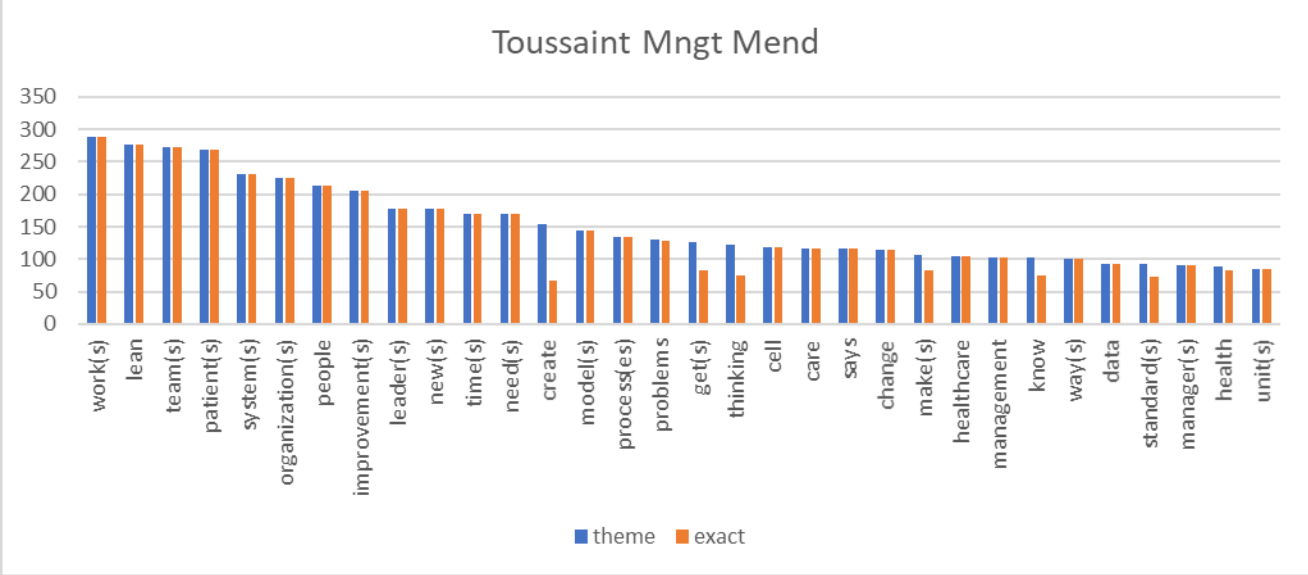
Supplemental Figure 1.7



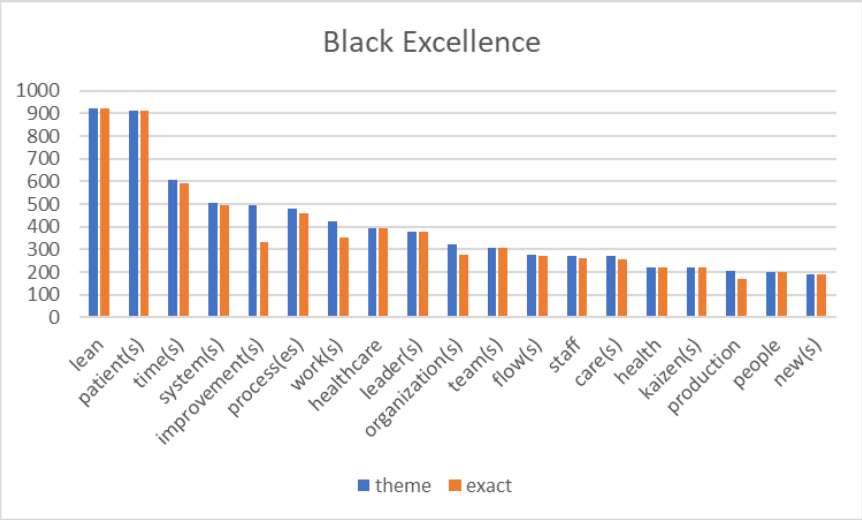

Supplemental Figure 1.8



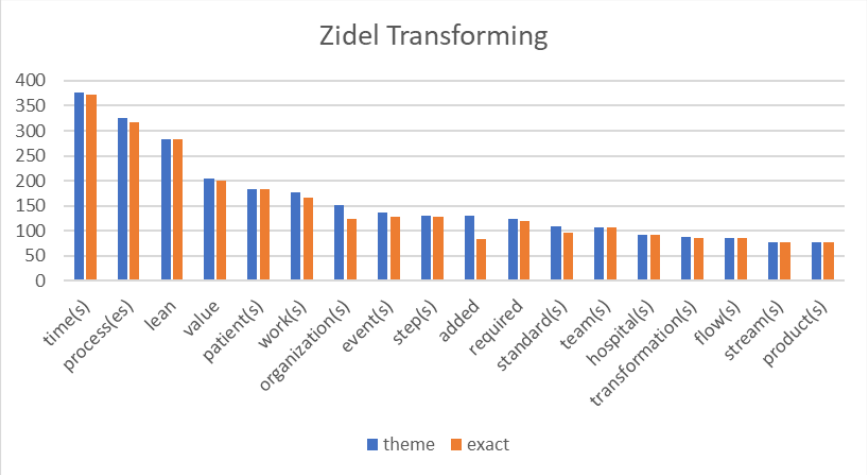

Supplemental Figure 1.9



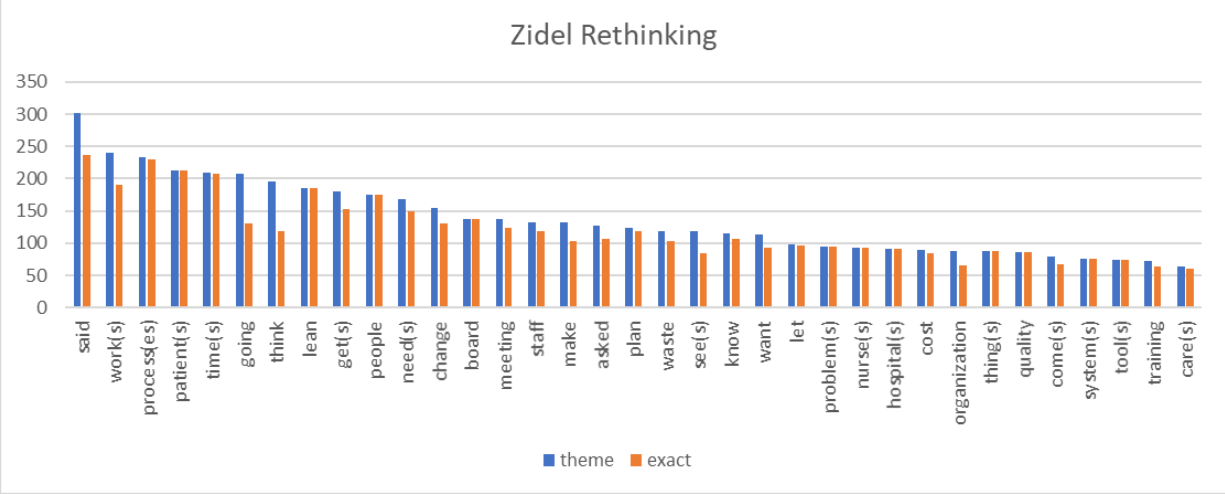
Supplemental Figure 1.10



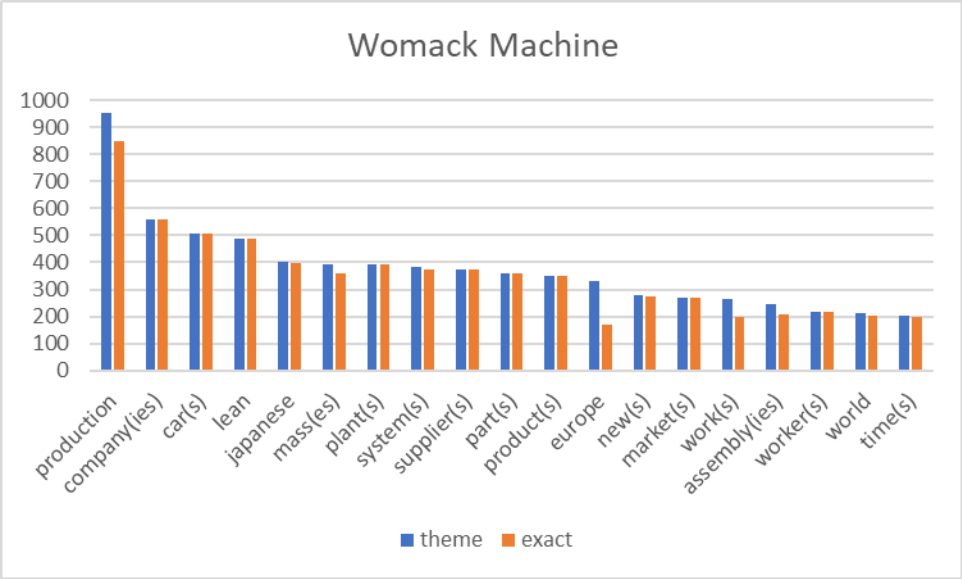

