Identifying innovation opportunities emerging from technology and business trends

by

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Preface

This thesis is submitted as the prerequisite for completion of the degree of Doctor of Philosophy (PhD) at the University of Stavanger (UiS), Norway. The research has been carried out at the Department of Mechanical and Structural Engineering and Material Science, Faculty of Science and Technology. The author also spent a semester at the Technical Research Centre of Finland (VTT) at Espoo, Finland, as part of the research study. The required PhD courses were attended at UiS. The research work was funded by the Norwegian Ministry of Education.

This thesis is divided into two parts:

Part I briefly presents the introduction, summarizes the research methodology, discusses the appended papers and, finally, describes the research contributions and proposals for further work.

Part II comprises six papers, of which two are published journal papers and one is under review, while the remaining three are published conference papers.

Acknowledgements

Throughout the journey of this research work, I have received a great deal of support and assistance from various people.

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Lastly, I would like to thank my friends and family for standing beside me in all endeavours of my life.

Summary

Businesses are continuously looking for opportunities to innovate. There is a gap in the literature regarding innovation models and approaches that are systematic, practical and easy to apply. This thesis addresses this issue through investigation of the potential for identifying innovation opportunities emerging from technology and business trends and of how to evaluate ideas. Technology trends depict the evolving direction of technology; can they be used to innovate products? Inspired by ideation literature, a novel model is presented which combines technology trends with product breakdown to generate product innovation ideas. The empirical evidence suggests that the model can generate quality ideas.

Further investigation of technology trends indicated that the largest trend of the near future will be autonomation, which suggests that many products and services will be delivered in a totally autonomous way. Operations that can be standardized have a high likelihood of being autonomated in the near future. This is because sensor advancement has made it possible to install low-cost sensors on machines; these act as senses for the machine, and then the sensor data can be processed in digital algorithms to carry out fine-tuned decision-making for the machine. This enables a paradigm shift in how machines and applications are operated. The megatrend of electrification has dominated the past century, during which the leading inspiration for innovators was how to electrify industry, households, automobiles, etc. The inspiration for future innovation could likewise be how to autonomate the same. Anecdotal evidence supports this claim. A model and case study are presented in this regard.

In a similar way to technology trends, business trends are also agents of change, revealing how businesses are evolving. The largest trend observed is servitization. Companies are gradually shifting away from the traditional model of selling just products towards selling the

functionality of the products as services. The shelf life of many products has been significantly reduced, and there is stiff competition in the market. Services, on the other hand, are more sustainable. Servitization is here defined as reducing tangibility in the product. A utility-driven approach is developed, in which the products are broken down into the utility features that encourage the customer to purchase the product and barriers that prohibit the customer from purchasing the product. The model presented in the study presents options to gradually enhance utility and reduce both barriers and the overall tangibility of the product. That can assist users in transforming their products into services. Another way to servitize is to add services to a product in the form of product-service-system. Financing/ownership value added services are explored, and the changes they bring to the business model are studied. These services do not require changes to the product or technological development and can add service benefits to the product. A systematic framework is presented, in which the options can be individually evaluated, and suitable value-added service options can be selected.

Another important business trend observed is outsourcing. Start-ups and high growth companies have limited resources, and they do not have the flexibility to carry out all business activities internally. Companies tend to outsource business activities, to survive with limited resources. However, sometimes outsourcing the core activities of the business can invite competition. In this thesis, a decision tree for evaluating business activities for outsourcing purposes is presented. The decision tree assists users in evaluating those activities that can be outsourced with minimal side effects for the business.

Traditionally, ideas are screened based on subjective judgement after a brainstorming session. In this thesis, a systematic high-level idea screening tool is presented, which is useful for screening ideas in a short period of time. Six key parameters, which are producibility, problem size, market size, novelty, profit margin and business alignment, are pillars of the idea screening tool, compiled by assorting the idea

screening literature. The tool is useful for screening the ideas generated in the aforementioned models.

Together, the appended papers contribute to filling the gap in the innovation literature regarding practical guidelines to innovate businesses.

List of Appended Papers

Paper 1 Tauqeer, M. A., & Bang, K. E. (2020). A novel systematic product ideation model using technology trends. International Journal of Innovation Science.

Paper 2 Tauqeer, M. A., & Bang, K. E. (2022). The technology megatrend of autonomization: What can be standardized – can be sensorized – can be digitalized – and will be autonomized. Design Studies (under review).

Paper 3 Tauqeer, M. A., & Bang, K. E. (2018). Servitization: a model for the transformation of products into services through a utility-driven approach. Journal of Open Innovation: Technology, Market, and Complexity, 4(4), 60.

Paper 4 Tauqeer, M., & Bang, K. E. (2019). Integration of value adding services related to financing and ownership: A business model perspective. In Proceedings of the Design Society: International Conference on Engineering Design (Vol. 1, No. 1, pp. 2279-2286). Cambridge University Press.

Paper 5 Tauqeer, M. A., & Bang, K. E. (2019). Outsourcing business activities: A decision tree for systematic evaluation. In Proceedings of the International Conference on Industrial Engineering and Operations Management.

Paper 6 Tauqeer, M. A., & Bang, K. E. (2019). A tool for idea screening by assortment of existing literature. In ISPIM Conference Proceedings (pp. 1-9). The International Society for Professional Innovation Management (ISPIM).

Additional not appended papers

Paper 7 Tauqeer, M. A., & Bang, K. E. (2018). Service development models: A literature review. International Journal of Economics, Finance and Business Management Studies, 52.

Paper 8 Tauqeer, M. A., & Bang, K. E. The association among firm growth, innovations and technology segments: empirical evidence from Danish enterprises (under review).

Paper 9 Tauqeer, M. A., & Bang, K. E. Innovativeness and human resource factors that affect firm growth – A Scandinavian study (under review).

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1 Introduction

Innovation refers to the process of developing and implementing new ideas, products, services, or processes that result in significant improvements or changes to existing systems. It involves creative thinking and problem-solving using methods to develop innovative solutions to meet the needs and demands of individuals, organizations, or society as a whole.

Innovation is possible in fields such as technology, commerce, science, medicine, education, and so on. Often this involves introducing something new, such as a new product invention, a revolutionary business model, a unique approach to problem solving, or a disruptive product or service that changes industries.

As the rate of variation increases in competitive situations, innovation has become increasingly important for companies to remain competitive (Lengnick-Hall, 1992). The role of innovation within companies is changing and being brought to the forefront (Kuczmarski, 2003). The industry can benefit from better knowledge not only of how to develop and innovate in technology but also of how to innovate by building new services that are based on the technology (Lusch and Nambisan, 2015). These are increasingly important areas where existing research is not sufficient.

The objective of this research is to contribute to the knowledge in the area of innovation at a level that can be useful for both students and industry. It is aimed at complementing existing knowledge on how ideas are generated and turned into successful innovations in industry. Research work has been targeted to develop models and approaches which can be applied by students and industry.

1.1 State of the art

In order to understand how business offerings can be innovated, it is important to understand the concept of innovation. Schumpeter (1934), who is considered among the pioneers of modern-day research on innovation, defined innovation as an activity that creates economic growth which leads to human development and is a vital element for global stability. Innovation has also been attributed to an idea or practice that is novel (Rogers, 2003). According to Thompson (1965), innovation is the development of new processes, products, and services. West and Anderson (1996) extend this definition by including organization and stakeholder benefits associated with new processes, products and services.

Largely, innovations originate from technological developments; however, they cannot be attributed to technological development alone. Innovation involves applying technological development to meet market needs, offer a better quality or cheaper product or service, as well as new organizational or management structure (Ettlie and Reza, 1992).

There is no objective method for recognizing an innovation (Kahn, 2018). Some innovations are obvious to distinguish, for example blockchain, which is a totally different way to record a ledger to what was previously in practice. However, many innovations appear to mimic features from what is already known, for example digital cameras. Some argue that this is not an innovation but a slight improvement of analogue cameras, essentially using similar principles. Van de Ven (1986) has pointed out an important principal to distinguish innovations. According to Van de Ven, ideas should be considered innovations if they are perceived as original to the users despite involving imitations of other things that are known.

Innovation has many implications for mankind (Kline and Rosenberg, 2010). As innovation is an important contributor to economic growth, studying it is important (Cameron, 1996). With reference to research in

innovation, the importance of innovation for economic progress has been a prime concern and remained under scientific scrutiny for decades.

According to McKinsey, the average lifespan of companies listed in Standard & Poor's 500 (S&P 500) these days is less than 18 years; it was 61 years in 1958. McKinsey estimates that, by 2027, 75% of the businesses presently listed on the S&P 500 will have vanished (Garelli, 2016). This shortened company lifespan has made companies realize that innovation is essential for their survival. Many of the S&P 500 companies have introduced a new leadership role of chief innovation officer (CIO), which was not the practice a few years ago. Zahra and Covin (1994) and Bessant et al. (2005) have emphasized innovation as essential for an organization's survival.

Innovation is not restricted to businesses alone but has significance for all kinds of organizations (Edquist, 2010). Today, universities are judged not only on the traditional indicators (Fritsch and Slavtchev, 2007) like research impact and disciplines offered etc., but also on the number of innovations they produce in the form of student start-ups and technology transfers.

There are two major dimensions to innovation: innovation culture and innovation process. Innovation culture is applied at a higher level of the organization (Linke and Zerfass, 2011), where the appropriate innovation methods and factors are introduced to promote innovation. Innovation culture refers to setting up values and practices that can stimulate innovative culture. Popular practices and methods are summarized in Table 1. For example, to change people's mindset, workshops and training sessions on innovation are adopted by the organization. In some organizations, employees' innovation is rewarded (Eisenberger and Davis-LaMastro, 1990), to induce motivation for innovation among other employees. Research on innovation culture has been mainstream, and various models and guidelines have been published. These models and guidelines find their origin in traditional

management theory, specifically diversity management, project management, performance management, knowledge management, and strategic planning. These disciplines are well established. Innovation culture is important for organizations to remain competitive, and, today, larger organizations have deeply embedded these principles in their management strategy. The challenge with innovation culture practices is the difficulty of quantifying the benefits or direct outcome. Likewise, these practices have a propensity to induce innovation, but innovation is not their direct result.

