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Three Essays on servitization

par
Nikhil Varma

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Présentée par :

Nikhil Varma

a été évaluée par un jury composé des personnes suivantes :

Jacques Roy
HEC Montréal
Président(e)-rapporteur(se)

Federico Pasin
HEC Montréal
Codirecteur de recherche

Julie Paquette
HEC Montréal
Codirectrice de recherche

Claudia Rebolledo
HEC Montréal
Membre du jury

Rohit Varma
Cornell University
Examinateur externe

Gilles Caporossi
HEC Montréal
Représentant du directeur de HEC Montréal

Résumé

Avec le paysage concurrentiel actuel et les attentes croissantes de la clientèle, les entreprises manufacturières doivent innover en matière de modèles d'affaires pour maintenir leur position concurrentielle. À ce titre, on peut citer la *servitisation*. Cette thèse est présentée sous la forme d'un ensemble de trois essais et utilise une approche multi-méthode pour analyser les tendances présentes dans la littérature, pour consolider la théorie, pour développer un cadre conceptuel qui permet d'évaluer l'impact de certains facteurs sur le niveau de *servitisation* et finalement pour présenter un mécanisme qui supporte la conception dynamique de services dans un contexte de *servitisation*.

Le premier essai analyse la littérature à propos de la *servitisation* pour en extraire les tendances et consolider la théorie en se basant sur la théorie ancrée comme méthodologie. Nous avons proposé des pistes de recherches futures pour remédier aux lacunes identifiées dans la littérature.

Dans le deuxième essai, une typologie de la stratégie des entreprises qui se *servitisent* a été développée. En utilisant cette typologie pour analyser des données transversales, notre recherche présente des tests confirmatoires pour expliquer les variations dans l'effet de certains facteurs sur le niveau de *servitisation*.

Le troisième essai présente un modèle de conception dynamique de services pour aider les gestionnaires. Les réseaux de neurones sont entraînés à l'aide de données comportementales provenant d'une expérience où le client achète un véhicule usagé en ligne. Le réseau de neurones est ensuite utilisé pour déterminer la gamme de services à offrir en fonction des interactions que l'usager a eues avec le système. On démontre que cette méthode est plus exacte que les méthodes de régression pour supporter la conception dynamique d'un service dans un environnement servitisé.

Les principales contributions de la thèse sont d'améliorer la connaissance à propos du phénomène de *servitisation* au niveau de trois dimensions, soit le quoi, le pourquoi et le comment. Cette connaissance permet d'aider les gestionnaires dans leurs décisions.

Mots clés : Servitisation, évolution de la théorie, avenues de recherche, facteurs influençant le niveau de servitisation, conception dynamique de services

Méthodes de recherche : recherche qualitative, analyse de contenu, analyse multivariée, expérimentation, enquête, apprentissage automatique, réseau de neurones, analyse des comportements

Abstract

With the competitive landscape and ever increasing customer expectations, manufacturing companies must undertake business model innovations like servitization to sustain their market position. This thesis uses a three-essay model and a multi-method approach to present the trends in servitization literature, consolidate the current theories, develop a framework to evaluate influencer effect on servitization and finally present a mechanism to support dynamic service design in a servitized environment.

The first essay analyzes the servitization literature to study the trends and iteratively develop the evolving theory using grounded theory methodology. We identified avenues where theory is not well developed to support future research.

Using the organizational motivation as a factor, the second essay theoretically builds a strategic typology for studying servitizing organizations. Using this strategic typology on a cross sectional data, the research presents confirmatory tests to explain variations in the effect of the same influencer on servitization.

The third essay assists managers' by providing a model for dynamic service design. Artificial neural networks(ANN) is trained using behavioral data from service infusion in an online car purchase experiment. The trained ANN is then used to hypothesize a service portfolio based on a user's behavioral interaction with the system. We demonstrate a higher accuracy than regression methods to support dynamic service design in a servitized environment.

This thesis contributes by providing three knowledge dimensions of know-what, know-why and know-how for servitization decision support to managers.

Keywords: Servitization, theory evolution, research directions, influencers, service infusion, dynamic service design

Research methods: Qualitative research, content analysis, multivariate analysis, experimentation, survey, machine learning, artificial neural network, behavioral analytics

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List of acronyms

SEM: Structural Equation Modelling

IMSS: International Manufacturing Strategy Survey

ISIC: International Standard Industrial Classification

OECD: Organization for Economic Cooperation and Development

SD: Standard Deviation

SI: Servitization Intensity

FP: Financial Performance relative to competitors

CI: Customer Integration

SPI: Supplier Integration

PC: Product Complexity

A: Automation

SA: Staff Ambidexterity

CMB: Common Method Bias

ML: Maximum Likelihood

ANN: Artificial Neural Network

ANOVA: Analysis of Variance

RMSE: Root Mean Squared Error

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Chapter 1

Introduction

Competitive external environments have forced manufacturing companies to understand the benefits of adding services in their value mix (Cowell 1980). Vandermerwe and Rada (1988) call this phenomenon "servitization," where services are added to manufactured products not as a "separate category" but as a "pervasive part." They also prescribe that managers should focus on service definition while defining their strategic mission and conducting corporate planning. Oliva and Kallenberg (2003) highlight that organizations servitize to obtain economic gains, to respond to customer demand or to position themselves strategically.

Over the years, servitization has transformed into a field of study in which scholars have examined various underpinnings of this strategic approach (Araujo and Spring 2006, Brax 2005, Mathieu 2001, Meier et al. 2010, Spring and Araujo 2009). The focus and definition of servitization has evolved. Based on our literature study, we use the following definition by Ren and Gregory (2007): "servitization is a process of change of strategy where manufacturing companies opt for an orientation in services and/or develop more and better services with the goal of satisfying customer needs, obtaining competitive advantages and improving company's performance."

Studies have highlighted that organizations adopt a servitization strategy to gain competitive advantage, develop customer relationships or respond to a change in economic conditions (Oliva and Kallenberg 2003, Slepniov et al. 2010, McGrath and Gilmore 1995). Research streams have developed around these core themes, however studies in strategic advantage have predominantly used the economic factor (Eggert et al. 2014, Verstrepen et al. 1999). Researchers have concluded that even after a reduction in the net sales, servitized organizations have become more profitable (Sawhney et al. 2004). Some studies have highlighted the stability of service firms during market cycles (Brax 2005), while others have shown that service firms are more susceptible to bankruptcy than are pure product firms (Neely 2008). Some research has also concluded that the profit

margins in a servitized organization are much higher than in a pure product environment (Heineke and Davis 2007, Wise and Baumgartner 1999).

In contrast, the customer relationships mindset is conceptualized by a solution-based approach (Davies et al. 2007, Shepherd and Ahmed 2000). The objective of the organization is to provide value to customers by presenting a solution instead of a product. Several studies have highlighted the service component of the solution as the key driving force in customer relationships (Berry 1995, Turunen and Toivonen 2011, Winer 2001). Some researchers have studied the antecedents of solutions and have identified customer demand as one antecedent of a solution (Nordin and Kowalkowski 2010, Ulaga and Reinartz 2011)

Several literature-based studies have been performed to identify the current state of research on servitization. These studies have either used a literature review approach (Almeida et al. 2008, Baines et al. 2009, Lightfoot et al. 2013) or a meta-analysis approach (Rese et al. 2009, Bastl et al. 2012, Luoto et al. 2016). Most of them call for work in theory development, transition process analysis and service design mechanisms. They also highlight that most research on servitization adopts a descriptive approach, and consequently managers have very few insights into the servitization business model transformation process.

The primary objective of this thesis is to present tools to assist managers in their servitization process. To this end, we followed a pragmatic path. Given the recency of the servitization phenomenon, we first aimed to answer "what" are the current trends in the servitization literature and to aggregate the current theories. We thus extensively searched the servitization literature and carefully selected papers to detect trends in the literature, and suggested future research avenues where gaps were noted. To better understand the organizational processes supporting servitization, we aggregated the current theories to develop the underpinnings in the organizational processes before, during and after servitization.

The next step was to identify "why" organizations servitize. Several prior studies have presented conflicting information on the servitization transition process. We have developed a typology of organizational strategic orientation to explain the conflicting results. We have studied the relationship of some important influencers of servitization intensity in organizations using the strategic orientation as a moderator.

The last step was to present an approach on "how" to servitize. Dynamic strategies to reconcile the customer expectations and organizational goals to undergo service infusion are sparse in the literature. Hence ad-hoc services are added during the servitization process and most reconciliation in the literature is done as an after-effect of the servitization process. We propose a way to design the service added component of a solution that reconciles the organization's objectives and the customers' expectations.

The three knowledge components of the thesis, namely what is the current state of the literature, why do organizations servitize and how can organizations servitize, provide a holistic view of the servitization phenomenon. Garud (1997) contends that most studies focus on the how aspect only; a complete understanding requires consideration of all three knowledge components. This approach of incorporating the three knowledge components is one of the main strengths of the thesis.

The objective of the thesis was difficult to achieve using a single methodology. The analysis of literature was done as a systematic literature review followed by a summative analysis to identify the trends and research directions. The theory aggregation was done using grounded theory. We used multivariate analysis to determine the impact of the strategic orientation on the link between influencers and servitization intensity. Finally, to answer the question of "how" organizations can servitize, we used neural networks trained by customers' behavioral data. This multi-method approach is one of the characteristics of this thesis.

1.1 Summary: Essay 1

This essay *"Servitization: Summative analysis, emergent theories and avenues for research"* examines the servitization literature to specify the current trends, theories that

are evolving from the literature and avenues where research is not well developed. This research is currently presented as one essay in the thesis. However, the two parts in this essay will be submitted as two different articles to target journals in the future, as suggested by the editor and reviewers of the *International Journal For Production Economics*.

This research was conducted following an exhaustive search of the servitization literature. 146 articles were recognized as suitable candidates for the study; they used an operations management lens and they discussed the servitization phenomenon. This study is divided into two parts. In the first part, we study the literature and highlight the trends in past research. The second part is a process-based approach where we use a grounded theory to inductively build theories about the servitization process.

More specifically this research paper addresses the three following questions:

RQ 1: What are the trends in the servitization literature? (Part I)

RQ 2: On which potential areas should future research focus? (Part I and II)

RQ 3: What are the evolving theories based on the current literature on servitization? (Part II)

1.1.1 Essay 1: Part I, methodology

The first part of this paper follows a contingency theory approach to identify important parameters through which to study the servitization literature. We base our identification on the premise that servitization influences organizational performance (Chen et al. 2016). According to contingency theory, organizational performance is dependent on the coherence levels between the external environment, the organizational strategy and organizational factors (Mintzberg 1979, Van de Ven and Drazin 1984, Donaldson 1987, Powell 1992). We hence identify parameters to code for external environment, organization strategy, organizational factors and outcomes. Had we defined a static set of parameters for the coding process, we would have limited the scope of the literature review considerably. Hence, we refined the parameters and inductively found new ones

during the coding process. The study was thus initiated with an initial set of parameters that were identified from the service and organizational change literatures. During the coding process of the 146 servitization papers, we discovered new or similar parameters. New parameters were added to the set, whereas similar parameters were used to refine the base of parameter definitions. The new set of parameters was then used in subsequent steps of the coding process. We also coded each article on the methodology, service type, year of publication, journal and country of study (for case-study-based research, if defined). Then, a summative analysis and a study of the trends in the literature was conducted. All these analyses were performed in NVIVO, a tool designed for qualitative analysis.

1.1.2 Essay 1: Part II, methodology

The second phase of the analysis was motivated by the objective to develop theory from process data (Langley 1999). This part of the article studied the literature on processes before, during and after servitization. Theoretical samples discussing motivations and classifications were collected for pre-servitization, while impediments and relationships were captured in the timeline during the servitization process. The interactions with organization factors, engagement of stakeholders, organizational performance and realignments after the first phase of servitization were collected in the post-servitization group. Similar approaches have been taken by researchers doing process studies using the grounded theory methodology (Gioia and Chittipeddi 1991, Mantere et al. 2012).

First order themes were coded in NVIVO. These themes served as the theoretical samples. A degree of abstraction was added to group these first-order concepts into a second-order concept that would then sum up to an aggregate dimension. A partial analysis is presented in Figure 1-1 to clearly demonstrate the abstraction process.
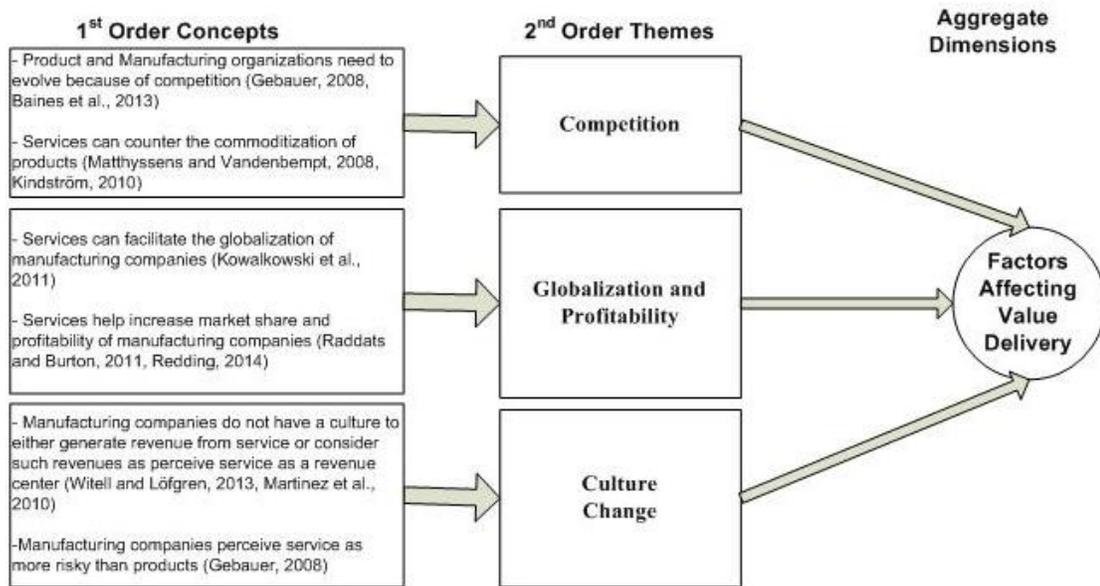
Figure 1-1: Partial analysis to demonstrate the abstraction mechanism

1.1.3 Essay 1: Findings

The research presents several findings on the trends in the servitization literature. We see that the diffusion of servitization research covers various domains. However, most research still appears to be descriptive in nature. The servitization phenomenon is mostly studied in European countries, with some recent studies conducted in North America and Asia. Overall, we provide several future research recommendations. Following our analysis of the servitization process, in the second part of the article, we develop 29 propositions that present the emergent theories on servitization. These propositions could be used for future confirmatory research in the area of servitization.

1.2 Summary: Essay 2

This essay "A strategic orientation typology for analysis of servitization intensity," examines the servitization decision making process. We specifically study the link between several influencers of servitization intensity and use a strategy typology to explain the conflicting effects mentioned in the literature. An extended abstract of this research was accepted in a special edition (Service transformation in Industrial

companies) of *The International Journal for Production Research*. The essay in its current form has been submitted to this journal for consideration.

The servitization literature presents several conflicting effects of factors on servitization intensity. Koren et al. (2009) observe that servitization is supported by a reduction in *customer integration* when customers perceive substantial value in the product. However, other studies have found that *customer integration* would support servitization (Verstrepen et al. 1999). Similarly, several researchers have highlighted the positive influence of *product complexity* on servitization (Quinn et al. 1990, Pilat et al. 2006), but Rosenzweig (2009) demonstrates that *product complexity* may have a negative effect on an organization's performance and may hinder servitization. These conflicting results hinder managers' decision-making process.

We argue that such contradictions arise because these studies do not consider the strategic orientation of the organization. Organizational theorists assert that most research in cause-and-effect analysis in an organizational context should use a contingency theory approach (Venkatraman 1989). In this approach, the impact of predictor variables on a dependent variable is studied by means of an interaction effect between predictors.

More specifically, the study seeks to answer the following research questions:

RQ 1: Why do firms servitize and how can we develop a strategic orientation typology for servitized firms?

RQ 2: Does strategic orientation have an impact on the influencers of servitization intensity?

1.2.1 Essay 2: Methodology

To build our typology, we have studied the literature on organizational strategic orientation (Miles et al. 1978, Snow and Hambrick 1980, Puranam et al. 2014). We have developed four strategic orientations: producer-centric, customer-centric, dyadic and evolving strategy. Organizations that are driven by profit and differentiation as motivators to servitize are categorized as 'producer-centric' (Neely 2008). Organizations that

servitize to provide customers with more flexibility and efficiency are categorized as 'customer-centric' (Baines et al. 2009). Organizations that follow a path of collaboration with customers to develop solutions and profitability are categorized as 'dyadic' (Finne and Holmström 2013). Organizations that follow a reactive approach and respond to external environmental changes to reconfigure are categorized to have an evolving strategy.

Based on the existing theories and logic, we have developed hypotheses for the effect of six important influencers: *financial performance, customer integration*, *supplier integration*, *product complexity, automation* and *staff ambidexterity,* on *servitization intensity,* our dependent variable, for the producer-centric, customer-centric and dyadic strategic orientations. Because the evolving strategy is treated as an exploratory research path, no hypotheses were developed for it.

This confirmatory research is conducted using a subset of the data collected from the International Manufacturing Strategy Survey (IMSS). In a sample of 712 plants that participated in this survey worldwide, 600 plants from OECD countries were chosen for this study. We operationalize the four strategic orientation by identifying factors in the survey that record the organization's strategic focus. The influencers are operationalized as latent variables. Using a structural equation model (SEM), we conduct a multi-group analysis to test the hypothesis. We then study the path variables to analyze the developed hypotheses. We also analyze the effects of the antecedents on servitization intensity in the evolving strategic group.

1.2.2 Essay 2: Findings

The research presents several findings to support managers' decision-making process. First, it demonstrates variability in the impact of influencers across different strategic orientations on servitization intensity. For example, the relative influencer that measures the firm's performance with respect to its competitor, i.e. *financial performance's* effect on *servitization intensity,* has a negative influence on servitization intensity in the producer-centric strategy, a positive influence in the customer-centric strategy and no

influence in the dyadic strategy. Such variability validates the strategic typology and clarifies the underlying mechanisms behind servitization business model transformation.

1.3 Summary: Essay 3

The essay "Service design in a servitized environment using behavioral analytics" aims at reconciling the organizational objective of achieving customer loyalty by creating satisfaction for the individual objective of value maximization of each customer. We use behavioral analytics to train an artificial neural network (ANN) to achieve this purpose.

As services grow in importance in OECD countries, they are replacing the manufacturing process (De Backer et al. 2015). To provide more value to the customers, organizations have been continuously adding services to their portfolio. However, this process of service addition is usually done as an end result of a business process change (Steiner et al. 2016). This static addition of services has resulted in a pre-defined set of offerings to customers, which tends to reduce the service experience over time. It is hence important that organizations undergo such transformations by using services as the change agent and not result of a transformation process. These services have to be directed specifically at the customer for value maximization. Customer behavior is non-linear in nature and hence traditional methods like regression cannot estimate it with a high degree of precision (Coombs and Avrunin 1977). We hence use behavioral analytics data to develop a non-compensatory system to assist managers in designing a dynamic service infusion.

More specifically, the study seeks to answer the following research question:

RQ 1: How can behavioral data be used to train ANN to support dynamic service infusion?

1.3.1 Essay 3: Methodology

In the first part of the study, we develop a model to understand the variables that affect the customer's online buying process. We operationalize these variables as experiment conditions. This experiment is first tested in a known group to improve the efficacy of the questions. Two experiments were then developed, one for a low priced car and another for a high priced car. We introduced four services, i.e. maintenance, financing, insurance

and carbon footprint management, as value added for the customers. A recommendation service, which provided another choice in the same brand that the user had first selected, was added to test customer satisfaction with delivery system manipulations. The experiments include instructional manipulation checks (Oppenheimer et al. 2009) to ensure that the high quality of the responses. We launched the two experiments at different times on the Amazon mechanical Turk (Mturk) crowdsourcing platform. A budget of $2.50 was allocated for each completed experiment, which was paid to the participant by the Mturk platform. Participants were limited to residents of the United States only. The first experiment, which involved a low-priced car, obtained 220 acceptable responses, whereas the second experiment, involving a high priced car, obtained 200 acceptable responses.

The collected information was analyzed in two steps for each experiment. The objective of the first step was to compare the accuracy of the regression method to that of the ANN. The data were randomly split into 80% for training and 20% for testing. We conducted a linear regression on the training data to develop the regression equation for customer satisfaction. This equation was used to predict customer satisfaction in the test data, and the root mean squared error (RMSE) was computed. For the ANN, we used a tool called *Multiple Back-propagation.* The training and test data were entered into the system. We used 12 hours as the cut-off period for training the network, after which the RMSE for the test data was studied.

The second step of the analysis used behavioral data only to predict a service design for a given customer. The four services (maintenance, finance, insurance and carbon footprint management) had two dimensions (rank and weight) estimated. We used this mechanism to support the service design process where managers can direct the right investments based on weight and rank of each service. For the recommendation service, the objective was to determine whether the user would appreciate it or not. We used the ANN to predict this aspect.

1.3.2 Essay 3: Findings

Our study found that the ANN was far superior in estimating customer satisfaction than the regression approach for both experiments. Using the ANN for service design, we observed that the RMSE for service prediction was low for both groups. However, for the prediction for the recommendation service, we observed that for the high priced car experiment (62.5% accuracy), the prediction had a much higher error than for the low priced car experiment (90% accuracy). We conducted a post-hoc analysis and doubled the number of responses for the high priced car experiment to determine whether this error was observed because of sample size. We observed a slight degradation in the accuracy to 58.75% by using the same behavioral parameters for both experiments (low priced and high priced car). We conclude that with the increase in value of the product, more behavioral aspects need to be analyzed for higher accuracy.

References

Almeida, L. F., Miguel, P. A. C. & Silva, M. 2008. 'A literature review of servitization: a preliminary analysis.' Paper presented at Proceedings of the POMS 19th annual conference, La Jolla, California, U.S.A..

Araujo, L. & Spring, M. 2006. 'Services, products, and the institutional structure of production.' *Industrial Marketing Management,* 35:7, 797-805.

Baines, T., Lightfoot, H., Benedettini, O. & Kay, J. M. 2009. 'The servitization of manufacturing: a review of literature and reflection on future challenges.' *Journal of Manufacturing Technology Management,* 20:5, 547-67.

Bastl, M., Johnson, M., Lightfoot, H. & Evans, S. 2012. 'Buyer-supplier relationships in a servitized environment: An examination with Cannon and Perreault's framework.' *International Journal of Operations & Production Management,* 32:6, 650-75.

Berry, L. L. 1995. 'Relationship marketing of services—growing interest, emerging perspectives.' *Journal of the Academy of Marketing Science,* 23:4, 236-45.

Brax, S. 2005. 'A manufacturer becoming service provider–challenges and a paradox.' *Managing Service Quality,* 15:2, 142-55.

Chen, K.-H., Wang, C.-H., Huang, S.-Z. & Shen, G. C. 2016. 'Service innovation and new product performance: The influence of market-linking capabilities and market turbulence.' *International Journal of Production Economics,* 172, 54-64.

Coombs, C. H. & Avrunin, G. S. 1977. 'Single-peaked functions and the theory of preference.' *Psychological Review,* 84:2, 216.

Cowell, D. W. 1980. 'The marketing of services.' *Managerial Finance,* 5:3, 223-31.

Davies, A., Brady, T. & Hobday, M. 2007. 'Organizing for solutions: Systems seller vs. systems integrator.' *Industrial Marketing Management,* 36:2, 183-93.

De Backer, K., Desnoyers-James, I. & Moussiegt, L. 2015. "Manufacturing or Services-That is (not) the Question'.' *OECD Science,* Technology and Industry

Donaldson, L. 1987. 'Strategy and structural adjustment to regain fit and performance: in defence of contingency theory.' *Journal of Management Studies,* 24:1, 1-24.

Eggert, A., Hogreve, J., Ulaga, W. & Muenkhoff, E. 2014. 'Revenue and profit implications of industrial service strategies.' *Journal of Service Research,* 17:1, 23-39.

Finne, M. & Holmström, J. 2013. 'A manufacturer moving upstream: triadic collaboration for service delivery.' *Supply Chain Management: An International Journal,* 18:1, 21-33.

Garud, R. 1997. 'On the distinction between know-how, know-why, and know-what.' *Advances in Strategic Management,* 14, 81-101.

Gioia, D. A. & Chittipeddi, K. 1991. 'Sensemaking and sensegiving in strategic change initiation.' *Strategic Management Journal,* 12:6, 433-48.

Heineke, J. & Davis, M. M. 2007. 'The emergence of service operations management as an academic discipline.' *Journal of Operations Management,* 25:2, 364-74.

Koren, Y., Bell, R. & Volinsky, C. 2009. 'Matrix factorization techniques for recommender systems.' *Computer* 42 no. 8, 30-37.

Langley, A. 1999. 'Strategies for theorizing from process data.' *Academy of Management Review,* 24:4, 691-710.

Lightfoot, H., Baines, T. & Smart, P. 2013. 'The servitization of manufacturing: A systematic literature review of interdependent trends.' *International Journal of Operations & Production Management,* 33:11/12, 1408-34.

Luoto, S., Brax, S. & Kohtamäki, M. 2016. 'Critical meta-analysis of servitization research: Constructing a model-narrative to reveal paradigmatic assumptions.' *Industrial Marketing Management*, in Press.

Mantere, S., Schildt, H. A. & Sillince, J. A. 2012. 'Reversal of strategic change.' *Academy of Management Journal,* 55:1, 172-96.

Mathieu, V. 2001. 'Service strategies within the manufacturing sector: benefits, costs and partnership.' *International Journal of Service Industry Management,* 12:5, 451-75.

McGrath, M. & Gilmore, D. 1995. 'Achieving growth, competitive advantage and increased profits.' *World Class Design to Manufacture,* 2:6, 11-16.

Meier, H., Roy, R. & Seliger, G. 2010. 'Industrial Product-Service Systems—IPS2.' *CIRP Annals-Manufacturing Technology,* 59:2, 607-27.

Miles, R., Snow, C., Meyer, A. & Coleman, H. 1978. 'Organizational strategy, structure, and process.' *Academy of Management Review,* 3:3, 546-62.

Mintzberg, H. 1979. 'The structuring of organizations: A synthesis of the research.' *Prentice-Hall.*

Neely, A. 2008. 'Exploring the financial consequences of the servitization of manufacturing.' *Operations Management Research,* 1:2, 103-18.

Nordin, F. & Kowalkowski, C. 2010. 'Solutions offerings: a critical review and reconceptualisation.' *Journal of Service Management,* 21:4, 441-59.

Oliva, R. & Kallenberg, R. 2003. 'Managing the transition from products to services.' *International Journal of Service Industry Management,* 14:2, 160-72.

Oppenheimer, D. M., Meyvis, T. & Davidenko, N. 2009. 'Instructional manipulation checks: Detecting satisficing to increase statistical power.' *Journal of Experimental Social Psychology,* 45:4, 867-72.

Pilat, D., Cimper, A., Olsen, K. & Webb, C. 2006. 'The changing nature of manufacturing in OECD economies.' In Directorate for science, technology and industry, STI Working paper series.

Powell, T. C. 1992. 'Organizational alignment as competitive advantage.' *Strategic Management Journal,* 13:2, 119-34.

Puranam, P., Alexy, O. & Reitzig, M. 2014. 'What's "new" about new forms of organizing?' *Academy of Management Review,* 39:2, 162-80.

Quinn, J. B., Doorley, T. L. & Paquette, P. C. 1990. 'Beyond products: services-based strategy.' *Harvard Business Review,* 68:2, 58-60.

Ren, G. & Gregory, M. 2007. 'Servitization in manufacturing companies: a conceptualization, critical review, and research agenda.' *In: Frontiers in Service Conference 2007, San Francisco, CA, US.*

Rese, M., Strotmann, W.-C. & Karger, M. 2009. 'Which industrial product service system fits best? Evaluating flexible alternatives based on customers' preference drivers.' *Journal of Manufacturing Technology Management,* 20:5, 640-53.

Rosenzweig, E. 2009. 'A contingent view of e-collaboration and performance in manufacturing.' *Journal of Operations Management,* 27:6, 462-78.

Sawhney, Balasubramanian & Krishnan 2004. 'Creating growth with services.' *MIT Sloan Management Review, 45.2 (2004):34.*

Shepherd, C. & Ahmed, P. K. 2000. 'From product innovation to solutions innovation: a new paradigm for competitive advantage.' *European Journal of Innovation Management,* 3:2, 100-06.

Slepniov, D., Waehrens, B. V. & Johansen, J. 2010. 'Servitization as a strategy for survival: an investigation of the process in Danish manufacturing firms.' Paper presented at the 15th Cambridge International Manufacturing Symposium.

Snow, C. & Hambrick, D. 1980. 'Measuring organizational strategies: Some theoretical and methodological problems.' *Academy of Management Review,* 5:4, 527-38.

Spring, M. & Araujo, L. 2009. 'Service, services and products: rethinking operations strategy.' *International Journal of Operations & Production Management,* 29:5, 444-67.

Steiner, M., Eggert, A., Ulaga, W. & Backhaus, K. 2016. 'Do customized service packages impede value capture in industrial markets?' *Journal of the Academy of Marketing Science,* 44:2, 151-65.

Turunen, T. T. & Toivonen, M. 2011. 'Organizing customer-oriented service business in manufacturing.' *Operations Management Research,* 4:1-2, 74-84.

Ulaga, W. & Reinartz, W. J. 2011. 'Hybrid offerings: how manufacturing firms combine goods and services successfully.' *Journal of Marketing,* 75:6, 5-23.

Van de Ven, A. H. & Drazin, R. 1984. 'The Concept of Fit in Contingency Theory.' DTIC Document.

Venkatraman, N. 1989. 'The concept of fit in strategy research: Toward verbal and statistical correspondence.' *Academy of Management Review,* 14:3, 423-44.

Verstrepen, S., Deschoolmeester, D. & van den Berg, R. J. 1999. 'Servitization in the automotive sector: creating value and competitive advantage through service after sales.' *Global Production Management:* 538-45. Springer.

Winer, R. S. 2001. 'Customer relationship management: a framework, research directions, and the future.' *Working paper series, Berkley: Haas School of Business*.

Wise, R. & Baumgartner, P. 1999. 'Go downstream.' *Harvard Business Review,* 77:5, 133-41.

Chapter 2

Servitization: Summative Analysis, Emergent Theories and

Avenues for Research

Nikhil Varma
HEC Montréal
3000, chemin de la Côte-Ste-Catherine
Montréal, Québec, H3T 2A7
Canada
nikhil.varma@hec.ca

Julie Paquette
HEC Montréal
3000, chemin de la Côte-Ste-Catherine
Montréal, Québec, H3T 2A7
Canada
julie.paquette@hec.ca

Rajesh Tyagi
rajeshtyagiqc@gmail.com

Abstract

The purpose of this paper is to conduct an extensive review of the servitization literature. Using organizations' operations as our focus, we perform two analyses of the literature. The first part develops a coding framework, underpinned by contingency theory. The sample of 146 articles was selected, coded and contextually analyzed to assess the evolution of servitization literature. Using a summative approach, trends were identified in the literature regarding the factors in our framework. Several research avenues and trends are proposed. In the second part, a process-based study is conducted. Using the same group of articles, discussions pertaining to pre-servitization, servitization and post-servitization are coded. Using the grounded theory methodology, we developed evolving theory models for each of the process stages. The evolving theory is presented in the form of propositions that can be validated by future research. The process analysis also enabled us to identify avenues where the literature is not well developed, for which we recommend future investigations.

Keywords: Servitization, product service systems, literature review, emergent theory, research avenues

2.1 Introduction

The competitive landscape has forced companies to adopt new business models. These business models often focus on the manner in which the company conducts business, and consist of two essential elements: the value proposition and the operation model (Schneider et al. 1996). While dealing with globalization and increasing customer expectations, the manufacturing sector has strived to remain competitive (Swamidass and Newell 1987, Hayes and Pisano 1996, Bozarth and McDermott 1998, Neely 2005). Improving the product service offering is one way to enhance the value proposition when pursuing business model innovation (Sørensen 2002). Using similar premises of business model innovation, Vandermerwe and Rada (1988) presented the concept of servitization, and proposed that manufacturing firms could add value to the offerings they provide to their customers by delivering a product/service mix to gain a competitive advantage. This work presented a new business model strategy of adding services not as a "separate category," as was previously done, but as a "pervasive part" of the offering that managers should consider when defining the strategic mission and conducting corporate planning. This work also emphasizes that the servitization endeavor is market-driven, primarily because the focus of organizations has shifted from satisfying customer needs to establishing customer relationships.

Following the first definition provided by Vandermerwe and Rada (1988), the focus of servitization has become sharper and hence the definition has evolved. Over the years, servitization has transformed into a field of study characterized by investigations of various underpinnings of this approach (Araujo and Spring 2006, Brax 2005, Mathieu 2001, Meier et al. 2010, Spring and Araujo 2009). Organizations like Rolls-Royce have redefined their business model and shifted to selling solutions instead of products (Harrison 2006). We have reviewed several definitions of servitization, as shown in Table 2-1.