Supplemental Figure 1.11



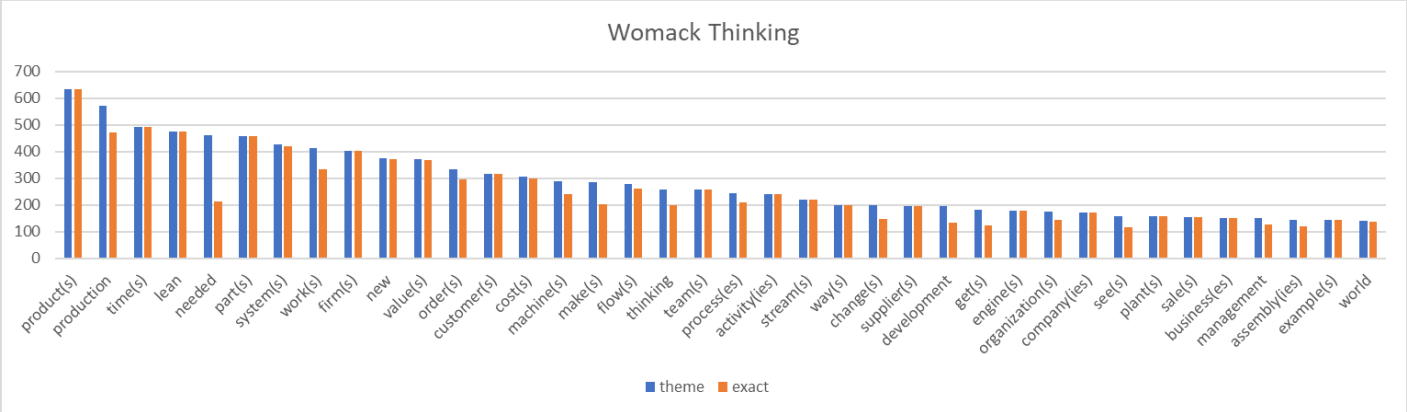

Supplemental Figure 1.12



Supplemental Figure 1.13




Supplemental Figure 1.14

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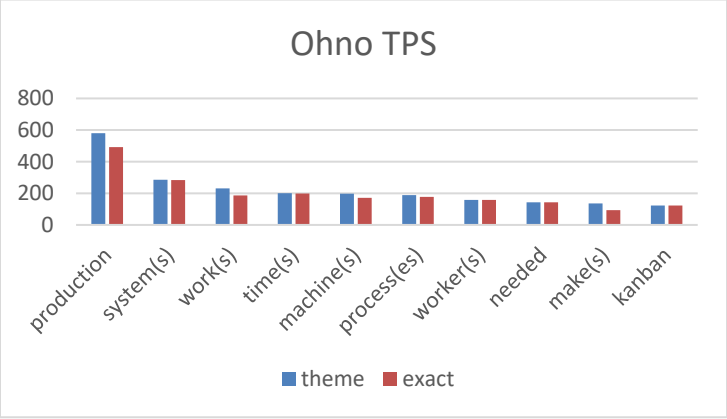
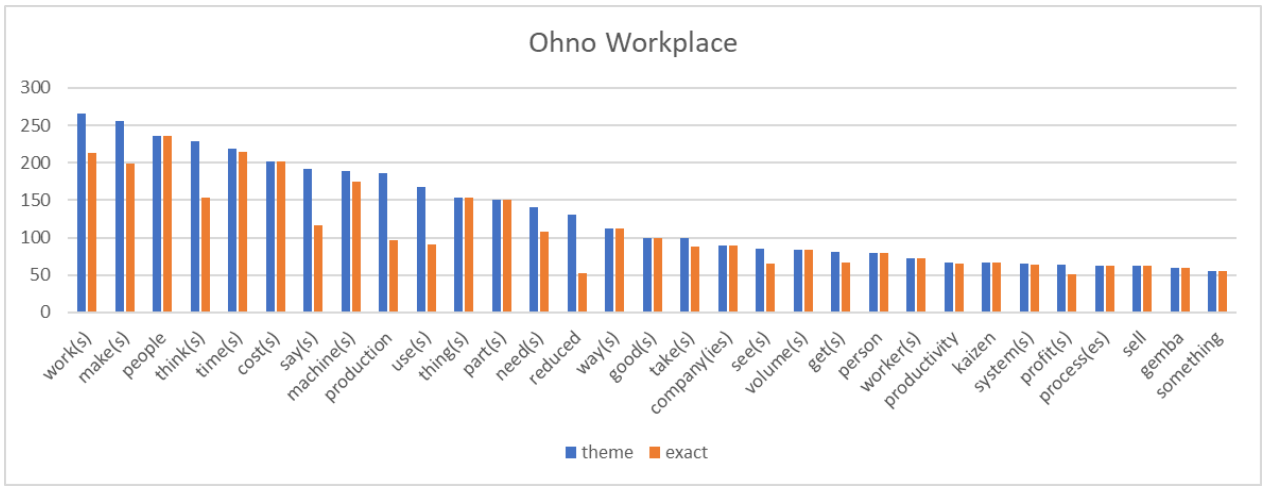
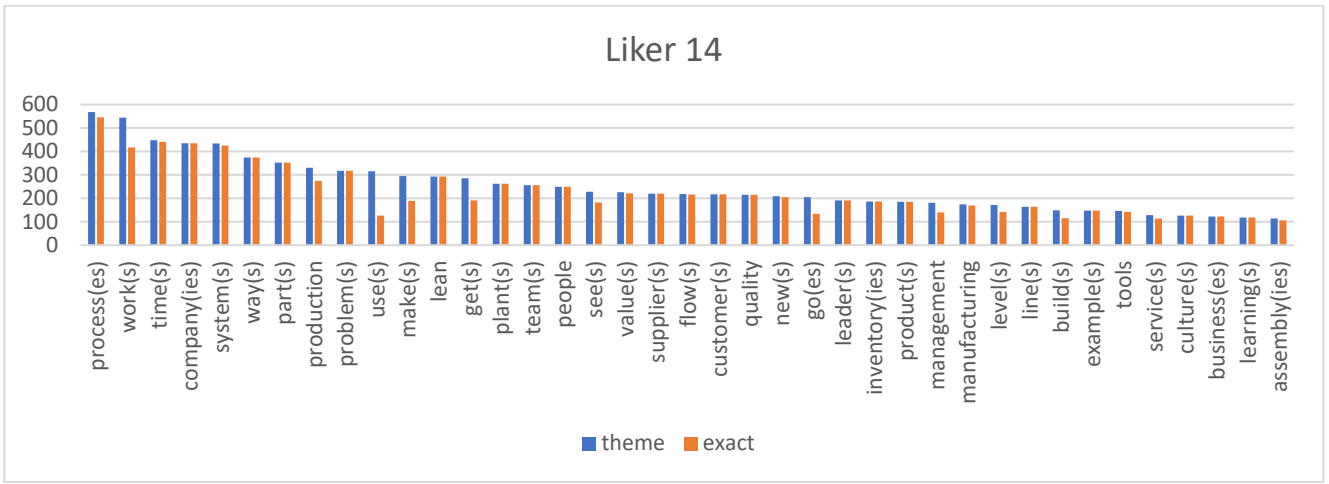