On the other hand, the innovation process appears to be more straightforward to implement and to have innovations as direct outcome. Within the innovation process, product, service, process, and business model innovations are primary elements. The methods widely shown in the literature are the fuzzy front-end of innovation, where new ideas are created. The fuzzy front-end of innovation has its foundation in ideation and creativity study, which are the most complex parts of innovation, yet to be explored further. These are the early stages of the innovation life cycle. In the later part of the innovation life cycle, new product development, new service development and business model innovation models dominate. These models are based on project management, strategic planning and scenario planning principles, which are comparatively straightforward. From the holistic viewpoint, the fuzzy front-end of innovation is the domain that has room for significant improvement, since the published approaches are yet at a higher level and are not of an applied nature. This is because ideation and creativity are complicated and chaotic in nature, making it difficult, to establish a structured approach. Ideation and creativity are inherent human capabilities and differ among individuals. Ideation is usually an outcome of creativity, as, according to the Oxford English Dictionary (2021), ideation is the creation of new ideas. It is also what can be the most difficult part of innovation and where room for improvements and new approaches is the greatest.

No.	Concept	Elements	Popular methods	Foundation
1	Innovation culture	Innovative mindset Organization culture Diversity	Innovation workshops Promote teamwork Competitions Inclusive environment Idea sharing Idea testing Innovative workplace Knowledge sharing Rewarding innovation Human capability	Diversity management Project management Performance management Knowledge management Strategic planning
2	Innovation process	Product innovation Service innovation Process innovation Business model innovation	Fuzzy font-end New product development New service development Business model innovation	Ideation Creativity Project management Strategic planning Scenario planning

Table 1 Summary of innovation dimensions (self-compiled based on literature review)

1.2 Research gap and questions

Organizations understand that innovation is necessary for sustaining and improving growth (Zhang, 2021). Innovation is usually part of the organization's mission and vision statements (Bacq and Aguilera, 2022). The term appears promising when associated with global leading organizations. However, so far, little is known on how to innovate (Saunila, 2020).

Indeed, the implementation of innovation can be complicated and difficult (Aslam et al., 2020). The concept of innovation may seem simple, there are limitations and factors that must be considered for implementation (Aslam et al., 2020). People are naturally resistant to change, and innovation often involves the introduction of new ideas, processes, or technologies. Without a well-defined innovation framework, resources may be allocated inefficiently, and innovation efforts will lack direction and focus on something (Cinar et al., 2029).

Practitioners can be sceptical about innovations, as the term appears to be conceptual and challenging to implement (Pelz, 1985). There are different models and approaches available in the literature, that includes systems thinking, design thinking, open innovation, agile innovation and disruptive innovation. These frameworks or approaches are at a high level and designed to address complex problems and foster innovation within organizations or societies. These models recognize that innovation is a multifaceted and dynamic process that involves various factors, such as technology, human behaviour, organizational structures, and societal contexts. Such models are not easy to apply since they require specialised people and resources to implement (Buchanan, 2019; Costa and Matias, 2020; Dupont, 2019; Si and Chen, 2020). These frameworks are not of an applied nature and provide limited utility for practitioners. On the other hand, there are relatively simple innovation models that provide steps or guidelines. These include:

The Innovation Funnel: The innovation funnel, also known as the stage-gate model, is a linear model that divides the innovation process into stages. It typically consists of several stages, such as idea generation, concept development, prototyping, testing, and commercialization. Each stage represents a gate where ideas are evaluated and filtered, and only promising ideas proceed to the next stage. The innovation funnel helps organizations manage and prioritize ideas, ensuring that resources are allocated to the most promising ones (Cooper and Edgett, 2009). Innovation funnel however provide limited support in generating new ideas.

Lean Startup: The lean startup model, popularized by Eric Ries, emphasizes a fast and iterative approach to innovation. It encourages organizations to quickly develop a minimum viable product (MVP) and gather feedback from users. The feedback is then used to make iterative improvements and pivot if necessary. The lean startup model aims to reduce waste and validate assumptions early in the innovation process, enabling organizations to build products or services that better meet customer needs (Reis, 2011). Lean startup also provides limited input regarding ideation.

TRIZ: TRIZ (Theory of Inventive Problem Solving) is a problem-solving methodology that aims to systematically identify innovative solutions. It provides a set of principles and patterns for problem solving. TRIZ encourages organizations to think beyond traditional problem-solving approaches and consider inventive principles to overcome technical contradictions and barriers. It helps in generating inventive solutions and overcoming roadblocks in the innovation process (Ilevbare et al., 2023).

Design Sprint: The design sprint model, is a time-constrained process that helps organizations tackle specific challenges and generate innovative solutions. It typically spans over several days and involves activities such as understanding the problem, prototyping, and user testing. The design sprint provides a structured framework for cross-

functional teams to collaborate and rapidly iterate through solutions, enabling organizations to make progress on complex problems within a short timeframe (Magistretti, 2020). Design sprint provides some input for ideation through collaboration of different users.

Innovation models and approaches available in the literature are largely based on innovation theory (Johannessen et al., 1999), drawing support from ideation, creativity, diversity management, project management, strategic planning, scenario planning, performance management and knowledge management. When these disciplines are brought together in innovation models, they are difficult for practitioners to implement. There is a gap in terms of both research and available practical models and approaches for ideation (Waldman and Bass, 1991).

The trending technology is a vital source of innovation. Technology-driven innovation applies technological advances and the use of digital tools to stimulate and enable innovation across industries. Technology can be a powerful catalyst for innovation, creating new opportunities and capabilities. Innovation through technology is a dynamic and continuous phenomenon, as technological advances continue to evolve and define the way we live and work. Embracing technology as an enabler for innovation can help unlock new possibilities, foster growth and keep organizations relevant in a rapidly changing world. Therefore, it is interesting to investigate:

1. How can the opportunities emerging for innovation from technology changes and development be systematically identified?

Similar to technology trends, business trends are important sources of understanding the state of the art in technology readiness and business practices (Bughin et al., 2010). The latest business trends can help inspire new ideas for products and services. Business trends highlight emerging market needs, changing customer preferences, and new technological advancements (Bughin et al., 2010). Trend monitoring enables

companies to identify potential opportunities for innovation (Li et al., 2011). Trends often highlight gaps in the market or areas where existing solutions can be improved. They provide insight into where innovation efforts should be focused. By understanding and applying business trends, organizations can anticipate change, identify opportunities, and adapt their new strategies accordingly (Mühlroth and Grottke, 2020). Business trend management keeps businesses at the forefront, taking advantage of emerging opportunities and developing innovative solutions that meet evolving market demand. Therefore, it is interesting to investigate:

2. How can the opportunities emerging for innovation from business trends be systematically identified?

Part of the innovation process is to screen the ideas generated (Onarheim and Christensen, 2012). Idea screening is a crucial step in the innovation process where the most promising idea for further development needs to be separated (Huang et al., 2020). It involves systematically analysing and assessing ideas to determine their feasibility, potential value, and alignment with strategic goals. Idea screening helps organizations allocate resources efficiently and focus efforts on ideas that have a higher likelihood of success (Ciriello et al., 2016). Before investing significant resources into the development of ideas, the goal is to filter out ideas that are unlikely to generate value (Ciriello et al., 2016). By conducting an idea screening, companies can avoid wasting resources on ideas that have little chance of success and instead prioritize those with the highest potential.

Different methods and tools can be employed for innovation screening, such as scoring systems (Moradian et al., 2014), decision matrices (Kwon et al., 2018), SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis (Huang et al., 2020), market research (Witell et al., 2011), customer feedback (Witell et al., 2011), and expert evaluations (Magnusson et al., 2016). These methods help assess various aspects of

an idea and provide a structured approach to comparing and prioritizing different concepts. However, there is a need for a structured approach that can be quickly applied and separates the valuable ideas from the idea pool. There for it is interesting to study:

3. How ideas can be evaluated and screened through a consistent and quick-to-apply approach for selecting potential innovation opportunities?

These three research questions are investigated further in the thesis and are used to formulate sub-questions.

1.3 Literature review

A systematic literature review is performed to evaluate articles published in the period, 2002–2022, with the key focus being to identify insights for ideation through technology and business trends. Scientific journals, books and conference proceedings are included in the literature review.

Literature review is performed by searching relevant articles in the databases with keywords. The top 100 hits are further screened based on title and abstract relevance. Literature databases searched are Google Scholar and Science Direct using the keywords combination ‘ideation’, ‘technology trends’, ‘business trends’, ‘technology innovation’ and idea screening. The main findings are described below.

Technological developments directly impact innovation (Sánchez and Hartlieb, 2020). Technology knowledge is essential for contributing to ideation. Users with limited technology knowledge cannot contribute much to the ideation process (Prahalad and Ramaswamy, 2004). Technology stimulus can enhance ideation process (Prajogo and Ahmed, 2006) and enable new market needs (Pantano and Viassone, 2014). In

the literature are some studies that have indicated how technological knowledge stimulus can be integrated in the ideation process.

- Users: Incorporating the extreme users in the ideation process can lead to great ideas. In the sports industry the extreme users have performed successful innovations for example in kayaking, snowboarding, and mountain-biking (Franke and Shah, 2003; Hienerth, 2006). These users have a deep understanding of the product and technology around it. On the other hand, ordinary users with limited insight of the technology provide limited insight for innovation (Prahalad and Ramaswamy, 2004). Enlighting ordinary users with the trending technologies can enable them to produce quality ideas.
- Crowdsourcing: When large crowds aware of the technological developments are involved in ideation, impressive new ideas are developed. For example, in hackathons, many technology enthusiasts are engaged in solving challenging problems where interesting new ideas a generated (Yokoi, Obwegeser and Beretta, 2021).
- Big Data: Analyzing large datasets can uncover hidden insights and opportunities for innovation (Mühlroth and Grottke, 2020), particularly when combined with machine learning and AI techniques. For example, using patent data mining for ideation (Bresciani et al., 2021).

These studies indicate that right technology implementation can amplify the effectiveness of innovation (Adner and Kapoor, 2010). Similar to technology trends business trends also serve as knowledge stimulus (Morabito, 2014).