Authors	Definition of servitization	Comments
Vandermerwe and Rada (1988)	"Modern corporations are increasingly offering fuller market packages or bundles of customer-focused combinations of goods, services, support, self-service, and knowledge. But services are beginning to dominate. This movement is termed the servitization of business "	Initial definition, captures the operational aspect
Verstrepen et al. (1999)	'Servitization', which entails adding extra service components to core products"	Captures operational aspect
Ren and Gregory (2007a)	"a process of change of strategy where manufacturing companies opt for an orientation in services and/or develop more and better services with the goal of satisfying customer needs, obtaining competitive advantages and improving company's performance"	Captures operational and three dimensions of motivation (increase company performance, customer orientation and strategic advantage)
Baines et al. (2009a)	"Manufacturers themselves can base their competitive strategies on services, and the process through which this is achieved is commonly known as servitization"	Captures motivation but only one dimension (strategic advantage)
Opresnik and Taisch (2015)	"Servitization' is the most high-level term for service-oriented strategies"	Broad definition

Table 2-1: Definitions of servitization

We base our study on a definition of servitization which encapsulates all its aspects: "a process of change of strategy where manufacturing companies opt for an orientation in services and/or develop more and better services with the goal of satisfying customer needs, obtaining competitive advantages and improving company's performance" (Ren and Gregory 2007).

The ongoing focus on servitization by the research community raises the need for an in-depth literature analysis to gain an overall understanding of the field. We embarked on this study with the following research questions:

Research Question 1: How has the literature in the field of servitization been evolving?

Research Question 2: On which potential areas should future research focus?

Research Question 3: What are the evolving theories within the current servitization literature?

This article builds on the literature review conducted by Baines et al. (2009a) and Lightfoot et al. (2013). Baines et al. (2009a) provide a foundation on the core principles of servitization, while Lightfoot et al. (2013) identify the multidisciplinary nature of the field of servitization across various research communities Eloranta and Turunen (2015) recently conducted a literature review on servitization to study the competitive advantage that companies could achieve from its implementation. This research aims to extend and enrich the findings of the work conducted by Eloranta and Turunen (2015) by providing avenues for potential research in the field of servitization. Using content and inductive analysis of 146 articles published between 1988 and 2014, we analyze the current state-of-the art on servitization. We also seek to provide managers with insights on diverse organizational parameters and their influence on servitization.

This paper is divided into two parts; in the first part in Section 2, we explain how the articles were selected for our systematic literature review. We then explain how we develop a model to identify factors for coding the literature. Section 4 proposes the summative analysis of the literature with insights on how it has evolved over the years and identifies future research avenues. In the second part of this paper, we adopt a process-view approach and inductively develop emerging theories from the literature on the servitization adoption process during the following three distinct periods: before, during and after servitization. In this part we identify areas that have not been adequately developed and provide implications for future research.

2.2 Methodology and framework

In this section, we will first explain how we selected the articles comprising our systematic literature review. We then specify how we proceeded to code each article and how we obtained our coding model.

2.2.1 Article selection methodology

We adopted a semi-structured approach for article selection. Our first step was to identify search keywords and develop a search string (reported in Appendix A) that is associated with the servitization literature. We then used the search string to identify articles published over the period of 1988 to 2014 (October 2014). The word *servitization* first appeared in the literature in 1988 (Vandermerwe and Rada 1988), hence we start our study from that year. Our search included three well-known databases: ***ABI/Inform, Emerald, JSTOR*** and ***Business Source Premier.*** The same search was conducted in ***Google Scholar***. We imported the journal name, authors and abstracts of the identified articles to an ***Endnote*** database. We obtained 2,037 articles in total. At this stage, we conducted our first phase of the selection process. Working with two judges looking into the publication source at the same time, we removed all articles that were published in conferences, because this type of publication reports research progress and therefore might be redundant if both a conference paper and a journal paper on the same topic written by the same authors are considered.

Following the first stage of screening, we obtained 578 articles, that were potential candidates for literature analysis. At this stage, we decided to enhance the completeness of our article search by using a commonly known snowball sampling method (Ang 2014). We selected some highly cited articles in servitization research such as Vandermerwe and Rada (1988), Neely (2005), Ren and Gregory (2007), Baines et al. (2009a) and Kastalli and Van Looy (2013). We then extracted all the articles written by these authors and their co-authors on servitization to create a set of articles. Following this process, we identified all the articles that had referenced this set of articles. The 480 articles extracted from this snowball process were then stored in a separate ***Endnote*** database. The next stage was to

merge the two databases by removing the duplicates. The selection process consequently yielded 628 articles.

This analysis was conducted independently by two judges. The first judge was a graduate student who had worked in the article extraction process and was proficient in the servitization literature. The second judge was one of the authors of this article. We aimed to identify the articles that discuss manufacturing and services issues from an operations management perspective. The rejection criteria used by the judges are presented in Table 2-2 . For example, articles that focused on services and/or marketing exclusively were rejected from the database.

Rejection reason	Indicator	Rejection description
Topic-Marketing	Marketing journal	If the article simply discusses marketing concepts and does not discuss aspects like implementation, measurement of servitization or services in a product or manufacturing environment
Topic-Services	Journals focusing on Service science	It the article discusses the service only and there is no description or product or manufacturing

Table 2-2: Rejection Criteria

We used two judges for this part to reduce type I errors (eliminating an article that addressed a topic related to servitization based on an OM perspective). The first judge had eliminated 229 articles. The second judge then analyzed the articles rejected by the first judge and decided to keep 25 of those. Only the articles rejected by the second judge were rejected definitively. Thus, 204 articles were eliminated from the list, which resulted in a database containing 424 articles that were candidates for further analysis. The complete article selection process is presented in Figure 2-1.
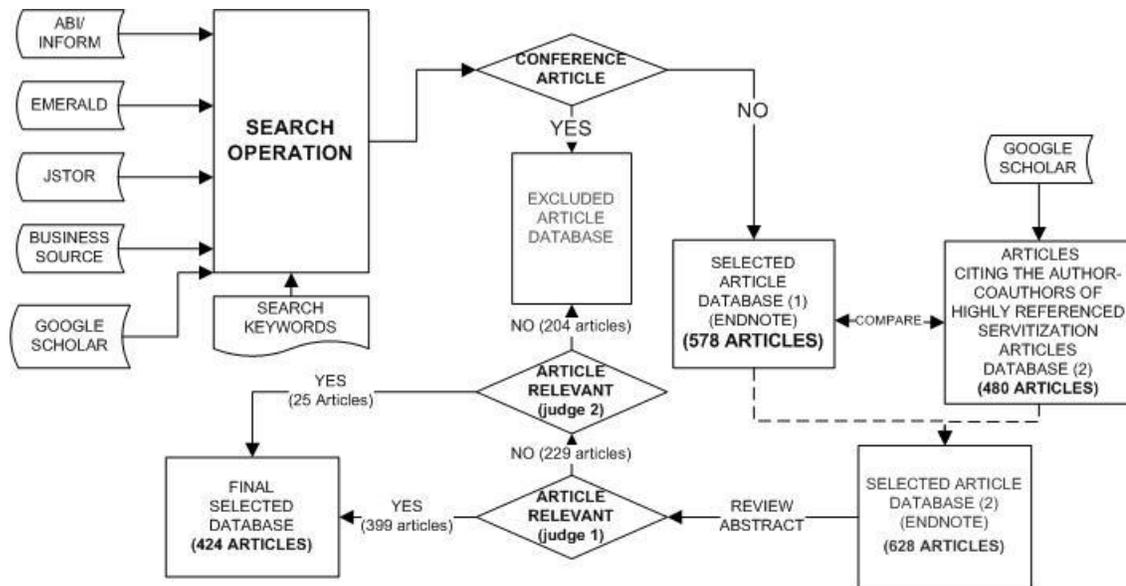
Figure 2-1: Article Selection Process

2.2.2 Coding Methodology

Researchers have highlighted the arduousness of coding qualitative data (Miles 1979, Sandelowski 1986, Hill et al. 1997). This process requires a deep understanding of the subject matter and involves active interaction among the coding team members. Keeping this complexity in mind, the coding process was conducted by two authors of this article. Another author was invited to participate in a periodic triangulation process to ensure that the article coding process was progressing in a controlled manner.

We followed a structured methodology for the coding process. The coding was done by reading the complete articles. For each paper, the coder would first determine if this paper should be kept for analysis or if it should be rejected based on the criteria mentioned in Section 2.1. This was necessary because sometimes the title and abstract of a paper were misleading. Then, the coder would identify contextual parameters to analyze the salient features of the articles. Four contextual parameters were coded for every article that was selected for analysis (an explanation of each of these terms is provided in Appendix 2.B): (1) year of publication, (2) name of the journal in which the article is published, (3) research methodology (case study, pure theory, quantitative, model) and (4) service type (tightly coupled or loosely coupled). Finally, the coder would also identify the

servitization parameters discussed substantively in the paper using the framework that will be discussed next. At this stage the coder would also identify new parameters that were not considered in the initial framework or propose changes to the initial set of parameters to better fit what was seen in the articles.

Therefore, our approach for identification of the organizational parameters mentioned in each article was mostly inductive in nature. The parameters in each block were first identified by a short preliminary literature review of highly cited articles on servitization and articles linked to various theories, as discussed in the following section. This initial set of parameters was then used to code the articles on servitization. During the coding process, we refined the parameters. For example, we merged two closely linked parameters and added new parameters. The evolved set of parameters was then used for further coding. Articles that were previously coded were then recoded with the new set of parameters to ensure consistency. We observed that this process served as a triangulation process. Further, this inductive process minimized the subjectivity aspect in parameter identification. The parameter identification process is outlined in Figure 2-2.
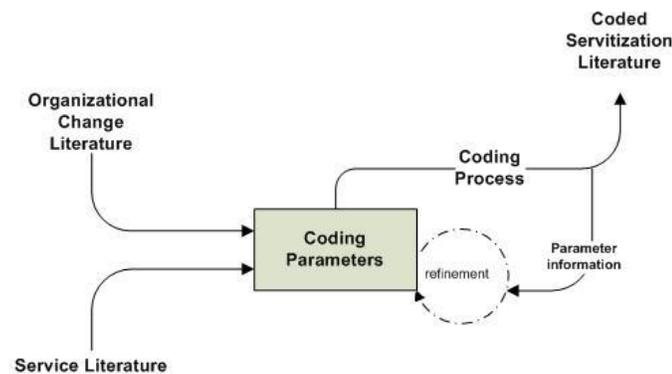
Figure 2-2: Model Parameter Evolution Process

To reduce the coders' workload, the 424 articles extracted from the selection process were distributed randomly in nine groups. In each group some articles were coded by both coders to ensure consistency. The remaining articles were divided into two groups, with each coder assigned to one of the groups. We saw an increase in inter-coder consistency

in the common group in every subsequent iteration, which was the motivation to reduce the number of common articles. For each group of articles, once the common articles were coded, the two coders would meet for a working session. Parameter evolution was discussed first in these meeting, followed by the articles that were not accepted as coding candidates. In our initial article selection process, we minimized Type I errors. At this stage, Type II errors (not eliminating an article that did not address a topic related to servitization using an OM perspective) were considered and minimized. Then, the parameters selected for each article were discussed. All differences were resolved by discussion. Following this meeting, the coders would each code their individual set of articles, from that group. A meeting was called after this stage, if there were parameter evolution aspects to be discussed. Otherwise we moved to the next group of articles. The first group of articles was smaller to accommodate the frequent meetings at the beginning of the coding process. Later groups of papers were bigger, because fewer meetings were necessary since a saturation about the parameter evolution was reached. This process continued for approximately nine months until all coding was completed. We digitally entered the coding information in *NVIVO 10.* In the next section, we develop the framework of analysis for the literature and iteratively develop the coding parameters.

2.2.3 Framework for analysis

The multidisciplinary nature of the current literature on servitization posed a challenge for our research objectives, hence we concluded that an appropriate strategy to study and analyze the servitization phenomenon was to examine the different factors affecting organizational performance.

Our founding premise is that servitization is initiated in organizations to gain competitive advantage (Vandermerwe and Rada 1988, Baines et al. 2009a). This business model of innovation in manufacturing companies is presented as a strategic initiative, with the organization as the unit of reference (Van de Ven and Drazin 1984, Mathieu 2001). We studied theories and related organizational parameters that directly pertain to the internal and external environment of the organization (Kindström and Kowalkowski 2009, Visnjic et al. 2014, and Ng and Nudurupati 2010) and their interactions with the resources within the organization's operations. This study led us to believe that the contingency theory

would serve as the best framework to study such parameters. Relating to the premises of contingency theory, we infer that organizational performance is dependent on coherence levels in the external environment, organizational strategy and organizational factors (Mintzberg 1979, Van de Ven and Drazin 1984, Donaldson 1987, Powell 1992). Our coding model is presented in Figure 2-3. These organizational factors enables us to code the article's content to extract meaningful information for researchers and practitioners. An explanation of all the parameters identified in the following sub-sections is presented in Appendix 2.C: Explanation of Parameters in Each Factor.
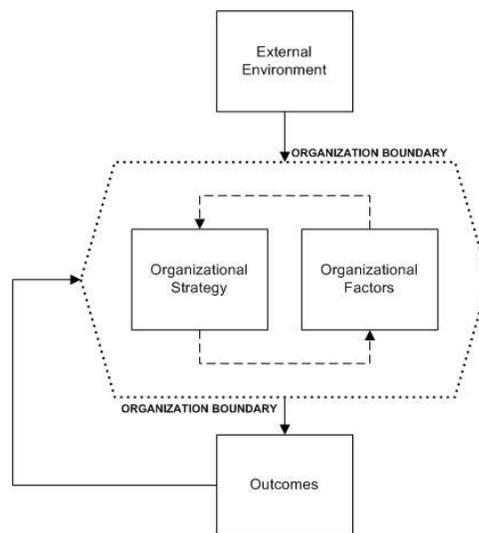
Figure 2-3: Model for coding of servitization literature

2.2.3.1 Parameters for External Environment Factors

An organization's strategic orientation with the external environment is one of the main reasons for any change initiative (Sastry 1997), such as the servitization process. We referred to the change management literature to identify the initial parameters set for external environment. The literature presented two viewpoints for organizational change driven by external factors (Greve 1996, Armenakis and Bedeian 1999). While one research stream discussed the organizational internal drive to change or take risks, (Sitkin and Pablo 1992, Kühberger 1998, Calantone et al. 2003), the other stream discussed

27

organizational response to external factor changes (Haveman 1992, Chattopadhyay et al. 2001). We initiated our coding process with these two parameters (organizational internal drive, organizational response) and arrived at five refined parameters presented in Figure 2-4. For example, when we were coding the articles with the parameter "organizational internal drive," we found a discussion on "market entry" in Gebauer (2007) and "globalization" in Gebauer et al. (2007) as the internal drive of organizations, so we added two sub-parameters as the subsequent coding parameters.
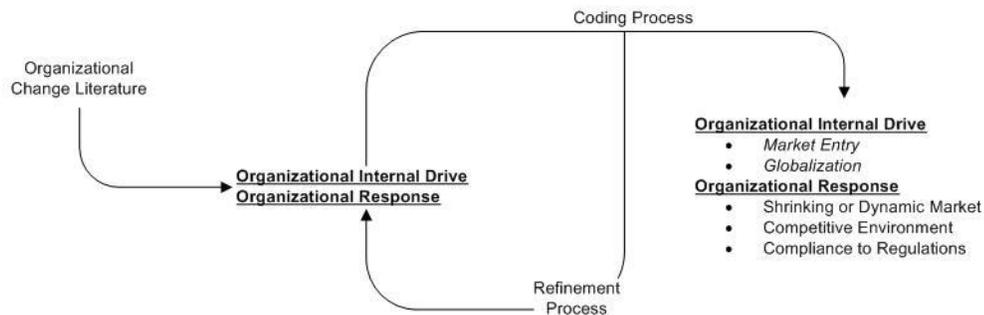
Figure 2-4: External Environment Parameters

2.2.3.2 Parameters for organizational strategy

In the process of developing the initial set of parameters for organizational strategy, we studied several aspects from the service literature such as new service deployment (Scheuing and Johnson 1989, Edvardsson and Olsson 1996), service addition and transition strategies (Oliva and Kallenberg 2003, Gebauer 2008, Kowalkowski et al. 2012), and other aspects from service marketing (Lovelock 1983, Zeithaml et al. 1985, Grönroos 2004). These studies pointed us to different strategic approaches that organizations have taken to identify initiatives related to services. The approaches, broadly classified as *Producer-centric*, *Customer-centric* and *Dyadic,* are discussed in the following subsections. We identified more specific parameters to help us categorize the articles. However, the articles were coded on the strategic approach level only.

2.2.3.2.1 Producer-centric strategy and its elements

Producer-centric strategies are approaches that are developed with the organization as the focal point. Several research initiatives that talk about producer-centric initiatives pertain to differentiation (Frambach et al. 1997, Levitt 1980, Van der Haar et al. 2001). In the past, manufacturers worked on product differentiation by adding measurable and identifiable functionalities to help ensure that products could last long and provide value to customers.

Neu and Brown (2005) have proposed adding services as a differentiation strategy. Product innovation has slowed, and service innovation initiatives have taken over. Services are seen as a more sustainable source of growth than products, and hence open a new dimension in innovation (Heskett et al. 1997). The previous challenge that manufacturers faced was the front-runner advantage, which was not sustainable because imitators could catch up. This resulted in huge losses for the innovator (Green 2008). However, with services this problem is minimized because most services are delivered uniquely to customers (Wernerfelt 1995). Services also provide the organization with a distinct identity and unique customer experience, which is also difficult to imitate.

Based on these readings, we identified *"differentiation"* and *"increasing profit margins"* as the two elements to categorize the identified strategy as producer-centric. As we evolved in the coding process, these two elements seemed adequate and no new parameters were added.

2.2.3.2.2 Customer-centric strategy and its elements

Customer-centric strategies are approaches developed with the customer as the focal point. Such approaches are usually undertaken in organizations that have strategically opted to offer the customer a value proposition and hence benefit from such endeavors.. To provide value, companies have tailored solutions to customers, addressing their business and operational needs (Parasuraman 1998, Stremersch et al. 2001). Moving to a solution-driven mindset is a strategic change in the organization's approach to its markets (Davies 2003, Galbraith 2011). Companies that provide solutions to customers extend

their offering by adding services to the baseline products and services (Gebauer and Friedli 2005, Oliva and Kallenberg 2003).

Some studies, for example (Kowalkowski 2006, Kumar and Kumar 2004), have shown that over time, these manufacturing organizations become service-driven, and service eventually takes precedence over their manufactured goods.

Based on this literature, we identified *"providing value to customer"* and *"solution-based approach"* as the two initial elements of customer-centric strategies. As we coded, we saw a convergence of these two elements because most articles discussed value to customers based on the solution provided. However, a new element emerged that discussed *"auxiliary services"* such as financing and support as strategies for servitization.

2.2.3.2.3 Dyadic strategy and its elements

Service is said to be co-produced between the consumer and the producer (Spohrer and Maglio 2008). Hence, not all service development strategies can be defined in isolation (either customer-centric or producer-centric). In some cases, the customer and producer must be considered simultaneously (perhaps to varying degrees). Such methodologies have recently been proposed, and appear to be a growing trend (Prahalad and Ramaswamy 2004, Vargo et al. 2008).

The internet has brought customers closer to companies. Companies like *Procter and Gamble* have initiated new avenues to collaborate with their customers (Dodgson et al. 2006). However, it remains to be seen whether companies should innovate on their own or consider using *ideation* (Cooper and Edgett 2008). The ideation process involves the generation of an idea by working with consumers to solve a consumer problem. The growing concept of crowdsourcing, which is an ideation process where companies use information syndicated through the *World Wide Web* to develop new products and services, has been studied from different perspectives (Howard et al. 2012, Libert and Spector 2010). Mature companies like *Procter and Gamble* have also benefited from crowdsourcing.

Based on this literature, we identified *"joint solution development"* and *"customer experience"* as the elements to identify a strategy as dyadic in nature. We did not add any new parameters during the coding process.

2.2.4 Parameters for organizational factors

We next identified the organizational factors that could positively or adversely impact the organizational strategy when the organization undergoes a change. The uniqueness of an organization has been studied by the accumulation of a knowledge base or tacit knowledge in the organization. Several organizational scholars have linked innovation and change to the tacit knowledge transfer capability of the organization (Kogut and Zander 1992, Cavusgil et al. 2003, Senker 2008). The service literature also relates companies' experience and tacit knowledge to the ability to successfully deploy new innovative service initiatives (Belal et al. 2012, Weeks 2010). Based on this literature, we identify *"company knowledge"* as a coding parameter.

Leadership of an organization is instrumental in defining, prioritizing and monitoring a radical change. Hence the leadership style has a direct impact on the change process (Lin et al. 2011). Transformational leadership has been linked to organizational change, and several studies have found a positive association between these concepts (Zeffane 1996, Eisenbach et al. 1999, Battilana et al. 2010). Strategic initiatives involving service deployment have also succeeded under strong leadership (Ahamed et al. 2012). Although many organizational theorists suggest that organic change is most sustainable (Weick and Quinn 1999, Dervitsiotis 2003), leadership has been shown to drive the process (Kotter 2008). We hence identify *"leadership"* as another coding parameter.

In discussions involving structural inertia and its interactions with organizational change, organizational sociologists unravel interesting factors impacting organizational change (Hannan and Freeman 1984, Fligstein and Dauber 1989). Hannan and Freeman (1984) argue that organizations attempting to change experience exhibit less reliable performance. Repetition of such endeavors increases the chances that the organization will perish. However, organizational structure appears to have a positive influence on the

change process (Romanelli and Tushman 1994). We thus identify "*organizational structure*" as a coding parameter.

There is a big difference between marketing products and marketing services (Berry 1980). The sales and marketing department of a manufacturer that servitizes must be either trained in the services mindset or hire people who can market services. A case study conducted by Neely (2008) that identified the "service paradox" found that manufacturing companies that added services to their offering became more financially delinquent. On further analysis, it was found that such companies had offered free services in addition to their products because the sales people lacked a vision of value generation from services (Neely 2008). We hence identify "*sales and marketing*" as a coding parameter.

Research in organizational change emphasizes that change is successful only when the people within the organization accept the change (Schneider et al. 1996, Weick and Quinn 1999). More broadly, the linkage of people to a successful change initiative has been expanded to the organizational culture (Heskett and Kotter 1992, Sørensen 2002). Heskett and Schlesinger (1994) also propose that a positive culture creates positive results for a service organization. We hence identify "*organizational culture*" as a parameter for coding the identified servitization literature.

We initiated the coding process using the parameters identified in the above discussion. We carefully analyzed the content of the articles around these parameters and inductively selected new parameters, modified these parameters and created categories as the coding progressed. The initial and final categories and their factors are presented in Figure 2-5.
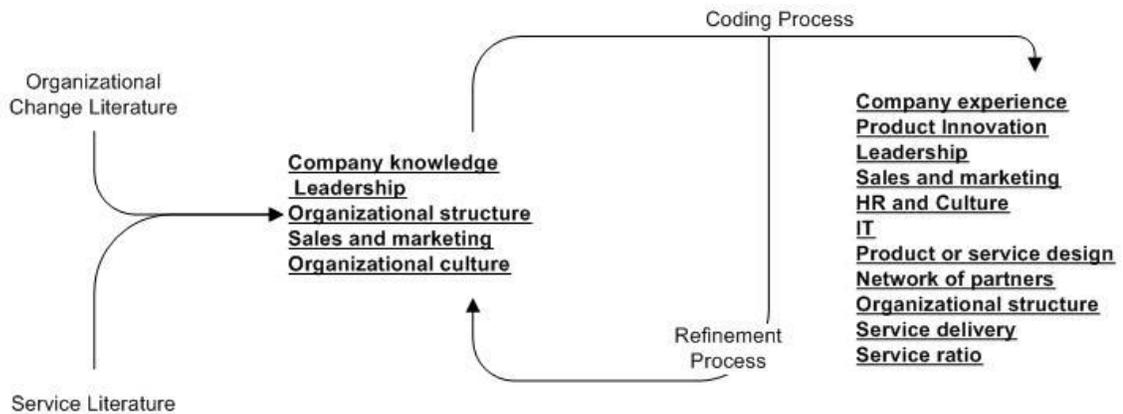
Figure 2-5: Parameters for Organizational factors

2.2.5 Parameters for Outcomes

Given that the measurement process is very contextual in nature (Hinkin 1995), we did not conduct a literature review on the measurement parameters. Instead, we initiated the measurement process along particular themes. Then, we inductively added, refined and combined parameters that yielded the set of parameters presented in Figure 2-6.
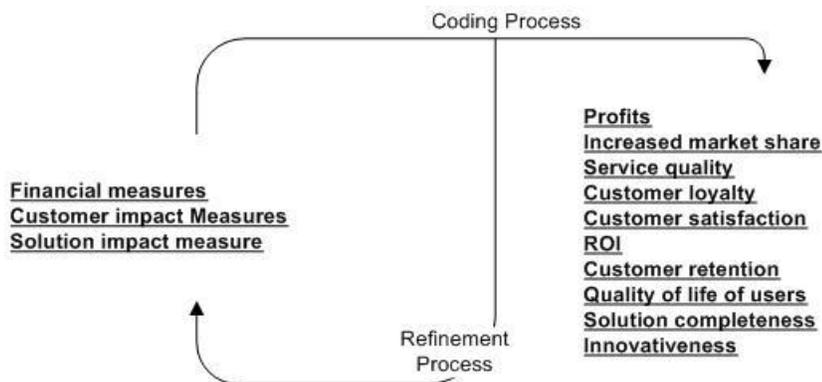
Figure 2-6: Parameters for Outcomes

2.3 Summative Analysis of the coded literature

2.3.1 Contextual Analysis

Articles were identified from 1988, the year when Vandermerwe and Rada (1988) coined the term "servitization," and the analysis was done in periods of ten years, with the last

period having seven years. The following graph in Figure 2-7 shows the number of articles in each period.
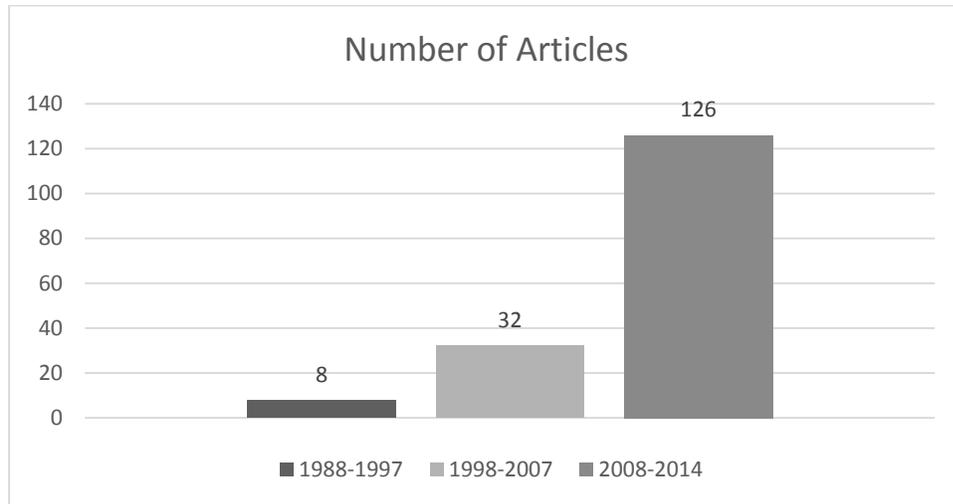
Figure 2-7: Number of Articles during each period

Figure 2-7 indicates a significant increase in the number of articles on servitization published over the years. This increase clearly signals academia's growing interest in this area of research. These investments in servitization research could have been driven by industry interest in this area, such as efforts put forth by organizations like IBM. To further our analysis of this descriptive information, we coded the journals in which the articles were published. Our first objective was to study the diffusion and acceptance of the concept of servitization in academia. To do so, we first present the journals that published articles on servitization and the average number of articles published in these journals in Table 2-3. The journals that published more than five articles in the most recent period (2008-2014) are listed in Table 2-4.

Year	Number of Journals	Articles/Journal (Average)
1988-1997	8	1.00
1998-2007	32	1.52
2008-2014	126	2.03

Table 2-3: Average number of articles published per Journal

Journal Name	Number of Articles
Journal of Service Management	11
Industrial Marketing Management	11
Journal of Manufacturing Technology	10
International Journal of Operations and Production Management	7
Journal of Business and Industrial Marketing	5

Table 2-4: Top Publishing Journals on Servitization (2008-2014)

Over the years, the average number of servitization articles per journal has increased considerably, showing that journals are recognizing this subject as an area of interest. However, the research is still distributed across various disciplines, which demonstrates that few non-interacting functional silos have formed. Admittedly, servitization is a multidisciplinary endeavor involving several aspects of business such as marketing, service, IT and operations strategy; this could also explain the dispersal of research. Indeed, as shown in Table 2-4, the journals with the most recent publications on servitization are from different backgrounds.

We then analyzed the type of service added by companies, as reported in articles. As identified previously, we had two categories; tightly and loosely coupled services. Note that some articles had descriptions of services that were both tightly coupled and loosely coupled. In articles that did not clearly mention the type of service, we did not record this item. This summative analysis is presented in Figure 2-8.
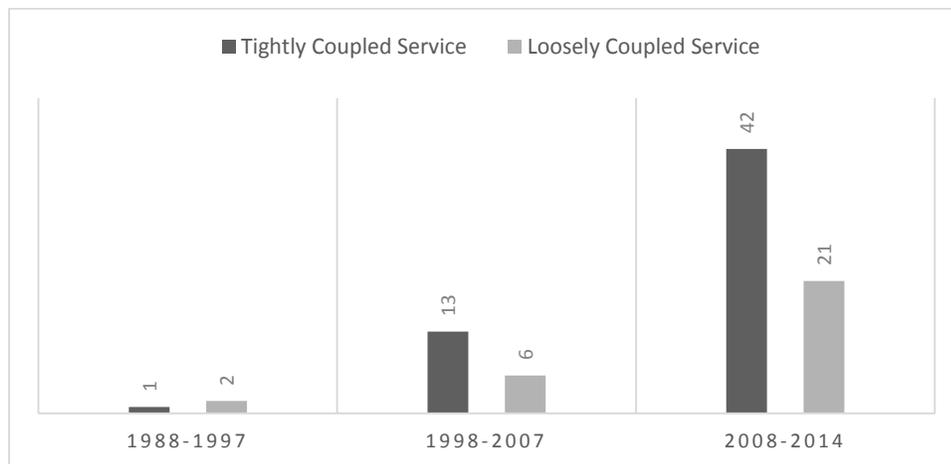
Figure 2-8: Service types added by manufacturers over each period

We observe that the articles have more references to services that are tightly coupled to products because, most often, companies start with bundles that require fewer changes to the organizational culture or acquisition of capability. This indicates an early growth phase of the practice reported by the literature. In our opinion, the loosely coupled services increase the firm's differentiation and competitive advantage. Research should consequently focus more on loosely coupled services.

To analyze the content of articles further, we studied the research methodologies adopted, as depicted in Figure 2-9. Considerable research has been conducted using case studies, most of which is exploratory in nature. Case studies discuss a specific example and are often difficult to generalize. The increase in quantitative research over the years shows that some theories developed are now being tested. Future research should use the vast case study literature to perform cross-comparisons using methods like iterative triangulation (Kindström 2010). Future research could also use a multi-method approach such as a combination of theory-building methods like qualitative research, followed by theory testing using quantitative methods.
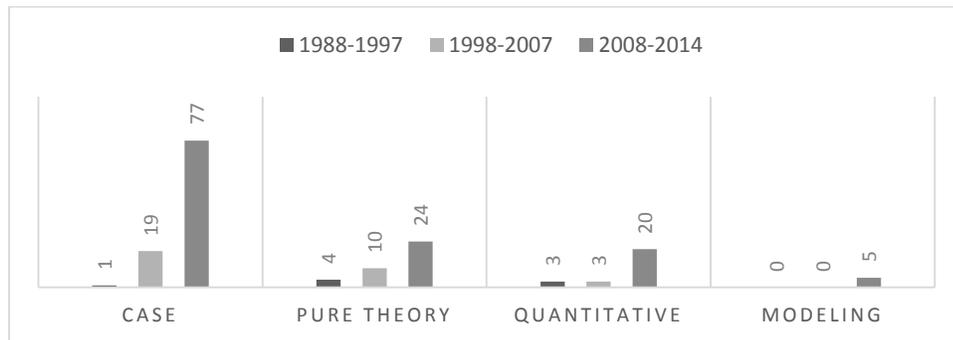
Figure 2-9: Research methodology used

To determine the geographic locations of these servitization studies, we recorded the country of the case study. In multi-case studies that covered several countries, we recorded the distinct count for each country. Several studies defined zones such as West European or OECD country; those classifications were not recorded. We also observed several studies that did not mention the country or even the company name for anonymity

purposes, which we could not include in our count. Figure 2-10 presents the number of case studies done in different countries. We observe that most of the studies are based in Europe, with United Kingdom being the country of prime interest. In the last few years, some studies have been conducted in China and Australia, which indicates the global diffusion of servitization.
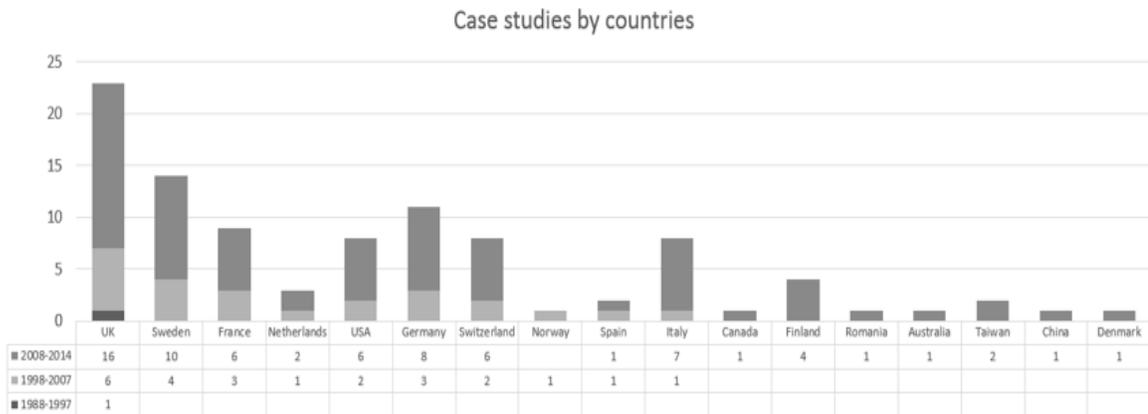
Figure 2-10: Case studies by country

2.3.2 Summative Content Analysis

In this part of the analysis, we will discuss which parameters were identified, and provide future research paths for each block.