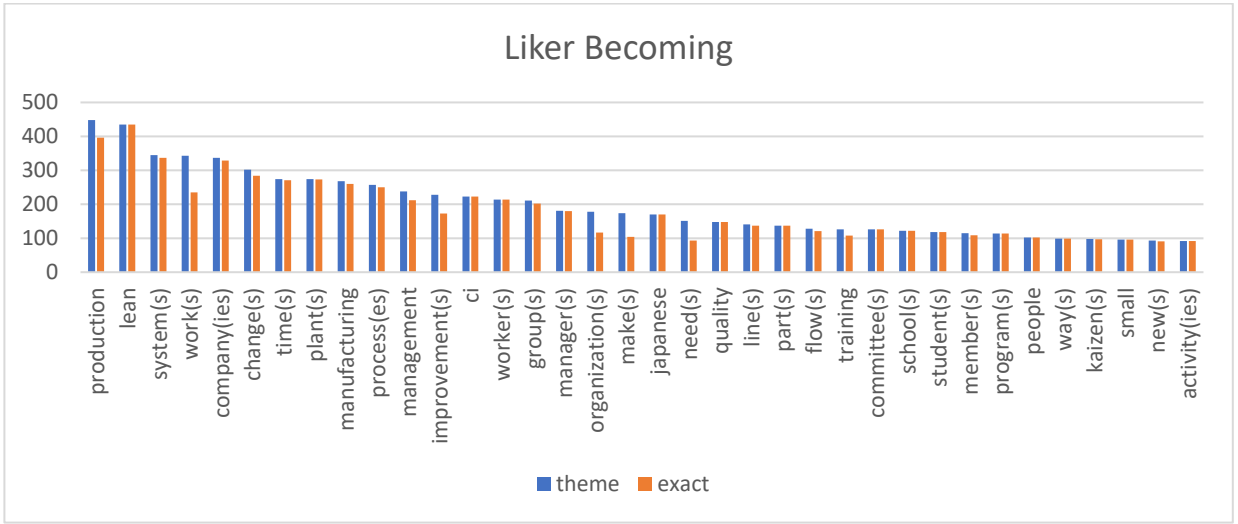
Supplemental Figure 1.16



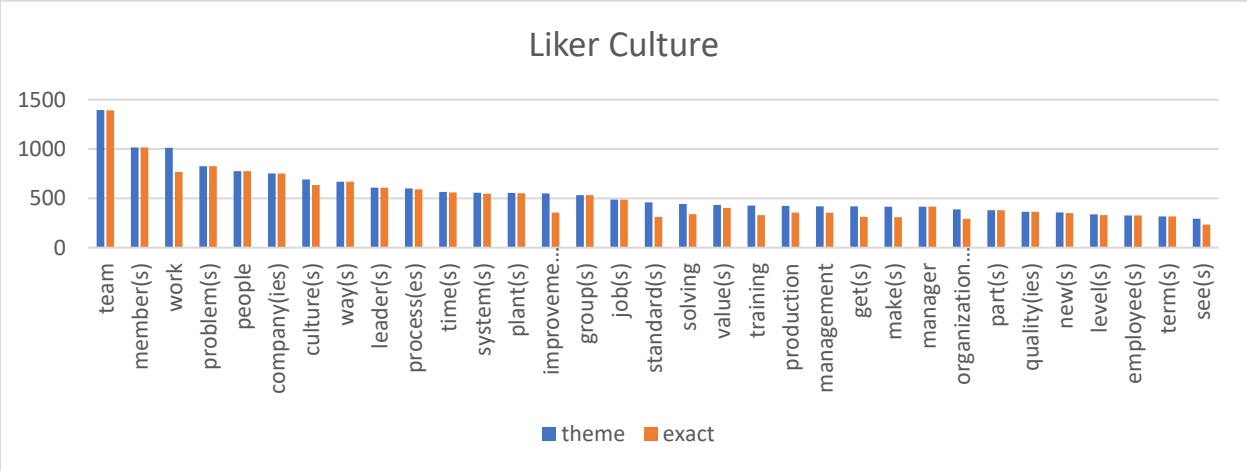

Supplemental Figure 1.17



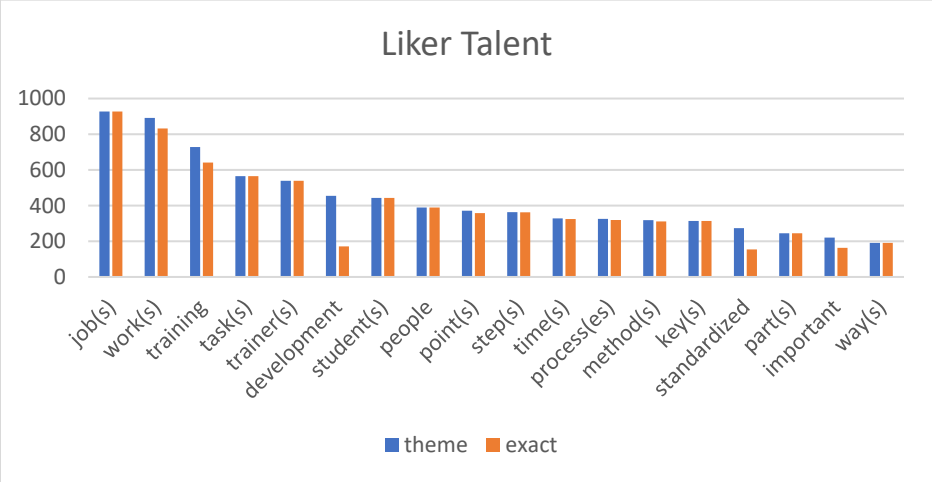

Supplemental Figure 1.18



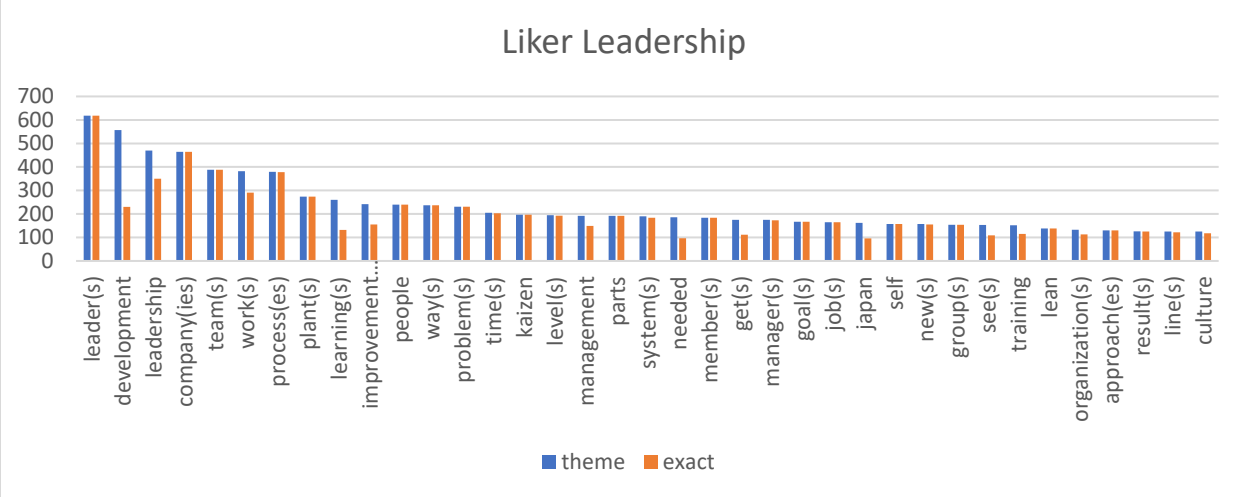
Supplemental Figure 1.19