1.4 Research purpose and objectives

The rate of change around us and in companies' competitive environment is increasing over time. The objective of this thesis is to *investigate whether the changes in a company's environment can be sources for innovation opportunities, and how to take advantage of these opportunities and turn them into successful innovations in a systematic way*.

The sources of changes can be technology trends that affect the company or its competitors or the business trends that can likewise affect one or more of the players in the competition. The changes can be related to the output (products and services) of the company or to the way of doing business or structuring the company.

The subobjectives of the thesis were defined as:

- To identify and evaluate the potential impact of technology trends on products and services and develop a method for doing this systematically.
- To identify ways to transform products into services and develop a method and approach for doing this.

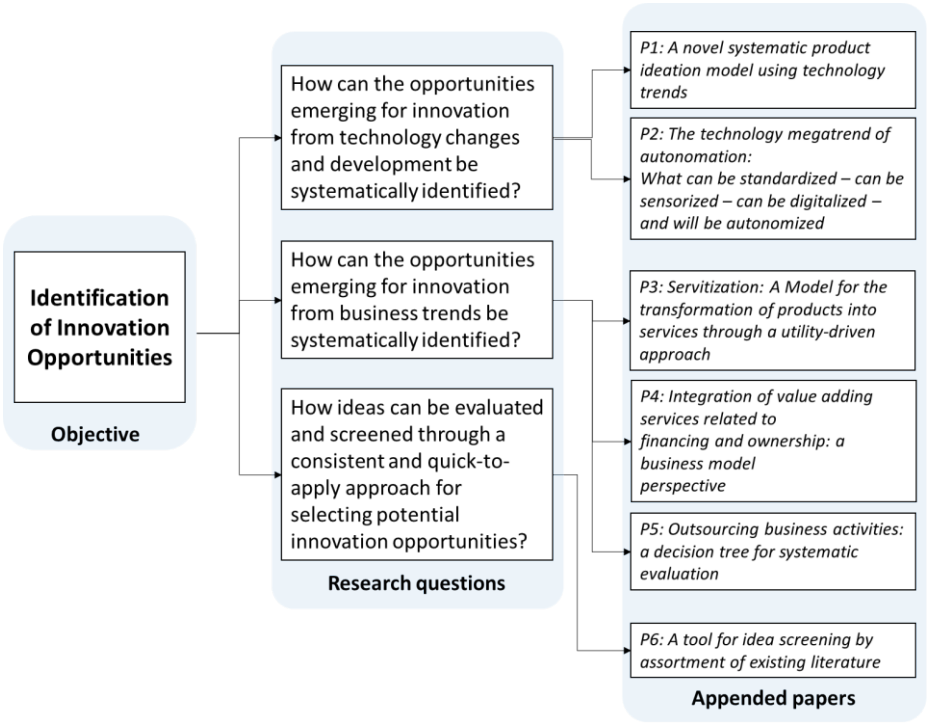

Figure 1 Objective and research questions

2 Research Methodology

Since innovation is a complex topic, no single research method is sufficient to triangulate the proposed hypothesis. Four research approaches have been applied in this thesis. They are described as follows:

2.1 Research methods

2.1.1 Literature review

A literature review is a summary of a subject field that supports the identification of specific research questions. Literature review is used to draw on and evaluate a range of different types of sources, including academic and professional journal articles, books, and web-based resources in different articles. The literature review search helped in the identification and location of relevant documents and other sources. Search engines were used to search web resources and bibliographic databases. Creating the literature review involved the following stages: scanning, making notes, structuring the literature review, writing the literature review, and building a bibliography (Rowley and Slack, 2004). A high-level literature review was performed in all different studies to derive theoretical underpinnings in Paper 1, 3 and 6.

2.1.2 Experimental investigation

Experimental research is a study that strictly adheres to a scientific research design. It includes a hypothesis, a variable that can be manipulated by the researcher, and variables that can be measured, calculated, and compared. Most importantly, experimental research is completed in a controlled environment.

In Paper 1, experimental validation of the conceptual model is tested in two different test configurations with university students (n=81).

2.1.3 Conceptual research

Conceptual research is an analytical tool with several variations and contexts. It is used to make conceptual distinctions and organize ideas. Largely already present information on a given topic is analysed, and it does not involve conducting any practical experiments. It is related to abstract concepts or ideas.

In Paper 1, the model is built by extending the theoretical framework of ideation study. It comprises morphological analysis, with product breakdown as the primary and technological trends as the secondary dimension to prompt product ideas from the user's intuition. The approach is multidisciplinary, using insights from the areas of cognition, management strategy and project management.

In Paper 3, the article deploys a conceptual approach, by taking anecdotes from literature and historical trends.

2.1.4 Case study

A case study can be defined as an intensive study about a person, a group of people or a unit, which is aimed to generalize over several units. The case study is relevant for understanding multivariant complex problems. In Paper 2, autonomation has been studied with the help of a pipeline routing autonomation case study. In the oil and gas industry, pipeline design engineers work extensively to optimize subsea routes. This case study provided implications for autonomation in general and validated the autonomation model presented in Paper 2.

No	Study title	LR	EI	CR	CS
1	A novel systematic product ideation model using technology trends	X	X	X	
2	The technology megatrend of automation: What can be standardized – can be sensorized – can be digitalized – and will be autonomized			X	X
3	Servitization: a model for the transformation of products into services through a utility-driven approach.	X		X	
4	Integration of value adding services related to financing and ownership: A business model perspective.			X	
5	Outsourcing business activities: A decision tree for systematic evaluation			X	
6	A tool for idea screening by assortment of existing literature	X		X	

LR: Literature review; EI: Experimental investigation; CR: Conceptual research; CS: Case study

Table 2 Summary of research methodology used in the studies

2.2 Research methodology applied

This thesis is aimed at developing practical models that can assist ideation and has emerged from practitioner's viewpoint. Therefore, a pragmatic approach governs the research methodology. The research methodology is positioned to address the problem in the most simple and applied way. The research method is aligned around how to use technology changes to for ideation in an easy way. This positioning and background directed the research method to qualitative design. The research method used in the thesis is discussed below.

A literature review on each research question was carried out to understand the background works and further breakdown the research

questions. Based on the grounded theory developed from literature review, conceptual research was applied to derive models. The conceptual research involved collecting technology and business trends data and idea screening indicators from different data sources, assorting and combining the data qualitatively and iteratively improving assortment by discussion with other practitioners. From the data assorted, different reference models were prepared qualitatively. The constituents, configuration and sequence of the reference models were sequentially improved based on idea generation quality, practicality, and generalizability.

Further these models were adjusted and changed in an iterative way by performing case study and small-scale experimental validations. The developed models were then published to get external insights from the reviewers so that they can be refined further. The testing could only be carried out on a limited scale.

The details of methodology applied in different articles are explained individually in those articles.

2.3 Research limitations

The topic selected in this thesis had a wide scope where data-driven research could not be carried out. Therefore, largely conceptual research was carried out by extending the existing literature. Also, the research work was time-bound and, therefore, rigorous testing could not be performed.

The research has been aimed at potential applicability for companies and can also be applied by others like public sector organizations or individuals. There could be limitations in the relevance of parts of the approaches.

The research is meant to be sector-independent, but there may be limits to the applicability for some sectors.

3 Results

3.1 Paper 1: A novel systematic product ideation model using technology trends

The existing literature on product ideation comprises unstructured brainstorming techniques or tightly structured approaches like patent data analysis and biological analogy. Unstructured brainstorming techniques do not provide a structured approach for users, and not all users can generate ideas. Tightly structured techniques, however, require considerable time and complex tools to implement.

Technology trends are agents of change which indicate the direction for the further evolution of technology. Developments in some technology areas can open up further developments for a company's specific products or services. They are technologies that have recently become trendy and are quickly being acknowledged in the market and industry. Systematically evaluating these agents of change against the products can lead to innovative ideas. This study puts forward a new model for product ideation that uses morphological analysis and technology trends. The model is based on breaking down both the product or services and the technology trends – the major changes happening around us – into their major elements and evaluating these against each other for potential improvement or innovation opportunities or the product. This gives a broader overview of potential impacts of technological developments on the various dimensions of the product, than just evaluating the product as a whole, and thereby provides an opportunity to find more potential improvements. This model can be applied to generate a considerably higher number of product ideas, in contrast to unstructured brainstorming. The generated ideas from the present model are of better quality when compared with the ideas generated through unstructured brainstorming.

The article starts by presenting an overview of the product ideation literature. There are *Early Ideation Techniques*, which are focused on the user's creativity to trigger ideas, for example brainstorming and bootstrapping. These techniques are quick to implement, but the ideas generated are highly dependent on individuals participating and result in a small number of ideas. Then there are *Improved ideation Models*, focused on diversity and user creativity, for example brainwriting and mind mapping. These models perform slightly better than *Early Ideation Techniques*; however, they are more time-consuming to implement. Further in these techniques are *Sophisticated Ideation Models*, which encompass creativity emerging from a large set of people. For example, crowdsourcing and ideation competitions are techniques in which a problem is presented, and ideas are gathered from a large user base, usually through competitions. Such techniques are relatively very time-consuming to implement, and usually small and medium enterprises lack the resources for such endeavours. The final group of models are *Advanced Ideation Models*, focused on information sources, for example patent data mining and biological analogy. These techniques are complex to implement and time-consuming.

This article and study identified a gap in the literature and proposed a novel technique of using technology trends as an information source to generate ideas through a structured approach. A new method of using morphological analysis and technology trends for ideation purposes is arranged and validated. This combination increases the chance of the user triggering ideas. The model is quick to implement, practical, and can be implemented by company employees or students to innovate their products. The model can generate a large number of high-quality ideas that cannot be achieved by unstructured brainstorming.

The model comprises four steps:

Step 1 – select a product

In this step, a product is selected to be checked for its further innovation potential. For an existing company with a range of products or services, this gives an opportunity to systematically go through their offerings.

Step 2 – product breakdown/product morphology

The second step is the breakdown of the product or services into the main categories in each of the main parts of the life cycle. The product is first broken down into key elements: production, operation and utilization. These are further broken down into the main areas of these phases. This helps the user understand the construction of the product, the type of skills required to operate the product and the type of utilities it provides. Understanding these elements reduces the complexity of the product in the user's mind.