2.3.2.1 External environment parameters

We first identify the external factors that were mentioned in the articles based on the model. In this part of the analysis, we allowed coders to identify multiple parameters in one article; hence the numbers in Table 2-5 are not representative of the number of articles, but rather the occurrences of the external parameters in articles.

Year	Reactive			Proactive	
	Competitive Environment	Compliance to Regulation	Shrinking Or Dynamic market	Globalization	Market Entry
1988-1997	4	0	3	0	0
1998-2007	6	1	5	1	1
2008-2014	24	2	4	2	1

Table 2-5: External environment parameters

These summative data present noteworthy information. First, we can observe that external motivators have been scantily noted in the research conducted to date. This observation can be traced to the case-based methodology followed by most of the studies. This methodology could help in future cross-comparisons, but the analysis lens is limited to the internal components of the organization and does not include the antecedents of servitization. We also notice that the reactive measures have been more widely studied than the proactive measures. This is another avenue for future research.

2.3.2.2 Organizational strategies

Next, we studied firms' organizational strategies towards servitization. This content analysis looked at the main reason or motivation for the organization to servitize. The summative analysis of the content in the selected articles is shown in Table 2-6.

Year	Producer-Centric Strategies	Customer-Centric Strategies	Dyadic Strategies
1988-1997	6 (75%)	2(25%)	0(0%)
1998-2007	19(59.4%)	13(40.6%)	0(0%)
2008-2014	95(75.4%)	21(16.7%)	10(7.9%)

Table 2-6: Organizational strategies for servitization

We can infer from this table that producer-centric strategies attract the most interest in all the periods. This could be interpreted as a possible result of our selection criteria for articles, which did not include research that had marketing as the topic of discussion, in which customer-centric strategies could be discussed more often. However, these data also suggest that most operational strategies for servitization are initiated to enable the organization to gain a competitive advantage, and are not primarily centered on customer satisfaction. The significant number of articles reporting a dyadic strategy in the last period also shows that some organizations have understood the importance of involving customers in their transition process.

2.3.2.3 Organizational parameters

We also studied the organizational parameters that could influence the implementation of the strategy chosen by the company. In this part of the analysis, we allowed coders to identify multiple parameters in one article; hence the numbers are not representative of the number of articles but rather reflect the occurrences of the factors in articles. We also conducted a cluster analysis using similarity of nodes, and grouped the factors based on the clusters identified. The results are presented in Table 2-7.

	Organizational Knowledge		Organizational Drive		Organizational Positioning		Organizational Resources					No Org. Parameters
	Company Experience	Product Innovation	Company Leadership	Sales and Marketing	Design	Network of Partners	HR and Culture	IT	Organizational Structure	Service Delivery	Service Ratio	
1988-1997	1	0	2	1	0	0	1	1	2	1	0	2
1998-2007	9	0	3	5	3	0	9	4	13	10	0	1
2008-2014	23	8	14	9	15	2	35	10	43	19	6	11

Table 2-7: Organizational parameters affecting servitization implementation

The parameters mentioned in the articles are distributed consistently across different clusters; this has several implications. It confirms that researchers have consistently studied the different factors such as organizational knowledge, positioning, resources and drive, which affect the servitization process. We can recognize from this summative information that these factors indeed play a role in the servitization implementation process.

2.3.2.4 Outcome parameters

To identify the outcomes of a servitization implementation, we identified several measures. The objective of this summative analysis is to present the measures and analyze the reasons for the results presented in Table 2-8.

	Financial Measures		Customer Impact Measures			General Impact		
	Profits	Increased Market Share	Service Quality	Customer Loyalty	Customer Satisfaction	Quality of Life for customers	Solution Completeness	Innovation
1988-1997	2	1	0	1	1	1	0	1
1998-2007	3	2	2	0	3	1	0	0
2008-2014	19	11	2	1	5	3	5	6

Table 2-8: Outcome measures of servitization initiatives

The "financial measures" and "other measures" have been identified by most of the studies as the outcomes of servitization initiatives. It appears that servitization initiatives presented in the literature seek to report or discuss short-term measures. Some long-term measures like "customer loyalty" and "solution completeness" have been identified but not adequately studied. Future research could focus on these measures.

2.4 Evolving theories in the Servitization literature

The summative analysis presented in the previous section outlined the trends in the servitization literature. These trends identify the focus areas of current research and topics for future research interest. Building on our findings, we look deeper into the literature to identify the evolving theories by adopting an interpretive approach. We adapted our methodology from grounded theory, which follows a four-step approach of coding, constant comparison analysis, theoretical sampling and theoretical saturation (Corbin and Strauss 1990). We used strategies for developing theories from process data (Langley 1999). By adopting a process analysis approach, we focused on the change happening in the organization (Gioia et al. 2013). We thus used the principles of grounded theory to study the literature on discussions before, during and after the servitization process.

We focused on collecting theoretical samples based on a timeline. Theoretical samples discussing motivations and classifications were collected for pre-servitization, while impediments and relationships were captured in the timeline during the servitization process. The interactions with organization factors, engagement of stakeholders, organizational performance and realignments after the first phase of servitization were collected in the post-servitization group. This logic has emerged from process studies that have used the grounded theory methodology (Gioia and Chittipeddi 1991, Mantere et al. 2012)

In this analysis, we studied the literature published between 2008 and 2014. The evolving theory was studied separately for the three strategies (producer-centric, consumer-centric and dyadic) for the process pre- and during servitization. Because the post-servitization discussions in the three strategies did not show marked variance, they were analyzed together. We coded and abstracted the theoretical samples in *NVIVO*. The coding was

done by one of the co-authors who marked the timeline of the theoretical samples using the articles collected from the literature. To triangulate the coding process, the initial codes were discussed with the other two co-authors. The theoretical samples were then abstracted to a second-order theme. These themes where then abstracted to a third-order category, which would serve as aggregate dimensions (Gioia et al. 2013). In areas where the theory is still at its nascent stage, the second-order construct was abstracted to a "not well developed" category to identify areas that require further research.

In our theoretical construct set, we captured the common message and linked some of the representative articles as references. Given the space limitations, only a subset of the references is presented. The identified theoretical constructs are included in the first-order constructs of the data structure diagram for each analysis. We develop the evolving theory in the form of propositions, which can be used in future research.

2.4.1 Evolving theory for servitization in producer-centric strategies

To develop the evolving theory for servitization in producer-centric strategies, we studied the 95 articles from the last period (2008-2014). We identified the pre-servitization and during servitization discussions in these articles.

After analyzing the theoretical constructs and abstracting them to a higher-order theory, we developed the data structure as presented in Figure 2-11 for the pre-servitization process.
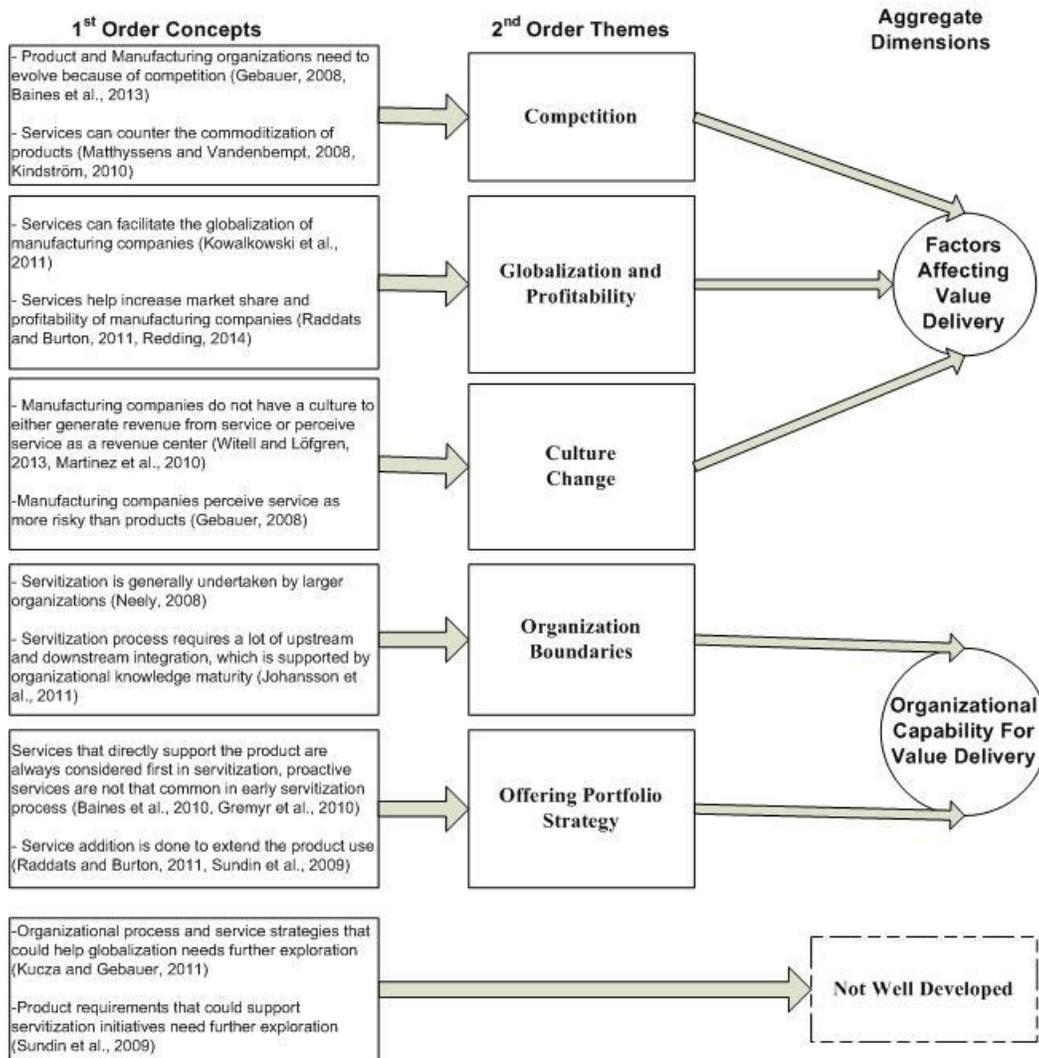
Figure 2-11: Data structure of theory (pre-servitization process, producer-centric)

The data structure for the pre-servitization process in producer-centric strategies has *value delivery* and *organizational capability for value delivery* as aggregate dimensions . We also identified the research body that discusses the organizational capability required for servitization change. Based on the data structure, we develop the following propositions for companies adopting a producer-centric strategy:

Proposition 1: Companies intend to servitize because of the competitive landscape and the risk of commoditization of their offerings.

Proposition 2: Increased profitability and market span motivate companies to servitize.

Proposition 3: Organizational culture of product-centricity can impede the servitization process.

Proposition 4: A successful servitization process requires organizations to be large and well connected with their upstream and downstream chain.

Proposition 5: Initially the servitization process should focus on adding services that complement the product.

The literature does not clearly describe the timing of the servitization process for producer-centric companies. Researchers like Sundin et al. (2009) highlight the need to understand product maturity. No research has been done on the product lifecycle stage and servitization process mapping, which would definitely help in developing theory in this area. Although globalization has several dimensions (Tausch and Heshmati, 2011), we focus on how servitization can help in the globalization process. Kucza and Gebauer (2011) report a shortage of studies discussing the organizational process and strategies that could help organizations undergoing servitization with thr objective of globalization.

We then analyzed the discussions during the servitization process for the producer-centric strategy. The data structure of the theoretical constructs following the interpretive analysis is presented in Figure 2-12.
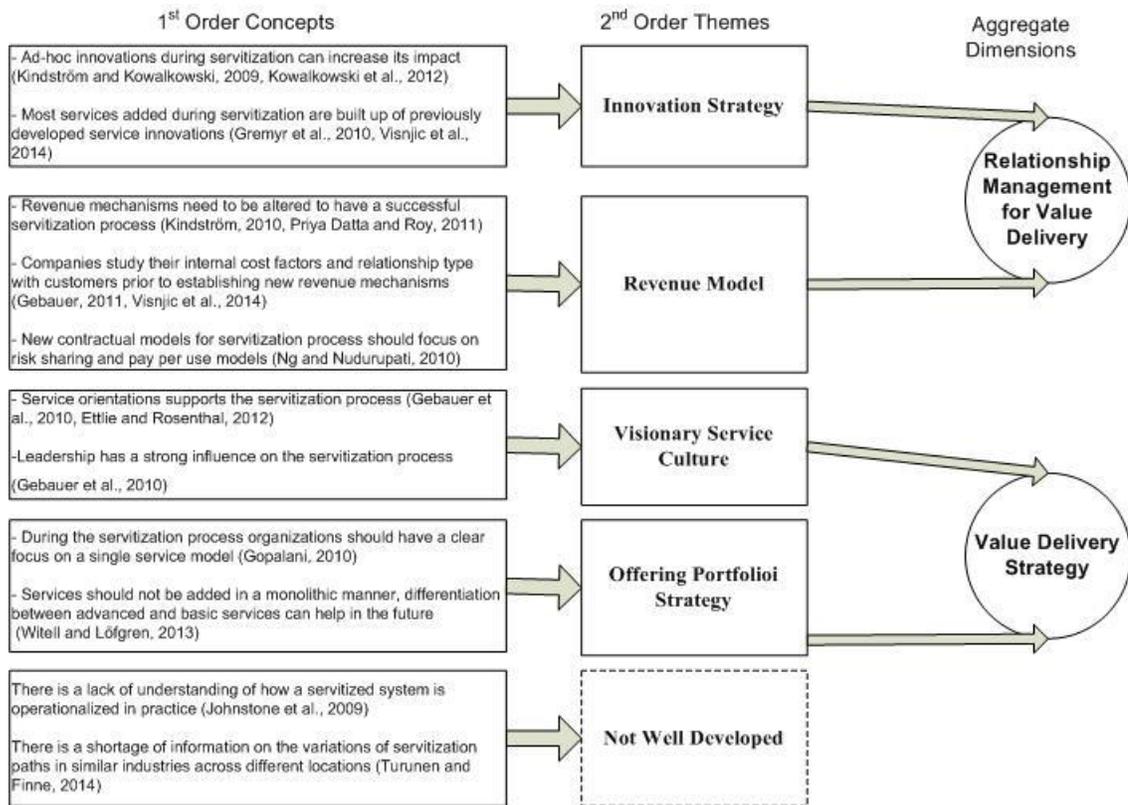
Figure 2-12:Data structure of theory (during servitization, producer-centric)

The data structure has two aspects: *relationship aspects* and *value-delivery strategy* presented during the servitization process. We identify the following propositions based on the data structure for companies adopting a producer-centric strategy.

Proposition 6: Innovation during servitization is generally ad-hoc but incremental in nature.

Proposition 7: Revenue models during servitization should focus on risk-sharing and be revised to take into account the internal organizational costs for a successful transition.

Proposition 8: Organizations should have support from leadership and transition into a service-oriented mindset for servitization transition success.

Proposition 9: Complex and simple services should be managed separately to ensure successful servitization transition.

Johnstone et al. (2009), in their example of the aerospace industry, highlight the fact that operationalization of servitization is not well developed in the literature. This statement could have several origins, including a lack of clear understanding of the antecedents of the complexity for the servitization process. Another possible reason could be a lack of classifications of servitization strategies. Turunen and Finne (2014) also highlight the need for transnational research on servitization. Johansson et al. (2011), in their empirical analysis, present aspects that help supply chains be responsive in global environments; similar strategies could be used to study the aspect of servitization process variability in global markets.

2.4.2 Evolving theory for servitization in customer-centric strategies

We analyzed the 21 articles identified to have discussed servitization following the customer-focused strategy and obtained a set of theoretical constructs for discussions pertaining to processes prior to servitization. The data structure following the interpretive analysis is presented in Figure 2-13.
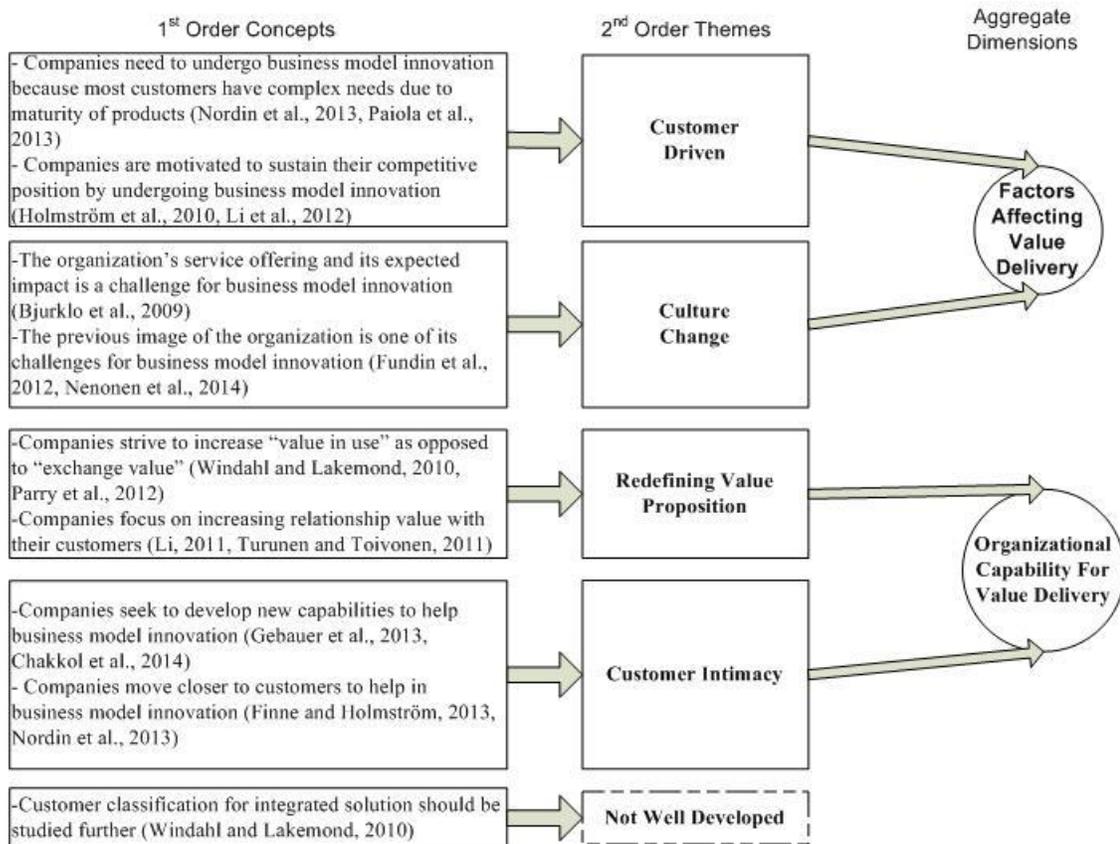
Figure 2-13: Data structure of theory (pre-servitization process, customer-centric)

The data structure for the pre-servitization process in customer-centric strategies has *value delivery* and *organizational capability for value delivery* as aggregate dimensions. The following propositions are developed from this data structure for companies adopting a customer-centric strategy:

Proposition 10: Companies attempt to servitize to sustain their competitive positioning with customers who have complex business needs.

Proposition 11: A previous product-oriented image and an unclear picture of the impact of the services added could impede servitization.

Proposition 12: The servitization process should give precedence to value-in-use over exchange-value for increased customer relationship value.

Proposition 13: To be successful, a servitization process requires organizations to develop new capabilities and move closer to customers.

Our scope was limited to literature covering operations management, so we did not see several aspects such as customer training and preparedness, marketing strategy, re-branding as areas of future research. The limited literature however highlighted customer classification as a potential area for future research (Windahl and Lakemond 2010). Such research could develop theories on linkages between the customer types and dimensions of the integrated solution.

After reviewing the discussions during the servitization process in the customer-centric strategy, we interpretively derived the data structure of the theoretical constructs presented   in

Figure 2-14.

1st Order Concepts

-Companies should use every opportunity of customer contact to collect data (Holmström et al., 2010, Turunen and Toivonen, 2011)
-Customer ecosystem should be considered in service design strategy (Parry et al., 2012)
-Technology should be appropriately used in customer behavior monitoring (Holmström et al., 2010)

-Communication should occur between all internal and external parties (Datta and Roy, 2010)
- Communication with customers will increase the understanding of their business processes (Holmström et al., 2010)

-Business model change should not focus on moving a goods orientation to a service orientation, without maintaining a right balance (Windahl and Lakemond, 2010)
-Organizations should develop capability inhouse in early stages(Paiola et al., 2013)
-Organization should consider a third party when their service offering gets complex (Nenonen et al., 2014)

-Organizations should evolve their structure based on the complexity of their solution offering (Nordin et al., 2013)
-At the beginning of a servitization transition, organization structure should separate service and product development processes (Fundin et al., 2012)

-Service transitions in different geographic locations should be studied (Windahl and Lakemond, 2010)
-Strategies for organizational identify change management require future research (Nordin et al., 2013)

2nd Order Themes

Customer Experience

Communication

Offering Portfolio Strategy

Organizational Structure

Not Well Developed

Aggregate Dimensions

Relationship Management for Value Delivery

Value Delivery Strategy

Figure 2-14: Data structure of theory (during-servitization, consumer-centric)

Similar to the differences observed between the data structure of the theory before servitization between the producer-centric and customer-centric strategies, we see more customer centrality during the servitization process in the customer-centric strategy than

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in the producer-centric strategy. The propositions for the data model shown in
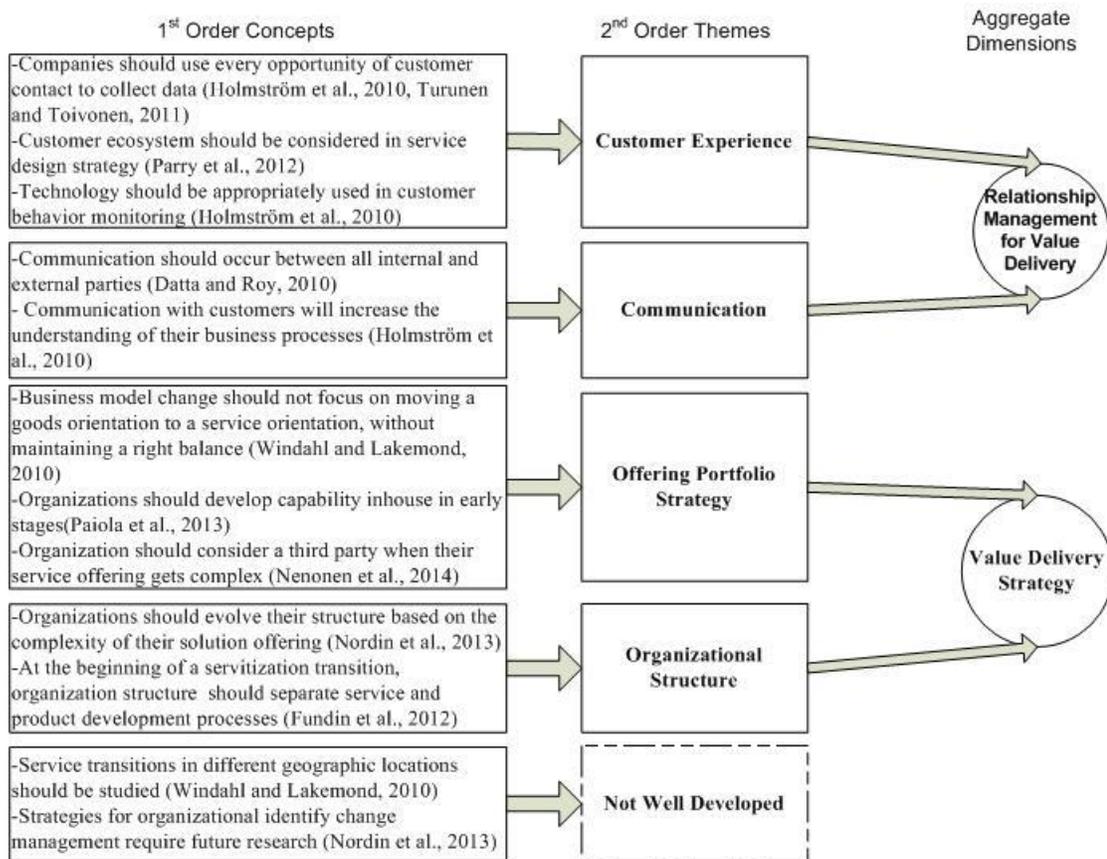
Figure **2-14**, regarding companies adopting a customer-centric strategy, are presented below:

Proposition 14: Organizations should understand the customer's eco-system and continuously monitor customer behavior for a successful servitization transition.

Proposition 15: Organizations should have open lines of communication within and outside their boundaries to ensure a successful servitization transition.

Proposition 16: Organizations should initiate servitization with the right mix of products and services, developing in-house capabilities. However, when services get more complex, external support must be sought to ensure servitization transition success.

Proposition 17: Organizations could keep the service and product offerings separate in the beginning of the servitization process. Future organizational changes should be done only as complexity increases, to ensure servitization transition success.

Windahl and Lakemond (2010) highlight the need to develop theory on reusing service infusion across geographic locations. We observed similar suggestions in producer-centric process analysis. However, the tone changed from an organization perspective to a customer perspective. We conclude that such transnational research would help in developing theory about servitization. Moreover, organizations that are customer focused have an image defined with their customers. For example, Nordin et al. (2013) suggest that future research should investigate the management of this identity change. This interdisciplinary research area could include disciplines such as human resources, marketing and operations.

2.4.3 Evolving theory for servitization in dyadic strategy

We coded the 10 articles identified to have discussed the dyadic strategy, and interpretively devised the following data structure presented in Figure 2-15.
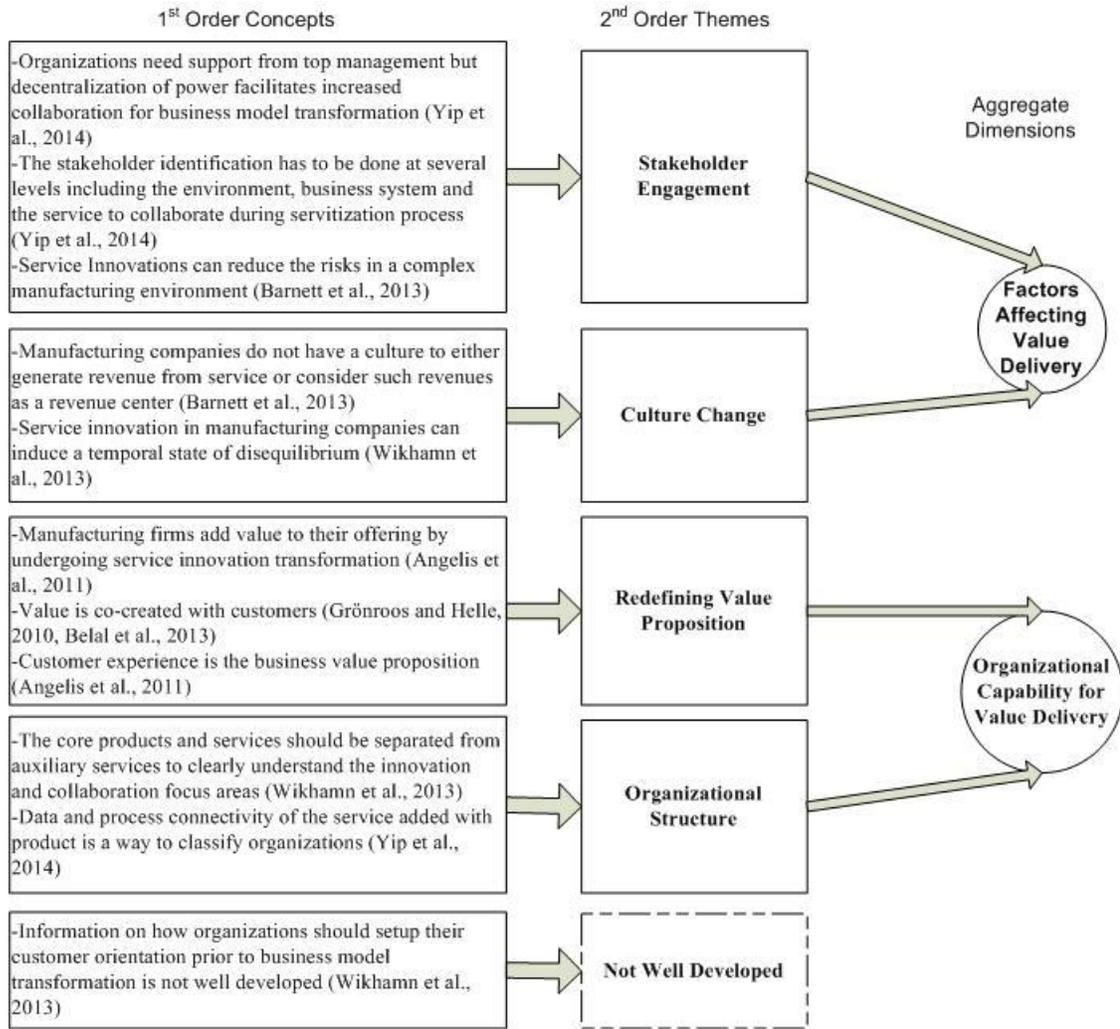
Figure 2-15: Data structure of theory (pre-servitization, dyadic strategy)

Based on our definition, we can see that the dyadic strategy is closely related to the customer-centric strategy but it has an extra dimension of customer engagement with the producer. This marked difference can be seen when we compare the data models for customer-centric and dyadic strategies. The second-order *customer driven* construct in the customer-focused theme is replaced by *stakeholder engagement*, which strongly corroborates our previous findings. The propositions for the evolved theory as illustrated in the data structure for companies adopting a dyadic strategy are presented below:

Proposition 18: Companies servitize to reduce risks and increase the effectiveness of their product offering.

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Proposition 19: Services accounted for as a cost center instead of a revenue center can impede the servitization process.

Proposition 20: The servitization process should express added value in terms of customer value proposition (value in use), which is co-created with customers.

Proposition 21: A successful servitization process requires data and process connectivity with customers to identify collaboration mechanisms and separation of core and auxiliary services.

Given that the dyadic strategy has been infrequently studied, we strongly recommend research on this strategy. Companies seek a customer orientation to enable increased collaboration. However, the literature does not address how manufacturing companies should transition into a service orientation (Wikhamn et al. 2013).