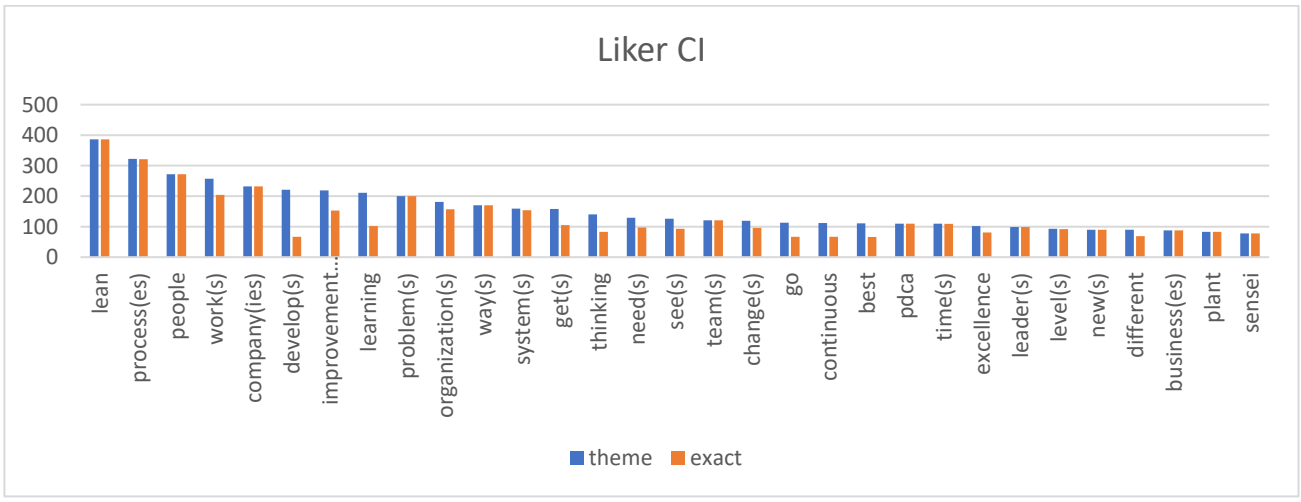

Supplemental Figure 1.20



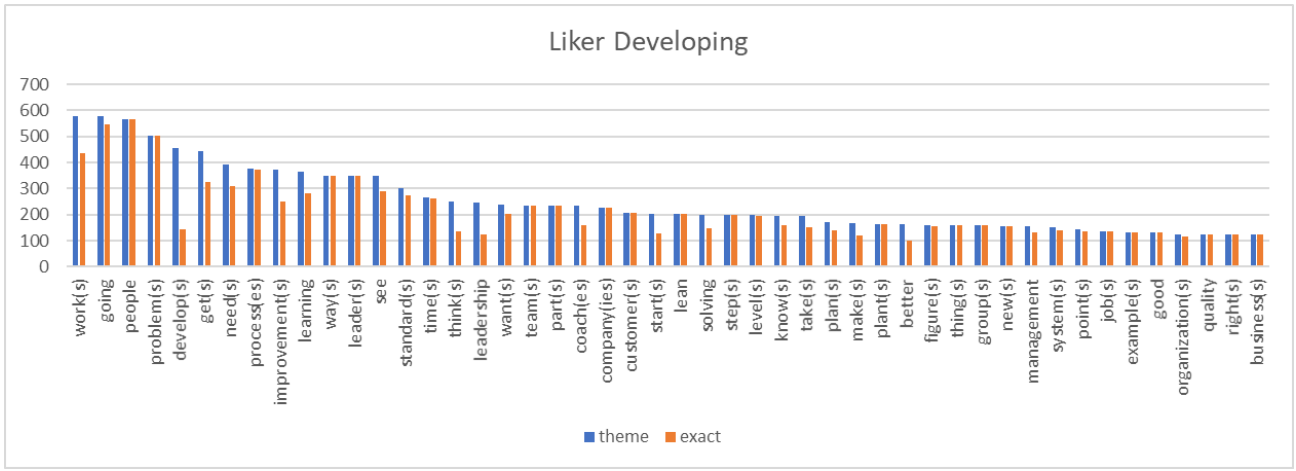

Supplemental Figure 1.21



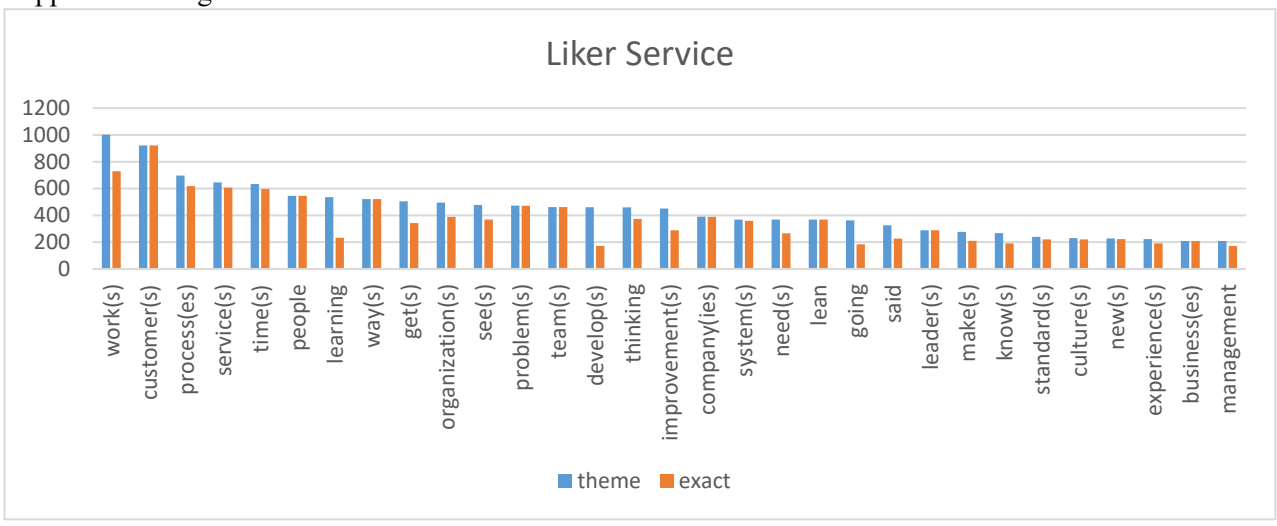
Supplemental Figure 1.22




Supplemental Figure 1.23

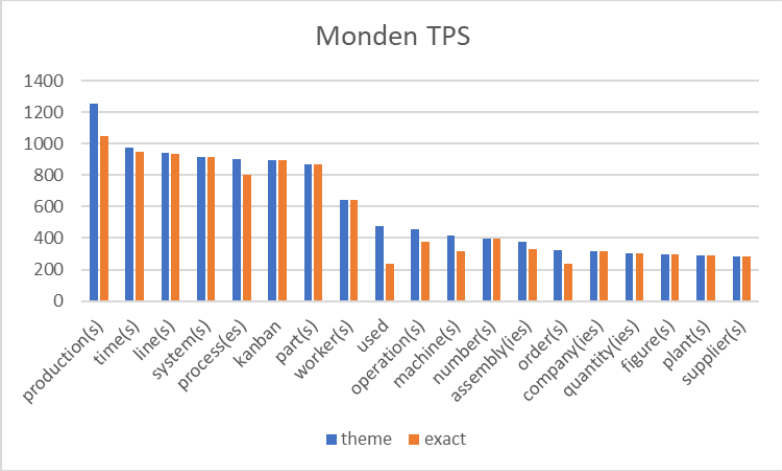



Supplemental Figure 1.24