Step 3 – selecting relevant technology trends

The third step is to identify the relevant technology trends that can potentially have an effect on one or more of the elements of the broken-down product. The key is that you get a much more detailed picture of the potential for the further development of a product, if you evaluate the individual elements of the product against the various developments in technology. The technology trends act as an information source and trigger for the user in terms of ideas for the further development of the products or of elements of the products. The study presents 50 recurring trends. The number of technology trends selected by the user is directly proportional to the ideas generated. Ideally, all relevant trends shall be selected.

Step 4 – recording the effect of technology trends on the product: idea generation

In this step, the user goes through the product breakdown of *Step 2* and checks for potential effects of the various technology trends against each of the elements of the broken-down product. The user evaluates how the technology trends can change the construction of the product, improve the operational efficiency, and increase the utility of the product. These evaluations can lead to several innovative ideas.

A case study of the application of the model is shown in the article. The study indicates that the present approach can be applied by start-up owners and managers of small and medium enterprises to explore innovation opportunities in their product ranges efficiently. The model is useful in organizing regular idea generation exercises in the light of new technology trends that can improve the competitive situation of the company.

3.2 Paper 2: The technology megatrend of autonomation: What can be standardized – can be sensorized – can be digitalized – and will be autonomized

To be able to evaluate the impact of the developments in technology on existing products and services, the major technology trends first need to be mapped. This study has identified and mapped a megatrend in the advancement of technology and predicts that the processes, operations and activities in many sectors of life are heading towards complete autonomation – not just automation as we have mostly seen so far but autonomation to include the managing and control of the process. This implies that many future operations and activities will require minimal human input.

In the past century, the dominant trend has been electrification, which has been the source of improvement and innovation in every sector. Firstly, it changed the industrial power distribution from mechanical drives to localized electric drives. Later, pneumatic and hydraulic systems were electrified, and gradually electrification penetrated households. This megatrend has recently transformed the automotive industry, in terms of electric cars. For innovators, how an operation can be electrified is the source of idea generation. This triggers the question of what the megatrend of the present and future is. The electrification trend draws a close analogy with an identified trend of autonomation. The megatrend of the present and future seems to be autonomating operations. For example, everyday activities like accounting or engineering design work can now take place by themselves, with negligible human input.

There are two main reasons for the empowering of this trend: (i) technology push and (ii) sequential pull. Technology push comes from the fact that computational power, data storage capacity, sensors' development and smart algorithms have gained enough progress that

they can be installed in any operation, leading it towards complete autonomy. Sequential pull implies that there are gradual steps that business operations are adopting which are leading them towards complete autonomy. Business operations were chaotic in the past but gradually have been standardized. The standardized operation has repeatability, which takes it a step closer to complete autonomy. The increased use of sensors in business processes to monitor and correct operations is providing humanlike senses in those operations. The sensors continuously monitor the operation and direct correction where necessary. Today, the sensors raise an alarm or notify the supervisor for corrective action, but not far in the future almost all decisions will be independently carried out by the sensors. The third step that is pushing processes towards autonomy is digitalization, where the data collected from sensors and other information sources is processed and used for decision-making and process improvement. Even now, most business operations have some degree of autonomy through these steps, but the natural next step could be complete autonomy, where no human input would be required to supervise an operation. Therefore, the study has summarized these steps as what can be standardized – standardizing an operation; can be sensorized – providing senses to the machine; can be digitalized – providing the capability to take decisions; and will be autonomated – leading to autonomizing operations in both the digital and physical domains.

A stage-gate model to determine which operations will be autonomized in the near term and long term is shown. A case study of an engineering design operation is presented. This exemplifies the megatrend of autonomation changing processes and operations around us.

3.3 Paper 3: Servitization: a model for the transformation of products into services through a utility-driven approach

Paper 3 pursues one of the major business trends of servitization. The area of servitization is investigated and various aspects are segmented and opportunities for servitizing products identified. This is set up and presented in terms of a model for servitization – for creating services – based on existing products.

When purchasing a product, consumers are often not interested in the product itself but the service it delivers to them. Therefore, organizations have realized that their business model can benefit from being service-centric. Selling a product in exchange for a one-time revenue is changing to selling repeated services for repeated revenues. Repositioning from selling products to offering services is an important source of innovation for companies. Highly product-centric company Rolls Royce changed its business model from selling jet engines to selling propulsion hours.

Due to the service transition, new offerings have emerged with both product and service elements and therefore difficult to attribute to product or service alone. A useful approach to understanding products and services is to follow a tangibility continuum. Offerings that are high in tangibility would be products and offerings high in intangibility would be services. Those offerings falling in the centre of the scale cannot be explicitly differentiated (Figure 1). In Paper 3, servitization is defined as moving an offering on the tangibility/intangibility scale towards the intangibility side. In the existing literature, there are several models and approaches related to servitization. However, most of these are high-level and not sufficiently practical to be implemented by practitioners. In Paper 3, a new servitization model is presented which can easily be implemented.

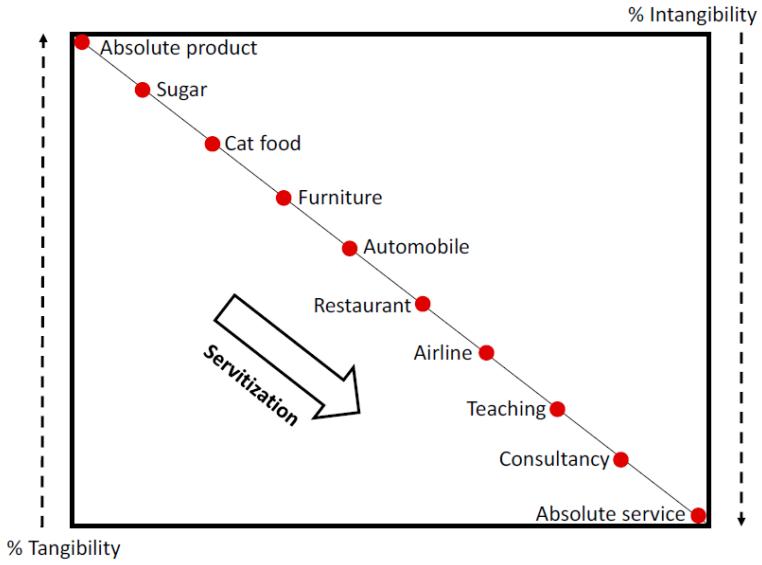

Figure 2 Products and services differentiated on a tangibility/intangibility continuum, which sets the basis for defining products and services, adopted from Tauqeer and Bang (2018)

The paper presents a new servitization model encompassing seven steps:

1. Select a product to be servitized – the product can be a simple item like a chair or a complex item like an aircraft.
2. Identify 'customer groups' of the selected product – customer groups depict the utility of the product. This step assists in understating the utility of the selected product.
3. Identify 'enablers' and 'barriers' of the selected item – enablers are defined as the utility that the customer is looking for in the product selected. Barriers are the hindrances that hinder customers from purchasing the product. Based on the customer segments identified in the previous step, the utility different customer groups look for in the product is investigated.
4. Rank 'enablers' and 'barriers' – all the identified enablers and barriers may not be of top concern. Therefore, they can be ranked according to their importance.

5. Locate product on the tangibility scale – this step is to understand the progress of the servitization process.
6. Checking options to servitize – there are several options presented in the paper to increase enablers or reduce barriers to servitize the product.
7. Check the tangibility of the product after implementing new options on the tangibility scale.

The major key of the model is that it provides practical guidance on how to servitize a product and make it more easily attainable for customers. It provides examples of different dimensions that can be pursued to make it more attractive for the customers, as shown in Figure 3.

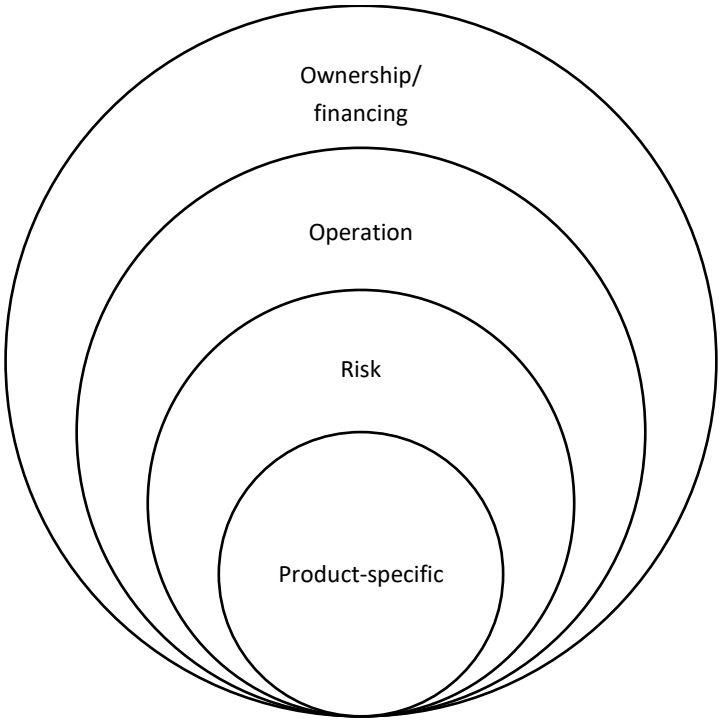

Figure 3 Barriers to the customer obtaining a product, adopted from Tauqeer and Bang (2018)

Each of the dimensions is accompanied by a tangibility/intangibility continuum, with examples of the steps that can be taken towards further servitization. Figure 4 below shows an example of this for the operations dimension. There are several options for operating the product, and the customer can choose to do it all by themselves or, to an increasing degree, obtain help from the supplier. When you go further to the left on the continuum (higher intangibility/more service content), it becomes more taken over and operated by the supplier and at the supplier's responsibility. These examples are repeated for the other dimensions of the product. The implication is that, for most products, there is a multitude of options for providing further services on top of, or in addition to, the existing products.