We also analyzed the discussions during the servitization process for the dyadic strategy. Following the interpretive analysis, we developed the data structure presented in Figure 2-16.
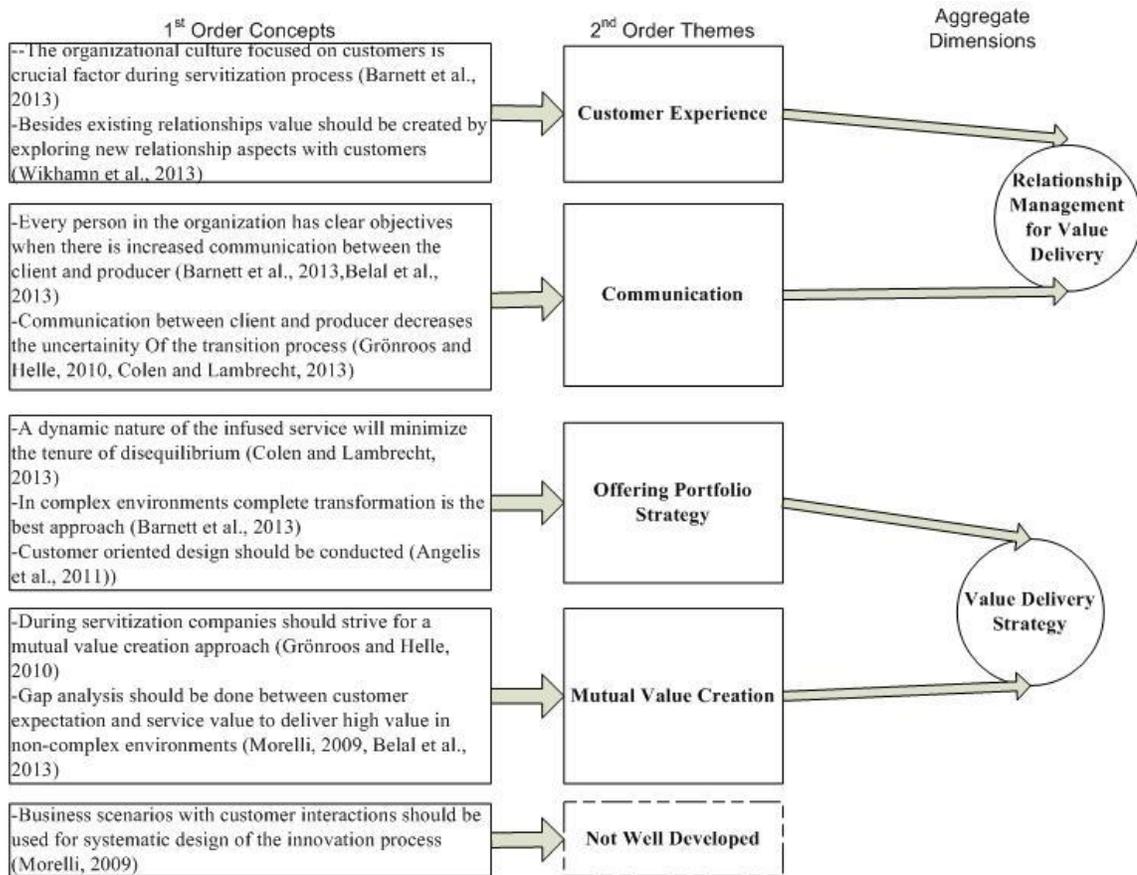
Figure 2-16: Data structure of theory (during servitization, dyadic strategy)

The data structure of the theory during servitization in the dyadic strategy is also closely related to the customer-centric strategy. However, owing to the limited number of articles, discussions pertaining to organization structure are missing in the dyadic strategy articles. In comparison to the customer-centric strategy, a new theme discussing mutual value creation has been found for the dyadic strategy. Below, we present the propositions of the evolved theory for companies adopting a dyadic strategy.

Proposition 22: Organizations should have a service culture and identify new avenues of relationships with customers for a successful servitization transition.

Proposition 23: Organizations should have internal and external open lines of communication to reduce the risks of the servitization transition process.

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Proposition 24: For complex services or customer relationships, complete transformation of the organization is the best strategy to ensure successful servitization transition.

Proposition 25: During servitization, organizations should use a mutual value creation approach with their customers to ensure a successful transition.

Based on our analysis, the dyadic strategy studies seem to have a very narrow focus. Aspects involving design, interaction study, classification, continuous monitoring and improvement do not appear often in the related literature. Therefore, future research should explore these avenues. Because dyadic strategy involves co-creation of mutual value by the customer and producer, investigating the design of customer interactions in different business scenarios could be an interesting future research avenue (Morelli, 2009).

2.4.4 Evolving theory for post-servitization for all strategies

As mentioned above, the discussions on post-servitization for all the strategies did not exhibit a marked difference between the strategies. The literature did not discuss the post-servitization effects in organizations extensively. We identify this area as the most nascent area in the literature, and strongly recommend future research into this aspect of servitization.

Based on our findings from the literature and interpretive analysis, we present the data structure of the evolving theory in Figure 2-17.
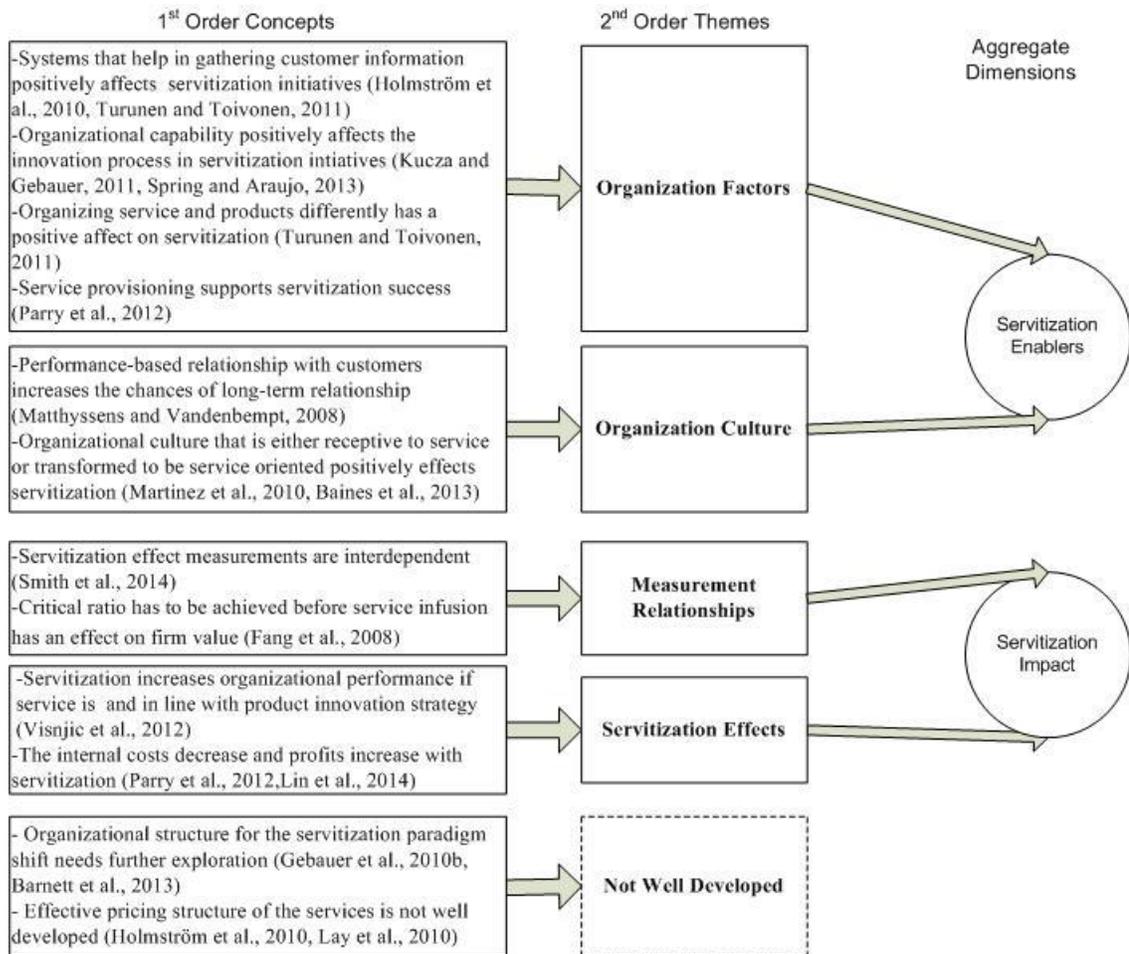
Figure 2-17: Data structure of theory for post-servitization process

The data structure classifies the post-servitization discussions under two aggregate dimensions: one that identifies the enablers and one that presents the servitization impact. Note that the enablers could also be identified in discussions prior to servitization, given the iterative nature of the servitization process. Based on the data structure of the theory, we identify the propositions for all strategies as follows:

Proposition 26: Organization factors that positively affect the servitization process include customer information, process innovations and service provisioning.

Proposition 27: Service-oriented culture that follows a performance-based relationship positively affects the servitization process.

Proposition 28: The effects of the servitization process are visible after a certain period.

Proposition 29: Organizations that focus on completeness of the service and innovation that complement the product line see revenue growth over time.

The organizational structure that would best support the servitization process requires further investigation (Gebauer et al., 2010b, Barnett et al., 2013). With the new offering that includes the service and product mix, pricing strategies have to be altered. This avenue is not well developed in the literature (Holmström et al., 2010, Lay et al., 2010) and should be explored further.

2.5 Concluding Discussion

To answer our research questions, we conducted a two-step analysis. The first analysis used the premises of contingency theory to develop a framework in which we identify three distinct strategies (producer-centric, customer-centric and dyadic), which was used to code 146 articles. The summative analysis that followed the coding process presented answers to the first and second research questions, namely: *How has the literature in the field of servitization been evolving?* and *On which potential areas should future research focus?*

The second analysis used a process-based approach to inductively develop an evolving theory for pre-servitization, during-servitization and post-servitization processes. The processes were studied separately for the three identified strategies. This analysis presented answers to the second (*On which potential areas should future research focus?*) and third (*What evolving theories are based on the current literature on servitization?*) research questions.

The overall summative data demonstrate growing interest in the area of servitization. The number of articles has risen, as has the number of articles per journal. However, the research appears to be dispersed across multiple disciplines, which calls for a multidisciplinary integrated approach to servitization research. Case-based research methodology has been widely used to study the servitization phenomenon. The theory developed from case-based research has to be integrated and validated before being

formalized. Currently, the theories in the area of servitization are highly dispersed across different disciplines. To test the theory, we recommend more quantitative research in the area of servitization. We also observe that the literature discussed service infusions, which are tightly coupled to the product. Future research should also develop avenues of business model innovation with loosely coupled services, given its potential to accentuate differentiation and give the firm a competitive advantage. Our summative analysis infers that reactive factors leading to servitization have been the primary area of interest in the literature, with little focus on proactive factors. Future research could study proactive factors for business model innovations by servitization. Such research could reinforce the sustainability of an organization's operations. In our study of organizational strategy, we identified more producer-centric approaches where the organization's motivation to servitization is self-directed. We believe that organizations should move closer to the customer and design services that aim to provide value to customers. Future research could also explore the relationship between value to the customer and profitability in an organization. After analyzing the outcome measures of servitization, we observed a huge opportunity for future research because this avenue is not well developed and has considered only short-term measures to date.

In our process-based analysis, we developed propositions from the evolving theory for each of the three identified strategies (producer-centric, customer-centric and dyadic). The pre-servitization, during-servitization and post-servitization literature was studied. In our analysis, we observed differences in the evolving theory for the three strategies between pre-servitization and during-servitization processes. However, we did not detect differences in the post-servitization literature. This is very much in line with our summative analysis, which did not indicate many outcome measures. For this reason, the post-servitization literature was analyzed for all the strategies combined.

The identified outcome measures were reactive in nature, showing a cross-sectional approach to studying servitization. The shortage of longitudinal studies could also be one of the reasons for missing pro-active measures. This paucity of studies also signals that the servitization literature is in an evolutionary stage; future research should focus on theory formalization.

For producer-centric strategies, we developed nine propositions from the evolving theories of the pre-servitization and during-servitization process analysis. Areas that do not have any analysis include servitization-initiation timing and its relationship to product maturity. Given that organizational processes that drive servitization have not been adequately studied in the literature, future research collaborations should examine the strategic aspect of servitization. A current state of affairs of servitization and organizational strategy is presented in the review by Gremyr et al. (2010). The propositions identify competition, profitability, culture and leadership as enablers for servitization. These propositions could be tested by quantitative studies using secondary or primary data.

For the customer-centric strategy, we developed eight propositions from the evolving theory of the pre-servitization and during-servitization process analysis. This strategic dimension is customer-oriented and very close to the strategic management and marketing disciplines. Future research on servitization in these disciplines should focus on developing customer classifications. However, we emphasize that multidisciplinary research between marketing and operations could help operationalize the organizational orientation for each proposed customer group. The propositions identify some organizational factors and capabilities that affect servitization. The model for maintaining customer relationships and delivering value to the customers is also highlighted. Experiments can be done to validate the propositions, especially for the business-to-consumer (B2C) environment.

For the dyadic strategy, we developed eight propositions from the evolving theory of the pre-servitization and during-servitization process analysis. The aggregate dimensions were very similar to the customer-centric approach, which also re-validates the summative analysis trends. In this analysis, we saw a need for communication strategies that would help organizations inform their customers about their service orientation. Design strategies for better customer engagement are also not well developed. The propositions identify organizational factors and capabilities for the dyadic model. They also highlight the relationship management and value delivery dimensions. Note that very few articles discuss the dyadic strategy, so future research should adopt this model. We believe that

customer value is situational and dynamic, and that reactive systems are best equipped to deliver high value to customers, in turn increasing the impact of servitization.

As mentioned, the post-servitization literature is scant, and the four propositions we developed for the evolving theory on analysis of the process identify some enablers of the servitization process. The impact of servitization is studied only by some reactive measures. Studying these identified enablers and their effect on servitization could be an area of future research. Alternatively, a post mortem analysis of servitization could help revalidate the propositions and add new measures. Aspects such as pricing strategies and organizational structure have not been studied in depth, and could represent avenues for multidisciplinary research. Servitization literature, in general, currently has a very cross-sectional approach; longitudinal studies could further define these effects and their measures.

2.6 Limitations and future research

Although we recommend that the propositions from the evolving theories be used for future validation studies, we would like to add a word of caution. The evolving theory is based on the current literature and is derived using grounded theory. One of the premises of an interpretive analysis is theoretical saturation. We cannot claim that every theme that we have derived is theoretically saturated. This could lead the propositions to vary slightly from their current state. Even though the evolved theory lacks sufficient saturation, our propositions do have the potential to support future research because they have evolved from peer-reviewed journal articles. In our future research, we will work with first-hand data and revalidate our evolved data model of the theory.

Another limitation of our work is that we present the discussions in order of appearance; discussions prior to servitization might have derived from the output of servitization from previous studies. This aspect of theory evolution is beyond the scope of this study. We minimize this effect by analyzing research in the recent timespan. We also recommend that the servitization enablers identified from the evolved theory of the post-servitization process be tested as initial conditions of a servitization initiative.

References

Ahamed, Z., Kamoshida, A. & Inohara, T. 2012. 'The influence of organizational factors on implementing servitization strategy.' Paper presented at 9th International Conference on Service Systems and Service Management (ICSSSM), 2012.

Almeida, L. F., Miguel, P. A. C. & Silva, M. 2008. 'A literature review of servitization: a preliminary analysis.' Paper presented at Proceedings of the POMS 19th annual conference.

Ang, S. H. 2014. Research Design for Business & Management. SAGE Publications Ltd.

Angelis, J., de Lima, E. P. & Širaliova, J. 2011. 'Servitised experiences: business and management implications.' Current Issues of Business and Law, 5:1, 6-21.

Araujo, L. & Spring, M. 2006. 'Services, products, and the institutional structure of production.' Industrial Marketing Management, 35:7, 797-805.

Armenakis, A. A. & Bedeian, A. G. 1999. 'Organizational change: A review of theory and research in the 1990s.' Journal of management, 25:3, 293-315.

Baines, T., Lightfoot, H., Benedettini, O. & Kay, J. 2009a. 'The servitization of manufacturing: A review of literature and reflection on future challenges.' Journal of Manufacturing Technology Management, 20:5, 547-67.

Baines, T., Lightfoot, H., Benedettini, O. & Kay, J. M. 2009b. 'The servitization of manufacturing: a review of literature and reflection on future challenges.' Journal of Manufacturing Technology Management, 20:5, 547-67.

Baines, T., Lightfoot, H., Benedettini, O., Whitney, D. & Kay, J. 2010. 'The adoption of servitization strategies by UK-based manufacturers.' Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture, 224:5, 815-29.

Baines, T. S., Lightfoot, H. W., Benedettini, O. & Kay, J. M. 2009c. 'The servitization of manufacturing: a review of literature and reflection on future challenges.' Journal of Manufacturing Technology Management, 20:5, 547-67.

Barnett, N. J., Parry, G., Saad, M., Newnes, L. B. & Goh, Y. M. 2013. 'Servitization: is a paradigm shift in the business model and service enterprise required?' Strategic Change, 22:3-4, 145-56.

Bastl, M., Johnson, M., Lightfoot, H. & Evans, S. 2012. 'Buyer-supplier relationships in a servitized environment: An examination with Cannon and Perreault's framework.' International Journal of Operations & Production Management, 32:6, 650-75.

Battilana, J., Gilmartin, M., Sengul, M., Pache, A.-C. & Alexander, J. A. 2010. 'Leadership competencies for implementing planned organizational change.' The Leadership Quarterly, 21:3, 422-38.

Belal, H., Shirahada, K. & Kosaka, M. 2012. 'Knowledge Space Concept and Its Application for Servitizing Manufacturing Industry.'

Belal, H., Shirahada, K. & Kosaka, M. 2013. 'Value Co-creation with Customer through Recursive Approach Based on Japanese Omotenashi Service.' International Journal of Business Administration, 4:1, p28.

Berry, L. L. 1980. 'Services marketing is different.' Business, 30:3, 24-29.

Berry, L. L. 1995. 'Relationship marketing of services—growing interest, emerging perspectives.' Journal of the Academy of marketing Science, 23:4, 236-45.

Bjurklo, M., Edvardsson, B. & Gebauer, H. 2009. 'The role of competence in initiating the transition from products to service.' Managing Service Quality: An International Journal, 19:5, 493-510.

Bozarth, C. & McDermott, C. 1998. 'Configurations in manufacturing strategy: a review and directions for future research.' Journal of Operations Management, 16:4, 427-39.

Brax, S. 2005. 'A manufacturer becoming service provider–challenges and a paradox.' Managing service quality, 15:2, 142-55.

Calantone, R., Garcia, R. & Dröge, C. 2003. 'The effects of environmental turbulence on new product development strategy planning.' Journal of Product Innovation Management, 20:2, 90-103.

Cavusgil, T. S., Calantone, R. J. & Zhao, Y. 2003. 'Tacit knowledge transfer and firm innovation capability.' Journal of Business & Industrial Marketing, 18:1, 6-21.

Chakkol, M., Johnson, M., Raja, J. & Raffoni, A. 2014. 'From goods to solutions: how does the content of an offering affect network configuration?' International Journal of Physical Distribution & Logistics Management, 44:1/2, 132-54.

Chattopadhyay, P., Glick, W. H. & Huber, G. P. 2001. 'Organizational actions in response to threats and opportunities.' Academy of Management Journal, 44:5, 937-55.

Chen, K.-H., Wang, C.-H., Huang, S.-Z. & Shen, G. C. 2016. 'Service innovation and new product performance: The influence of market-linking capabilities and market turbulence.' International Journal of Production Economics, 172, 54-64.

Colen, P. & Lambrecht, M. 2013. 'Product service systems: exploring operational practices.' The Service Industries Journal, 33:5, 501-15.

Coombs, C. H. & Avrunin, G. S. 1977. 'Single-peaked functions and the theory of preference.' Psychological review, 84:2, 216.

Cooper, R. G. & Edgett, S. 2008. 'Ideation for product innovation: What are the best methods?' PDMA Visions Magazine, 1, 12-17.

Corbin, J. M. & Strauss, A. 1990. 'Grounded theory research: Procedures, canons, and evaluative criteria.' Qualitative sociology, 13:1, 3-21.

Cowell, D. W. 1980. 'The marketing of services.' Managerial Finance, 5:3, 223-31.

Cyert, R. M. & March, J. G. 1963. 'A behavioral theory of the firm.' Englewood Cliffs, NJ, 2.

Davies, A. 2003. 'Integrated solutions: the changing business of systems integration.' The business of systems integration, 333-68.

Davies, A., Brady, T. & Hobday, M. 2007. 'Organizing for solutions: Systems seller vs. systems integrator.' Industrial Marketing Management, 36:2, 183-93.

De Backer, K., Desnoyers-James, I. & Moussiegt, L. 2015. "Manufacturing or Services-That is (not) the Question'.' OECD Science, Technology and Industry

Policy Papers No. 19.

Dervitsiotis, K. 2003. 'The pursuit of sustainable business excellence: Guiding transformation for effective organizational change.' Total Quality Management and Business Excellence, 14:3, 251-67.

Dodgson, M., Gann, D. & Salter, A. 2006. 'The role of technology in the shift towards open innovation: the case of Procter & Gamble.' R&D Management, 36:3, 333-46.

Donaldson, L. 1987. 'Strategy and structural adjustment to regain fit and performance: in defence of contingency theory.' Journal of management studies, 24:1, 1-24.

Edvardsson, B. & Olsson, J. 1996. 'Key concepts for new service development.' Service Industries Journal, 16:2, 140-64.

Eisenbach, R., Watson, K. & Pillai, R. 1999. 'Transformational leadership in the context of organizational change.' Journal of Organizational Change Management, 12:2, 80-89.

Ettlie, J. E. & Rosenthal, S. R. 2012. 'Service innovation in manufacturing.' Journal of service Management, 23:3, 440-54.

Fang, E., Palmatier, R. W. & Steenkamp, J.-B. E. 2008. 'Effect of service transition strategies on firm value.' Journal of Marketing, 72:5, 1-14.

Finne, M. & Holmström, J. 2013. 'A manufacturer moving upstream: triadic collaboration for service delivery.' Supply Chain Management: An International Journal, 18:1, 21-33.

Fligstein, N. & Dauber, K. 1989. 'Structural change in corporate organization.' Annual Review of Sociology, 73-96.

Frambach, R. T., Wels-Lips, I. & Gündlach, A. 1997. 'Proactive product service strategies: an application in the European health market.' Industrial Marketing Management, 26:4, 341-52.

Fundin, A., Witell, L. & Gebauer, H. 2012. 'Service transition: finding the right position on the goods-to-services continuum.' International Journal of Modelling in Operations Management, 2:1, 69-88.

Galbraith, J. R. 2011. Designing the customer-centric organization: A guide to strategy, structure, and process. Jossey-Bass.

Gavetti, G., Levinthal, D. & Ocasio, W. 2007. 'Perspective-Neo-Carnegie: The Carnegie School's Past, Present, and Reconstructing for the Future.' Organization science, 18:3, 523-36.

Gebauer, H. 2007. 'Extending the service business in china: experience of Swiss companies.' Singapore Management Review, 29:1, 59.

Gebauer, H. 2008. 'Identifying service strategies in product manufacturing companies by exploring environment–strategy configurations.' Industrial Marketing Management, 37:3, 278-91.

Gebauer, H. 2011. 'Exploring the contribution of management innovation to the evolution of dynamic capabilities.' Industrial Marketing Management, 40:8, 1238-50.

Gebauer, H. & Friedli, T. 2005. 'Behavioral implications of the transition process from products to services.' Journal of Business & Industrial Marketing, 20:2, 70-78.

Gebauer, H., Wang, C., Beckenbauer, B. & Krempl, R. 2007. 'Business-to-business marketing as a key factor for increasing service revenue in China.' Journal of Business & Industrial Marketing, 22:2, 126-37.

Gioia, D. A. & Chittipeddi, K. 1991. 'Sensemaking and sensegiving in strategic change initiation.' Strategic management journal, 12:6, 433-48.

Gioia, D. A., Corley, K. G. & Hamilton, A. L. 2013. 'Seeking qualitative rigor in inductive research notes on the Gioia methodology.' Organizational Research Methods, 16:1, 15-31.

Gopalani, A. 2010. 'A new model for service businesses in product-centric firms.' Journal of Business Strategy, 31:6, 4-11.

Green, J. 2008. 'The Front-Runner's Fall.' The Atlantic, 39, 315-35.

Gremyr, I., Löfberg, N. & Witell, L. 2010. 'Service innovations in manufacturing firms.' Managing Service Quality: An International Journal, 20:2, 161-75.

Greve, H. R. 1996. 'Performance, Aspirations and Risky Organizational Change.' Paper presented at Academy of Management Proceedings.

Grönroos, C. 2004. 'The relationship marketing process: communication, interaction, dialogue, value.' Journal of Business & Industrial Marketing, 19:2, 99-113.

Grönroos, C. & Helle, P. 2010. 'Adopting a service logic in manufacturing: Conceptual foundation and metrics for mutual value creation.' Journal of service Management, 21:5, 564-90.

Hannan, M. T. & Freeman, J. 1984. 'Structural inertia and organizational change.' American sociological review, 149-64.

Harrison, A. 2006. 'Design for service: harmonising product design with a services strategy.'

Haveman, H. A. 1992. 'Between a rock and a hard place: Organizational change and performance under conditions of fundamental environmental transformation.' Administrative science quarterly, 48-75.

Hayes, R. H. & Pisano, G. P. 1996. 'Manufacturing strategy: at the intersection of two paradigm shifts.' Production and operations management, 5:1, 25-41.

Heineke, J. & Davis, M. M. 2007. 'The emergence of service operations management as an academic discipline.' Journal of Operations Management, 25:2, 364-74.

Heskett, J. L. & Kotter, J. P. 1992. 'Corporate culture and performance.' Business Review. Vol, 2, 83-93.

Heskett, J. L., Sasser, W. E. & Schlesinger, L. A. 1997. Service profit chain. Free Press.

Heskett, J. L. & Schlesinger, L. 1994. 'Putting the service-profit chain to work.' Harvard business review, 72:2, 164-74.

Hill, C. E., Thompson, B. J. & Williams, E. N. 1997. 'A guide to conducting consensual qualitative research.' The counseling psychologist, 25:4, 517-72.

Hinkin, T. R. 1995. 'A review of scale development practices in the study of organizations.' Journal of management, 21:5, 967-88.

Holmström, J., Brax, S. & Ala-Risku, T. 2010. 'Comparing provider-customer constellations of visibility-based service.' Journal of service Management, 21:5, 675-92.

Howard, T. J., Achiche, S., Özkil, A. G. & McAloone, T. C. 2012. 'Open Design and Crowdsourcing: Maturity, Methodology and Business Models.'

Johansson, C., Hicks, B., Larsson, A. C. & Bertoni, M. 2011. 'Knowledge maturity as a means to support decision making during product-service systems development projects in the aerospace sector.' Project Management Journal, 42:2, 32-50.

Johnstone, S., Dainty, A. & Wilkinson, A. 2009. 'Integrating products and services through life: an aerospace experience.' International Journal of Operations & Production Management, 29:5, 520-38.

Kastalli, I. V. & Van Looy, B. 2013. 'Servitization: Disentangling the impact of service business model innovation on manufacturing firm performance.' Journal of Operations Management, 31:4, 169-80.

Kindström, D. 2010. 'Towards a service-based business model–Key aspects for future competitive advantage.' European Management Journal, 28:6, 479-90.

Kindström, D. & Kowalkowski, C. 2009. 'Development of industrial service offerings: a process framework.' Journal of service Management, 20:2, 156-72.

Kogut, B. & Zander, U. 1992. 'Knowledge of the firm, combinative capabilities, and the replication of technology.' Organization science, 3:3, 383-97.

Koren, Y., Bell, R. & Volinsky, C. 2009. 'Matrix factorization techniques for recommender systems.' Computer:8, 30-37.

Kotter, J. P. 2008. Force for change: How leadership differs from management. Free Press.

Kowalkowski, C. 2006. 'Enhancing the industrial service offering: new requirements on content and processes.' Linköping.

Kowalkowski, C., Kindström, D., Alejandro, T. B., Brege, S. & Biggemann, S. 2012. 'Service infusion as agile incrementalism in action.' Journal of Business Research, 65:6, 765-72.

Kowalkowski, C., Kindström, D. & Brehmer, P.-O. 2011. 'Managing industrial service offerings in global business markets.' Journal of Business & Industrial Marketing, 26:3, 181-92.

Kucza, G. & Gebauer, H. 2011. 'Global approaches to the service business in manufacturing companies.' Journal of Business & Industrial Marketing, 26:7, 472-83.

Kühberger, A. 1998. 'The influence of framing on risky decisions: A meta-analysis.' Organizational behavior and human decision processes, 75:1, 23-55.

Kumar, R. & Kumar, U. 2004. 'A conceptual framework for the development of a service delivery strategy for industrial systems and products.' Journal of Business & Industrial Marketing, 19:5, 310-19.

Langley, A. 1999. 'Strategies for theorizing from process data.' Academy of management review, 24:4, 691-710.

Lay, G., Copani, G., Jäger, A. & Biege, S. 2010. 'The relevance of service in European manufacturing industries.' Journal of service Management, 21:5, 715-26.

Levitt, T. 1980. Marketing success through differentiation-of anything. Graduate School of Business Administration, Harvard University.

Li, H., Ji, Y., Gu, X., Qi, G. & Tang, R. 2012. 'Module partition process model and method of integrated service product.' Computers in Industry, 63:4, 298-308.

Libert, B. & Spector, J. 2010. We Are Smarter Than Me: Crowdsourcing New Businesses. FT Press.

Lightfoot, H., Baines, T. & Smart, P. 2013. 'The servitization of manufacturing: A systematic literature review of interdependent trends.' International Journal of Operations & Production Management, 33:11/12, 1408-34.

Lin, Y., Luo, J., Zhou, L., Ma, S. & Zhou, Z. 2011. 'Servitization strategy: Strategic priority, capacity requirement, and organizational feature.' Paper presented at Service Operations, Logistics, and Informatics (SOLI), 2011 IEEE International Conference on.

Lovelock, C. H. 1983. 'Classifying services to gain strategic marketing insights.' The Journal of Marketing, 9-20.

Luoto, S., Brax, S. & Kohtamäki, M. 2016. 'Critical meta-analysis of servitization research: Constructing a model-narrative to reveal paradigmatic assumptions.' Industrial Marketing Management, In Press.

Mantere, S., Schildt, H. A. & Sillince, J. A. 2012. 'Reversal of strategic change.' Academy of Management Journal, 55:1, 172-96.

Mathieu, V. 2001. 'Service strategies within the manufacturing sector: benefits, costs and partnership.' International Journal of Service Industry Management, 12:5, 451-75.

Matthyssens, P. & Vandenbempt, K. 2008. 'Moving from basic offerings to value-added solutions: Strategies, barriers and alignment.' Industrial Marketing Management, 37:3, 316-28.

Meier, H., Roy, R. & Seliger, G. 2010. 'Industrial Product-Service Systems—IPS[2] ' CIRP Annals-Manufacturing Technology, 59:2, 607-27.

Miles, M. B. 1979. 'Qualitative data as an attractive nuisance: The problem of analysis.' Administrative science quarterly, 590-601.

Miles, R., Snow, C., Meyer, A. & Coleman, H. 1978. 'Organizational strategy, structure, and process.' Academy of management review, 3:3, 546-62.

Mintzberg, H. 1979. 'The structuring of organizations: A synthesis of the research.' University of Illinois at Urbana-Champaign's Academy for Entrepreneurial Leadership Historical Research Reference in Entrepreneurship.

Morelli, N. 2009. 'Service as value co-production: reframing the service design process.' Journal of Manufacturing Technology Management, 20:5, 568-90.

Neely, A. 2005. 'The evolution of performance measurement research: developments in the last decade and a research agenda for the next.' International Journal of Operations & Production Management, 25:12, 1264-77.

Neely, A. 2008. 'Exploring the financial consequences of the servitization of manufacturing.' Operations Management Research, 1:2, 103-18.

Nenonen, S., Ahvenniemi, O. & Martinsuo, M. 2014. 'Image risks of servitization in collaborative service deliveries.' The Service Industries Journal, 34:16, 1307-29.

Neu, W. A. & Brown, S. W. 2005. 'Forming successful business-to-business services in goods-dominant firms.' Journal of Service Research, 8:1, 3-17.

Ng, I. C. & Nudurupati, S. S. 2010. 'Outcome-based service contracts in the defence industry-mitigating the challenges.' Journal of service Management, 21:5, 656-74.

Nordin, F., Lindahl, I. & Brege, S. 2013. 'The applicability of integrated solutions offerings: differential effects of product complexity.' Journal of Relationship Marketing, 12:1, 59-78.

Oliva, R. & Kallenberg, R. 2003. 'Managing the transition from products to services.' International Journal of Service Industry Management, 14:2, 160-72.

Oppenheimer, D. M., Meyvis, T. & Davidenko, N. 2009. 'Instructional manipulation checks: Detecting satisficing to increase statistical power.' Journal of Experimental Social Psychology, 45:4, 867-72.

Opresnik, D. & Taisch, M. 2015. 'The value of Big Data in servitization.' International Journal of Production Economics, 165, 174-84.

Paiola, M., Saccani, N., Perona, M. & Gebauer, H. 2013. 'Moving from products to solutions: Strategic approaches for developing capabilities.' European Management Journal, 31:4, 390-409.

Parasuraman, A. 1998. 'Customer service in business-to-business markets: an agenda for research.' Journal of Business & Industrial Marketing, 13:4/5, 309-21.

Parry, G., Bustinza, O. F. & Vendrell-Herrero, F. 2012. 'Servitisation and value co-production in the UK music industry: an empirical study of consumer attitudes.' International Journal of Production Economics, 135:1, 320-32.

Pilat, D., Cimper, A., Olsen, K. & Webb, C. 2006. 'The changing nature of manufacturing in OECD economies.' In D. F. S. T. A. industry (Ed.) 38 pages. .

Powell, T. C. 1992. 'Organizational alignment as competitive advantage.' Strategic management journal, 13:2, 119-34.

Prahalad, C. & Ramaswamy, V. 2004. 'Co-creating unique value with customers.' Strategy & Leadership, 32:3, 4-9.

Priya Datta, P. & Roy, R. 2011. 'Operations strategy for the effective delivery of integrated industrial product-service offerings: two exploratory defence industry case studies.' International Journal of Operations & Production Management, 31:5, 579-603.

Puranam, P., Alexy, O. & Reitzig, M. 2014. 'What's "new" about new forms of organizing?' Academy of management review, 39:2, 162-80.

Quinn, J. B., Doorley, T. L. & Paquette, P. C. 1990. 'Beyond products: services-based strategy.' Harvard business review, 68:2, 58-60.