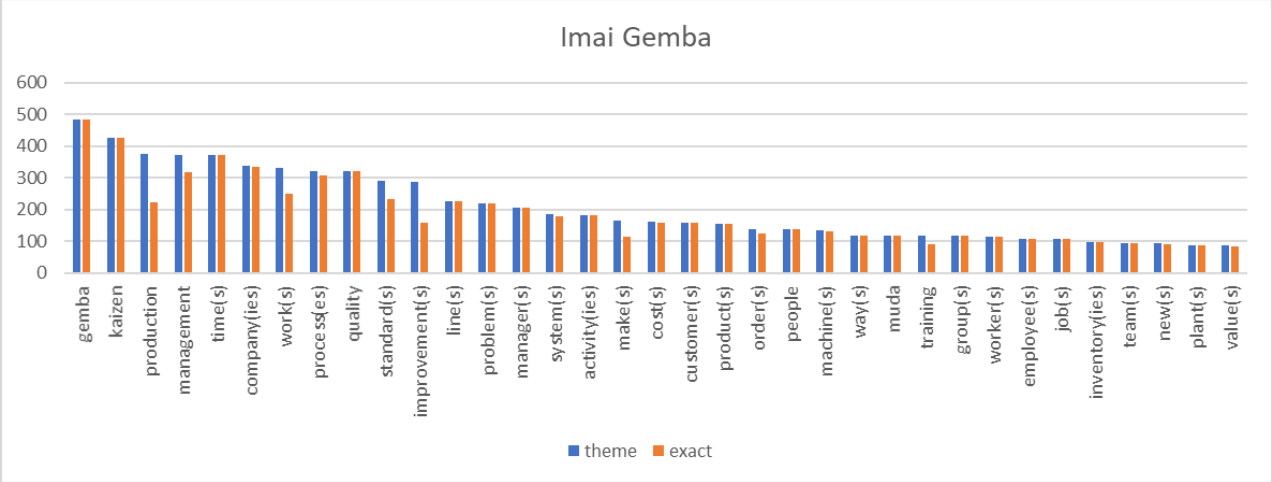



Supplemental Figure 1.25

ci




Supplemental Figure 1.26

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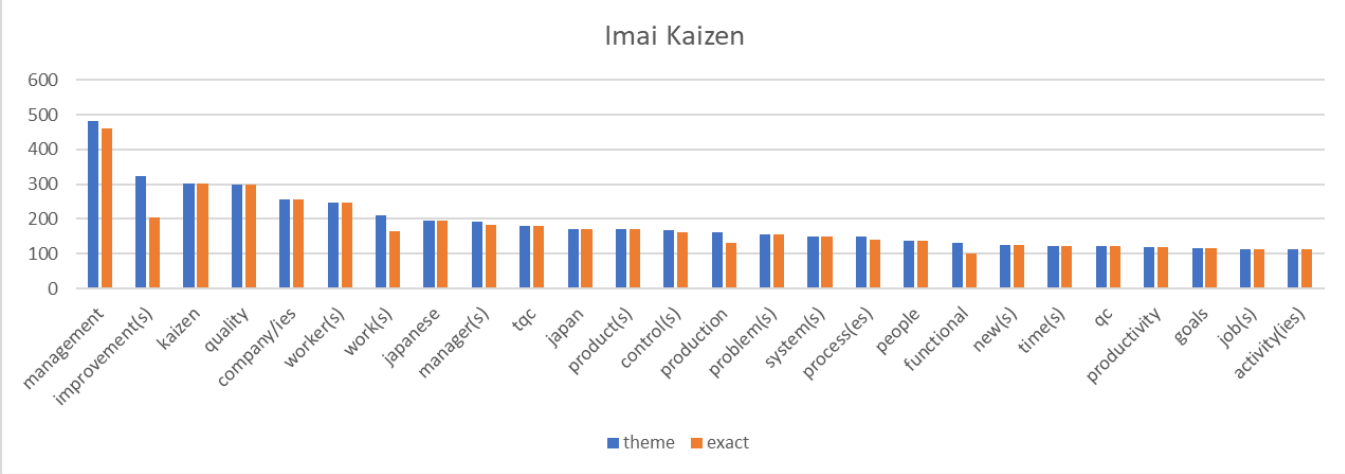
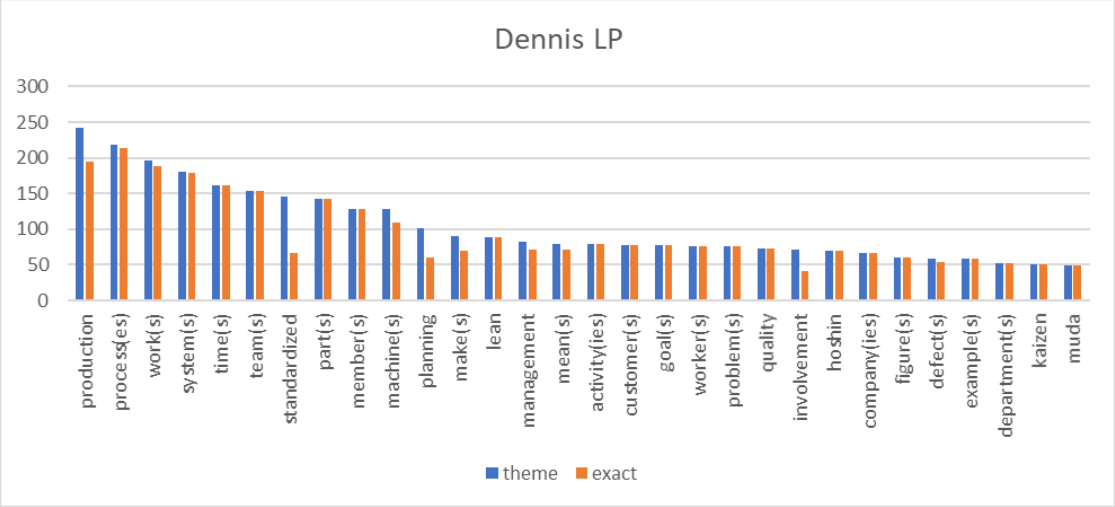
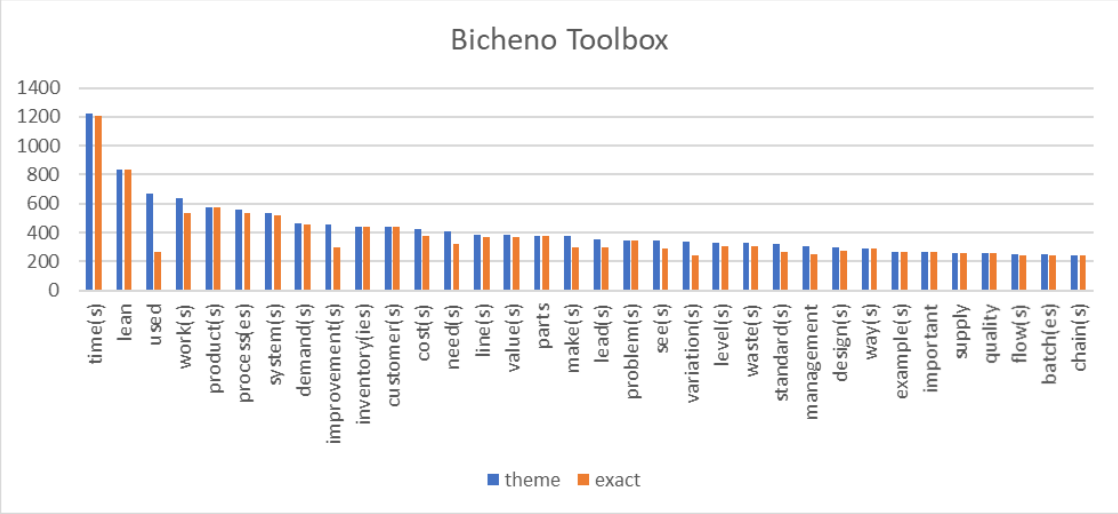