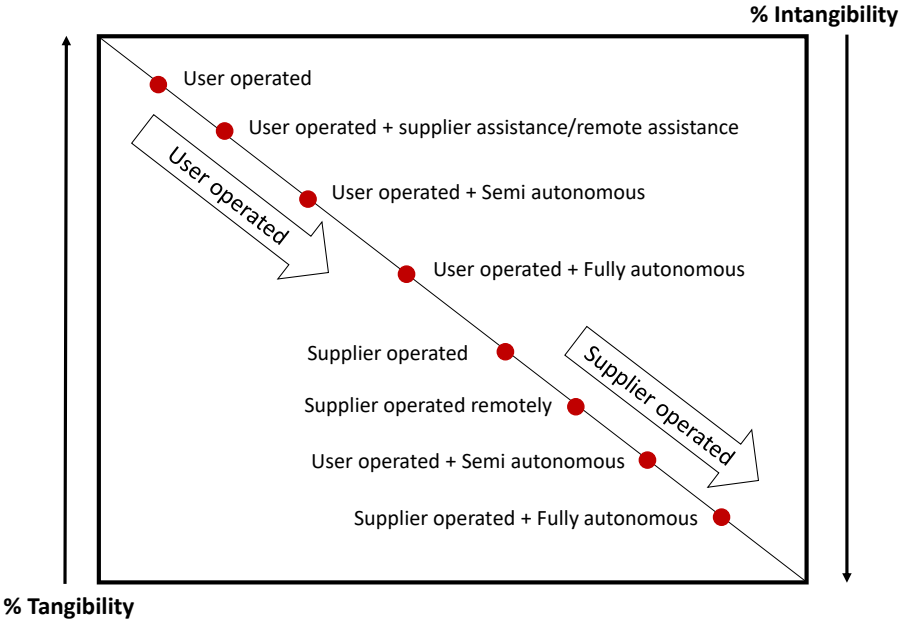

Figure 4 An example of reducing operations barriers for the user, adopted from Tauqeer and Bang (2018)

This trend of servitization brings benefits to both customers and suppliers. Customers can benefit from more purchasing options and from reduced uncertainty when product life cycles are becoming shorter. The supplier can benefit from more opportunities to provide services on a broader basis and with a repeated revenue stream.

3.4 Paper 4: Integration of Value Adding Services Related to Financing and Ownership: A Business Model Perspective

Paper 4 follows partly as an example of the application of the servitization model and detailing the effects this can have on the business model of a company. It is a study in which seven value-added services related to financing/ownership options are presented and the influence of these options on the business model of the product is discussed. These options have been identified by reviewing published literature and are shown in Figure 5. The study shows that a company can increase the value of its existing product by gradually offering financing services on top of the product. These options are sorted according to their potential for intangibility, ease of financing, reduction in ownership and value addition. For example, owning a car is getting a product, whereas renting a car is getting a service. Renting the car reduces the product tangibility for the user, for example no maintenance is required. It also reduces the financial burden for the user; instead of one full-time payment, the user only needs to pay for the number of days the car is rented. This service also reduces the ownership of the user and thus the ownership risks like value depreciation. Therefore, renting services can offer additional value to the user.

Not all options listed in Figure 4 will be relevant for all products.

The paper also discusses the fact that companies will be compelled to offer these value-added services to keep their products relevant in the market. This will eventually change how they operate and modify their business model. Companies will have the option of offering these value-added services by themselves or through a third party. The business model will be slightly different when the company directly offers these services versus routing through a third party. To directly offer a new service, the company will need to establish a new process and operations, which will require increased working capital for the company, whereas,

if the service is outsourced to a third party, very few changes would be required to incorporate the financing service from a third party. Offering the service directly will lead to increased revenue for the company and competitive strength. However, this will also lead to increased risk from defaulting users. Offering value-added services will require additional financing and bring increased competence to the company. In contrast, if the value-added services are offered by co-operating with a third-party company, there will be increased revenue. This revenue, however, would be less than directly offering the service, since the third party will take a cut for their service. Yet, this cooperation will remove the risk of default, since the third party will bear the risk. The company, nevertheless, will gain less competence compared to directly offering the service, and the competitive strength will also be reduced.

The paper also shows a high-level overview of how the business model will evolve when these services are offered. For example, if the company offers a loan, together with their product, the company will essentially be a production company and a bank. The company will obtain revenue from selling and interest. However, the company will need to have capital of approximately 10% of its sales, obtain a banking licence and have a debt recovery department. Similarly, the study shows business model changes for other value-added services.

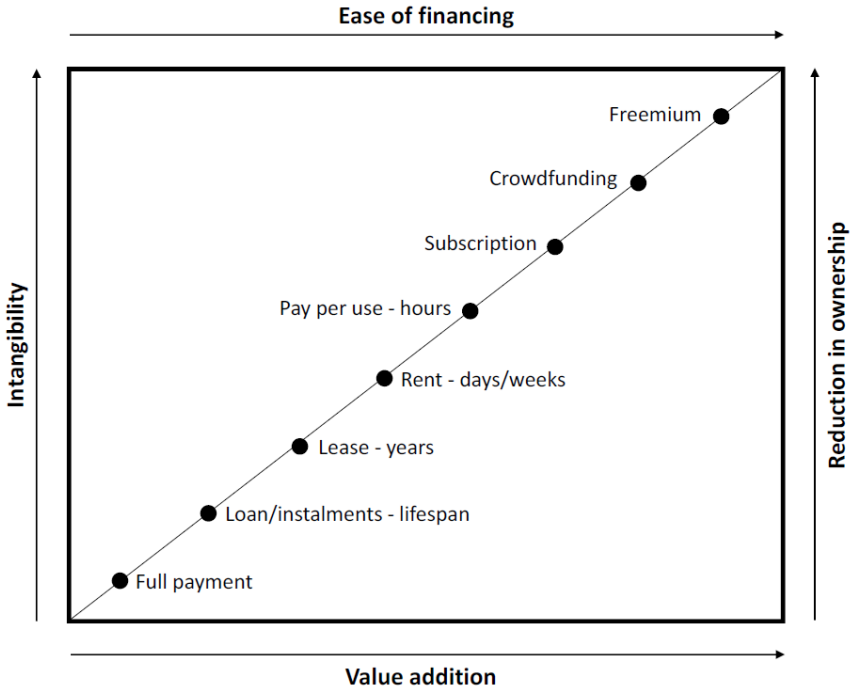

Figure 5 Financing/ownership options sorted for intangibility, ownership and value addition capability for the customers (Tauqeer and Bang, 2019a)

3.5 Paper 5 Outsourcing business activities: A decision tree for systematic evaluation

Paper 5 addresses another of the main business trends, namely, outsourcing. Outsourcing has been practised by companies to subcontract non-essential business operations that are not core activities of the business. This increases the overall efficiency of the company, so that it can invest more in the core activities which contribute to the highest value addition. Through a literature review, the study shows that, by outsourcing, companies can more easily adjust to market disruptions. The company's areas of core competence remain at the forefront within the company, and it can benefit from reduced labour costs though offshore outsourcing. This makes outsourcing very attractive to start-ups and small companies. However, outsourcing can make the company supplier-dependent and may lead to suppliers becoming competitors over time. Therefore, it is important to systematically assess the processes to be outsourced. A decision tree for evaluating business processes for outsourcing has been developed, as presented in Figure 6.

The study discusses the fact that highly standardizable and specifiable activities like accounting and IT support can be outsourced, since they are well known and common in most organizations. Non standardizable activities pose issues in outsourcing, since they are difficult to pass on to the vendors. If such activities are core, the company will abstain from outsourcing them. The next step in evaluating a business activity for outsourcing is whether it is a source of input for innovation. Organizations innovate by acquiring tacit knowledge of business processes like production or interaction with clients. Outsourcing business operations can create hindrances for the organization in getting essential know-how for innovation. This challenge can be addressed by collaborating with vendors on error-fix and troubleshooting issues. Also, access to the vendor processes data can provide input for innovation.

The next step to be evaluated for outsourcing a business process is whether it contributes to a barrier to entry. Essential barriers, such as intellectual property rights and protection clauses in the agreement, can serve as a purpose for protection. The last step for outsourcing investigations is the right contracts setup. Advice from consultants and experts shall be considered in setting up the contracts.

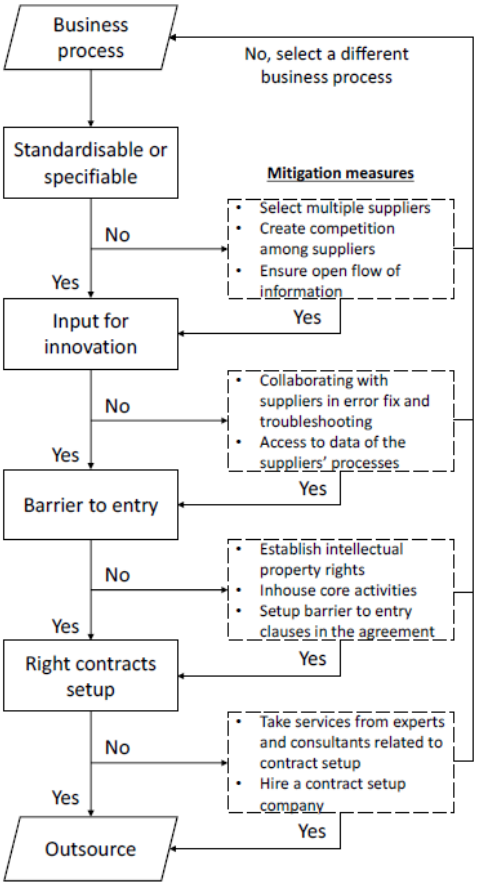

Figure 6 Decision tree to evaluate business processes that can be outsourced (Tauqeer and Bang, 2019b)

The article supplements Papers 3 and 4, in shedding light on the important options and considerations that need to be made, both for existing processes or when setting up new processes for delivering services, according to Paper 3 and exemplified in Paper 4.