Raddats, C. & Burton, J. 2011. 'Strategy and structure configurations for services within product-centric businesses.' Journal of service Management, 22:4, 522-39.

Redding, L. 2014. 'A Strategy for Service Delivery Systems.' Strategic Change, 23:5-6, 287-302.

Ren, G. & Gregory, M. 2007. 'Servitization in manufacturing companies: a conceptualization, critical review, and research agenda.' In: Frontiers in Service Conference 2007, 2007-10-4 to 2007-10-7, San Francisco, CA, US.

Rese, M., Strotmann, W.-C. & Karger, M. 2009. 'Which industrial product service system fits best? Evaluating flexible alternatives based on customers' preference drivers.' Journal of Manufacturing Technology Management, 20:5, 640-53.

Romanelli, E. & Tushman, M. L. 1994. 'Organizational transformation as punctuated equilibrium: An empirical test.' Academy of Management Journal, 37:5, 1141-66.

Rosenzweig, E. 2009. 'A contingent view of e-collaboration and performance in manufacturing.' Journal of Operations Management, 27:6, 462-78.

Sandelowski, M. 1986. 'The problem of rigor in qualitative research.' Advances in nursing science, 8:3, 27-37.

Sastry, M. A. 1997. 'Problems and paradoxes in a model of punctuated organizational change.' Administrative science quarterly, 237-75.

Sawhney, Balasubramanian & Krishnan 2004. ' Creating growth with services.' MIT Sloan management review.

Scheuing, E. E. & Johnson, E. M. 1989. 'A proposed model for new service development.' Journal of Services marketing, 3:2, 25-34.

Schneider, B., Brief, A. P. & Guzzo, R. A. 1996. 'Creating a climate and culture for sustainable organizational change.' Organizational dynamics, 24:4, 7-19.

Senker, J. 2008. 'The contribution of tacit knowledge to innovation.' Cognition, Communication and Interaction: 376-92. Springer.

Shepherd, C. & Ahmed, P. K. 2000. 'From product innovation to solutions innovation: a new paradigm for competitive advantage.' European journal of innovation management, 3:2, 100-06.

Sitkin, S. B. & Pablo, A. L. 1992. 'Reconceptualizing the determinants of risk behavior.' Academy of management review, 17:1, 9-38.

Smith, L., Maull, R. & CL Ng, I. 2014. 'Servitization and operations management: a service dominant-logic approach.' International Journal of Operations & Production Management, 34:2, 242-69.

Snow, C. & Hambrick, D. 1980. 'Measuring organizational strategies: Some theoretical and methodological problems.' Academy of management review, 5:4, 527-38.

Sørensen, J. B. 2002. 'The strength of corporate culture and the reliability of firm performance.' Administrative science quarterly, 47:1, 70-91.

Spohrer, J. & Maglio, P. P. 2008. 'The Emergence of Service Science: Toward Systematic Service Innovations to Accelerate Co-Creation of Value.' Production and operations management, 17:3, 238-46.

Spring, M. & Araujo, L. 2009. 'Service, services and products: rethinking operations strategy.' International Journal of Operations & Production Management, 29:5, 444-67.

Steiner, M., Eggert, A., Ulaga, W. & Backhaus, K. 2016. 'Do customized service packages impede value capture in industrial markets?' Journal of the Academy of marketing Science, 44:2, 151-65.

Stremersch, S., Wuyts, S. & Frambach, R. T. 2001. 'The Purchasing of Full-Service Contracts:: An Exploratory Study within the Industrial Maintenance Market.' Industrial Marketing Management, 30:1, 1-12.

Sundin, E., Lindahl, M. & Ijomah, W. 2009. 'Product design for product/service systems: design experiences from Swedish industry.' Journal of Manufacturing Technology Management, 20:5, 723-53.

Swamidass, P. M. & Newell, W. T. 1987. 'Manufacturing strategy, environmental uncertainty and performance: a path analytic model.' Management Science, 33:4, 509-24.

Tausch, A. & Heshmati, A. 2011. 'Dimensions of Globalization.' Journal of Globalization Studies, 2:2, 89-128.

Turunen, T. & Finne, M. 2014. 'The organisational environment's impact on the servitization of manufacturers.' European Management Journal, 32:4, 603-15.

Turunen, T. T. & Toivonen, M. 2011. 'Organizing customer-oriented service business in manufacturing.' Operations Management Research, 4:1-2, 74-84.

Van de Ven, A. H. & Drazin, R. 1984. 'The Concept of Fit in Contingency Theory.' DTIC Document.

Van der Haar, J. W., Kemp, R. G. & Omta, O. 2001. 'Creating value that cannot be copied.' Industrial Marketing Management, 30:8, 627-36.

Vandermerwe, S. & Rada, J. 1988. 'Servitization of business: adding value by adding services.' European Management Journal, 6:4, 314-24.

Vargo, S. L., Maglio, P. P. & Akaka, M. A. 2008. 'On value and value co-creation: A service systems and service logic perspective.' European Management Journal, 26:3, 145-52.

Venkatraman, N. 1989. 'The concept of fit in strategy research: Toward verbal and statistical correspondence.' Academy of management review, 14:3, 423-44.

Verstrepen, S., Deschoolmeester, D. & van den Berg, R. J. 1999. 'Servitization in the automotive sector: creating value and competitive advantage through service after sales.' Global production management: 538-45. Springer.

Visnjic, I., Wiengarten, F. & Neely, A. 2014. 'Only the Brave: Product Innovation, Service Business Model Innovation, and Their Impact on Performance.' Journal of Product Innovation Management.

Weeks, R. V. 2010. 'The culture and skills challenges associated with servitization: a South African perspective.'

Weick, K. E. & Quinn, R. E. 1999. 'Organizational change and development.' Annual review of psychology, 50:1, 361-86.

Wernerfelt, B. 1995. 'The resource-based view of the firm: Ten years after.' Strategic management journal, 16:3, 171-74.

Wikhamn, B. R., Ljungberg, J. & Styhre, A. 2013. 'Enacting Hard And Soft Product Offerings In Mature Industries: Moving Towards Servitisation In Volvo.' International Journal of Innovation Management, 17:04, 1350014.

Windahl, C. & Lakemond, N. 2010. 'Integrated solutions from a service-centered perspective: Applicability and limitations in the capital goods industry.' Industrial Marketing Management, 39:8, 1278-90.

Winer, R. S. 2001. 'Customer relationship management: a framework, research directions, and the future.' Haas School of Business.

Wise, R. & Baumgartner, P. 1999. 'Go downstream.' Harvard business review, 77:5, 133-41.

Yip, M. H., Phaal, R. & Probert, D. R. 2014. 'Stakeholder engagement in early stage product-service system development for healthcare informatics.' Engineering Management Journal, 26:3, 52-62.

Zeffane, R. 1996. 'Dynamics of strategic change: critical issues in fostering positive organizational change.' Leadership & Organization Development Journal, 17:7, 36-43.

Zeithaml, V. A., Parasuraman, A. & Berry, L. L. 1985. 'Problems and strategies in services marketing.' The Journal of Marketing, 33-46.

Chapter 3

A strategic orientation typology for analysis of servitization

Nikhil Varma
HEC Montréal
3000, chemin de la Côte-Ste-Catherine
Montréal, Québec, H3T 2A7
Canada
nikhil.varma@hec.ca

Claudia Rebolledo
HEC Montréal
3000, chemin de la Côte-Ste-Catherine
Montréal, Québec, H3T 2A7
Canada
Claudia.rebolledo@hec.ca

Julie Paquette
HEC Montréal
3000, chemin de la Côte-Ste-Catherine
Montréal, Québec, H3T 2A7
Canada
julie.paquette@hec.ca

Abstract

Servitization is a business model innovation where traditional manufacturers expand the scope of their offerings by adding services. Although researchers have explored different influencers of servitization intensity, most of these studies adopt a case-based approach that is difficult to generalize. Further, some studies report conflicting results, which complicates servitization efforts. To provide managers with decision support, we introduce and operationalize a typology of servitization strategic orientation that moderates the influence of several antecedents on servitization intensity. Using structural equation modelling (SEM) multi-group analysis on survey data, we show that the influence of financial performance, customer integration, supplier integration, product complexity, automation and staff ambidexterity on servitization intensity differs according to firms' strategic orientation. We contribute to the literature by introducing a typology of the strategic orientation of servitizing firms and by testing the impact of influencers on servitization intensity. Our results are useful for managers undergoing the servitization transformation.

Keywords: Service-oriented manufacturing systems, Product service systems, Supply chain collaboration, Structural equation modelling, Automation

3.1 Introduction

The manufacturing environment in developed economies is extremely competitive, with decreased transportation costs and the development of infrastructure in low labor-cost locations (Srivastava and Khan 2016). Manufacturing companies are hence continuously innovating to increase the value proposition to their customers. One approach to increase competitiveness is to change from the traditional mind-set of a transactional approach to a relationship-based approach by adding more service offerings for customers (Quinn et al. 1990). Vandermerwe and Rada (1988) coined the term servitization to describe this business model transformation in which services are added as a 'pervasive part' of the manufactured product.

With the proliferation of servitization initiatives in recent years, numerous academic studies call for further developments in this area. Johnstone et al. (2009) highlight the dearth of studies that identify antecedent patterns for the servitization process. In their review of the servitization literature, Baines et al. (2009) conclude that most studies have adopted a theoretical or a comprehensive approach to servitization, which provides insufficient insights for managers willing to servitize. This discussion is extended by Turunen and Finne (2014), who identify a lack of theory on the variations of the antecedents of servitization in similar industries. Most studies of servitization are based on individual case studies, resulting in findings attached to a specific context, and providing limited decision support or insights to managers seeking to undertake this business model transformation (Luoto et al. 2016).

The literature also shows conflicting and unclear findings for antecedents of servitization such as *customer integration* and *product complexity*. Koren et al. (2009) observe that servitization is supported by a reduction in *customer integration* when customers perceive that the product has substantial value. However, other studies have found that *customer integration* supports servitization (Verstrepen et al. 1999). Similarly, several researchers have highlighted the positive influence of *product complexity* on servitization (Quinn et al. 1990, Pilat et al. 2006), but Rosenzweig (2009) demonstrates that *product complexity* may have a negative effect on an organization's performance and may hinder servitization.

We argue that such contradictions arise because these studies do not consider the strategic orientation of the organisation. Organisational theorists postulate that most research in cause-and-effect analysis in an organisational context should use a contingency theory approach (Venkatraman 1989). In this approach, the impact of predictor variables on a dependent variable is studied by means of an interaction effect between predictors. Servitization antecedent studies may present conflicting results because they study the single effect of predictor variables (such as *product complexity, customer integration* and *producer integration*) on *servitization intensity*. We propose a typology of the organisation's strategic orientation. By positing strategic orientation as a contextual variable and studying this moderation effect relative to the predictor variables, we will explain the variations in the impact of these variables on *servitization intensity*.

To resolve the predicament faced by managers of manufacturing firms that are willing to servitize, this study aims to test the influence of specific predictor variables or influencers on *servitization intensity*, with the strategic orientation of the organisation serving as a moderator. This objective is operationalised through multi-group SEM on survey data from manufacturing plants.

The remainder of the article is structured as follows. Section 3.2 defines and develops the theoretical constructs and hypotheses that will be used in the analysis. Section 3.3 outlines the research methodology. Section 3.4 presents the data analysis and results, along with the theoretical and managerial implications. Finally, Section 3.5 states the conclusions, research limitations and future research directions.

3.2 Theoretical background and research hypothesis

In this section, we first present the theoretical background of the proposed typology. We then define servitization intensity, our independent variable, and present the influencers of servitization that we are studying. We also formulate hypotheses on the impact of these influencers on servitization intensity for each strategic orientation proposed in the typology.

To build our typology, we studied the literature on strategic orientation of an organization (Miles et al. 1978, Snow and Hambrick 1980, Puranam et al. 2014). This area of study is characterized by two schools of thought: the planning school and the learning school (Slater et al. 2006). The planning school is driven by the assumption that strategy formation gives an organization direction. Such formation shows the coherence of operations with a predefined set of objectives, often rationally quantified (Mintzberg and Waters 1985, Demeester et al. 2014). The learning school, in contrast, proposes a gradual development of strategy that is built over time by reacting to environmental changes (Weick et al. 2005, Vries et al. 2016).

In our conceptualization of the strategic orientation typology, we used the planning school of thought to propose the first three strategic orientations: 'producer-centric', 'customer-centric' and 'dyadic.' Organizations that are driven by profit and differentiation as motivators to servitize are categorized as 'producer-centric' (Neely 2008). Organizations that servitize to provide customers with more flexibility and efficiency are categorized as 'customer-centric' (Baines et al. 2009). Organizations that follow a path of collaboration with customers to develop solutions and profitability are categorized as 'dyadic' (Finne and Holmström 2013). Using the learning school of thought, we propose a fourth strategy called 'evolving.' This strategy takes into account the organizations that modify their strategy frequently based on the changes in their environment (as posited by the learning school).

'Producer-centric' manufacturers undertake servitization business model transformation to create profitability through differentiation. Manufacturers have historically achieved product differentiation by adding measurable and identifiable functionalities. Neu and Brown (2005) present a model in which manufacturing firms can differentiate themselves by adding services. Services have been seen as a conduit for manufacturing firms to innovate (Heskett et al. 1997) and generate benefits from innovation (Wernerfelt 1995).

'Customer-centric' manufacturers often offer more services (Gebauer and Friedli 2005) and have even transformed into pure service companies where value is delivered solely by the service (Kowalkowski 2006). The servitization literature also highlights the

importance of being customer-centric (Lightfoot et al. 2013). Understanding a customer's business and operational needs and thereby providing customers with higher value is an objective set by many companies (Parasuraman 1998, Stremersch et al. 2001). Transformation from a product- to a solution-driven mind-set is a strategic change observed in such organizations (Davies 2003, Galbraith 2011).

'Dyadic' manufacturers actively engage with customers and transform their offerings to create market differentiation that no competitor can replicate. This approach reflects the growing trend of adopting differentiation strategies to increase profitability by engaging with the customer (Prahalad and Ramaswamy 2004). Companies like Procter and Gamble have initiated new avenues to collaborate with their customers (Dodgson et al. 2006).

Finally, the 'evolving' orientation seeks to describe an organization that configures itself to fit environmental changes. Such organizations follow a complex gestalt model to undergo configurations that would help them achieve their objectives (Slater et al. 2006).

We summarise the characteristics of each organisational strategy in Figure 3-1.

Figure 3-1: Organisational strategic typology for servitization

3.2.1 Conceptualisation of servitization intensity

Manufacturers can servitize their offer through various options. Traditional services such as maintenance, repairs and spare parts have been integral to the manufacturing process for over a century (Schmenner 2009). Xu et al. (2002) discuss the importance of training and help desks as aspects that can increase client retention. Business model transformation also requires organisations to reshape the way customer engagements are managed. One such model is power-by-the-hour, followed by companies like Rolls Royce. In this approach, manufacturers deliver and manage solutions for customers, and the payment terms are defined based on usage. We used seven service types to develop the dependent variable, servitization intensity. These service types—maintenance, power-by-the-hour, product upgrades, helpdesk, training, repairs, and spare parts—will be discussed in further detail in section 3. The extent of these services would determine a manufacturer's servitization intensity.

3.2.2 Conceptualisation of influencers of servitization

We selected six influencers that are based on the key motivators of servitization proposed by Oliva and Kallenberg (2003). They suggest that organisations servitize to obtain economic gains, to respond to customer demand or to position themselves strategically. A similar categorisation was done by Raddats et al. (2016). In Table 3-1, we map the identified influencers with the motivation to servitize. We further develop hypotheses between these influencers and servitization intensity for the different strategic orientations. The hypotheses pertain to producer-centric, customer-centric and dyadic strategy only. Given that the present evolving strategy study is exploratory in nature, we do not develop any related hypotheses.

Influencers	Servitization Motivation		
	Economic	Customer demand based	Strategic advantage
Financial performance	X		
Customer integration		X	X
Supplier integration			X
Staff ambidexterity		X	X
Product complexity			X
Automation	X		X

Table 3-1: Mapping influencers to servitization motivation

3.2.2.1 Influence of financial performance

The momentum of change in an organisation is driven by two factors: the urgency for change and the feasibility of the change (Dutton and Duncan 1987). Companies may seek mechanisms to increase their financial performance such as implementing servitization. When companies perform significantly poorer than their competition, this could serve as a momentum for change.

Manufacturing organisations that are driven by profits and perform better financially than competitors would not invest in services because of the potential risk. Conversely, organisations that focus on providing customers with solutions would invest in service provisioning if their financial performance is high, because they have more resources. Hence the following hypotheses.

Hypothesis 1a: Financial performance is negatively related to the servitization intensity of a producer-centric organization.

Hypothesis 1b: Financial performance is positively related to the servitization intensity of a customer-centric or dyadic organization.

3.2.2.2 Influence of supply-chain integration

Supply-chain management is defined as the management of the flow of goods and information from the supplier to the customer (Fawcett and Magnan 2002). To effectively manage these flows, the supply-chain must be integrated (Frohlich and Westbrook 2001). This integration comprises two parts: customer integration and supplier integration.

Manufacturing companies face constant pressure from customers to increase their service portfolio. Customer integration can procure strategic information on customers (Lau and Ngo 2004). In a servitization context, customer integration could aid service provisioning (Moeller 2008) and improve service design. Customers are identified as co-producers of services, and better customer integration would thus affect business model innovation, including servitization.

Product range and innovation are deeply influenced by customer feedback (VanDoorn et al. 2010). High customer integration for manufacturing organisations that focus on product innovation would reduce their service provisioning focus owing to their limited resources. In contrast, organisations that are customer oriented would increase their service provisioning with high customer integration, because they would focus on providing better solutions to integrated customers. Hence the following hypotheses.

Hypothesis 2a: Customer integration is negatively related to the servitization intensity of a producer-centric organisation.

Hypothesis 2b: Customer integration is positively related to the servitization intensity of a customer-centric or dyadic organisation.

Supplier integration relates to involvement, coordination and information sharing with key suppliers during the product development process. By performing confirmatory tests, Petersen et al. (2005) demonstrate that supplier integration has a positive influence on firms' financial performance and product design performance.

We expect that being profit-driven and having high supplier integration would increase organisations' service provisioning. Service investments would require less investment because of the information and support received from the suppliers. Similarly, organisations driven by providing solutions to customers would also benefit from supplier integration. Hence the following hypotheses.

Hypothesis 3: Supplier integration is positively related to the servitization intensity of an organisation (for producer, customer-centric and dyadic strategies).

3.2.2.3 Influence of staff ambidexterity

Tushman and O'Reilly (1996) introduce the concept of firm ambidexterity as a strategic advantage. Ambidextrous organizations efficiently co-manage the current business (exploitation), and change based on future demand (exploration). Birkinshaw and Gibson (2004) explained this concept by introducing the concepts of structural and contextual ambidexterity. In the structural form, the organization forms separate teams for exploration and exploitation. These teams work as specialists to help the organization be ambidextrous. Contextual ambidexterity, in contrast, involves employees who work as generalists and are willing to adapt to organizational changes while working on the firm's current activities. We posit that assigning people to multiple roles by rotation, having teams that are cross-functional and having a mechanism of discussion among team members would positively impact contextual ambidexterity. We define this influencer of servitization intensity as staff ambidexterity.

Organizations that are driven by product innovations would divert the staff ambidexterity towards their products rather than towards service provisioning. However, organizations that are solution-driven would benefit from their service provisioning because staff ambidexterity could enhance their service offerings. Hence the following hypotheses.

Hypothesis 4a: Staff ambidexterity is negatively related to the servitization intensity of a producer–centric organization.

Hypothesis 4b: Staff ambidexterity is positively related to the servitization intensity of a customer–centric or dyadic organization.

3.2.2.4 Influence of product complexity

Hobday (1998) asserts that product complexity has a significant impact on the innovation process. Raddats et al. (2016) study the effects of different degrees of product complexity on servitization. They identify three complexity types (non-complex, complex products and systems) and demonstrate that each of these groups has a different type of service composition in their servitization endeavour.

Producer-centric organisations seek to differentiate by offering innovative products. Such organisations consistently add complexity to their product by innovation, which is perceived as a strategic advantage (Reed and DeFillippi 1990). They would hence not focus on service provisioning. In contrast, organisations that focus on providing customers with solutions would enhance their product complexity by adding more services to support their customers. Hence the following hypotheses.

Hypothesis 5a: Product complexity is negatively related to the servitization intensity of a producer-centric organisation.

Hypothesis 5b: Product complexity is positively related to the servitization intensity of a customer-centric or dyadic organisation.

3.2.2.5 Influence of automation

Automation has been found to impact organisational performance (Jayaram and Xu 2013), responsiveness (Williams et al. 2013) and external integration (Zhao et al. 2011). Process automation is driven by the technology usage within the organisation (Oh et al. 2012).

Organisations driven by profit would gain efficiency by automation, and hence be negatively motivated to do service provisioning. Automation in solution-driven organisations would positively affect their ability to deliver solutions because efficiency could free up resources. Hence the following hypotheses.

Hypothesis 6a: Automation is negatively related to the servitization intensity of a producer-centric organisation.

Hypothesis 6b: Automation is positively related to the servitization intensity of a customer-centric or dyadic organisation.

## 3.3 Research methodology

3.3.1 Sample

The analysis was done using a subset of the data from International Manufacturing Strategy Survey V (IMSS). IMSS is a global network where several contributors collect

data on various aspects of manufacturing and supply chains such as strategy, performance and practices. The targeted organisations were in the engineering and assembly industries (ISIC 28-35). The questionnaires were completed by the director of operations or the equivalent. Only companies with more than 50 employees were considered. The survey instrument was developed in English and was translated into the local language in countries where English was not the official language. The unit of analysis for the survey is the plant.

In total, 712 plants in various countries responded to the survey sent out by contributors to the IMSS network. Given that the core focus of our study is service development in the manufacturing sector, we selected plants only in OECD countries where most of the economic growth is derived from services (Chen et al. 2016). Six hundred plants in OECD countries were included in the analysis.

3.3.2 Categorisation of plants

To classify the strategic orientation of the plant, we selected six core organisational strategic elements to form two indicators for strategic orientation. The 'producer-centric indicator' is composed of: wider product range, frequent new product offering and innovative products. For the 'customer-centric indicator,' we used dependable deliveries, faster deliveries and order-size flexibility. We then followed the mechanism shown in Figure 3-2 to classify the plants into four subgroups.
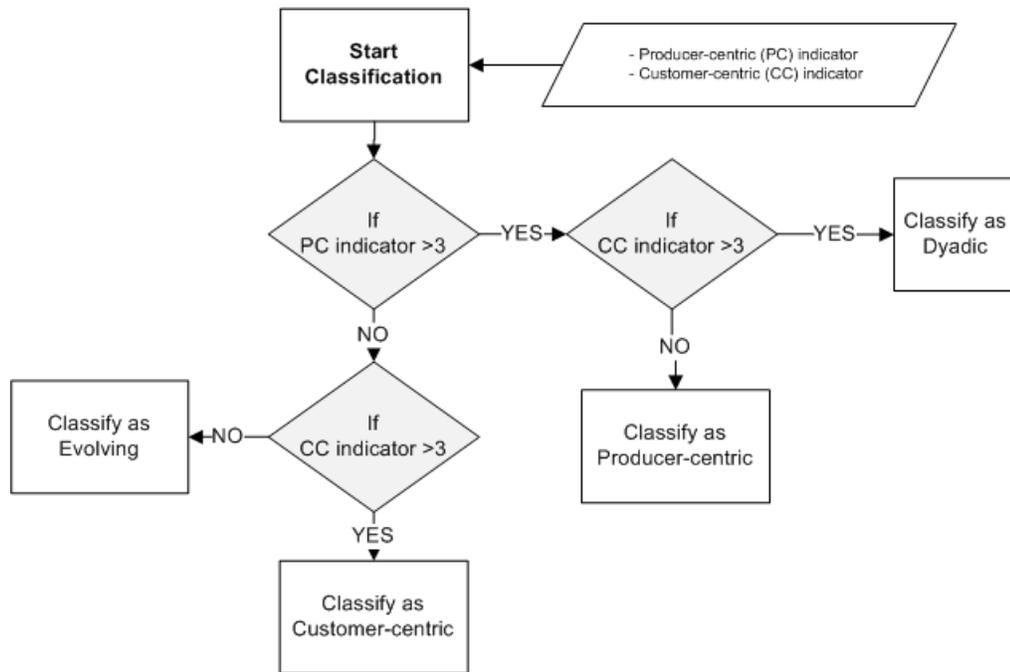
Figure 3-2: Classification of Strategies

3.3.3 Data Analysis Methodology

We used SEM to analyze the data and test the hypotheses (Byrne 2013). We employed the two-step approach proposed by Anderson and Gerbing (1988), where we first establish the validity and reliability of the measures and then test the relationships in a conceptualized model. To test the hypotheses, we used multi-item scales for each of the theoretical constructs. Based on the definitions of the theoretical constructs from the literature and the measurement items in the IMSS database, these items were selected to ensure content validity. The scale items, mean, standard deviation (SD), loadings, variance and Cronbach's alpha values for each construct are presented in Table 3-2.

Constructs/Items	Mean	SD	Loading	Variance Explained	Cronbach's α
Servitization Intensity (SI) S1. To what extent does your business unit/plant offer the following services alongside with the products?				57.7%	0.876
Maintenance	2.93	1.53	0.83		
'Power-by-the-hour'	2.86	1.48	0.70		
Product upgrades	2.65	1.37	0.79		
Help desk	2.97	1.43	0.76		
Training	2.88	1.41	0.78		
Repairs	3.12	1.42	0.80		

Constructs/Items	Mean	SD	Loading	Variance Explained	Cronbach's α
Spare parts	3.45	1.45	0.67		
Financial Performance relative to competitors (FP) A5. What is the current business unit performance? For market share indicate average in market(s) served by the business unit.				65.83%	0.824
Sales	3.31	0.83	0.78		
Market share	3.32	0.81	0.80		
Return on sales	3.19	0.73	0.83		
Return on investment	3.17	0.72	0.84		
Supplier Integration (SPI) SC7. How do you coordinate planning decisions and flow of goods with your key/strategic suppliers and customers?				63.52%	0.712
Share inventory-level information	2.92	1.22	0.78		
Dedicated capacity	2.78	1.12	0.79		
Plan forecast replenish collaboratively	2.84	1.18	0.85		
Customer Integration (CI) SC7. How do you coordinate planning decisions and flow of goods with your key/strategic suppliers and customers?				63.64%	0.713
Share inventory-level information	2.87	1.34	0.80		
Dedicated-capacity	2.73	1.29	0.79		
Plan forecast replenish collaboratively	2.68	1.21	0.8		
Product complexity (PC) T1. How advanced is the core process technology of your dominant activity?				55.88%	0.729
Modular product design vs. Integrated product design	3.32	1.25	0.64		
Single-manufactured components vs. Finished assembled products	3.7	1.42	0.74		
Very-few-parts/materials/one-line bill of material vs. Many parts/materials/complex bill of material	3.7	1.3	0.84		
Very-few-steps/operations required vs. Many-steps/operations required	3.87	1.05	0.76		
Automation (A) T2. Indicate the effort put into implementing the following action programs in the last three years.				60.39%	0.781
Engaging in process automation programs	2.36	1.20	0.74		
Engaging in flexible manufacturing/assembly systems	2.47	1.21	0.76		
Engaging in product/part tracking and tracing programs	2.73	1.28	0.81		
Implementing ICT	2.84	1.18	0.79		
Staff ambidexterity (SA) O11. Indicate the effort put into implementing the following action programs in the last three years.				49.31%	0.737
Increasing level of delegation and knowledge of workforce	3.03	1.07	0.76		
Implementing the lean organisation model	3.06	1.20	0.77		
Implementing continuous improvement programs through systematic initiatives	3.33	1.24	0.78		
Increasing the level of workforce flexibility following your business unit's competitive-strategy	3.18	1.13	0.52		
Enhancing corporate reputation through firm's direct contribution	3.18	1.13	0.64		

Table 3-2: Scale description with convergence and reliability measures

Reliability analysis was performed by studying the convergence of the items on the posited underlying construct (Anderson and Gerbing 1988). Convergent validity is established by the significant loadings of the factors. The variance explained and the acceptance values of Cronbach's alpha over 0.6 affirm the reliability of the measuring scale (Cronbach 1951, Chen and Paulraj 2004). Table 3-3 presents the correlation matrix between the variables under study.

Constructs	SI	FP	SPI	CI	PC	A
SI	1					
FP	0.067*	1				
SPI	0.11**	0.133**	1			
CI	-0.082*	0.109**	0.541**	1		
PC	0.291**	0.047	0.096**	0.015	1	
A	0.102**	0.204**	0.402**	0.397**	0.088*	1
SA	0.239**	0.264**	0.278**	0.247**	0.180**	0.497**

* Correlation significant at 0.05
** Correlation significant at 0.01

Table 3-3: Correlation matrix

The conceptualised model is an antecedent framework that studies the effect of each of the influencers on servitization intensity. We use strategic orientation as a moderator in the model and record the model fit and other indices for each strategic orientation.

3.3.4 Common method bias test

Surveys based on self-reports raise the possibility of common method bias (CMB). Such bias is characterised by covariance between the variables that can be attributed to the measurement method rather than to the construct that the instrument seeks to measure (Lindell and Whitney 2001). We performed a single factor test as suggested by Harman (1967) to test the CMB. The complete data were loaded on one factor with no rotation; this factor accounted for 16.98% of the variance. We also studied the accounted variance for all factors with Eigenvalues greater than one, and saw 13 distinct factors, which accounted for 64.27% of the variance. Based on the findings of Podsakoff et al. (2003), we can conclude that CMB does not represent a critical problem in the study.

3.4 Data analysis and results

The SEM analysis was done using the EQS tool (Byrne 2013). The data were coded to identify the four strategic orientations, and the model relationships were validated for each of the strategic orientations.

3.4.1 Confirmatory factor analysis

Several measures were assessed to study the quality of the models and the results. We used the thresholds recommended by Byrne (2013) and Hooper et al. (2008) to suggest a good model fit. We found that all the fit measures were at an acceptable level, which ensures that they are reliable. The fit measures are presented in Table 3-4. The normality tests for servitization intensity show arbitrary distributions. To account for this result, we used the methodology proposed by Satorra and Bentler (1990). We used the maximum likelihood (ML) standard normal estimating method and corrected for non-normality by using the 'Robust' method in EQS.

Fit Measures	Values	Acceptable Levels (Byrne (2013) and Hooper et al. (2008))
Absolute measures		
Chi Square (Probability)	122.261(0.08)	Significant
GFI (Goodness of fit)	0.94	>0.9 (good) >0.95 (excellent)
Standardised Root Mean Square Error (SRMR)	0.07	<0.08 (acceptable)
Root Mean Squared Error of approximation (RMSEA)	0.045	<0.05(very good) <0.08 (good)
Incremental Fit Indices		
Comparative fit Index (CFI*)*	0.931	>0.9 (good) 0.95 (very good)

Table 3-4: Fit Indices for the structural model

3.4.2 Structural model results and test of hypotheses

The results of the SEM multi-group analysis are presented in Table 3-5, including the test of hypotheses. When we performed additional analysis using size as a control variable, the test of the hypothesis did not change. The coefficients are significant at $\alpha \leq 0.05$.

Relationship	Regression coefficient	Hypotheses
Producer centric (n=90)		
FP→SI	-0.529	H1a (supported)
CI→SI	-0.542	H2a (supported)
SPI→SI	Not-significant	H3 (not supported)
SA→SI	Not-significant	H4a (supported)
PC→SI	0.242	H5a (not supported)
A→SI	-0.34	H6a (supported)
Customer centric (n=146)		
FP→SI	0.921	H1b (supported)
CI→SI	-0.791	H2b (not-supported)
SPI→SI	2.321	H3 (supported)
SA→SI	0.234	H4b (supported)
PC→SI	0.890	H5b (supported)
A→SI	0.149	H6b (supported)
Dyadic (n=226)		
FP→SI	Not-significant	H1b (not-supported)
CI→SI	-0.240	H2b (not-supported)
SPI→SI	0.232	H3 (supported)
SA→SI	0.772	H4b (supported)
PC→SI	0.696	H5b (supported)
A→SI	0.023	H6b (supported)
Evolving (n=138)		
FP→SI	-0.259	No-hypothesis
CI→SI	0.6	No-hypothesis
SPI→SI	-0.991	No-hypothesis
SA→SI	1.627	No-hypothesis
PC→SI	0.882	No-hypothesis
A→SI	-0.413	No-hypothesis

Table 3-5: Regression coefficients/hypothesis testing for Influencers of SI

3.4.3 Theoretical and managerial findings

Our study presents several findings that contribute to theory development in the area of servitization. First, we introduce and operationalise a strategic typology to explain the difference in antecedent behaviours for servitization (Turunen and Finne 2014). Second, we found that the impact of influencers varies according to firms' strategic orientation.