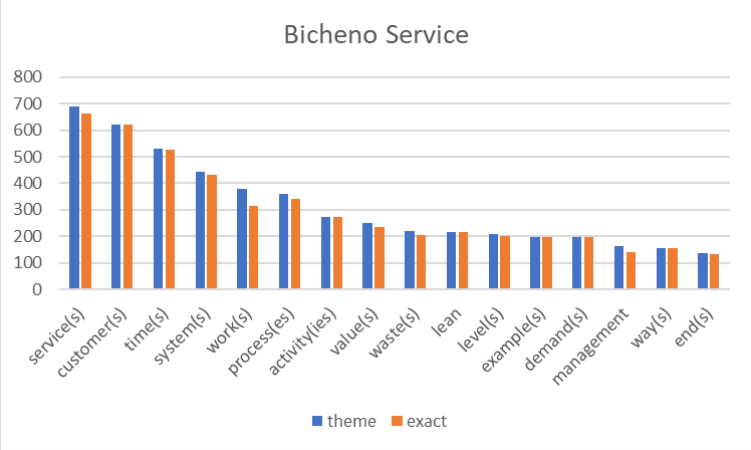
Supplemental Figure 1.28



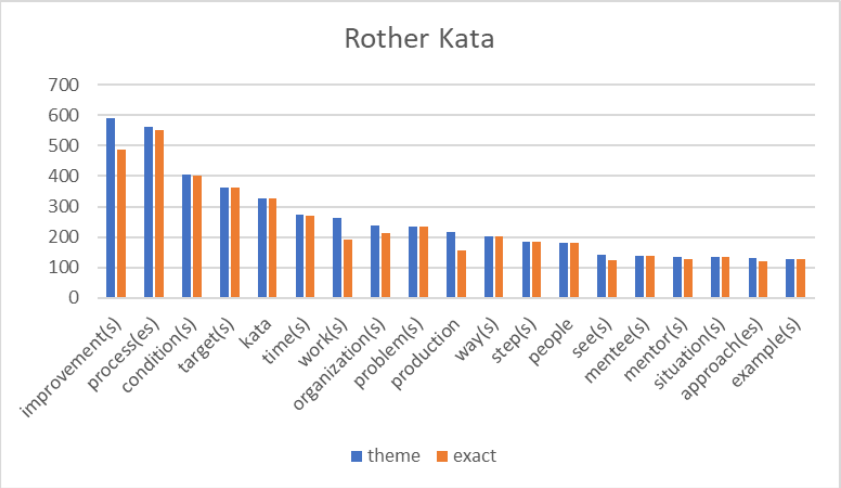

Supplemental Figure 1.29



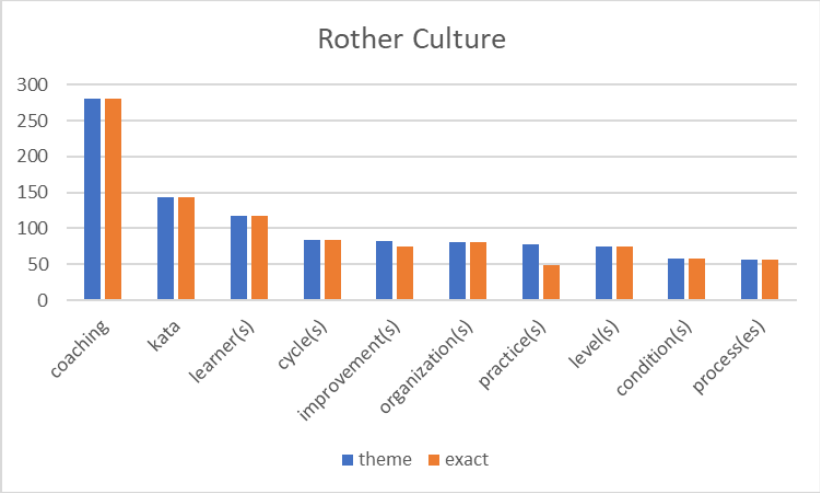

Supplemental Figure 1.30



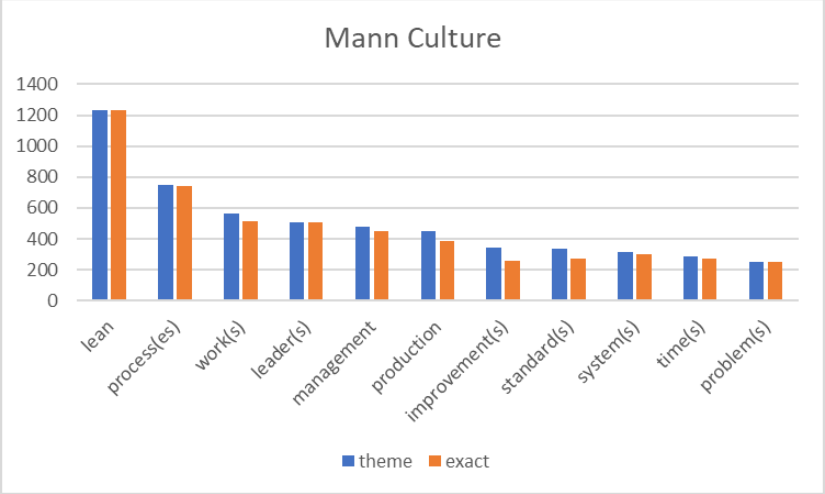
Supplemental Figure 1.31




Supplemental Figure 1.32




Supplemental Figure 1.33



Appendix 3.3 Supplemental table 1: Extra "stop and go" words list removed

| First author/Title | Extra "stop and go" words removed in step four |
|---|---|
| Graban Hospitals: | can, s, might, one, often, just, also, many |
| Graban Kaizen: | can, s, one, Franciscan, will, might |
| Graban Executives: | s, Franciscan, can, one, small, will, better |
| Kenney Transforming: | Virginia, Mason, s, t, one, Kaplan, many, re, can, day |
| Plsek Innovation: | virginia, mason, s, one, can, also, vmps |
| Kenney Leadership: | Virginia, Mason, s, t, can, one, every, many, years, Kaplan |
| Toussaint Mend: | s, thedacare, one, every, can, will, also, years, john |
| Barnas Beyond Heroes: | s, will, one, every, unit, can, like, day, also |
| Toussaint Mngt Mend: | will, s, every, one, can, thedacare, also, everyone, first, year, like, two, many, now, must, instead, just, better |
| Black Excellence: | s, one, percent, can, first, also, Saskatchewan, t |
| Zidel Transforming: | will, must, s, one, may, can, non, first |
| Zidel Rethinking: | Nick, s, t, can, will, one, don, just, re, megan, everyone, joe, first, m, two, like, back, donna, well, three, next, good, also, il, must, however, another, now, okay, morning, ron, didn, even, ve, asha, day |
| Womack Machine: | s, ford, one, will, many, can, Toyota |
| Womack Thinking: | s, one, can, Toyota, will, pratt, many, every, first, porshe, percent, even, just, next, t, two, much, three, years, large, however, wiremold, also |
| Ohno TPS: | Toyota, s, can, one, must, toyoda, however, ford, will, just, even, many |
| Ohno Workplace: | will, can, just, one, even, Toyota, may, must, many, s, t, like, percent |

| | |
|---|---|
| Liker 14: | Toyota, s, one, will, can, tps, like, many, even, first, just, every, also, day, ford |
| Liker Becoming: | s, one, Toyota, will, ford, first, can, tps, two, also, just, three, many, day, percent, u, year, t, years |
| Liker Culture: | toyota, will, s, one, can, many, also, first, two, even |
| Liker Talent: | will, Toyota, can, may, must, one, s, also |
| Liker Leadership: | Toyota, s, gary, one, can, many, first, dana, t, even, will, every, also, like |
| Liker CI : | toyota, will, can, one, s, like, many |
| Liker Developing: | Toyota, will, can, one, like, s, might, first, also, now, just, many, even, every, really, may, actually, year, next, gary |
| Liker Service: | s, one, Toyota, can, will, t, like, leslie, first, day, many, even, sam, every, us, just, Joe |
| Monden TPS: | toyota, will, can, s, one, must, also, two |
| Imai Gemba: | s, one, can, must, many, first, also, will, day, two, daily, just, every, well, t, often, Percent |
| Imai Kaizen: | s, one, can, often, may, must, will, also, many, years, three, u |
| Dennis LP: | can, Toyota, s, will, must, also, one, us |
| Bicheno Toolbox: | can, will, one, may, s, also, many, often |
| Bicheno Service: | may, can, will, one, also, s, many, good |
| Rother Kata: | toyota, s, one, can, will, many, may, next |
| Rother Culture: | s, steve, can, Nancy, will, next, one, roger, five |
| Mann Culture: | s, can, one, will, day |

Appendix 3.4 Supplemental Table 2: Theme word content list of top relevant keywords

**Work**: works, workable, worked, working, workings

**Time**: times, timed, timeliness, timely, timing

**Process**: processes, processed, processing

**Lean**

**System**: systems, systematic, systematically, systematize, systemized, systemic

**Improvement**: improvements, improve, improved, improves, improving

**Production**: produce, produced, produces, producing

**Patient**: patients

**People**

**Team**: teams, teaming

**Problem**: problems, problematic

**Organization**: organizations, organizational, organizationally, organize, organized, organizing

Appendix 3.5 Supplemental Tables 3: Candidate relevant keywords (adjusted ordering by books)