3.6 Paper 6: A tool for idea screening by assortment of existing literature

The idea-generation models presented in the previous papers lead to several ideas being generated. However, only a few ideas can be taken further for intervention. The existing idea-screening approaches are detailed and time-intensive for screening large numbers of ideas. Traditionally, gut feeling or discussion rounds are used to quickly screen a large number of ideas. In this study, a literature review on the idea-screening research has been carried out. In general, the studies can be divided into two sets, i.e., studies that present idea-screening methodologies and studies that present idea-screening criteria. The idea-screening parameters discussed in these studies can be summarized in six groups, which are set as a basis for the idea-screening ladder, shown in Figure 7. These groups are:

- Producibility: Checking for technological progress and assessing whether the idea can be realized. Many generated ideas cannot be developed, since technological improvements are required.
- Problem size: Checking whether the idea solves a real problem. Many interesting ideas lack a market; therefore, it is important to determine the market for the idea.
- Market size: Checking how large the market for this idea is. A market size large enough for commercial viability is required.

- Novelty: Checking how novel the idea is compared to the available solutions. Novelty is crucial for an idea to become high growth.
- Profit margin: Checking the profitability of the idea. Generally, novel ideas have a tendency for high profitability, since they can restrain competition by setting up intellectual property rights.
- Business alignment: For established companies, it is important to investigate alignment with the existing business. However, for start-ups and entry level companies, this check is not relevant.

The article presents a ladder in the form of a checklist that enables actors to perform a quick sorting evaluation covering the main areas and requiring little input. It is suitable for evaluating entrepreneurial pitches, emerging ideas inside or outside a company or a start-up venture. The article follows on the heels of the work done on idea generation and rounds off the articles presented.

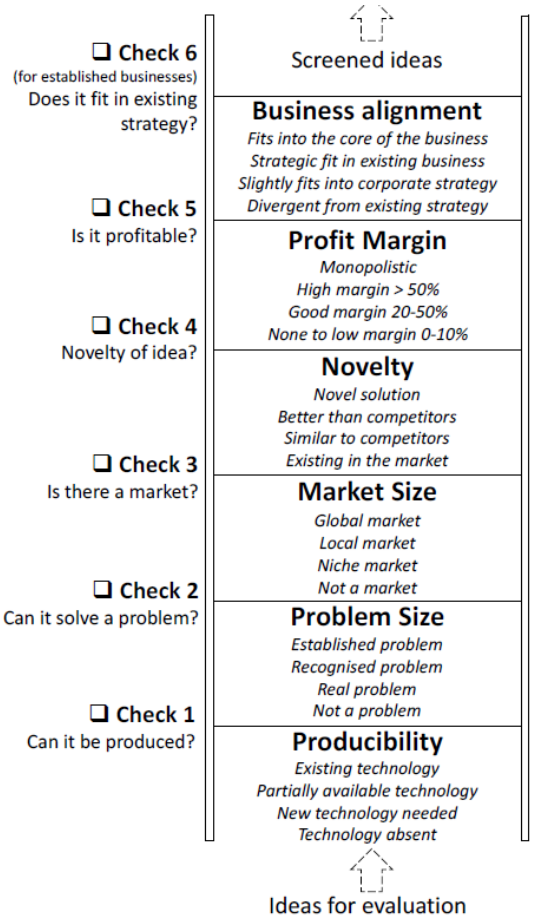

Figure 7 Ladder diagram for preliminary screening of ideas (Tauqeer and Bang, 2019c)

4 Discussion of the results

4.1 Identifying innovation opportunities from technology trends

Developments in technologies are seen as agents of change. By using an overview of relevant technology trends and evaluating their potential impact on the main dimensions of specific products or services, opportunities for further developments of the products and services can be identified.

Paper 1 presents a novel approach of using technology trends to trigger product ideas. The approach is based on inference from management strategy and project management. From management strategy, in order to create competitive advantage, either the products or services need to be delivered at a cheaper cost or they need to be differentiated from the existing products and services. This paper focuses on differentiation of products and services through the addition of state-of-the-art technology. To check for compatibility and added benefits, a project management approach of breaking down the problem into constituent pieces and addressing one at a time is applied. These two approaches are combined in a product ideation model. It primarily addresses product ideation where limited applied approaches are available. The results indicate that this systematic model can increase the quality and number of ideas generated by this approach compared to generally practised approaches. This approach is shown to increase the chances of triggering ideas. The model is tested repetitively but with room for more exhaustive testing. Product innovation currently has limited systematic ideation tools, which is where this study makes a contribution.

Paper 2 presents the current megatrend of autonomization. Identifying relevant technology trends to use in the model developed in Paper 1 pointed to more digitalization, automation and further autonomation. This covers the machines doing the job and also supervising themselves,

known as complete autonomy. Following new technological possibilities, autonomation has started to become mainstream, affecting all kinds of operations. Autonomation is now evolving, and it seems this trend can become as large as the earlier trend of electrification, which has dominated industrial innovation for the past century. It appears that there are two main reasons for this trend expanding now: a push from the accumulated developments in technology being an enabler and a pull from the sequential steps that pave the path to autonomizing. These steps are: standardization – standardizing an operation; sensorizing – providing senses to the machine, and digitalizing – providing the capability to take decisions. They lead to autonomizing operations in both the digital domain, i.e., performed within a computer, and the physical domain, i.e., performed in the physical world, like robotics that can work without human intervention. This study presents a model of this development and a case study providing guidelines on how tasks can be autonomized.

These articles contribute to systematically identifying innovation opportunities for companies. It is an attempt to provide tools for achieving innovation in practice. Both a model for how this can be done and guidance on what the main developments are that can generate opportunities are provided. For academia, it addresses a gap in the literature related to innovation. It also points to a possible direction of research by testing out the models. For existing companies, start-ups and entrepreneurs, it provides tools that can be used for practical innovation work.

4.2 Identifying innovation opportunities from business trends

The change from manufacturing to services is one of the major business trends currently ongoing. Some of the main findings of the research are related to this trend and associated business trends. They are presented in three papers. Paper 3 presents a model for transforming products into

services which can assist businesses in following the major business trend. Based on the gap identified in Paper 3, a business model perspective was taken on how financing options could be integrated into service offerings. This is shown in Paper 4. The financing options were to include newer developments in financing and marketing like crowdfunding and freemiums and, thus, to yield a more updated overview of the available options. The effects of the service options on the business model were investigated and mapped, and both a model and a decision tree of the options and their requirements were developed. Paper 5 builds further on the results of Paper 4. A model for the development of services along multiple dimensions, which aims to be practical and implementable for companies, is developed. It shows the available alternatives for the development or servitization of products along the dimensions of ownership/financing, operation, risk and the product-specific.

These articles contribute to systematically identifying innovation opportunities for companies using business trends. The main servitization article – Paper 3 – demonstrates an approach that can be used by existing companies to devise new offerings, as well as examples of how to do this. For academia, it offers an opportunity to test out the model in case studies in cooperation with the industry. The other papers on business trends – Papers 4 and 5 – demonstrate the practical implementation of this kind of servitization. They address the issues that should be considered in order to gain competitiveness through servitization, who to team up with, what must be done internally and what can be done by others.

4.3 On evaluation of innovation opportunities

The models presented in the study can leave practitioners with several different ideas to work on. It is difficult to screen all the generated ideas in a short period of time. Paper 6 presents a model that highlights the major checks necessary for an idea to become successful.

5 Research contributions and implications for practitioners

The objective of this thesis is to investigate whether the changes in a company's environment can be sources for innovation opportunities and how to take advantage of these opportunities and turn them into successful innovations in a systematic way. This is addressed in the six appended papers. Papers 1 and 2 address developments in technology in the form of technology trends that can contribute to identifying opportunities for innovation (Research question 1). These studies show how changes in the products, services and business processes of the company inspired by technology trends can be systematically identified and turned into successful innovation opportunities.

Similarly, Papers 3, 4 and 5 presents how business trends can be systematically used to bring changes to the company offerings and processes and turn them into innovation opportunities (Research question 2).

Paper 6 addresses how to evaluate and select among innovation opportunities that have been identified (Research question 3).

5.1 The research gap

Changes in a company's environment can be threats to the company and its profitability. On the other hand, these changes can also constitute opportunities for the company.

There was identified a gap in the literature related to practical approaches that could easily be applied. The gap extended to using approaches to investigating the changes in the company's environment and if those could constitute opportunities for innovation. In order to transform

environmental changes of the companies into innovation opportunities, five models and an idea screening tool are presented.

The focus of the work was on potential changes brought by technology trends and business trends, specifically the trend of servitization. Those trends seemed to yield the greatest opportunity to impact on existing products and services of the company.

Combining approaches from project management and management strategy led to a new model that can be used on a company's products and services to identify what range of opportunities or options opens up for developing the products further from the developments in technology in the company's environment. The model bridges the academic models at a higher level with the needs of the practitioners. Further studying technology trends revealed that the trend of autonomation has disruptive potential. In retrospect, an approach to investigate the implications of autonomation on business processes is presented that provides deeper insight into how companies processes can become smarter and efficient.

Similarly, a model was developed for servitization of products or further servitization of existing services. It was built on the available theories of the area and adjusted to take into account and evaluate opportunities arising from the available options and changes in the company's environment. Further value-added service options were studied and a model for integrating these services in the company offerings is presented.

Studying business trends further revealed that outsourcing of less important business operations can allocate organizational resources at the core of the business core. A practical approach is presented to evaluate business processes that can be outsourced.

Together these models bridge between the theoretical and the practical and contributes to filling the gap in the literature. The evaluation model

adds to this by a practical way to select the direction from the range of opportunities that emerge.

5.2 Paper contributions

There are several implications for practitioners and contributions to the theoretical framework of identifying innovation opportunities in the six papers presented.

Paper 1 presents an overview of the major technology trends influencing businesses. The study further presents an applied approach to innovating products and services. The study is built on theoretical foundations of ideation literature and further enhances it.

Paper 2 highlights one of the most important technology trends that is changing not only businesses but all kinds of operations. The trend of autonomizing operations is influencing all types of companies, organizations and government agencies. The study presents an applied approach to autonomating business operations.

For academia, there are two areas of contribution from these articles on innovation opportunities from technology trends. The first is that of helping to close the gap on "how to" in the innovation literature. The other is that of assisting in teaching students both how the world of technology is changing around us and how this can be used to identify innovation opportunities. This material is currently being used in master classes at the University of Stavanger for these purposes. For industry practitioners, it can similarly be used as tools in their work on strategy and in innovation.