For producer-centric organisations that are driven by profitability, we see expected results for all influencers except for product complexity, which shows a positive association with servitization intensity instead of the expected negative influence. This result can be

explained using the notion of incremental versus innovative services (Brentani 2001). Producer-centric organisations might not invest in innovative services like power-by-the-hour to complement the increase in product complexity. However, they might invest in incremental services such as providing spare parts and customer training to complement product complexity, which could explain the positive association. The counter-intuitive result for supplier integration can also be explained by the size of the sample and the underlying kurtosis in the small data sample. Although we seek to counter the effects by using a robust method, the smaller sample sizes reduce the power of the statistical analysis, and Type I error cannot be ruled out (DeCarlo 1997).

For customer-centric organisations that focus on providing solutions, we see the expected results with all influencers except customer integration. Customer integration shows a negative relationship with servitization intensity instead of the expected positive behaviour. Such organisations might consider customer integration as a substitute for service provisioning, which would explain the negative relationship.

In dyadic firms, we see the expected results for all influencers except financial performance and customer integration. Financial performance is not significantly related to servitization intensity. The dyadic strategic orientation requires maturity in the organisation. The non-significant relationship is probably driven by the fact that such organisations might have developed their service provisioning based on different strategic paths. Hence, we see a situation where there is no effect because one strategic orientation's effect could have countered that of the other strategic orientation. The unexpected influence of customer integration on servitization intensity is similar to that observed in customer-centric orientation, where such organisations might perceive customer integration as a substitute for services.

Further, evolving strategy organisations reduce their servitization intensity with increased profitability. They implement change to react to the external environment, so an increase in financial performance would surely deter them from making any investments. Customer integration has a positive influence on servitization intensity, unlike the other three strategic orientations. Owing to the reactionary nature of evolving strategy

organisations, where customer closeness leads them to develop more services. Like all other strategies, an increase in product complexity positively influences servitization intensity, which arises from services being added to support a complex product. The employee influence is also seen in such organisations, where staff ambidexterity positively influences servitization intensity. We observe a negative relationship between supplier integration and automation with regard to servitization intensity. Supplier integration and automation influences internal efficiency, which could be the sole objective of an evolving strategy organisation. This internal efficiency could provide strategic advantage to such organizations and hence they would not seek to gain strategic advantage by service provisioning.

The typology we propose can be used in future research to analyse and explain antecedent influence. Further, our approach provides managers with more concrete directions for their business model transformation.

3.5 Conclusions, limitations and future research avenues

Our primary objective with this research was to develop a strategic typology that could explain the previous contradictory research results on the influence of different antecedents on servitization intensity. Using a confirmatory approach, we demonstrated that antecedents have different influences on servitization intensity for the proposed strategic orientations.

Our research has several limitations although we foresaw approaches to minimise their impact on our results. We conducted the analysis on a self-reported secondary dataset. The CMB test was done to ensure that our survey data did not have a systematic problem, yet we lacked triangulation data to validate the comparative measures such as performance relative to competitors. We conducted SEM analysis but did not develop causal relationships because all of our data are cross-sectional.

The strategic orientation typology we propose can be tested in different industries. Further, studies could focus on interactions between influencers, and could aim to detect

the presence of mediation and moderation effects. Lastly, longitudinal studies could study the impact of influencers on servitization intensity and on organisational performance.

References

Anderson, J. & Gerbing, D. 1988. 'Structural equation modeling in practice: A review and recommended two-step approach.' Psychological bulletin, 103:3, 411-23.

Baines, T., Lightfoot, H., Benedettini, O. & Kay, J. M. 2009. 'The servitization of manufacturing: a review of literature and reflection on future challenges.' Journal of Manufacturing Technology Management, 20:5, 547-67.

Birkinshaw, J. & Gibson, C. 2004. 'Building ambidexterity into an organization.' MIT Sloan management review, 45:4, 47-55.

Brentani, U. 2001. 'Innovative versus incremental new business services: different keys for achieving success.' Journal of Product Innovation Management, 18:3, 169-87.

Byrne, B. 2013. Structural equation modeling with EQS: Basic concepts, applications, and programming. Routledge.

Chen, I. & Paulraj, A. 2004. 'Towards a theory of supply chain management: the constructs and measurements.' Journal of Operations Management, 22:2, 119-50.

Chen, K.-H., Wang, C.-H., Huang, S.-Z. & Shen, G. C. 2016. 'Service innovation and new product performance: The influence of market-linking capabilities and market turbulence.' International Journal of Production Economics, 172, 54-64.

Cronbach, L. 1951. 'Coefficient alpha and the internal structure of tests.' Psychometrika, 16:3, 297-334.

Davies, A. 2003. 'Integrated solutions: the changing business of systems integration.' The business of systems integration, 333-68.

DeCarlo, L. 1997. 'On the meaning and use of kurtosis.' Psychological methods, 2:3, 292-307.

Demeester, L., DeMeyer, A. & Grahovac, J. 2014. 'The role of operations executives in strategy making.' Journal of Operations Management, 32:7, 403-13.

Dodgson, M., Gann, D. & Salter, A. 2006. 'The role of technology in the shift towards open innovation: the case of Procter & Gamble.' R&D Management, 36:3, 333-46.

Dutton, J. & Duncan, R. 1987. 'The creation of momentum for change through the process of strategic issue diagnosis.' Strategic management journal, 8:3, 279-95.

Fawcett, S. E. & Magnan, G. M. 2002. 'The rhetoric and reality of supply chain integration.' International Journal of Physical Distribution & Logistics Management, 32:5, 339-61.

Finne, M. & Holmström, J. 2013. 'A manufacturer moving upstream: triadic collaboration for service delivery.' Supply Chain Management: An International Journal, 18:1, 21-33.

Frohlich, M. & Westbrook, R. 2001. 'Arcs of integration: an international study of supply chain strategies.' Journal of Operations Management, 19:2, 185-200.

Galbraith, J. 2011. Designing the customer-centric organization: A guide to strategy, structure, and process. John Wiley and Sons.

Gebauer, H. & Friedli, T. 2005. 'Behavioral implications of the transition process from products to services.' Journal of Business & industrial marketing, 20:2, 70-78.

Harman, D. 1967. 'A single factor test of common method variance.' Journal of Psychology, 35:1967, 359-78.

Heskett, J., Sasser, W. & Schlesinger, L. 1997. Service profit chain. Free Press.

Hobday, M. 1998. 'Product complexity, innovation and industrial organisation.' Research policy, 26:6, 689-710.

Hooper, D., Coughlan, J. & Mullen, M. 2008. 'Structural equation modelling: Guidelines for determining model fit.' Electronic Journal of Business Research Methods, 6:1, 53-60.

Jayaram, J. & Xu, K. 2013. 'The relative influence of external versus internal integration on plant performance in China.' International Journal of Production Economics, 146:1, 59-69.

Johnstone, S., Dainty, A. & Wilkinson, A. 2009. 'Integrating products and services through life: an aerospace experience.' International Journal of Operations & Production Management, 29:5, 520-38.

Koren, Y., Bell, R. & Volinsky, C. 2009. 'Matrix factorization techniques for recommender systems.' Computer:8, 30-37.

Kowalkowski, C. 2006. 'Enhancing the industrial service offering: new requirements on content and processes.' Department of Management and Engineering: 203. Linköping University.

Lau, C. & Ngo, H. 2004. 'The HR system, organizational culture, and product innovation.' International business review, 13:6, 685-703.

Lightfoot, H., Baines, T. & Smart, P. 2013. 'The servitization of manufacturing: A systematic literature review of interdependent trends.' International Journal of Operations & Production Management, 33:11/12, 1408-34.

Lindell, M. & Whitney, D. 2001. 'Accounting for common method variance in cross-sectional research designs.' Journal of applied psychology, 86:1, 114-21.

Luoto, S., Brax, S. & Kohtamäki, M. 2016. 'Critical meta-analysis of servitization research: Constructing a model-narrative to reveal paradigmatic assumptions.' Industrial Marketing Management, In Press.

Miles, R., Snow, C., Meyer, A. & Coleman, H. 1978. 'Organizational strategy, structure, and process.' Academy of management review, 3:3, 546-62.

Mintzberg, H. & Waters, J. 1985. 'Of strategies, deliberate and emergent.' Strategic management journal, 6:3, 257-72.

Moeller, S. 2008. 'Customer integration—a key to an implementation perspective of service provision.' Journal of Service Research, 11:2, 197-210.

Neely, A. 2008. 'Exploring the financial consequences of the servitization of manufacturing.' Operations Management Research, 1:2, 103-18.

Neu, W. & Brown, S. 2005. 'Forming successful business-to-business services in goods-dominant firms.' Journal of Service Research, 8:1, 3-17.

Oh, L., Teo, H. & Sambamurthy, V. 2012. 'The effects of retail channel integration through the use of information technologies on firm performance.' Journal of Operations Management, 30:5, 368-81.

Oliva, R. & Kallenberg, R. 2003. 'Managing the transition from products to services.' International Journal of Service Industry Management, 14:2, 160-72.

Parasuraman, A. 1998. 'Customer service in business-to-business markets: an agenda for research.' Journal of Business & Industrial Marketing, 13:4/5, 309-21.

Petersen, K., Handfield, R. & Ragatz, G. 2005. 'Supplier integration into new product development: coordinating product, process and supply chain design.' Journal of Operations Management, 23:3, 371-88.

Pilat, D., Cimper, A., Olsen, K. & Webb, C. 2006. 'The changing nature of manufacturing in OECD economies.' In D. f. s. t. a. industry (Ed.) 38 pages. .

Podsakoff, P., MacKenzie, S., Lee, J. & Podsakoff, N. 2003. 'Common method biases in behavioral research: a critical review of the literature and recommended remedies.' Journal of applied psychology, 88:5, 879-903.

Prahalad, C. & Ramaswamy, V. 2004. 'Co-creating unique value with customers.' Strategy & Leadership, 32:3, 4-9.

Puranam, P., Alexy, O. & Reitzig, M. 2014. 'What's "new" about new forms of organizing?' Academy of management review, 39:2, 162-80.

Quinn, J. B., Doorley, T. L. & Paquette, P. C. 1990. 'Beyond products: services-based strategy.' Harvard business review, 68:2, 58-60.

Raddats, C., Baines, T., Burton, J., Story, V. & Zolkiewski, J. 2016. 'Motivations for servitization: the impact of product complexity.' International Journal of Operations & Production Management, 36:5, 572-91.

Reed, R. & DeFillippi, R. 1990. 'Causal ambiguity, barriers to imitation, and sustainable competitive advantage.' Academy of management review, 15:1, 88-102.

Rosenzweig, E. 2009. 'A contingent view of e-collaboration and performance in manufacturing.' Journal of Operations Management, 27:6, 462-78.

Satorra, A. & Bentler, P. 1990. 'Model conditions for asymptotic robustness in the analysis of linear relations.' Computational Statistics & Data Analysis, 10:3, 235-49.

Schmenner, R. 2009. 'Manufacturing, service, and their integration: some history and theory.' International Journal of Operations & Production Management, 29:5, 431-43.

Slater, S., Olson, E. & Hult, G. 2006. 'The moderating influence of strategic orientation on the strategy formation capability–performance relationship.' Strategic management journal, 27:12, 1221-31.

Snow, C. & Hambrick, D. 1980. 'Measuring organizational strategies: Some theoretical and methodological problems.' Academy of management review, 5:4, 527-38.

Srivastava, S. & Khan, A. 2016. 'Globalization and Development in Contemporary India: Cultural Perspective.' International Journal of Social Science Studies, 4:3, 18-23.

Stremersch, S., Wuyts, S. & Frambach, R. 2001. 'The Purchasing of Full-Service Contracts:: An Exploratory Study within the Industrial Maintenance Market.' Industrial Marketing Management, 30:1, 1-12.

Turunen, T. & Finne, M. 2014. 'The organisational environment's impact on the servitization of manufacturers.' European Management Journal, 32:4, 603-15.

Tushman, M. & O'Reilly, C. 1996. 'The ambidextrous organizations: managing evolutionary and revolutionary change.' California management review, 38:4, 8-30.

Vandermerwe, S. & Rada, J. 1988. 'Servitization of business: adding value by adding services.' European Management Journal, 6:4, 314-24.

VanDoorn, J., Lemon, K., Mittal, V., Nass, S., Pick, D., Pirner, P. & Verhoef, P. 2010. 'Customer engagement behavior: Theoretical foundations and research directions.' Journal of Service Research, 13:3, 253-66.

Venkatraman, N. 1989. 'The concept of fit in strategy research: Toward verbal and statistical correspondence.' Academy of management review, 14:3, 423-44.

Verstrepen, S., Deschoolmeester, D. & van den Berg, R. J. 1999. 'Servitization in the automotive sector: creating value and competitive advantage through service after sales.' Global production management: 538-45. Springer.

Vries, J., Koster, R. & Stam, D. 2016. 'Safety does not happen by accident: antecedents to a safer warehouse.' Production and operations management.

Weick, K., Sutcliffe, K. & Obstfeld, D. 2005. 'Organizing and the process of sensemaking.' Organization science, 16:4, 409-21.

Wernerfelt, B. 1995. 'The resource-based view of the firm: Ten years after.' Strategic management journal, 16:3, 171-74.

Williams, B., Roh, J., Tokar, T. & Swink, M. 2013. 'Leveraging supply chain visibility for responsiveness: The moderating role of internal integration.' Journal of Operations Management, 31:7, 543-54.

Xu, Y., Yen, D. C., Lin, B. & Chou, D. C. 2002. 'Adopting customer relationship management technology.' Industrial management & data systems, 102:8, 442-52.

Zhao, X., Huo, B., Selen, W. & Yeung, J. 2011. 'The impact of internal integration and relationship commitment on external integration.' Journal of Operations Management, 29:1, 17-32.

Chapter 4

Service Design in a Servitized Environment using behavioral analytics

Nikhil Varma
HEC Montréal
3000, chemin de la Côte-Ste-Catherine
Montréal, Québec, H3T 2A7
Canada
nikhil.varma@hec.ca

Julie Paquette
HEC Montréal
3000, chemin de la Côte-Ste-Catherine
Montréal, Québec, H3T 2A7
Canada
julie.paquette@hec.ca

Federico Pasin
HEC Montréal
3000, chemin de la Côte-Ste-Catherine
Montréal, Québec, H3T 2A7
Canada
federico.pasin@hec.ca

Abstract

Service is considered as the differentiator in traditional sectors; organizations are actively adding services to their portfolio to enhance the customer experience. Most research in dynamic service deployment classifies customers in different interest categories and defines different services to each category. This leads to a pre-defined set of offerings to customers. This article analyzes the impact of service design on customer satisfaction and presents a dynamic approach supported by behavioral analytics to enhance customers' experience.

We use an online car-buying example to collect behavioral analytics data and to train an artificial neural network (ANN). We introduce services that enhance the product experience and provide customers with solutions. The trained network predicts customer acceptance of services, thereby assisting in dynamic service design. We conduct two experiments, one with a low-priced car and one with a high-priced car. We use the same behavioral variables for both studies.

The experiments are conducted on the Amazon Mechanical Turk (Mturk) crowdsourced platform, where respondents were compensated for participation. Several validations were incorporated in the study to ensure a high quality of responses. Respondents could respond to one of the experiments only.

Analysis of the data for both the experiments leads us to conclude that the artificial neural network (ANN) has a higher degree of accuracy in predicting customer satisfaction than does the regression approach. However, one of the service predictions degraded considerably from the low-priced car to the high-priced car. A post-hoc analysis was done to test whether this was due to the sample size. The follow-up experiment with a larger sample showed further degradation in the predictability of the ANN. We hence conclude that an increase in product value requires an increase in behavioral variables to maintain the accuracy of an ANN. The research highlights that a classical service addition strategy using a traditional regression approach has a lesser impact on customer satisfaction than do dynamic, behavioral analytics supported by an ANN approach. The main contribution

of this article is to present a mechanism that uses an ANN to assist in dynamic service design.

Keywords: Customer experience, Service experience, Servitization, machine learning, big data, behavioral analytics, neural networks, service design

4.1 Introduction

Over the years, the manufacturing industry has been replaced by the services economy as the area with the biggest growth in OECD countries (De Backer et al. 2015). One of the reasons cited for this decrease in manufacturing or product economy has been its inability to fight commoditization which has affected the strategic positioning of the organization and leads to undifferentiated price competition (Lightfoot et al. 2013, Dotzel et al. 2013). Services infusion was identified as facilitating business model innovation that helps firms remain competitive by offering more value to the customers (Swamidass and Newell 1987, Vandermerwe and Rada 1988).

Owing to this global service orientation, the focus has moved from product manufacturing to provision of systemic solutions constituted by products and service. Organizations have hence strategically transformed from product manufacturers to solution providers, a process often labeled as servitization. Servitization is a business model transformation where the central focus is to provide value to the customer (Baines et al. 2009). Business model transformation requires organizations to develop new service design strategies. Several studies present effects and strategies for service infusion. In their study of the impact of service infusion, Visnjic et al. (2014) recommend completeness of service and a service innovation path that is aligned with the product innovation path. Kowalkowski et al. (2012) highlight the concept of "agile incrementalism," where service infusion is continuously done by "recalibration of opportunities" and management of organizational objectives.

With the advent of the experience economy, service design definition has become more complex (Pine and Gilmore 1998). Organizations have to develop strategies to create a service experience that has a lasting impression on customers. The total service experience and its lasting experience has been found to be an important aspect of customer loyalty (Leventhal et al. 2006). This aspect has been well studied in the marketing literature, where product and service bundling enhances customers' experience (Adomavicius et al. 2015, McQuilken et al. 2015). Another important aspect that has been studied is the timing aspect of service deployment; studies have focussed on "when" to introduce the service to positively impact the customer experience (Dixon and Walsman 2014, Dixon and

Verma 2013). This aspect, also known as "service sequencing," focuses on temporal placement of a service to increase customers' repurchase intentions. Several researchers have also examined the aspect of an optimal product service mix based on operational constraints. Pullman and Moore (1999) proposed a service design model for profit maximization. Their work used interdisciplinary strategies from operations and marketing and took a conjoint analysis approach to develop the model. Building further on this area, Verma et al. (2001) used operational constraints to build a product-service mix for maximizing profitability. Kotri and Mourey (2011) used conjoint analysis to identify customers' needs on various service constructs.

The idea of adding service to the product offering is driven by the motivation that the service will create additional value for the product, thereby granting the organization a strategic advantage. Organizations add services to their portfolio to enhance the customer experience based on a strategic positioning that leads to a static infusion of services. However, the dynamic service definition in a process by using customer interactions is not well developed in the literature (Forkmann et al. 2016). Most of the studies have used an a priori assumption that an optimal product service mix can be estimated using a linearly compensatory model. Such decisions use a linear additive structure to mimic consumer behavior and choice. These decisions are best estimated by statistical techniques such as analysis of variance (ANOVA), logistical regression, least squares regression and discriminant analysis. However, this approach has been challenged by a literature stream that identifies that consumer behavior is non-linear in nature and often single-peaked (Coombs and Avrunin 1977). This stream of research suggests that a non-linear behavior pattern is best captured by non-compensatory models like an ANN.

With the advent of multiple computing devices, firms' online sales have become increasingly difficult to predict. A study conducted by the Centre for Retail Research (CRR 2015) projected that the average value per online transaction in the USA was expected to be $115, with every user doing approximately 16 transactions each year. This purchasing behavior trend of buying low-priced goods is usually forced by companies that have tight supply chains and profit margins. For high value products, firms continuously face a challenge with customers not opting for the online route to buy such goods. We

analyze such a market of high value goods and propose a dynamic service infusion model using behavioral analytics. More specifically, we study the used-car online purchasing process and propose a model for dynamic service addition.

Bryson and Daniels (2010) identified categories of service based on the time when they are offered to the customer. More precisely, they classify them as: "*Before manufacturing, during manufacturing, when selling, during utilization* and *post utilization.*" Given that we focus on selling the product (a used-car), we looked into service aspects that deliver value to the customer. Services in this form primarily provide information to customers on salient features of the product during and after the utilization of the services. Most websites are designed to deliver product information to assist the selling process. Our objective is to extend this by adding services that give information that will be helpful after the selling process *during the utilization* and *after the utilization* of the product. This is the value added that our services provides to the customer. We use the "Service-Opportunity Matrix" proposed by Sawhney et al. (2004) to classify these services into two groups. The first group, called tightly coupled services, provides information to assist in the primary path of consumption of the product. In our study, we define maintenance information as a tightly coupled service. The second group, called loosely coupled services, provides other information that would help the customer continue to consume the product. We selected financing, insurance and carbon-footprint management as such services.

The contribution of this research is twofold. First, we provide a conceptual model that can serve as the basis for dynamic service infusion. This conceptual model is an expectation vector based on the buying process. By using behavioral analytics during the buying process, we introduce a service portfolio to enhance customer satisfaction based on the expectation vector. This online experiment is similar to a traditional experience where an experienced sales agent presents the right things to customers at the right time to enhance their experience, thereby positively influencing their satisfaction and buying intention. Second, by using behavioral analytics on non-compensatory models, we present a new approach to dynamic service infusion that can help organizations undergo the servitization transformation.

The article is organized as follows. In the next section, we introduce the ANN decision-making approach, the customer decision-making process and the parameters for our experiment. Section 4.3 describes the research methodology. In section 4.4, we report and analyze the results of our two experiments. In section 4.5, we conclude by highlighting the managerial implications, study limitations and future research directions.

4.2 Theoretical Framework

This section presents the theoretical framework of our study. We describe the decision-making process using neural networks and identify the important factors that influence customers' buying process. We also use the theoretical constructs to build an expectation vector that models the customer's view of the buying process.

4.1.1 Neural networks decision making approach

Neural networks have been widely used in several areas. Their ability to model the capability of the human brain makes them a good alternative to traditional techniques. The decision-making ability of a neural network is driven by its ability to learn from the data. With the advent of big data, where organizations have accumulated immense amounts of customer data, neural networks appear to be a good method for predicting customers' behavior. Several start-ups have used this premise as their underlying analytical framework to make information more relevant to customers. RadiumOne, a California based start-up, uses big data to help companies direct the right products to customers (RadiumOne 2016). Data-driven decision making has been studied in academia, and several applications have emerged from such research (Chen et al. 2012, Fanning and Cogger 1998, Koren et al. 2009).

The neural network system is arrayed as a set of hierarchical layers; input layer, hidden layer(s) and output layer. In the first layer, each node takes the value of each input data item. The second layer nodes then process the values of these input nodes to generate the processed information to the output layers' nodes. A node activation function translates the inputs to the output by adding weights based on a previously chosen function. These weights are adjusted as the network receives more data. This process is called training the system. The core idea is to build a relationship between the input and output over time.

The network does not have any initial relationship fed into the system, and hence the dependent and independent variable relationships are iteratively self-generated by the data (Hagan et al. 1996, Haykin and Network 2004). The node activation function or the transfer function has the primary objective of activating each node to transform an input to an output. The sigmoid activation function has been widely used because it captures the population variance most effectively (Wilson and Cowan 1972).

Backpropagation is a powerful tool to manage the learning process of neural networks. In this approach, the various parameters (notably the weights) in the system are adjusted iteratively so that the virtual outputs calculated from the inputs approach the real outputs in the data. The neural network is adapted by assigning weights to the different inputs across various layers of the network. The objective is to minimize the square error (E) presented in Equation 4-1.

(Where: Y* is the estimated output ,Y is the actual output for each output i in the time interval t)

$$E = \sum_{t=1}^{T} E(t) = \sum_{t=1}^{T}\sum_{i=1}^{n} (\frac{1}{2})(Y_i^*(t) - Y_i(t))^2$$

Equation 4-1: Backpropagation minimization function

Studies that try to predict customer behavior have found that a neural network gives more accurate results than regression techniques (Wong et al. 1997, Abdou and Pointon 2011, Setiono and Thong 2004). This study aims to present similar results in the context of product-service systems design with a high-net-worth good online purchase.

4.1.2 Dissecting customer's decision process

In order to influence customers' buying behavior in an online e-commerce system, it is important to understand customers' decision process. Product companies that seek to offer an online sales model must identify the levers that could persuade a consumer to buy. A web interface serves as a service frontier for the product. It is hence important to

customize the service to enhance the customer experience, thereby positively affecting the customer's buying decision. We analyze the decision process from the perspective of buying a high-net-worth good, like a used car, online and identify the factors that could influence the customer decision.

In a systematic literature review, Chan et al. (2003) present a framework of an online consumer decision process. In a subsequent study, Constantinides (2004) perform a detailed analysis of the factors that influence this decision process. The online buying process is often depicted in three stages, as illustrated in Figure 4-1.
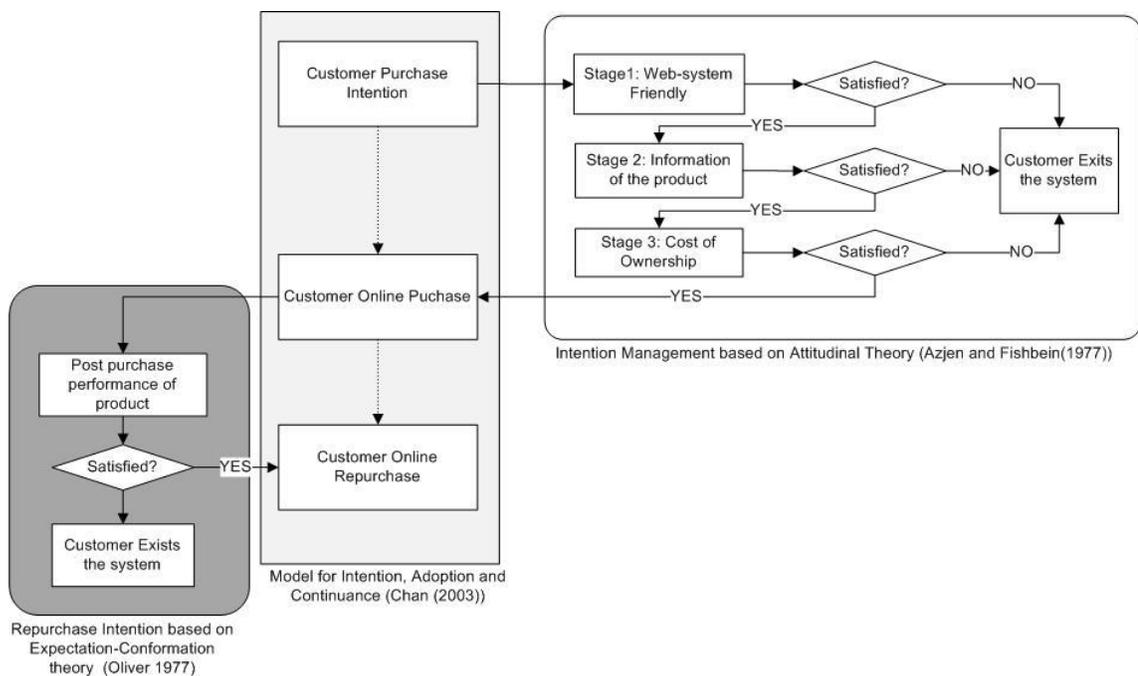
Figure 4-1: The online Buying Process

Our focus is to design an adaptive system that would influence buying behavior. Therefore, we examine the activities included in the intention management part of this buying process (in the right box in the figure). Note that the three stages identified in the intention management part do not necessarily follow the sequence shown in the diagram. The order of these stages could vary with each individual. Further, the definitions and tolerance levels of each of these stages could also vary from person to person. We model the buying intention in the form of an expectation vector.

An online service encounter is composed of multiple interactions between the user and the system (Van Dijk et al. 2007). We extend the model presented in Figure 4-1 to clearly model a service encounter. We propose that besides the attitudinal aspect, there is an expectation-confirmation mechanism after each interaction in a high involvement web system selling used cars. It is hence important to positively influence the customer experience at each encounter to have a positive effect on the buying decision. This is why we will take into consideration multistage interactions between the customer and interface in our estimation of customer satisfaction.

Our research also seeks to introduce an element of stimulation to enhance the customer experience. Over time, when customers get used to the external stimulus, expectations rise and the system has to increase the frequency of the stimuli to maintain the satisfaction level. Customers with increased satisfaction levels will have higher expectation levels and would require an increased stimulus (Matzler and Hinterhuber 1998). Clark et al. (1996) discuss employee job satisfaction over time and empirically show that it is a "U" shaped curve. Similarly, we postulate that customer satisfaction will also have a non-linear relationship with time. Figure 4.2 below summarizes these customer behavior patterns.
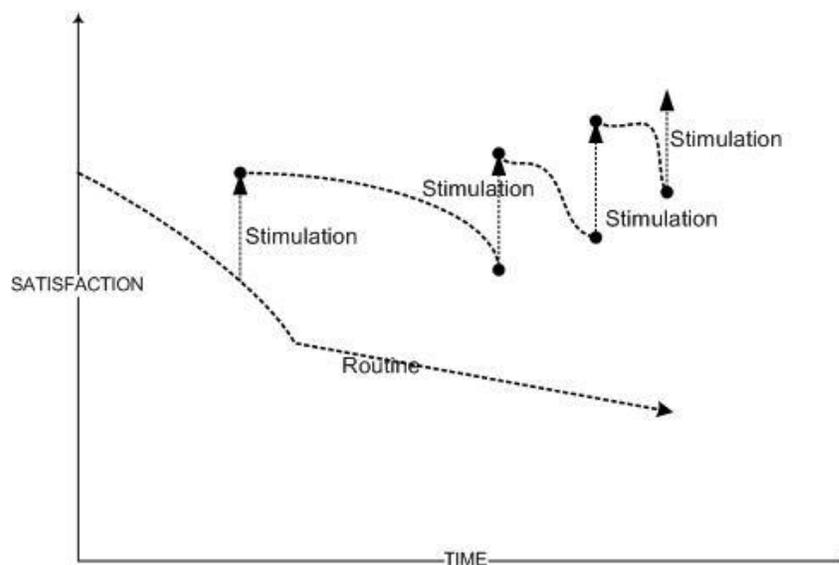
Figure 4-2: Sustained Satisfaction by stimulation

The stimulations depicted will be generated by having an underlying system that can forecast user expectation. A good forecast of user expectation at time t_1 will dynamically

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change the system configuration to comply to the user expectation and possibly enhance the web experience of the customer at time t_2. Assuming that there are n interactions leading to a purchase decision, and that the expectation vector at time t is represented by $\mathbf{E_t}$. and the forecast vector is represented by $\mathbf{F_t}$, we seek to minimize the following summation Equation 4-2 to increase customer satisfaction:

$$\sum_{t=0}^{n}(E_t - F_t)$$

Equation 4-2: Expectation-Forecasting Equation

4.1.3 Expectation vector factors and their manipulations

In order to influence customers' buying behavior, it is important to identify the factors that have an impact on it. We identify three primary forces that influence the customer's online behavior: environmental and customer factors, marketing mix and web experience (Constantinides 2004, Kotler and Keller 2003).

Environmental and customer factors are qualified as uncontrollable factors because they define the customer demographics pertaining to personal, cultural and sociological aspects. These factors are usually influenced in the long run, and such factors are difficult to influence in a single web interaction. Some customer factors such as demographics and results of previous interaction can have a short-term impact on the customer decision process. The marketing mix has long-term and short-term implications on the customer. We will focus on the web experience factor and the marketing mix with a short-term vision that are controllable in nature, and that have a significant impact on customer behavior. The timeline of influence of the primary forces on a customer's online behavior are presented in Table 4-1.

Primary forces influencing customer behavior	Timeline of Impact
Environment and customer factors	Long Term and Short Term
Marketing mix	Long and Short Term
Web experience factor	Short term

Table 4-1: Primary forces and their impact on customers

Following a literature review, Constantinides (2004) classified the web experience into three categories: functionality, psychological and content. Several factors and sub-factors were identified for each of these categories. Functionality takes into consideration the ease of use and interfaces of the website. Psychological factors take into consideration the factors that build the trust level that the customer perceives from the website. The content factors take into consideration the look and feel of the website and the information about the product in terms of its marketing mix. These factors and their interrelationships are depicted in Figure 4-3.
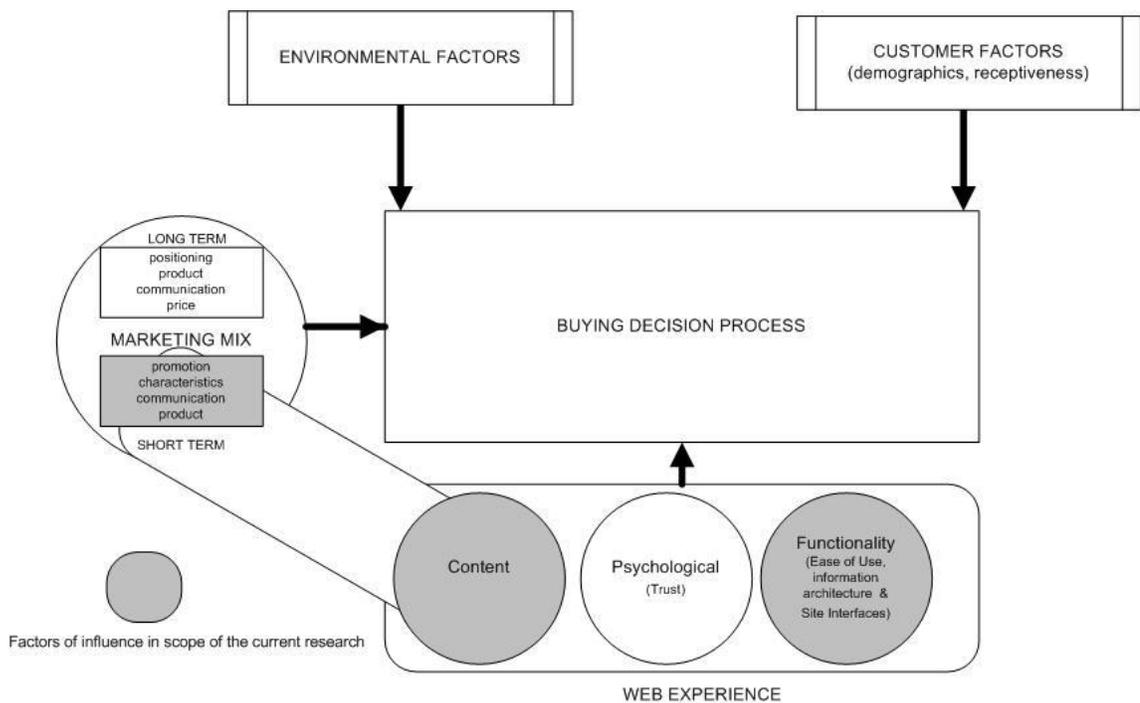
Figure 4-3: Factors influencing customer buying decisions

The factors identified as being part of the expectation vector are also identified in the diagram. The psychological aspect of trust is not considered in the expectation vector, but we control for this factor by explicitly stating that the site is secure in nature and that all user information is private and no privacy violations take place in the system. Note that services offered alongside the product are implicitly defined within the definition of the product. The two groups of services, tightly coupled and loosely coupled, are presented as extra information after the initial product search. The environmental factors take the macro-environment into account, and are beyond the scope of this study. However, we

take into consideration the customer factor, which is a part of the expectation vector. The factors posited to affect customers' expectation in our specific case are summarized in Table 4-2.