Supplemental Table 3.1 ALL – LH – LG – LL cases

| cRK | ALL | LH | LG | LL |
|---|---|---|---|---|
| work | 5.88% | 2.09% | 1.77% | 2.02% |
| time | 5.27% | 1.83% | 2.30% | 1.14% |
| process | 4.52% | 1.09% | 2.01% | 1.41% |
| Lean | 3.83% | 1.49% | 1.62% | 0.72% |
| system | 3.62% | 0.95% | 1.80% | 0.87% |
| improvement | 3.50% | 1.77% | 0.94% | 0.79% |
| production | 2.84% | 0.11% | 2.26% | 0.47% |
| patient | 2.62% | 2.62% | 0.00% | 0.00% |
| people | 2.52% | 1.00% | 0.28% | 1.24% |
| team | 2.43% | 1.12% | 0.20% | 1.12% |
| problem | 2.12% | 0.56% | 0.57% | 0.98% |
| organization | 2.04% | 1.22% | 0.22% | 0.59% |
| kaizen | 2.03% | 1.61% | 0.31% | 0.11% |
| leader | 2.00% | 0.92% | 0.26% | 0.83% |
| company | 1.86% | 0.00% | 0.75% | 1.11% |
| way | 1.83% | 0.31% | 0.49% | 1.03% |
| management | 1.64% | 0.21% | 0.89% | 0.54% |
| part | 1.59% | 0.00% | 0.99% | 0.61% |
| new | 1.39% | 0.51% | 0.37% | 0.50% |
| need | 1.36% | 0.37% | 0.52% | 0.46% |
| customer | 1.35% | 0.00% | 0.80% | 0.55% |
| standard | 1.34% | 0.36% | 0.48% | 0.50% |
| make | 1.19% | 0.10% | 0.57% | 0.52% |
| sum | 58.76% | 20.23% | 20.41% | 18.12% |

Supplemental Table 3.2 ALL – LS – LAP cases

| cRK | ALL | LS | LAP |
|---|---|---|---|
| work | 5.88% | 2.75% | 3.12% |
| time | 5.27% | 2.43% | 2.84% |
| process | 4.52% | 1.61% | 2.90% |
| Lean | 3.83% | 1.78% | 2.05% |
| system | 3.62% | 1.38% | 2.24% |
| improvement | 3.50% | 1.96% | 1.54% |
| production | 2.84% | 0.11% | 2.73% |
| patient | 2.62% | 2.62% | 0.00% |
| people | 2.52% | 1.24% | 1.28% |
| team | 2.43% | 1.31% | 1.12% |
| problem | 2.12% | 0.77% | 1.35% |
| organization | 2.04% | 1.44% | 0.60% |
| kaizen | 2.03% | 1.61% | 0.42% |
| leader | 2.00% | 1.04% | 0.96% |
| company | 1.86% | 0.17% | 1.69% |
| way | 1.83% | 0.63% | 1.21% |
| management | 1.64% | 0.40% | 1.24% |
| part | 1.59% | 0.00% | 1.59% |
| new | 1.39% | 0.61% | 0.78% |
| need | 1.36% | 0.53% | 0.83% |
| customer | 1.35% | 0.78% | 0.57% |
| standard | 1.34% | 0.47% | 0.88% |
| make | 1.19% | 0.22% | 0.97% |
| sum | 58.76% | 25.84% | 32.92% |

# Appendix 3.6 Supplemental Table 4: Top relevant keywords selection process

| Top23 cRK | LH-all cRK | LH-Top23cRK | LG-all cRK | LG-Top23 cRK | LL-all cRK | LL-Top23 cRK | LS - all cRK | LS - Top23 cRK | LAP - all cRK | LAP-Top23 cRK | Top RK |
|---|---|---|---|---|---|---|---|---|---|---|---|
| work | patient | patient | time | time | work | work | work | work | work | work | work |
| time | work | work | production | production | process | process | patient | patient | process | process | time |
| process | time | time | process | process | people | people | time | time | time | time | process |
| Lean | improvement | improvement | system | system | time | time | improvement | improvement | production | production | Lean |
| system | kaizen | kaizen | work | work | team | team | Lean | Lean | system | system | system |
| improvement | Lean | Lean | Lean | Lean | company | company | process | process | Lean | Lean | improvement |
| production | organization | organization | part | part | way | way | kaizen | kaizen | company | company | production |
| patient | team | team | improvement | improvement | problem | problem | organization | organization | part | part | patient |
| people | process | process | management | management | system | system | system | system | improvement | improvement | people |
| team | people | people | product | customer | develop | leader | team | team | problem | problem | team |
| problem | care | system | customer | company | leader | improvement | people | people | people | people | problem |
| organization | system | leader | company | problem | improvement | Lean | leader | leader | management | management | organization |
| kaizen | leader | problem | worker | make | get | part | care | customer | way | way | |
| leader | staff | new | line | need | job | organization | staff | problem | team | team | |
| company | idea | need | machine | way | Lean | customer | say | way | plant | make | |
| way | say | standard | problem | standard | see | management | customer | new | make | leader | |
| management | problem | way | make | new | plant | make | problem | need | leader | standard | |
| part | hospital | management | use | kaizen | part | new | service | standard | product | need | |
| new | | production | need | people | training | standard | idea | management | standard | new | |
| need | | make | value | leader | organization | production | way | make | need | organization | |
| customer | | company | way | organization | learning | need | new | company | job | customer | |
| standard | | part | standard | team | customer | kaizen | | production | line | kaizen | |
| make | | customer | | patient | management | patient | | part | new | patient | |
| | | | | | make | | | | see | | |
| | | | | | member | | | | worker | | |
| | | | | | new | | | | quality | | |
| | | | | | standard | | | | use | | |
| | | | | | go | | | | develop | | |
| | | | | | production | | | | get | | |
| | | | | | culture | | | | training | | |
| | | | | | need | | | | value | | |

## Appendix 3.7 Supplemental Table 5: Definition of TIME

### Definition of TIME

(according to: Time. (n.d.), retrieved June 6th, 2018, from https://merriam-webster.com/dictionary/time)

1 a: the measured or measurable period during which an action, process, or condition
exists or continues: DURATION
b: a nonspatial continuum that is measured in terms of events which succeed one
another from past through present to future
c: LEISURE ; *time* for reading

2 the point or period when something occurs: OCCASION

3 a: an appointed, fixed, or customary moment or hour for something to happen, begin, or
end arrived ahead of *time*
b: an opportune or suitable moment
decided it was *time* to retire
—often used in the phrase *about time*
about *time* for a change

4 a: a historical period : AGE
b: a division of geologic chronology
c: conditions at present or at some specified period —usually used in plural
*times* are hard; move with the *times*
d: the present time
issues of the *time*

5 a: LIFETIME
b: a period of apprenticeship
c: a term of military service
d: a prison sentence

6 SEASON
very hot for this *time* of year

7 a: rate of speed : TEMPO
b: the grouping of the beats of music : RHYTHM

8 a: a moment, hour, day, or year as indicated by a clock or calendar
what *time* is it
b: any of various systems (such as a sidereal or solar system) of reckoning time

9 a: one of a series of recurring instances or repeated actions
you've been told many *times*
b: times *plural*
(1) : added or accumulated quantities or instances
five *times* greater
(2) : equal fractional parts of which an indicated number equal a comparatively greater quantity

seven *times* smaller; three *times* closer
c: TURN ; three *times* at bat

10 finite as contrasted with infinite duration

11 a person's experience during a specified period or on a particular occasion
a good *time*; a hard *time*

12 a: the hours or days required to be occupied by one's work
make up *time*
on company *time*
b: an hourly pay rate
straight *time*
c: wages paid at discharge or resignation
pick up your *time* and get out

13 a: the playing time of a game
b: TIME-OUT 1

14 a period during which something is used or available for use
computer *time*

Appendix 4.1 Short report on artificial intelligence (AI) and content analysis

Progress in artificial intelligence (AI) has been phenomenal in recent years and is destined to become ever more impressive. Examples of prodigious natural language processing from chatbots such as Siri by Apple or Alexa by Amazon are entering our lives sleekly with perhaps not as much appreciation as they deserve for the major achievement they represent and realization for all their implications. We live in an exponentially increasing electronic information age and there is a race on how to and who will best manage all this data to create and then capture its value. What place 'self-conscious' intelligent machines will occupy in our lives in the future remains to be seen. We can only hope it will be for more good than evil (Gill, 2019).