Manufacturing businesses are increasingly struggling to survive due to the reduced shelf life of their products. Paper 3 highlights the importance of servitization to increase the sustainability of the company. A model

for transforming product-selling businesses into service-offering businesses is presented. The model can serve as a guideline for businesses to transform their products into service offerings. For academia, it is a contribution to closing the gap on how to achieve innovation. It is currently used in teaching master classes on innovation.

Paper 4 further presents several examples of how services can be added to a product business.

Paper 5 highlights an important business trend, outsourcing. Modern businesses are driven to outsource major components of their businesses. However, that may invite competition, or the company may lose out on learning new techniques. Paper 5 presents a decision tree for practitioners to evaluate business activities to be outsourced. The decision tree includes checks that are important for the sustainability of businesses. Both papers address the challenges industry faces in innovation in servitization and can help in guiding its innovation efforts.

Paper 6 presents an idea-screening tool which can be used by students, designers and start-ups to evaluate business ideas. The models presented in Papers 1-4 can result in several ideas. The approach presented in Paper 6 is time-efficient and only stresses the most important checks for a business idea.

6 Limitations and future research suggestions

This thesis has some limitations that should be understood, and which suggest future research work.

The models developed in this thesis are largely based on conceptual research, and limited empirical validation has been performed. Large-scale validation can assist in refining the models and testing their practicality. Paper 1 presents a product ideation model which has been tested in a limited manner. The model can be further tested and optimized in different settings, such as with employees of different organizations, designers in companies, students of different disciplines in universities, etc.

Paper 2 presents a model for autonomating operations with the help of a case study. The autonomation model can be validated in autonomizing different operations, and details in the model can be enhanced. The implications of large-scale autonomation on businesses and economics in general should also be studied.

Paper 3 presents a model for servitization that assists users in transforming products into services. However, the model requires validation. A study on the transformation of products into services with start-ups and companies can be carried out, in order to practically test the model. Correlation between servitization and business sustainability can also be studied.

Papers 4 and 5 present a decision matrix for business models, in terms of value-added services and outsourcing business activities, respectively. These studies are based on conceptual reasoning and can be improved by providing case studies from different industries.

Paper 6 introduces a simplified idea-screening tool for the rapid screening of business ideas. The tool has major idea-screening checks but is not backed with market data or analytics. The idea-screening tool can be of further use, if some of the checks can be autonomized, for example the checking of novelty from patent databases and market size from online sources.

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Appended Papers

A novel systematic product ideation model using technology trends

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Tauqeer, M. A., & Bang, K. E. (2022). The technology megatrend of autonomization: What can be standardized – can be sensorized – can be digitalized – and will be autonomized.

Design Studies (under review).

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Article

Servitization: A Model for the Transformation of Products into Services through a Utility-Driven Approach

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Abstract: The economies of the industrialized world have become dominated by services. Many manufacturing companies have changed from producing products to providing services. However, many companies still lag behind in this transformation. It is observed that most of the published methodologies are at an advanced level and provide minimal assistance to help managers and especially the managers of small and medium enterprises (SMEs) who are interested in easy-to-use methodologies for transforming their product range. Therefore, a model that assists the transformation of products into services is proposed, which is at a level that can be directly applied by SMEs. A utility-driven approach is followed to establish the model that consists of seven steps. In the initial steps, a product that is to be servitized is selected and broken down into its utility features and customer barriers. Furthermore, options for increasing utility and reducing barriers are presented such that the overall tangibility of the existing product is reduced. This reduction in tangibility in both physical and psychological dimensions is defined as servitization in the present study. This article presents a practical framework for the transformation of company offerings so that they are gradually adjusted to a service economy.

Keywords: servitization; service transformation; service opportunities; service innovation; product service system

1. Introduction

A paradigm transition has taken place regarding business understanding; that is, businesses are evolving from selling products into offering services [1]. Globally, in 2017, nearly 63% of the gross domestic product was derived from the service sector, according to *The World Fact Book* [2]. It has been observed that the service market is not only larger, but also more sustainable than the product market [3].

According to Druker [4], the customer considers value not in a product, but in the utility that it provides, which is the service that it delivers. This implies that, inherently, customers are not looking for products, but services, where products can be the tools to deliver those services. Many technology companies have transformed their business models from selling products to offering services. Jet engine manufacturers such as Rolls-Royce have changed their business models from selling engine units to offering thrust hours, i.e., the utility the customer is looking for. Therefore, while servitization is the natural next step for established companies to ensure sustainability, it also offers opportunities for small and medium enterprises (SMEs). It is regarded as the process of adding value to products by adding services [5].

Primarily, the terms "product" and "service" are interrelated in the understanding of servitization [6]. Several scholars distinguish services from products, based on perishability, inseparability, ownership,

and intangibility, (e.g., reference [7]). Introductory textbooks on business and economics segregate products and services with respect to intangibility; e.g., reference [8]. "Product" is a tangible commodity produced to be sold [9]. Whereas "service" is an act offered by one party to another, where the process may involve physical products, but the performance is primarily intangible and poses no ownership rights [10]. These definitions have emphasized important characteristics distinguishing products and services, yet it is difficult to differentiate them in some cases. For example, computer software is treated as a product; software is highly intangible, but companies such as Microsoft advertise their software as products (e.g., on Microsoft's website, items of software are listed under the "products" tab). Similarly, services such as the drilling service in the oil and gas industry are highly tangible. Tangible equipment is required to produce a drill, and on the surface where the service is delivered, the outcome is also tangible, i.e., the drill hole produced. Despite all the tangibility involved, drilling is regarded as a service.

A different viewpoint for understanding products and services is to separate them on a continuum, ranging from tangible-dominant to intangible-dominant, e.g., references [11,12]. Tangibility is considered in physical terms by these studies, and the possibility of segregating the aforementioned examples remains unresolved. However, if tangibility is defined not only in physical terms, but also includes a psychological dimension, the segregation of products and services on a continuum is possible [13]. For example, a piece of software will be placed towards the tangible-dominant side, since it has psychological tangibility associated with it; i.e., the user needs to operate it and perform tasks independently. This approach is based on the assumption that absolute products or services are nonexistent, but can be categorized based on features of tangible-dominance and intangible-dominance. Items that have tangible dominance are viewed as products, and items with intangible dominance are called services; see Figure 1.

The literature shows that the term, "servitization", was first used by Vandermerwe and Rada [5] as a competitive business strategy and is not a recent phenomenon. They defined servitization as an increased offering, i.e., offering services on top of products. Since then, the term has been widely endorsed by scholars and considered to create additional value for the business, e.g., [6,14–16]. Defining servitization as an increased offering is a useful approach, but it does not capitalize on the full spectrum of benefits. Therefore, in the present study, a more practical definition of servitization is proposed, which is built on the logic of product service segmentation on the tangibility scale. As products and services are defined on a continuum of tangibility, the repositioning of an item on this scale from the tangible-dominant side towards the intangible-dominant side is defined as servitization in the present study; see Figure 1. This definition has higher objectivity compared to the existing definitions and sets out a sequential methodology to achieve servitization.

From the customer's perspective, servitization reduces risk level and uncertainty. It also reduces liabilities, process knowledge requirement, competence level needs, and the requirement for various resources. Therefore, the servitization of a product or service on the continuum shall be visualized from the customers' perspective and not from the supplier's perspective, since tangibility has a psychological dimension and may be misunderstood when looked at from the supplier's perspective. For a taxi driver, taxi service is tangible when taking car ownership into consideration, but from the passenger's perspective, it is highly intangible.

As it is argued that the products and services cannot be explicitly differentiated in various cases, they are, therefore, collectively called an offering where it is difficult to characterize them further in this study.

The remaining paper is organized as follows: a literature review is provided in the proceeding section, followed by presentation of the servitization model, and conclusions are discussed in the end.

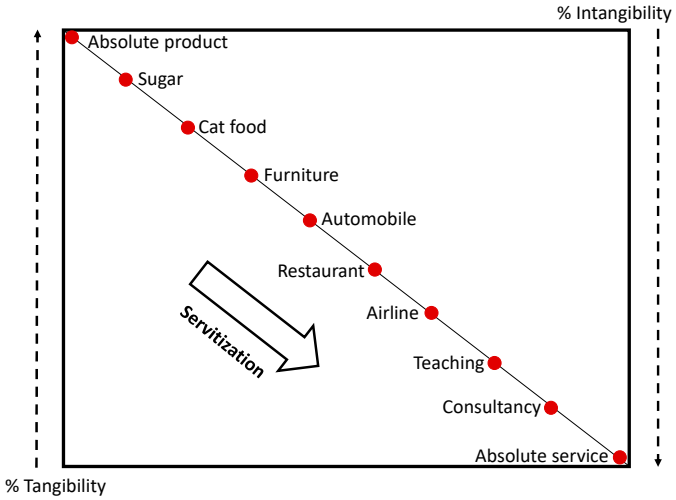

Figure 1. Products and services differentiated on a tangibility/intangibility continuum, which sets the basis for defining products and services, inferred from [13,17]. Here, servitization is defined as the repositioning of any offering on the tangibility/intangibility continuum towards the intangibility side; e.g., an automobile can be servitized by including additional services such as self-driving features.

Literature Review

Various scholars have presented their models, strategies, and ideas for servitizing a product. The literature abounds with studies using the servitization expression. The literature review shows that most of the studies related to servitization have emerged in the last two decades, and academicians have presented a number of different approaches. The studies include the process cycle of service development stages; for example, idea generation, design, development, testing, and launch [18]. Various other studies [19,20], have different numbers of stages, i.e., six and ten, respectively. Studies have also mentioned capabilities that trigger servitization, e.g., reference [21]. Similarly, many studies, such as those by references [15,22–24], present detailed strategy with regard to servitization as offering product-related services as the first stage (e.g., maintenance services), an installed base as the second stage (e.g., Rolls-Royce jet engines "power by the hour" service), and integrated solutions as the final stage (e.g., drilling service). These studies provide a good understanding of the various stages of servitization and formulate a theoretical base upon which the servitization discipline is being established. However, these studies are less practical [25], because the key objective of these studies is to formulate a theoretical base, contrary to the requirements of the industry. These studies are not aimed at the managers in SMEs to act as service transformation tools for them.