Factor Name	Category	Manipulation Type	Manipulation Description
Product (car)	Marketing Mix	Relatively controlled	The survey instrument will present a search result with two cars
Characteristics (car)	Marketing Mix	Relatively controlled	The survey has a basic and advanced search by characteristics for the car
Promotion (service)	Marketing Mix	Relatively controlled	User is offered four types of services, one closely related to the product and three supporting the product.
Ease of use/Site Interface	Web Experience	Controlled	The survey instrument compares the site with a well-known site
Content	Web Experience	Controlled	User gets to see all the content that would appear following their selection process
Customer Demographics	Customer Factors	Customer entered	Customers enter their demographic data
Customer receptiveness	Customer Factors	Relatively controlled	Only customers who show an interest in purchasing a car online are considered in the study

Table 4-2: Factors in the Expectation Vector and their manipulations

4.2 Research Methodology

This section presents information about the recruitment of study participants, the experiment instrument used, the randomization of the sample and the methodology for prediction comparison and for forecasting dynamic service design

4.2.1 Recruitment of participants

The participants for this study were recruited using a crowdsourced platform known as the Amazon Mechanical Turk (*MTurk*). This platform has recently become an avenue for

experiment or survey based research (Berinsky et al. 2012, Casler et al. 2013, Paolacci and Chandler 2014). This platform matches the needs of the person (known as "requestor") for a particular task (known as human intelligence tasks (HIT)) with people who can complete the task (known as workers). The requestor posts a HIT in the *Mturk* website with the pay rate for the HIT. Qualified workers then receive the offer to complete the job. This model has been widely used, several researchers have studied the efficacy of collecting data via this crowdsourced technique. Hauser and Schwarz (2015) used instructional manipulation checks (IMCs) (Oppenheimer et al. 2009) to study the attentiveness of workers compared to graduate students. In their series of experiments, the workers were far more attentive to the IMCs than the graduate students were. In order to ensure a high degree of reliability, we have also introduced some IMCs in our experiment.

We use the Qualtrics survey tool to gather the experiment responses of the participants. Participants were recruited from the United States only, to ensure their consistent understanding of terminologies in the experiment. The survey was conducted in two phases (low-priced cars followed by high-priced car), and participants of the first phase were not allowed to participate in the second phase. The groups are characterized by the price of used cars, namely low price range ($10,000 to $20,000) and high-price range ($45,000 to $60,000).

Based on the recommendation for compensation provided in various discussion forums (reddit, turkopticon) the respondents were compensated $2.50 for their response.

4.2.2 Experiment instrument description

For each group, the experiment firstly engages the participant through a car purchase process by gathering their inputs on the basic product attributes. The experiment also captures the importance of each feature for the participants by explicitly asking them to rank the features. We conducted this exercise to record users' preferences. Consistency of entries was checked at random locations, and all inconsistencies were highlighted to the respondent to ensure a high quality response. Given our objective of supporting service design, we introduced four services: maintenance, insurance, financing and carbon

footprint management. For a given group of participants (low value and high value), we provided a selection and preference option in each of the four services.

At the end of the experiment, we introduce a recommendation service that suggests a same brand car within the price range the participant selected. However, this car, which has many interesting features, did not show up in the search results because one of the search criteria (such as mileage) was not satisfied.

Most responses to manipulation questions were recorded on a 7-point scale. This is line with the recommendations of scale selection by Cox III (1980) where an equal number of positive and negative responses is recommended. The experiment captures user satisfaction using three measures: satisfied with the transaction, willing to recommend and will come back in the future (Spreng et al. 1995) at each stage of the process (search, informational service, recommendation service and complete service experience).

This survey instrument was first checked for language, understability and response time using 50 known participants (80% response rate). Several recommendations on the questions were received to minimize vagueness and simplify complicated sentences. The average response time for the final experiment with the improved version with a new set of five users was twelve minutes. We introduced a qualifying question that asked respondents to indicate their willingness to buy cars online (in Appendix 4.A and Appendix 4.B, see question 1.7). Responses from all respondents who explicitly mentioned that they would never consider an online option to research or buy cars were not considered in the analysis.

4.2.2.1 The variables for analysis

The various inputs that were received from the participants are analyzed in two phases. The first phase of analysis is a comparative study between regression and ANN to accurately estimate satisfaction with the complete service experience. The objective of this phase is to demonstrate that linearly compensatory models suggested by regression approaches have lower prediction accuracy than do non-compensatory models derived from neural networks. The different inputs taken from the participants with an explanation of how they will be used in the analysis are presented in Table 4-3. We also define a link

to the survey instrument presented in Appendix 4.A to demonstrate the measurement approach.

Type	Variables inputs	Explanation	Question(s) in Survey
Customer factors - Demographics	Age/Gender/Annual income/ Exposure to internet/Education level/ Ethnicity	Independent variables	1.1,1.2.1.3,1.4,1.8,1.9
Customer factors – Experience	Number of cars owned/Online car buying experience/ Understanding of mobile app	Independent variables	1.6,1.7,1.5
Product functionality	Brand/Model/ Maximum price	Independent variables	2.1
Advanced product functionality	Mileage/Transmission type/Fuel type	Independent variables	2.2
Complete satisfaction with search functionality	Satisfied/ Recommend to others/ Will use in the future (Average of the three variables)	Independent variable	3.1
Tightly-coupled and loosely-coupled service utility	Insurance/Finance/Maintenance/ Carbon foot-print	Independent variable	4.2
Tightly-coupled and loosely-coupled service rank	Insurance/Finance/Maintenance/ Carbon foot-print	Independent variable	4.3
Tightly-coupled and loosely-coupled service weight	Insurance /Finance/Maintenance/ Carbon foot-print	Independent variable	4.4
Complete satisfaction with services (tightly and loosely coupled)	Satisfied/ Recommend to others/ Will use in the future (Average of the three variables)	Independent variable	4.1
Complete satisfaction with recommendation Service	Satisfied/ Recommend to others/ Will use in future (Average of the three variables)	Independent variable	5.1(1st -3rd question)
Complete satisfaction with the buying experience	Satisfied/Will recommend/Will come back (Average of the three variables)	Dependent variable	5.2

Table 4-3: Variables for studying the impact of service on customer satisfaction

The second part of the analysis aims to present a model to assist managers in service design. We use neural networks to predict the importance of the four tightly-coupled and loosely-coupled services and the recommendation service based on user demographics and interaction with the system. We do not use the satisfaction variables, only the variables that a user would click in a website such as choice for search options. The

outcome variables would be weights assigned to each of the four services and the degree of importance given to the recommendation service. The different inputs used in the analysis are presented in Table 4-4. We also define a link to the survey instrument presented in Appendix 4.A and 4.B to demonstrate the measurement approach.

Group	Variables inputs	Explanation	Question(s) in Survey
Customer factors - Demographics	Age/Gender/Annual income/ Exposure to internet/Education level/ Ethnicity	Independent variables	1.1,1.2.1.3,1.4,1.8,1.9
Customer factors - Experience	Number of cars owned/Online car buying experience/ Understanding of mobile app	Independent variables	1.6,1.7,1.5
Product functionality	Brand/Model/ Maximum price	Independent variables	2.1
Advanced product functionality	Mileage/Transmission type/Fuel type	Independent variables	2.2
Tightly-coupled and loosely-coupled service ranks ad weights	Insurance/Finance/Maintenance/ Carbon foot-print	Dependent variable	4.3 and 4.4
Complete satisfaction with recommendation service	Satisfied/ Recommend to others/ Will use in the future (Average of the three variables)	Dependent variable	5.1(1st -3rd question)

Table 4-4: Variables for ANN to propose a Service Design

4.2.3 Randomization of the sample

In this study, we follow the method proposed by Gorr et al. (1994) where the entire data population is resampled into ten independent samples eight samples are randomly selected for training and two random samples are used for validation. This was done in two steps. A new field "step1", a random number generated between 0 to 9999, was added to each sample. The data were then sorted in ascending order based on the step1 value. We then grouped an equal number of data-sets into ten groups and created a new field "step 2", where a random number between 0 to 999 is assigned to each group of data-sets. The data were re-sorted based on the value of the field "step 2". The first eight groups were used to train the system and the last two groups were used to test the system. To ensure that our results were reliable, we repeated this process of creating training and test groups five times. In all, this gave us five sets of training and test data.

4.2.4 Methodology for prediction comparison

This analysis is done to compare the prediction ability of a regression approach versus an ANN. Based on the training data, the overall satisfaction is computed as a function of the dependent parameters. We use SPSS to do a simple regression (step-wise fit approach) where we identify the significant coefficients of each of the dependent variable to develop a linear function as presented in Equation 4-3.

$$
\begin{aligned}
OverallSatisfaction \\
= \ & Constant + \beta_1 \, (Age) + \ \beta_2 \, (Gender) + \ \beta_3 \, (Annual \ Income) \\
& + \beta_4 \, (InternetExposure) + \ \beta_5 \, (Educationlevel) \\
& + \beta_6 \, (Ethnicity) + \beta_7 \, (Age\#ofCarsOwned) + \ \beta_8 \, (OnlinePurchaseExperience) \\
& + \beta_9 \, (Understanding \ of \ Mobile \ App) + \beta_{10} \, (BrandImportance) \\
& + \beta_{11} \, (ModelImportance) + \ \beta_{12} \, (MaxPriceImportance) \\
& + \beta_{13} \, (MileageImportance) + \ \beta_{14} \, (TransmissionTypeImportance) \\
& + \beta_{15} \, (FuelTypeImportance) + \beta_{16} \, (Satisfied_{Search}) \\
& + \beta_{17} (InsuranceServiceImportance) \\
& + \beta_{18} \, (FinanceServiceImportance) + \beta_{19} \, (MaintainenceServiceImportance) \\
& + \beta_{18} \, (CarbonFootprintImportance) + \beta_{19} \, (Satisfied_{Services}) \\
& + \beta_{20} \, (Satisfied_{recommendation})
\end{aligned}
$$

Equation 4-3: Equation for overall satisfaction

Based on the value of the significant regression coefficients, the overall satisfaction is computed for each response in the testing groups. We compute the average root mean squared error (RMSE) as a measure of accuracy for the estimation ability of the regression approach.

We conduct the neural network analysis in an open source tool called the Multiple Back-propagation (Lopes 2012). This tool provides a simple interface to load the input file (training and testing), and define the network typology and activation function. The network typology for this study is a fully connected back-propagation network. To study the predictive power of the ANN, we determined two important components of a neural network system: the activation function and the number of hidden layers. As most studies in ANN using a back propagation, we use the sigmoid activation function to activate the nodes in the network. Many studies in neural networks have reported that the hidden layers should be added incrementally and warn that having many hidden layers could result in over-specification (Jain and Nag 1997). We initiate all specifications with one hidden layer and then plan to increase layers only if the performance (root mean square

error) improves. Another important aspect in the ANN prediction process is the pruning of the inputs. Pruning of the inputs requires a sensitivity analysis where we study the significance of each of the input to the RMSE. Inputs that do not impact the RMSE are iteratively removed. The network is then set to retrain and predict.

The prediction comparison analysis is done for all five groups of training and test data sets. However, the results are presented for the group that represented the smallest difference between the ANN and the linear regression.

4.2.5 Methodology for forecasting dynamic service design

This part of the analysis will use the variables identified in Table 4-4 to predict the insurance, financing, maintenance, carbon-footprint and recommendation services. To assist in the design process, the order of importance (1-highest; 4-lowest) of the insurance, financing, maintenance and carbon-footprint services are predicted based on the independent variables. The ANN also assigns a weight (0-lowest; 100-highest) to support managers' investment decisions regarding services. For the recommendation service, a value between 7-highest and 1-lowest is predicted to identify the importance of introducing this service.

This analysis uses all five sets of training and test data to determine the efficacy of the prediction. We also conduct sensitivity analysis of the inputs to improve the prediction of the system. However, the results with the lowest prediction accuracy are reported in the analysis so that we do not over-estimate the accuracy.

4.3 Data Sample

The data were collected in two separate and independent experiments. Respondents were allowed to participate in one experiment only. All respondents who showed a lack of interest in buying cars online (Question 1.7 in Appendix 4.A and Appendix 4.B) were compensated, but their responses were not considered in the analysis. Table 4-5 presents the participants' demographic information.

	Low-priced Car	High-priced Car
Number of valid respondents	200	200
Age group of respondents		
Under 25 years	23	18
25-34 years	124	97
35-44 years	43	39
45-54 years	17	31
55+ years	3	15
Gender of respondents		
Male	83	105
Female	125	93
Prefer not to identify	2	2
Annual income of respondents		
Less than $10,000	5	4
$10,000-$19,999	13	15
$20,000-$29,999	30	38
$30,000-$39,999	44	23
$40,000-$49,999	27	28
$50,000-$59,999	25	19
$60,000-$69,999	16	18
$70,000-$79,999	14	11
$80,000-$89,999	10	17
$90,000-$99,999	10	12
$100,000+	16	15

Table 4-5: Demographic information of the participants

4.4 Experiment results and analysis

We conducted two experiments; one with a low-priced car and second with a high-priced car. As outlined earlier, each study has two parts; the first part is done to demonstrate the predictability power of an ANN versus a regression approach. The second part of the study aims at supporting service design using behavioral analytics to train an ANN.

4.4.1 Predictability power of an ANN vs regression

We conducted a linear regression with *Complete satisfaction from the buying experience* as a dependent variable for the training data. Using a stepwise fit approach in SPSS, the regression fit five variables into the regression equation. Table 4-6 presents the regression model summary (for the lowest RMSE among the five training data sets).

Experiment Type	R	R Square	Adjusted R Square	RMSE
Low-priced car	0.710	0.504	0.484	0.452
High-priced car	0.791	0.626	0.612	0.679

Table 4-6: Regression model summary

The constant and coefficients of independent variables that significantly determine the linear regression are presented in Table 4-7 for the low-priced car and in Table 4-8 for high-priced car.

Factors	Survey Question (See Appendix 1)	Explanation	Unstandardized Coefficients		Significance
			B	Std. Error	
(Constant)	-	-	2.418	0.367	0.00
RecoUseful	5.1(a)	Captures whether the respondent considers the recommendation useful	0.132	0.031	0.00
SatisfiedOverallSearch	3.1(a,f,g)	Captures customer satisfaction with search	0.179	0.035	0.00
SatisfactionOverallExtraInfo	4.1	Captures customer satisfaction with extra services	0.194	0.043	0.00
WillUseExtraItems	2.1(e)	Captures whether a respondent needs extra items	0.138	0.042	0.001
Gender	1.2	Gender of the respondent	-0.182	0.072	0.012
CarsOwned	1.6	Number of cars owned by the respondent	0.069	0.027	0.013

Table 4-7: Regression coefficients of the parameters model for low-priced car

Factors	Survey Question (See Appendix 1I)	Explanation	Unstandardized Coefficients		Significance
			B	Std. Error	
(Constant)	-	-	0.106	0.049	0.00
RecoUseful	5.1(a)	Captures whether the respondent considers the recommendation useful	0.309	0.062	0.00
SatisfiedOverallSearch	3.1(a,f,g)	Captures customer satisfaction with search	0.252	0.047	0.00
SatisfactionOverallExtraInfo	4.1	Captures respondent satisfaction with extra services	0.357	0.062	0.00
WillNotClickReco	5.1(c)	Captures whether the respondent will not click on the recommendation	0.097	0.038	0.013
FinancingUseful	4.2(d)	Captures whether the respondent considers the financing service useful	0.138	0.058	0.020
RankByYearOfManufacturing	2.3	Captures the importance that the respondent gives to the year of manufacturing	-0.076	0.033	0.024

Table 4-8: Regression coefficients of the parameters model for high-priced car

Using these coefficients, we predicted the dependent variable for the testing data set. Comparing the error between the predicted value and the actual value, we computed the RMSE for the model. The RMSE for the predictions based on the regression models for the low-priced and high-priced car are presented in Table 4-9.

	Root Mean Square Error (Regression)
Low-priced Car	1.436050
High-priced Car	0.678579

Table 4-9: RMSE for Regression Analysis

Using the value 4 (on a 7-point Likert scale) as the switchover point for satisfaction, we computed the p-values for the binomial distribution: one considering the prediction probability of the training system and the other assuming that the probability is 50% (equal chance of success and failure). The results are presented in Table 4-10.

	Low-priced Car	High-priced Car
Prediction ability – training data	95%	95%
Prediction ability - test data	80%	77.5%
p-value (test data vs training data)	0.99	0.99
p-value (test data vs coin toss)	0.00009	0.0003

Table 4-10: P-value for regression forecasting

The significant p-value with 50% probability demonstrates that the forecasts for the test data outperforms a prediction done by a coin toss. However, the p-value is not significant compared with the training data, which highlights the fact that the test data prediction is not different from the training data prediction. This validates the prediction ability of the regression model.

We conducted the analysis for forecasting the dependent value in a completed connected back-propagation ANN. The training and testing data set were simultaneously entered in the tool during the training process. During that process, the inputs that were not significant were pruned and the number of hidden layers were adjusted. The sigmoid activation function was used to activate the nodes. Table 4-11 presents the details for the analysis.

	Low-priced Car	High-priced car
Number of variables pruned	12	4
RMSE (training data)	0.0219	0.0361
RMSE (test data)	0.0672	0.0810

Table 4-11: ANN analysis parameters for comparative study

To test the prediction of the ANN, we compute two p-values using the same logic as in the regression model. The results are presented in Table 4-12.

	Low-priced Car	High-priced Car
Prediction ability of the training data	98.75%	99.375%
p-value (compared to training data)	0.99	0.99
p-value (compared to 50% probability)	0.00000009	0.000000009

Table 4-12: P-value for ANN forecasting

The ANN demonstrates much higher accuracy than did the regression model. We also see a significant difference in the prediction relative to the fair coin decision process. The

ANN prediction for the test data is not significantly different from the training data which establishes the validity of the trained network.

4.4.2 Dynamic service design

To assist in dynamic service design, we used the actual user entries as input data. This is a model of real life interaction with the user, where the user selects/enters certain information based on which a trained network would hypothesize two outputs (rank and weight) for the maintenance, insurance, financing and carbon-footprint services. The trained network would also hypothesize the customer response to the recommendation service. The rank and the weight provide a two dimensional recommendation to assist in service design. The rank of the service provides the order of preference for the customer and the weight provides a guidance for resource allocation.

In Table 4-13, we present the rank and weight RMSE for the training and test data for the four services. The results are presented for both the low-priced and high-priced car. It is to be noted that the RMSE is normalized because the rank has a range of four levels while the weight has a range of 100.

Service Type	Low-priced Car				High-priced Car			
	$RMSE_{rank}$ (training)	$RMSE_{rank}$ (test)	$RMSE_{weight}$ (training)	$RMSE_{weight}$ (test)	$RMSE_{rank}$ (training)	$RMSE_{rank}$ (test)	$RMSE_{weight}$ (training)	$RMSE_{weight}$ (test)
Maintenance	0.13	0.32	0.09	0.18	0.13	0.33	0.08	0.19
Insurance	0.07	0.2	0.08	0.14	0.09	0.27	0.08	0.12
Finance	0.09	0.22	0.10	0.21	0.10	0.28	0.12	0.27
Carbon-Footprint Management	0.10	0.23	0.04	0.09	0.12	0.26	0.09	0.18

Table 4-13: ANN accuracy in forecasting tightly and loosely coupled services

We see that the four services are forecast very accurately using behavioral data from both the low-priced and high-priced car experiments. The RMSE reported is a normalized value, and all values are less than 0.33, which implies that these ANNs probably forecast the correct values. However, we see a slight degradation in the prediction power for services in the high-priced car experiment than in that of low-priced car.

We next analyze the recommendation service forecast. This service provides the customer a recommendation after the completion of searching the car and access of the four tightly and loosely coupled services. The recommendation service does not present a new set of cars but highlights a car within the searched car family that did not appear in the search because of a constraint set by the user (e.g. car's distance from the user). Based on the user inputs/interactions with the system, we study the accuracy of the forecast. In this study we also analyze the percentage of accuracy. This is computed using the value 4 as the inflection point (7-point Likert scale). All customers with values 4 and over are considered to be receptive to the recommendation service whereas a value less than 4 shows that the customer is not interested in the recommendation service. We evaluate the forecasting for this binary state for the training and test data sets. We also compute the p-value for this forecast for the test data with respect to training data and a fair coin toss. The results are presented in Table 4-14.

Service Type	Forecasting parameters					
	RMSE (training)	RMSE (test)	Prediction accuracy (training)	Prediction accuracy (test)	p-value (test vs training)	p-value (test vs coin toss)
Low-priced car	0.08	0.22	98.75%	90%	0.9999	0.0000001
High-priced car	0.11	0.29	88.125%	62.5%	0.99999999	0.0365847

Table 4-14: ANN accuracy in forecasting recommendation service

We see a marked degradation in accuracy of the prediction for the high-priced car with relative to the low-priced car. We analyzed the reason for this degradation. ANN training relies on several aspects such as training duration and the data sample size. The other aspects that could cause this reduction in accuracy could be the need for more parameters. We use the same set of behavioral parameters for the low-priced and high-priced car studies. To make more accurate predictions for the high-priced car, we might need more behavioral parameters. To confirm this aspect, we conducted a post-hoc analysis where we re-conducted the experiment and gathered responses with 200 participants for the high-priced car experiment. None of those participants has responded previously to another of our experiments. We specifically studied the recommendation service for the high-priced car with 200 more participants. The ANN was trained with 320 training data

and 80 test data. We had five different sets of training and test data and report the result with the highest RMSE.

In Table 4-15, we present the results for the high-priced car experiment for forecasting the recommendation service. For clarity of comparison, we present the result from a sample of 200 participants (presented previously) and a sample of 400 participants.

Recommendation service - high-priced car	Forecasting Parameters				p-value	
Total sample size	RMSE (training)	RMSE (test)	Prediction accuracy (training)	Prediction accuracy (test)	test vs training	Test vs coin toss
200	0.11	0.29	88.125%	62.5%	0.99999	0.0001
400	0.26	0.35	84.6875%	58.75%	0.99999	0.0001

Table 4-15: ANN accuracy for post-hoc analysis of recommendation service

Based on this post-hoc study, we conclude that there is further degradation in the prediction of the ANN. This analysis confirms that the prediction ability was not affected by the size of the sample. However, we can infer that the study involving a high-priced car requires more behavioral parameters to improve prediction accuracy.

4.5 Conclusion

We studied customers' buying process and developed a conceptual model to determine customers' expectation. Using this model as a guide, we gathered customer behavioral analytics on various preferences that the customers selected during the online car buying process. We introduced five services—maintenance, financing, insurance, carbon footprint management and a recommendation service—,and studied their influence on satisfaction. We tested whether an ANN is more accurate than a regression method for forecasting customer expectations. Finally, we use behavioral analytics to forecast nine parameters. We forecast two parameters, weight and rank, for the maintenance, financing, insurance and carbon footprint management services. We also forecast the particular customer response to the recommendation service.

4.5.1 Managerial Implications

Abundant research literature examines the causes and effects of transitions of good-centric organizations to solution driven. However, most research focuses on the reasons that lead companies to undergo such transformations (Lightfoot et al. 2013, Oliva and Kallenberg 2003), capability development for such transitions (Paiola et al. 2013, Bjurklo et al. 2009) or the financial and performance implications of such transitions (Visnjic et al. 2014, Kastalli and Van Looy 2013, Gebauer et al. 2012). Limited research guides management on how to undergo such transitions. Given the dynamic and competitive business environment, organizations have to continuously add services to their portfolio to satisfy customer needs. This process of adding services is seen as an end-result of a business change process and not the change itself (Steiner et al. 2016). It is hence important for managers to rethink the process of business model transformation by using services as the catalyst, and not as the end result.

In our research, we present a model of a customized dynamic service addition strategy that is supported by behavioral analytics. Managers previously used regression approaches to define service packages that could best fit a user profile. This degree of resolution took into consideration salient features such as demographics to classify users into groups. By comparing the regression and ANN results, we demonstrate that such approaches were more likely to miss a user preference. We built a model to capture the user behavior, and used this behavioral data to predict users' service portfolio preferences.

We introduced one tightly coupled service (maintenance) and three loosely coupled services (insurance, financing and carbon footprint management) and used an ANN to derive the service design strategy for managers. The customized rank prediction for each customer provides information to decide the order of the services, while the weight estimation guides the organizational resource allocation mechanism. To dynamically change the service delivery mechanism, we also provide guidance to the web system on the user's satisfaction with the car recommendation service .

In the past, managers have relied on static models to influence customers. We demonstrate how a model based on theory l can be used to collect customer behavioral analytics. We

then use these behavioral analytics to train neural networks to support the dynamic service infusion mechanism. We thus develop a model where services can catalyse the business model transformation rather than deriving the service configuration after the business model transformation.

4.5.2 Research Limitations

This research demonstrated new avenues for managers regarding dynamic service design. However, it has some limitations. The study was carefully designed to invite participants who had prior experience in searching cars online or were open to buying online. In studies where participants receive compensation, some questions might be perceived as qualifiers, and respondents tend to select safe answers (Downs et al. 2010). We however minimize this risk by not specifically identifying the qualifier question and explicitly stating that all completed surveys (completed in more than 12 minutes but less than 2 hours) would be accepted. Another limitation are the types of cars that we introduce in the study. We do not have an avenue to determine whether there is a pre-existing bias for these brands of car. This could affect the customer responses. This limitation could also affect the recommendation service that we introduce in the experiment.

In our study, we used the same set of behavioral variables for the low-priced and high-priced cars. We observe that the estimations for the service enhancing the delivery system are not as accurate for the high-priced car as they are for the low priced car. Although this could also be seen as a research finding, we conclude that for higher value products, more behavioral variables should be introduced.

4.5.3 Future research

This study collected behavioral data in the form of user responses to the different options in a survey model. We plan to extend this research to study the behavioral aspects of a customer in a real environment where this information is setup as a web system and user responses can be collected and analyzed in real time. The current setup could not study implicit feedback such as mouse movements and click patterns. Studies have statically predicted user intent using such implicit inputs (Martín-Albo et al. 2016). Coupling these

implicit behavioral data with the explicit behavioral data, we plan to make this model more robust and accurate.

Deep machine learning process could also be done when there is considerable implicit data along with the explicit data. This would ensure that the ANN predictions are not bound by the input variable selection and more behavioral parameters can be identified which could help in theory advancement. However, we firmly believe that ANN is not a substitute for the theory development process, but a tool to support it. Hence, all such initiatives should be based on prior theory.

References

Abdou, H. A. & Pointon, J. 2011. 'Credit scoring, statistical techniques and evaluation criteria: a review of the literature.' *Intelligent Systems in Accounting, Finance and Management,* 18:2-3, 59-88.

Adomavicius, G., Bockstedt, J. & Curley, S. P. 2015. 'Bundling Effects on Variety Seeking for Digital Information Goods.' *Journal of Management Information Systems,* 31:4, 182-212.

Arnould, E. J. & Price, L. L. 1993. 'River magic: extraordinary experience and the extended service encounter.' *Journal of consumer Research*, 24-45.

Baines, T. S., Lightfoot, H. W., Benedettini, O. & Kay, J. M. 2009. 'The servitization of manufacturing: a review of literature and reflection on future challenges.' *Journal of Manufacturing Technology Management,* 20:5, 547-67.

Berinsky, A. J., Huber, G. A. & Lenz, G. S. 2012. 'Evaluating online labor markets for experimental research: Amazon. com's Mechanical Turk.' *Political Analysis,* 20:3, 351-68.

Bjurklo, M., Edvardsson, B. & Gebauer, H. 2009. 'The role of competence in initiating the transition from products to service.' *Managing Service Quality: An International Journal,* 19:5, 493-510.

Bryson, J. R. & Daniels, P. W. 2010. 'Service Worldsservice worlds.' *Handbook of Service Science:* 79-104. Springer.

Casler, K., Bickel, L. & Hackett, E. 2013. 'Separate but equal? A comparison of participants and data gathered via Amazon's MTurk, social media, and face-to-face behavioral testing.' *Computers in Human Behavior,* 29:6, 2156-60.

Chan, G., Cheung, C., Kwong, T., Limayem, M. & Zhu, L. 2003. 'Online consumer behavior: a review and agenda for future research.' *BLED 2003 Proceedings*, 43.

Chen, H., Chiang, R. H. & Storey, V. C. 2012. 'Business Intelligence and Analytics: From Big Data to Big Impact.' *MIS quarterly,* 36:4, 1165-88.

Clark, A., Oswald, A. & Warr, P. 1996. 'Is job satisfaction U-shaped in age?' *Journal of occupational and organizational psychology,* 69:1, 57-81.

Constantinides, E. 2004. 'Influencing the online consumer's behavior: the Web experience.' *Internet research,* 14:2, 111-26.

Coombs, C. H. & Avrunin, G. S. 1977. 'Single-peaked functions and the theory of preference.' *Psychological review,* 84:2, 216.

Cox III, E. P. 1980. 'The optimal number of response alternatives for a scale: A review.' *Journal of Marketing Research*, 407-22.

CRR 2015. 'Online Retailing in Europe,   the U.S. and Canada 2015-2016.' *Online Retailing in Europe,   the U.S. and Canada 2015-2016:* 24. Nottingham, UK: Centre for Retail Research Limited.

De Backer, K., Desnoyers-James, I. & Moussiegt, L. 2015. "Manufacturing or Services-That is (not) the Question'.' *OECD Science,* Technology and Industry

Policy Papers No. 19.

Dixon, M. & Verma, R. 2013. 'Sequence effects in service bundles: Implications for service design and scheduling.' *Journal of Operations Management,* 31:3, 138-52.

Dixon, M. J. & Walsman, M. C. 2014. 'Using Behavioral Research to Design Better Customer Experiences.' *Cornell Hospitality Quarterly,* 55:3, 221-27.

Dotzel, T., Shankar, V. & Berry, L. L. 2013. 'Service innovativeness and firm value.' *Journal of Marketing Research,* 50:2, 259-76.

Downs, J. S., Holbrook, M. B., Sheng, S. & Cranor, L. F. 2010. 'Are your participants gaming the system?: screening mechanical turk workers.' Paper presented at Proceedings of the SIGCHI Conference on Human Factors in Computing Systems.

Fanning, K. M. & Cogger, K. O. 1998. 'Neural network detection of management fraud using published financial data.' *International Journal of Intelligent Systems in Accounting, Finance & Management,* 7:1, 21-41.

Forkmann, S., Ramos, C., Henneberg, S. C. & Naudé, P. 2016. 'Understanding the service infusion process as a business model reconfiguration.' *Industrial Marketing Management*.

Gebauer, H., Ren, G.-J., Valtakoski, A. & Reynoso, J. 2012. 'Service-driven manufacturing: provision, evolution and financial impact of services in industrial firms.' *Journal of service Management,* 23:1, 120-36.

Gorr, W. L., Nagin, D. & Szczypula, J. 1994. 'Comparative study of artificial neural network and statistical models for predicting student grade point averages.' *International Journal of Forecasting,* 10:1, 17-34.

Hagan, M. T., Demuth, H. B., Beale, M. H. & De Jesús, O. 1996. *Neural network design.* PWS publishing company Boston.

Hauser, D. J. & Schwarz, N. 2015. 'Attentive Turkers: MTurk participants perform better on online attention checks than do subject pool participants.' *Behavior research methods*, 1-8.

Haykin, S. & Network, N. 2004. 'A comprehensive foundation.' *Neural Networks,* 2:2004.

Jain, B. A. & Nag, B. N. 1997. 'Performance evaluation of neural network decision models.' *Journal of Management Information Systems,* 14:2, 201-16.

Kastalli, I. V. & Van Looy, B. 2013. 'Servitization: Disentangling the impact of service business model innovation on manufacturing firm performance.' *Journal of Operations Management,* 31:4, 169-80.