The potential and challenges for content analysis to generate academic and practitioner knowledge has been recognized for more than fifty years particularly in its tedious and labor-intensive process and difficulties to 'teach' computers how to properly 'read' content and interpret ambiguity in language (written and verbal) (van Cuilenburg *et al.*, 1988). But, technology advancements have now made virtually any home computers capable to indisputably process data in scale humanly unachievable. Access to even greater performance can be obtained by cloud computing making computer-aided text analysis (CATA) not only possible but an inescapable mean of the future in research. From the fairly recent academic systematic literature review on CATA by Duriau *et al.* (2007) and the anonymous report on current top commercial AI software programs enabling CATA (predictiveanalyticstoday.com, 2019), there appears to be an emerging gap between a rather shyly use of CATA in management academia and its apparent wider exploitation in the business world.

Indeed, where only 98 papers, mainly in the field of business policy and strategy, using some form of content analysis methodology, principally basic frequency count, were found by Duriau *et al.* over a period of 25 years (2007), predictiveanalyticstoday.com report (2019) covers 63 different software programs offering a wide range of capabilities for various purposes. DiscoveryText, Expert System, Verint Systems, Lexalytics Salience, IBM SPSS Text analytics are the five highest rated programs and differ from

the top three enabling emergent coding mentioned by Neuendorf (2017): CATPAT II, T-Lab pro and PolyAnalyst. Commercial use of artificial intelligence-aided content analysis tends to propose means to perform business intelligence on internal or market collected unstructured data from all kinds of information sources (documents, electronic and even oral conversation, customer reviews in all forms, etc.) and to provide various performance indicators (lagging and leading) from natural language processing. Most but not all (60%) help to hierarchically mine, classify, cluster and identify patterns and trends within data and are promoted as decision tools (30%). About half (46%) particularly target social media content (such as Facebook, Google+, blogs, Tumblr or Twitter) and offer sentiment analysis (40%) for brand performance monitoring (positive, neutral, negative). Curiously, only 13% appear yet to be able to do so in real-time and just 11% are cloud-based. 35% are said to be multilingual: some, such as Bitext and Semantria for Excel are even already supporting over 20 different languages. Reported service charges pricing ranges from free to over 5000$ per month and these programs are said to be in use by, understandably, mega-international corporations to small-medium enterprises from various industries (such as financial, healthcare, retail, technology) but also by governments, non-profit organizations and universities.

It should be noted that preditiveanalyticstoday.com report (2019) appears to be a collection of promotional material from each software programs. Its methodology is not disclosed, especially whether it is sponsored or not, and it does not provide an assessment of comparative performance against some common material to allow assessment of validity, reliability and accuracy of the report and each programs' output.

There is certainly a need to establish a gold standard or at least a benchmark in this technology and to determine if and how artificial intelligence-aided content analysis and which programs with which algorithms and other features could be use productively in management academic research.

Montreal appear to show pioneer and cutting-edge expertise in AI with enterprises such as Provalis Research, located 1255 Robert Bourassa St, founded in 1989, which has now more than 6000 clients from 80 countries over all 5 continents (2019) and the recent

inauguration of the Institut québécois d'intelligence artificielle (Mila), located 6666 St-Urbain St, on January 28th, 2019 which is a joint venture between University of Montreal and McGill University to attract and retain fundamental and applied researchers in the area of deep learning and machine learning for AI (2019).

In summary, AI is here and growing. CATA will become ever more powerful, sophisticated and accessible. Their value for management academia and practitioners is in determination.

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Appendix 4.2 Lean assessment tools and Lean cultural clusters analysis

The following tables (1, 2 and 3) illustrate Lean cultural clusters analysis ('operations'- no fill; 'change'- vertical line fill; 'humanity'- dot fill and 'collectivity'- horizontal line fill) of eleven Lean assessment tools identified in article 1 (chapter 1) Lean culture comprehensive systematic literature review.

It demonstrates how dimensions of every tools could be linked to one of chapter 3's Lean cultural clusters (operations, change, humanity and collectivity). No conceptual gaps were identified.

Some tools appear to put more emphasis on operations such as Mann (2015)'s Lean management standards whereas others were heavier on collectivity such as Jenei et al. (2014)'s Lean healthcare organization culture questionnaire. The two most balanced tools between the four cultural clusters appear to be Guimaraes & de Carvalho (2014)'s Lean assessment package and Jobin and Lagacé (2014)'s Lean maturity model.

This analysis to be more valid should be performed by multiple graders. Greater insights could be obtained from deeper analysis of each tools at item levels. Incorporation of other Lean assessment tools, not necessarily linked to Lean culture, such as Nightingale and Mize (2002)'s LESAT: The Lean enterprise self assessment tool or Shah and Ward (2007)'s Lean production questionnaire, may provide further validation of the four Lean cultural clusters. Finally, a proper meta-analysis of all these tools could facilitate creation of a more solid experts' evidence-based Lean culture assessment tool.

Table 1 Lean assessment tools

| Lean audit tool<br>Bhasin(2011) | Lean assessment package<br>Guimaraes & Carvalho (2014) | Lean values questionnaire<br>Ingelsson & Martensson (2014) | Lean culture questionnaire<br>Jayamaha et al. (2014) |
|---|---|---|---|
| Overall safety, cleanliness and orderliness | Enterprise Alignment | Eliminate waste | process standardization |
| Production and operational flow (JIT) | Time/Delivery | | applying process consistently |
| Processes and operations | Cost/Productivity | | explaining how employee peer performance affects the org. |
| Visual management | Quality | | assessment of alternative courses of action |
| Quality designed into the product | | | promoting 'learning from mistakes' |
| | | Long-term thinking | management by fact |
| | | Continuous improvement | jidoka (stopping work to learn what happened) |
| | | | use of objective metrics to judge employee performance |
| | | | process-strategic objective match |
| | Continuous improvement | | implementing best practices |
| | | | planning based on facts and data |
| Continuous improvement | Education Training & Coaching | | root cause analysis |
| Lean change strategy | Empowerment & Involvement | | superior product and service provision to the customers |
| Lean sustainability | Morale | Customer focus | encourage of new ideas |
| | Customer satisfaction | | valuing peoples' opinion and ideas |
| | | | customer first' policy |
| | | | people development to better serve the customers |
| Culture - employee oriented | | System view | treating an employee growth and development |
| | | Supportive leadership | valuing knowledge sharing |
| Organizational culture-organizational practices | | | consensus around common goals |
| Lean treated as a business | Environmental & Safety Systems | | equity - all treated fairly |
| Philosophy | Safety | | internal and external cooperation |
| | | | frequency of using Toyota Way principles |
| | | | demonstrating outstanding knowledge of the TW |
| | | | discussing how to best implement the Toyota Way |

Table 2 Lean assessment tools

| Lean healthcare organizational culture questionnaire<br>Jenei et al. (2014) | Lean maturity model<br>Jobin and Lagacé (2014) | Lean management standards<br>Mann (2015) |
|---|---|---|
| performance evaluation | la gestion de la performance | Lean standard work |
| | les processus (outils et techniques) | value stream mapping |
| innovation | | visual controls |
| long-term thinking | | Daily accountability process |
| | | Process definition |
| | la pérennisation et l'amélioration continue | Process discipline |
| rewarding | le projet et la gestion du changement | Problem solving (root cause) |
| involvement | | |
| Internal relations | la valeur patient-usager | |
| external relations | les parties prenantes | |
| atmosphere | | |
| communication of goals | | |
| learning | | |
| support | la stratégie et la gouvernance | |
| communication | la gestion transversale | |
| | le leadership | |
| | le soutien aux projets et à la transformation | |
| | | Process improvement |

Table 3 Lean assessment tools

| Lean assessment tool<br>Padkil & Leonard (2014) | Critical Lean culture criteria model<br>Salah et al. (2015) | Lean management maturity self-assessment tool<br>Urban (2015) | Lean culture diagnostic tool<br>van der Merwe (2015) |
|---|---|---|---|
| quality | root cause problem solving | associated with the value stream | consistency |
| process | standard work | Lean results obtained | |
| cost | visual controls | | |
| delivery | level out work load | | |
| inventory | waste reduction | | |
| | Kaizen training | | awareness |
| | training and learning | | engagement |
| | motivation | operational improvement | |
| | empowerment | | |
| | customer focus | | |
| | leaders go to gemba | people treatment | |
| | daily accountability | | |
| | mutual respect | | |
| Time effectiveness | mutual trust | | |
| | team work | organization's vision components | |
| | communications | leadership | |
| customer | visionary leadership | | accountability |
| | clear goals | | |
| | supplier relationships | | |
| human resources | | | |

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