Koren, Y., Bell, R. & Volinsky, C. 2009. 'Matrix factorization techniques for recommender systems.' *Computer*:8, 30-37.

Kotler, P. & Keller, K. 2003. 'Marketing Management, (international version).' Prentice Hall, Englewood Cliffs, NJ.

Kotri, A. & Mourey, J. 2011. 'Identifying customer value in emerging markets via conjoint analysis: a case study of an Estonian packaging company.' *International Journal of Business and Emerging Markets,* 4:1, 49-68.

Kowalkowski, C., Kindström, D., Alejandro, T. B., Brege, S. & Biggemann, S. 2012. 'Service infusion as agile incrementalism in action.' *Journal of Business Research,* 65:6, 765-72.

Leventhal, R. C., Mascarenhas, O. A., Kesavan, R. & Bernacchi, M. 2006. 'Lasting customer loyalty: a total customer experience approach.' *Journal of Consumer Marketing,* 23:7, 397-405.

Lightfoot, H., Baines, T. & Smart, P. 2013. 'The servitization of manufacturing: A systematic literature review of interdependent trends.' *International Journal of Operations & Production Management,* 33:11/12, 1408-34.

Lopes, N. 2012. 'Multiple Back-Propagation.' Sourceforge.

Martín-Albo, D., Leiva, L. A., Huang, J. & Plamondon, R. 2016. 'Strokes of insight: User intent detection and kinematic compression of mouse cursor trails.' *Information Processing & Management*.

Matzler, K. & Hinterhuber, H. H. 1998. 'How to make product development projects more successful by integrating Kano's model of customer satisfaction into quality function deployment.' *Technovation,* 18:1, 25-38.

McQuilken, L., Robertson, N., Polonsky, M. & Harrison, P. 2015. 'Consumer perceptions of bundles and time-limited promotion deals: Do contracts matter?' *Journal of Consumer Behaviour,* 14:3, 145-57.

Oliva, R. & Kallenberg, R. 2003. 'Managing the transition from products to services.' *International Journal of Service Industry Management,* 14:2, 160-72.

Oppenheimer, D. M., Meyvis, T. & Davidenko, N. 2009. 'Instructional manipulation checks: Detecting satisficing to increase statistical power.' *Journal of Experimental Social Psychology,* 45:4, 867-72.

Paiola, M., Saccani, N., Perona, M. & Gebauer, H. 2013. 'Moving from products to solutions: Strategic approaches for developing capabilities.' *European Management Journal,* 31:4, 390-409.

Paolacci, G. & Chandler, J. 2014. 'Inside the turk understanding mechanical turk as a participant pool.' *Current Directions in Psychological Science,* 23:3, 184-88.

Pine, B. J. & Gilmore, J. H. 1998. 'Welcome to the experience economy.' *Harvard business review,* 76, 97-105.

Pullman, M. E. & Moore, W. L. 1999. 'Optimal service design: integrating marketing and operations perspectives.' *International Journal of Service Industry Management,* 10:2, 239-61.

RadiumOne 2016. 'RadiumOne.' https://radiumone.com/: RadiumOne Ins.

Sawhney, Balasubramanian & Krishnan 2004. ' Creating growth with services.' *MIT Sloan management review*.

Setiono, R. & Thong, J. Y. 2004. 'An approach to generate rules from neural networks for regression problems.' *European Journal of Operational Research,* 155:1, 239-50.

Spreng, R. A., Harrell, G. D. & Mackoy, R. D. 1995. 'Service recovery: impact on satisfaction and intentions.' *Journal of Services marketing,* 9:1, 15-23.

Steiner, M., Eggert, A., Ulaga, W. & Backhaus, K. 2016. 'Do customized service packages impede value capture in industrial markets?' *Journal of the Academy of marketing Science,* 44:2, 151-65.

Swamidass, P. M. & Newell, W. T. 1987. 'Manufacturing strategy, environmental uncertainty and performance: a path analytic model.' *Management Science,* 33:4, 509-24.

Van Dijk, G., Minocha, S. & Laing, A. 2007. 'Consumers, channels and communication: Online and offline communication in service consumption.' *Interacting with computers,* 19:1, 7-19.

Vandermerwe, S. & Rada, J. 1988. 'Servitization of business: adding value by adding services.' *European Management Journal,* 6:4, 314-24.

Verma, R., Thompson, G. M., Moore, W. L. & Louviere, J. J. 2001. 'Effective Design of Products/Services: An Approach Based on Integration of Marketing and Operations Management Decisions*.' *Decision Sciences,* 32:1, 165-94.

Visnjic, I., Wiengarten, F. & Neely, A. 2014. 'Only the Brave: Product Innovation, Service Business Model Innovation, and Their Impact on Performance.' *Journal of Product Innovation Management*.

Wilson, H. R. & Cowan, J. D. 1972. 'Excitatory and inhibitory interactions in localized populations of model neurons.' *Biophysical journal,* 12:1, 1.

Wong, B. K., Bodnovich, T. A. & Selvi, Y. 1997. 'Neural network applications in business: A review and analysis of the literature (1988–1995).' *Decision Support Systems,* 19:4, 301-20.

Conclusions

This thesis studied the servitization phenomenon to assist manager decision making in the servitization process. This normative approach required us to study the current state-of-the-art and influencers of servitization, and then use tools to support choices that managers face during transitioning from a good-centric mindset to a solution-centric mindset. Instead of directly delving into the know-how aspect of servitization, the thesis first addressed the know-what and know-why aspects of servitization. This is one of the major contributions of the thesis.

The first essay analyzed the servitization literature through an operations management lens. The study is divided into two parts to identify the "know-what" about servitization. The first part analyzed the trends in literature while the second part iteratively abstracted the theory constructs in the literature to present an evolving theory set in servitization.

The trends in the literature were analyzed by iteratively developing a coding framework. Servitization articles were coded based on the theoretical constructs in the framework. This coding process was followed by a summative analysis where we holistically studied the current trends in the external environment, organizational strategy, organizational parameters and outcomes of the servitization phenomenon. We also coded for the methodology, service type and journal types. The trends in the literature present a diffusion of servitization across disciplines, yet at a very descriptive stage of theory development. Future research can use these findings to focus on areas that need further development.

Abstraction of the theoretical constructs in servitization literature was done using the principles of grounded theory. A process-based approach was followed to study the underpinnings of organizational configurations before, during and after the servitization process for different strategic orientations. Several avenues where theories are not adequately developed were identified and highlighted for future research. The abstracted theories can also serve as inputs for future confirmatory research.

Our study of the "know-why" of servitization is presented in the second essay. We used the strategic orientation construct from the first essay to hypothesize that the strategic orientation interacts significantly with the influencers of servitization. Studies of the on servitization antecedent effect have postulated conflicting results. Using our strategic typology, we demonstrate a difference in influencers' effect on servitization intensity. This is the major contribution of our article. We also prescribe future research to consider the strategic orientation of the organization to better explain the servitization phenomenon..

Finally, in the third essay, we provided the managers with a "know-how" on servitization. Using the online purchase of a high-net-worth good as an example, we developed a method that could enable service infusion influence the customers' purchasing decisions. We use customers' behavioral analytics to train an ANN to accurately predict customer preferences. These preferences can be dynamically injected in the system during the interaction process, thereby using services to catalyze the transformation process. We also demonstrate that as the product's value increases, the number of parameters for behavioral analytics should be increased for better accuracy.

On post reflection, we see that our approach is coherent with the ***Carnegie school decision model*** or ***Praxeology*** proposed by Ludwig von Mises for studying organizational behavior. This philosophy has three founding premises; understanding of the organizational processes, studying the decision making process and finally reconciling the individual and organizational goals by economic, social and political mechanisms (Gavetti et al. 2007).

Our first objective was to understand the organizational process for undergoing servitization. We thus studied the literature to identify the different trends in servitization. Our second objective was to study the decision making process. Several prior studies have presented conflicting information on the servitization transition process. We present a new typology to clearly explain the main influencers in a servitization transition process. Lastly, to reconcile the organization and individual objectives, we explain how companies can undergo this business model transformation. Most reconciliations in the literature are

done as an after-effect of the servitization process; dynamic strategies to reconcile and undergo the business model transformation are scant. We conducted an experiment in which, we collected behavioral analytics with which we trained an ANN to assist in the reconciliation of objectives.

In conclusion, we believe this thesis contributes to the literature on the servitization phenomenon. The use of diverse methodologies has enabled us to answer "what", "why" and "how" questions linked to the servitization phenomenon and has provided managers with tools to undergo this business model transformation.

Reference

Gavetti, G., Levinthal, D. & Ocasio, W. 2007. 'Perspective-Neo-Carnegie: The Carnegie School's Past, Present, and Reconstructing for the Future.' Organization science, 18:3, 523-36.

Appendix

Appendix 2.A: Search String Construction

- The search string was a composed of three searches components linked by OR function of article titles and abstracts
    - **Search component 1**
        - "Servitization" OR "Servicisation" OR "Service Infusion" OR" integrated solutions"
    - **Search Component 2**
        - Service*

            AND (using one or more strings)

            - Service strategy
            - Service orientation
            - New service development
            - Service operations management
            - Service operations
            - After-sales service
            - Integrated solutions
            - Customer service management
            - Product-service systems
            - Customer solutions
            - Product service bundle*
            - Manufactur*
            - Manufacturing company*
            - Manufacturing industr*
            - Product manufacturing
            - Product management
            - Production management
    - **Search Component 3**
        - manufacturing

            AND

            - sustainability
            - servicing
            - Quick delivery services
            - Design and engineering services
            - service delivery
            - Customer focus

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Appendix 2.B: Explanation of Contextual Parameters

Parameter name	Explanation
Year of Publication	The year of publication as identified in the reference
Name of Journal in which article is published	The journal publishing the article. Journals (if any) which had name changes would have been recorded as two different entries
Research Methodology- Case	Articles that are either a single case or multiple case
Research Methodology- Pure theory	Articles that are theoretical discussions and either propose a concept or a model
Research Methodology- Quantitative	Articles that use secondary or primary data to conduct statistical analysis for theory testing and validation. This group does not take into consideration the Operational Research articles
Research Methodology- Model	Articles that develop a model and use mathematical technique to validate, optimize or demonstrate a phenomenon.

Service Type- Tightly Coupled	Services that are tightly related to the core product. e.g. maintenance, support
Service Type- Loosely Coupled	Services that are complementary to the core product e.g. Financing

Appendix 2.C: Explanation of Parameters in Each Factor

External environment	
Market entry	Organization intends to enter into a new market space (global market is not recorded in this aspect)
Globalization	Organizations intends to enter into global market
Shrinking or dynamic market	Organizations face challenge because their current markets are dynamic in nature or the market is reducing in size.
Competitive environment	Organizations are facing stiffer competition
Compliance to regulations	Organizations have to comply to government regulations such as green certifications
Producer centric strategy	Organizations where the main objective to servitize is to either increase profits or differentiate from competitors
Customer centric strategy	Organizations where the main objective to servitize is to provide value to customers or have a solution based approach
Dyadic strategy	Organizations where the main objective to servitize is to provide customer experience or conduct joint solution development

	Organizational factors
Company experience	The organization's servitization process is affected because of their experience in the industry or market
Product innovation	The organization's servitization process is affected because their products have great deal of innovation
Leadership	The organization's servitization process is affected because of their upper management
Sales and marketing	The organization's servitization process is affected because of their sales and marketing team orientation
HR and culture	The organization's servitization process is affected because of their culture and human resources
IT	The organization's servitization process is affected because of their IT infrastructure or technology adoption
Product or service design	The organization's servitization process is affected because of the design of their product and service offering
Network of partners	The organization's servitization process is affected because of their connectivity to their upstream and downstream partners
Organizational structure	The organization's servitization process is affected because of their structure
Service delivery	The organization's servitization process is affected because of their service delivery mechanisms

Service ratio	The organization's servitization process is affected because of their current product to service ratio

Outcomes	
Profits	Organizations that report a change in profitability because of servitization
Increased market share	Organizations that report change in their current market share because of servitization
Service quality	Organizations that report a change in the quality of their service offering because of servitization
Customer loyalty	Organizations that report a change in customer loyalty because of servitization
Customer satisfaction	Organizations that report a change in their customer satisfaction because of servitization
ROI	Organizations that report a change in their ROI because of servitization
Customer retention	Organizations that report a change in their customer retention because of servitization
Quality of life of users	Organizations that report a change in the quality of life of their customer because of servitization
Solution completeness	Organizations that report a change in their customer's perception of the completeness of the offering because of servitization

Innovativeness	Organizations that report a change in a degree of innovation because of servitization

Note:

- All factors that were coded at least had a short discussion in the articles.

Appendix 4.A : Low Priced Car Survey

SECTION 1

Assume that you are visiting a reputed website like http://www.autotrader.com which sells used cars. You have a good credit history to be able to finance the car. Assume that you are a safe driver and do not have a problem insuring the car. The website is in the form search engine where you enter or select options. The website is safe and will not gather personal information and all your entries are anonymous

1.1 How old are you ?

❍ Under 25 years
❍ 25-34 Years
❍ 35-44 Years
❍ 45-54 Years
❍ 55+ Years

1.2 You are a

❍ Male
❍ Female
❍ Prefer not to be identified

1.3 Your Annual Household Income is

❍ less than $10,000
❍ $10,000 to $19,999
❍ $20,000 - $29,999
❍ $30,000-$39,999
❍ $40,000-$49,999
❍ $50,000-$59,999
❍ $60,000-$69,999
❍ $70,000-$79,999
❍ $80,000-$89,999
❍ $90,000-$99,999
❍ $100,000+

1.4 How much time on a weekly basis do you spend on the Internet?

○ Less than 10 hours
○ Between 10 to 19 hours
○ Between 20 to 40 hours
○ More than 40 hours

1.5 In your opinion, what is a mobile app (Click all that apply)

❑ A mobile website
❑ Not a website but an application
❑ Something that you use to buy goods
❑ Not sure

1.6 How many cars have you owned till date?

○ None
○ 1
○ 2
○ 3
○ 4
○ 5 or more

1.7 Have you researched or bought cars online?

○ Yes
○ No, but open to it
○ Do not select this answer
○ Will never consider it

1.8 What is the highest level of education that you have completed?

○ Junior High School
○ High School diploma
○ Some College degree
○ Bachelor's degree
○ Master's degree
○ Teminal/PhD degree

1.7 What is your ethnicity?

❍ African American
❍ Asian
❍ Caucasian
❍ Hispanic
❍ Native American
❍ More than one race / Other

Assume that you are visiting a reputed website like http://www.autotrader.com which sells used car. You have a good credit history to be able to finance the car. Assume that you are a safe driver and do not have a problem insuring the car. The website is in the form of a search engine. You can enter one or more items in your search criteria (Price Range or Car Specifics) .The search screen opens up as follows

2.1 Answer the following based on you search choices

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
You will search with the brand name (Like Honda, Toyota Pontiac, etc..)	○	○	○	○	○	○	○
You will search with the model (Like Civic, Corolla, Sunfire etc.)	○	○	○	○	○	○	○
The system never asks you for your ZIP code	○	○	○	○	○	○	○
You will enter the maximum price	○	○	○	○	○	○	○
You will search with more search items	○	○	○	○	○	○	○

On clicking "want more search items" the following screen appears. You can select one or more options. For options where you do not select any item the search will give you all the choices.

2.2 Answer the following based on the advanced search options

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
You had selected that you did not need more search items	○	○	○	○	○	○	○
These items are important for your search	○	○	○	○	○	○	○
You will use these options for your search	○	○	○	○	○	○	○
You need even more options	○	○	○	○	○	○	○

2.3 Rank the items based on how you consider it to be important. The top priority will have a rank 1 followed by 2 and so on. You have to rank 8 items. you can move the items by clicking and moving them.

_____ Manufacturer of the car (Like Honda, Toyota Pontiac, etc..)
_____ Style of the car (Like Compact, sedan, SUV, Sports Car, Convertible etc.)
_____ Year of Manufacturing of the car
_____ Mileage of the car
_____ Fuel Economy
_____ Transmission of the car
_____ Price of the Car
_____ Rank this option as one

Assume that you are looking for a Honda Civic or a Toyota Corolla and you have a budget of $18000   Assume that you are looking for a car that was manufactured in 2013 and after   Assume that you are looking for a car that has a mileage less than 50,000 miles   YOUR SEARCH RESULTS IN THE FOLLOWING 8 CARS (For space limitations we are showing you listings for just 8 cars)

USED CERTIFIED HONDA CIVIC

Price: $18,000
Year: 2015
Mileage: 22,584

New car in 2015 would cost :
$22,000

Color:

USED HONDA CIVIC

Price: $16,900
Year: 2013
Mileage: 25,584

New car in 2013 would cost :
$21,000

Color:

USED CERTIFIED HONDA CIVIC

Price: $13,200
Year: 2013
Mileage: 38,293

New car in 2013 would cost :
$21,000

Color:

USED CERTIFIED HONDA CIVIC

Price: $9999
Year: 2013
Mileage: 48,678

New car in 2013 would cost :
$21,000

Color:

USED CERTIFIED TOYOTA COROLLA

Price: $17,989
Year: 2015
Mileage: 21,611

New car in 2015 would cost :
$22,100

Color:

USED CERTIFIED TOYOTA COROLLA

Price: $17,200
Year: 2014
Mileage: 24,611

New car in 2014 would cost :
$21,900

Color:

USED TOYOTA COROLLA

Price: $11,999
Year: 2013
Mileage: 42,011

New car in 2013 would cost :
$21,500

Color:

USED CERTIFIED TOYOTA COROLLA

Price: $10,232
Year: 2014
Mileage: 49,019

New car in 2014 would cost :
$21,900

Color:

150

3.1 Based on these search results, select the following options

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
You are happy with the search	○	○	○	○	○	○	○
You will choose to see and buy one of these cars (if everything is OK)	○	○	○	○	○	○	○
You will look for more options	○	○	○	○	○	○	○
You will abandon your search and quit	○	○	○	○	○	○	○
You will recommend this search to others	○	○	○	○	○	○	○
You will use this search for future purchases	○	○	○	○	○	○	○

Following the search results you will have the option to see some extra information. You will get a screen as follows. You can select one or more options

When you select Comparative maintenance costs for 3 years. You get the following screen (just 2 results shown to minimize space utilization)

When you select Comparative Insurance costs based on your ZIP CODE (Annual premium)You get the following screen (just 2 results shown to minimize space utilization)

USED CERTIFIED HONDA CIVIC	USED CERTIFIED TOYOTA COROLLA
Price: $18,000 Year: 2015 Mileage: 22,584 Color:	Price: $17,989 Year: 2015 Mileage: 21,611 Color:
Insurance Premium for a year = $2200	Insurance Premium for a year = $2100

When you select Comparative Financing costs (assuming you have a good score)You get the following screen (just 2 results shown to minimize space utilization)

USED CERTIFIED HONDA CIVIC	USED CERTIFIED TOYOTA COROLLA
Price: $18,000 Year: 2015 Mileage: 22,584 Color:	Price: $17,989 Year: 2015 Mileage: 21,611 Color:
Financing rate (7 year term) = 3.26%	Financing rate (7 year term) = 3.5%
Monthly Payment = $239.95	Monthly Payment = $241.76

When you select to manage your Carbon Footprint. You get the following screen

SERVICE TO MANAGE YOUR CARBON FOOTPRINT

SERVICE PRICE: $12 per month
SERVICE FEATURES:
    Carbon Footprint summary
    Engine tune-up alert
    Oil Change Alert
    Using your GPS analytics to suggest best times to leave and return from work
Bonus: Free Oil Change (1 per year)   [A value of $49.99]

4.1 Based on this extra information and service provided by the system, answer the following

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Are you satisfied by the extra information	O	O	O	O	O	O	O
Will you recommend others to choose the extra information option?	O	O	O	O	O	O	O
Next time, will you click on this extra information option?	O	O	O	O	O	O	O

4.2 Based on these screens, answer the following questions

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
You consider the maintenance information useful	○	○	○	○	○	○	○
The maintenance cost of Honda is cheaper than Toyota in the given data	○	○	○	○	○	○	○
You consider the insurance information useful	○	○	○	○	○	○	○
You consider the financing information useful	○	○	○	○	○	○	○
None of the information is useful	○	○	○	○	○	○	○
Your buying decision is not influenced by these information	○	○	○	○	○	○	○
You consider the Carbon footprint management service useful	○	○	○	○	○	○	○

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4.3 Rank the extra information based on your preference. For the information that you consider most important rank it to 1

_____ Information about Maintenance costs of the car
_____ Information about Insurance Costs of the car
_____ Do not rank under 1
_____ Information about Financing Costs of the car
_____ Carbon Footprint management service

4.4 Suppose you had to distribute 100 points between the 4 extra information. You can assign based on how important each group is. Assignments can be of any format, however if you consider any information of no use assign 0 to it.A total of 100 points have to be achieved.

_____ Information about Maintenance costs of the car
_____ Information about Insurance Costs of the car
_____ Information about Financing Costs of the car
_____ Carbon Footprint management service

Suppose you complete the search and have decided to look for one of the cars selected from the list, the system gives you the following message

Based on your search parameters we have a recommendation for a different brand at the same price

Click to see our recommendation

On clicking the recommendation button, you will see the following information

This recommendation is based on the fact that: You are looking for a Honda Civic or a Toyota Corolla and you have a budget of $18000   You are looking for a car that was manufactured in 2013 and after You are looking for a car that has a mileage less than 50,000 miles You are looking for a car within 50 miles from you   Assume from the search you selected a Toyota Corolla 2015 with a mileage of 21,611   The base price of the car is : $17,989 The 3 year maintenance will cost you : $3000 The insurance will cost you : $2100 The financing @3.5 APR : $241.76 Monthly

5.1 Following this recommendation answer the following questions

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
You consider the recommendation useful	❍	❍	❍	❍	❍	❍	❍
Your buying decision is influenced by this recommendation	❍	❍	❍	❍	❍	❍	❍
You will choose the recommendation	❍	❍	❍	❍	❍	❍	❍
You will NOT click on the recommendation link	❍	❍	❍	❍	❍	❍	❍

5.2 Based on your complete buying experience that include the search, extra services and recommendation , answer the following

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Are you satisfied by the complete buying experience?	○	○	○	○	○	○	○
Will you recommend this to others?	○	○	○	○	○	○	○
Will you come back for choosing your next car?	○	○	○	○	○	○	○

6.1 Comment on your feelings following the survey

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
The questions are clear	❍	❍	❍	❍	❍	❍	❍
The survey is long and boring	❍	❍	❍	❍	❍	❍	❍
I will never select any option that has agree if I am reading properly	❍	❍	❍	❍	❍	❍	❍
You understand the objective of the survey	❍	❍	❍	❍	❍	❍	❍

6.2 According to you what is the purpose of the survey (min 50 characters)

Appendix 4.B : High Priced Car Survey

SECTION 1

Assume that you are visiting a reputed website like http://www.autotrader.com which sells used cars.You have a good credit history to be able to finance the car. Assume that you are a safe driver and do not have a problem insuring the car. The website is in the form search engine where you enter or select optionsThe website is safe and will not gather personal information and all your entries are anonymous

1.1 How old are you ?
- ❍ Under 25 years
- ❍ 25-34 Years
- ❍ 35-44 Years
- ❍ 45-54 Years
- ❍ 55+ Years

1.2 You are a
- ❍ Male
- ❍ Female
- ❍ Prefer not to be identified

1.3 Your Annual Household Income is
- ❍ less than $10,000
- ❍ $10,000 to $19,999
- ❍ $20,000 - $29,999
- ❍ $30,000-$39,999
- ❍ $40,000-$49,999
- ❍ $50,000-$59,999
- ❍ $60,000-$69,999
- ❍ $70,000-$79,999
- ❍ $80,000-$89,999
- ❍ $90,000-$99,999
- ❍ $100,000+

1.4 How much time on a weekly basis do you spend on the Internet?
- ❍ Less than 10 hours
- ❍ Between 10 to 19 hours
- ❍ Between 20 to 40 hours
- ❍ More than 40 hours

1.5 In your opinion, what is a mobile app (Click all that apply)
- ❑ A mobile website
- ❑ Not a website but an application
- ❑ Something that you use to buy goods
- ❑ Not sure

1.6 How many cars have you owned till date?
- ○ None
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5 or more

1.7 Have you researched or bought cars online?
- ○ Yes
- ○ No, but open to it
- ○ Do not select this answer
- ○ Will never consider it

1.8 What is the highest level of education that you have completed?
- ○ Junior High School
- ○ High School diploma
- ○ Some College degree
- ○ Bachelor's degree
- ○ Master's degree
- ○ Teminal/PhD degree

1.7 What is your ethnicity?
- ○ African American
- ○ Asian
- ○ Caucasian
- ○ Hispanic
- ○ Native American
- ○ More than one race / Other

Assume that you are visiting a reputed website like http://www.autotrader.com which sells used car.You have a good credit history to be able to finance the car. Assume that you are a safe driver and do not have a problem insuring the car. The website is in the form of a search engine. You can enter one or more items in your search criteria (Price Range or Car Specifics) .The search screen opens up as follows

2.1 Answer the following based on you search choices

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
You will search with the brand name (Like BMW, Audi, etc..)	○	○	○	○	○	○	○
You will search with the model (Like Civic, Corolla, Sunfire etc.)	○	○	○	○	○	○	○
The system never asks you for your ZIP code	○	○	○	○	○	○	○
You will enter the maximum price	○	○	○	○	○	○	○
You will search with more search items	○	○	○	○	○	○	○

On clicking "want more search items" the following screen appears. You can select one or more options. For options where you do not select any item the search will give you all the choices.

2.2 Answer the following based on the advanced search options

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
You had selected that you did not need more search items	❍	❍	❍	❍	❍	❍	❍
These items are important for your search	❍	❍	❍	❍	❍	❍	❍
You will use these options for your search	❍	❍	❍	❍	❍	❍	❍
You need even more options	❍	❍	❍	❍	❍	❍	❍

2.3 Rank the items based on how you consider it to be important. The top priority will have a rank 1 followed by 2 and so on. You have to rank 8 items. you can move the items by clicking and moving them.

_____ Manufacturer of the car (Like Honda, Toyota Pontiac, etc..)
_____ Style of the car (Like Compact, sedan, SUV, Sports Car, Convertible etc.)
_____ Year of Manufacturing of the car
_____ Mileage of the car
_____ Fuel Economy
_____ Transmission of the car
_____ Price of the Car
_____ Rank this option as one

Assume that you are looking for a BMW 5 series or an Audi A6 and you have a maximum budget of $47,000   Assume that you are looking for a car that was manufactured in 2013 and after   Assume that you are looking for a car that has a mileage less than 50,000 miles   YOUR SEARCH RESULTS IN THE FOLLOWING 8 CARS (For space limitations we are showing you listings for just 8 cars)

USED CERTIFIED BMW 5 Series

Price: $42,860
Year: 2015
Mileage: 37,584

New car in 2015 would cost :
$56,000

Color:

USED CERTIFIED AUDI A6

Price: $40,990
Year: 2014
Mileage: 41,988

New car in 2014 would cost :
$54,550

Color:

USED CERTIFIED BMW 5 Series

Price: $37,099
Year: 2013
Mileage: 48,584

New car in 2013 would cost :
$53,00

Color:

USED CERTIFIED AUDI A6

Price: $37,840
Year: 2013
Mileage: 44,611

New car in 2013 would cost :
$53,120

Color:

USED CERTIFIED BMW 5 Series

Price: $46,079
Year: 2015
Mileage: 42,309

New car in 2015 would cost :
$56,000

Color:

USED CERTIFIED AUDI A6

Price: $46,121
Year: 2015
Mileage: 47,011

New car in 2015 would cost :
$57,121

Color:

USED CERTIFIED BMW 5 Series

Price: $39,334
Year: 2013
Mileage: 48,678

New car in 2013 would cost :
$53,000

Color:

USED CERTIFIED AUDI A6

Price: $39,232
Year: 2013
Mileage: 49,019

New car in 2013 would cost :
$53.120

Color:

3.1 Based on these search results, select the following options

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
You are happy with the search results	❍	❍	❍	❍	❍	❍	❍
You will choose to see and buy one of these cars (if everything is OK)	❍	❍	❍	❍	❍	❍	❍
You will look for more options	❍	❍	❍	❍	❍	❍	❍
You will abandon your search and quit	❍	❍	❍	❍	❍	❍	❍
You will recommend this search to others	❍	❍	❍	❍	❍	❍	❍
You will use this search for future purchases	❍	❍	❍	❍	❍	❍	❍

Following the search results you will have the option to see some extra information. You will get a screen as follows. You can select one or more options

When you select Comparative maintenance costs for 3 years. You get the following screen (just 2 results shown to minimize space utilization)

When you select Comparative Insurance costs based on your ZIP CODE (Annual premium)You get the following screen (just 2 results shown to minimize space utilization)

USED CERTIFIED BMW 5 Series

Price: $42,860
Year: 2015
Mileage: 37,584
Color:

Insurance Premium for a year = $3600

USED CERTIFIED AUDI A6

Price: $40,990
Year: 2014
Mileage: 41,988
Color:

Insurance Premium for a year = $3490

When you select Comparative Financing costs (assuming you have a good score)You get the following screen (just 2 results shown to minimize space utilization)

USED CERTIFIED BMW 5 Series

Price: $42,860
Year: 2015
Mileage: 37,584
Color:

Financing rate (6 year term) = 1.9%

Monthly Payment = $630

USED CERTIFIED Audi A6

Price: $40,990
Year: 2014
Mileage: 41,988
Color:

Financing rate (6 year term) = 2.9

Monthly Payment = $621

When you select to manage your Carbon Footprint You get the following screen

SERVICE TO MANAGE YOUR CARBON FOOTPRINT

SERVICE PRICE: **$12 per month**
SERVICE FEATURES:
  Carbon Footprint summary
  Engine tune-up alert
  Oil Change Alert
  Using your GPS analytics to suggest best times to leave and return from work

Bonus: Free Oil Change (1 per year)   [A value of $49.99]

4.1 Based on this extra information and service provided by the system, answer the following

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Are you satisfied by the extra information	○	○	○	○	○	○	○
Will you recommend others to choose the extra information option?	○	○	○	○	○	○	○
Next time, will you click on this extra information option?	○	○	○	○	○	○	○

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4.2 Based on these screens, answer the following questions

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
You consider the maintenance information useful	❍	❍	❍	❍	❍	❍	❍
The maintenance cost of BMW is cheaper than Audi in the given data	❍	❍	❍	❍	❍	❍	❍
You consider the insurance information useful	❍	❍	❍	❍	❍	❍	❍
You consider the financing information useful	❍	❍	❍	❍	❍	❍	❍
None of the information is useful	❍	❍	❍	❍	❍	❍	❍
Your buying decision is not influenced by these information	❍	❍	❍	❍	❍	❍	❍
You consider the Carbon footprint management service useful	❍	❍	❍	❍	❍	❍	❍

4.3 Rank the extra information based on your preference. For the information that you consider most important rank it to 1

_____ Information about Maintenance costs of the car
_____ Information about Insurance Costs of the car
_____ Rank this as 1
_____ Information about Financing Costs of the car
_____ Carbon Footprint management service

4.4 Suppose you had to distribute 100 points between the 4 extra information. You can assign based on how important each group is. Assignments can be of any format, however if you consider any information of no use assign 0 to it.A total of 100 points have to be achieved.

_____ Information about Maintenance costs of the car
_____ Information about Insurance Costs of the car
_____ Information about Financing Costs of the car
_____ Carbon Footprint management service

Suppose you complete the search and have decided to look for one of the cars selected from the list, the system gives you the following message

Based on your search parameters we have a recommendation for a different brand at the same price

Click to see our recommendation

On clicking the recommendation button, you will see the following information

This recommendation is based on the fact that: You are looking for a BMW 5 Series or an Audi A6 and you have a budget of $47,000   You are looking for a car that was manufactured in 2013 and after You are looking for a car that has a mileage less than 50,000 miles You are looking for a car within 50 miles from you   Assume from the search you selected an Audi A6 (2015) with a mileage of 47,011   The base price of

the car is : $46,121 The 3 year maintenance will cost you : $5400 The insurance will cost you : $3490 The financing @2.9 APR for 6 years : $699 Monthly

5.1 Following this recommendation answer the following questions

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
You consider the recommendation useful	○	○	○	○	○	○	○
Your buying decision is influenced by this recommendation	○	○	○	○	○	○	○
You will choose the recommendation	○	○	○	○	○	○	○
You will NOT click on the recommendation link	○	○	○	○	○	○	○

5.2 Based on your complete buying experience that include the search, extra services and recommendation , answer the following

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
Are you satisfied by the complete buying experience?	❍	❍	❍	❍	❍	❍	❍
Will you recommend this to others?	❍	❍	❍	❍	❍	❍	❍
Will you come back for choosing your next car?	❍	❍	❍	❍	❍	❍	❍

6.1   Comment on your feelings following the survey

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
The questions are clear	❍	❍	❍	❍	❍	❍	❍
The survey is long and boring	❍	❍	❍	❍	❍	❍	❍
I will never select only options that have disagree if I am reading properly	❍	❍	❍	❍	❍	❍	❍
You understand the objective of the survey	❍	❍	❍	❍	❍	❍	❍

6.2 According to you what is the purpose of the survey (min 50 characters)