Specific models that are more practical and aimed at various target groups within servitization are also present. Noh et al. [26] have presented a model to develop technology-based services using function analysis and technology trees. Several studies have applied the product–service system (PSS) models in industrial applications [27–34], where visualization analysis, stakeholder management, environmental sustainability, customer integration, and modularization are set as key aspects in developing new service concepts. Sun et al. [35] have presented a model where the product needs to be designed in such a way that additional services can be added. For example, a product shall be designed for repairs so that the repair service can be provided, and the product shall be modular so that the spare parts can be added as after-sales service. Fargnoli et al. [36] have presented a framework to address customer satisfaction and environmental sustainability in a regulated market. Haber and Fargnoli [33] have presented a methodology for PSS functional integration enhancement that combines existing models in the literature to establish a unified approach. Kim et al. [37] have presented a model that includes value modeling, service activity design, service interaction, and experience

management. Similarly, Marques et al. [38] have presented a model comprised of four steps: readiness, planning, design, and post-processing. These studies present models and frameworks for servitization with specific aims and objectives and are targeted towards specific applications. They appear to be complicated and time-demanding for the user, whereas traditional SMEs are looking forward to a more practical and easy-to-use approach, hinted in references [25,33], which can be directly applied and are not too time-consuming. Designing products and services simultaneously in PSS originates challenges such as higher complexity and optimization issues [39]. Despite the challenge of increased complexity originating from existing PSS models, little insight is available in the published literature to mitigate these challenges [34]. The existing studies require survey data, customer feedback, and sophisticated software tools to implement servitization. Contrarily, the managers of SMEs need models that do not require extensive data acquisition and learning complicated tools to develop services. The published articles are valuable for managers who are highly qualified and closely linked to academia, but they are insufficient for those that operate startups and SMEs. Large companies also have the possibility of hiring consultant companies, while on the other hand, it is generally not possible for SMEs to afford consultants. The service idea generation in the existing studies is primarily addressed through techniques such as brainstorming, customer feedback, and data interpretation, which are relatively demanding, whereas room for a technique that itself presents service options is available.

Accordingly, the present study is aimed at answering the following research question: How can managers of SMEs servitize their product range without data acquisition and learning sophisticated software tools independently in a minimal time frame?

Based on this research question, the objective of the present study is to develop a systematic model that is simple yet useful and at a level that may be useful for managers of SMEs. The model shall provide practical options of servitization on the tangibility scale such that the options can be checked for a product. The present approach shall replace customer data collection, customer feedback, and complicated software tools so that servitization can be achieved in a time-effective manner.

The objectives of the present study are achieved by conceptually developing a model that is part of a larger study aimed at developing practical tools for the industry. The model is conceptualized by keeping its objectivity as the foremost feature.

2. Servitization Model

Companies are constantly competing against each other to servitize their offerings [40] and are looking for novel ways to carry out servitization [41]. Several methodologies have been published in this regard, and in the light of these existing methodologies, we are proposing a new servitization model that is shown in Figure 2. Contrary to the existing models, the present model acts as a simple, time-efficient tool, with seven steps that can servitize products, and has increased practicality. The model requires qualitative judgements from the user at several steps. Therefore, the results may vary among different users for similar problems, as the qualitative judgement is dependent on the performer's knowledge [42]. The present model is different from the existing approaches because the existing models primarily require data acquisition or customer feedback to trigger service ideas, whereas the present approach takes care of the idea generation part by presenting options. This approach may not be useful to generate state-of-the-art service ideas, but can lead to the development of service offerings by SMEs.

First, a product or service, collectively called an "offering", is selected to be servitized. Then, different customer groups of the offering are identified; this assists in understanding the utilization of that offering. Next, the offering is decomposed into its enablers and barriers: enablers are the utility that supports customers' purchase of that offering, and barriers are the hindrance that stops customers' from buying that offering. Decomposition of an offering into its enablers and barriers provides a better understanding of the offering itself. They help in assessing the reasons that make customers buy an offering and those that prevent them from doing so. Furthermore, the identified enablers and barriers are ranked in accordance with their severity for the major customer groups.

Finally, servitization options are applied to make changes to these enablers and barriers such that the tangibility of the offering is reduced. The details of each step are further discussed in the following.

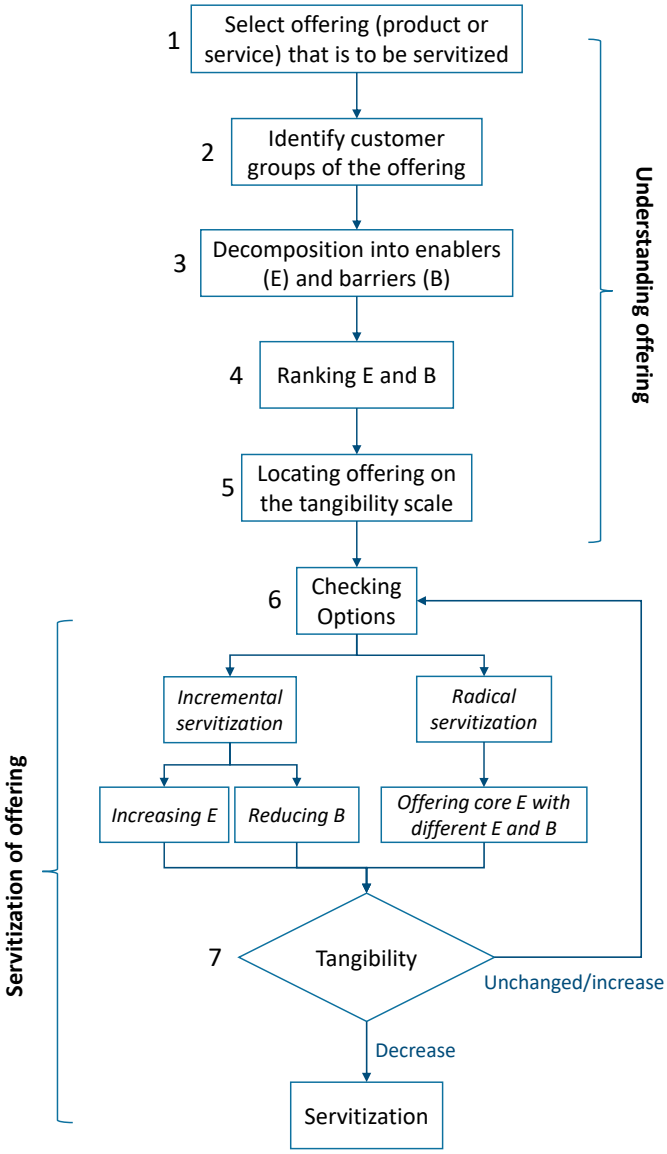

Figure 2. Servitization model.

2.1. Select Offering: Step 1

Due to recent developments in technology and the advent of new business models, almost any product or service can be servitized in the present era. The pace of technological changes has accelerated [43] and opened up new possibilities. Previously, servitization was possible in the form of value-added services for complex products [44], such as the maintenance of diesel generators. It was difficult to servitize a simple product such as a chair. However, the present technology and business trends have empowered the servitization of any product. For example, a chair can be servitized by

placing temperature sensors on it that can monitor the health of the user. Similarly, developments in business trends have also opened up opportunities for servitization: for example, leasing or sharing a chair. Likewise, existing services also have the possibility to be servitized because servitization is defined as a continuous process. Therefore, the present model can be applied to any product or service. However, the significance of the predicted service opportunities is dependent on the product or service selected.

Action item: Select a product or service that appears to have potential for servitization.

2.2. Identify Customer Groups: Step 2

The identification of customer groups is vital to determine the utility of a product or service and to understand it better. Customer groups are to be identified by the segmentation of the market [45] of the offering selected. Customer segmentation is primarily used in marketing, where the target market is identified for the product or service [46]. However, in the present case, an existing product or service is to be servitized and its major customer groups are already known. They assist in the identification of enablers and barriers in the next step.

In order to successfully implement the model presented in this study, any customer groups' segmentation can be relevant. However, a simple methodology, comprising of four parameters for the segmentation of customers in a business-to-customer and business-to-business domain, is shown in Figure 3. These parameters are demographics, monetary, geographic, and psychographic [47]. Examples of customer segments within these parameters are presented in Figure 3. For the offering selected in Step 1, customer groups can be identified from Figure 3.

Psychographic	Lifestyle, personal interests, socially responsible, quality conscious, etc.	Innovation, openness, socially responsible, etc.
Geographic	Location, mobility, etc.	Office locations, presence, etc.
Monetary	Income, home owner, assets, etc.	Revenue, net profit, assets, etc.
Demographic	Age, occupation, education, gender, etc.	Type, size, industry, employees, structure, etc.
	Business-to-customer	**Business-to-business**

Figure 3. Customer groups' segmentation overview.

Action item: Identify customer groups of the offering from Figure 3.

2.3. Decomposition into Enablers and Barriers: Step 3

Numerous scholars have discussed the dilemma of a product's utility—it is not the product itself that is important to the customer, but the utility that it provides to them; see reference [4]. Extending this concept further reveals that each product or service available in the market has enablers, i.e., the utility the customer is looking for and the reason for customers to buy that product or service, and barriers, i.e., the hindrance that stops customer from purchasing the product or service. Sheth et al. [48] have used the term "value", which appears to be analogous to "enabler" in the present study. However, the value of the product is dependent on enablers and barriers, collectively. Therefore, the present approach is a step forward from the approach of Sheth et al. [48], where enablers increase value and barriers compromise it. The tradeoff between the enablers and the barriers sets a decision basis for the customer to purchase the product or service. Consequently, in the present study, a product or service is considered an aggregate of enablers and barriers in order to understand their utilities and hindrances. Thus, it is essential to identify enablers and barriers. An overview of the identification of enablers and barriers is presented in Figure 4.

	Enablers	Barriers
Specific	**Subutility:** What is the utility that different customer groups (identified in step 2 of the model) are looking for, contrary to each other?	**Product-specific barriers:** What are the hindrances unique in different customer groups that stop customer segments from buying the offering?
Common	**Common utility:** What is the utility that most of the customer groups (identified in step 2 of the model) are looking for in the offering?	**Common barriers:** What are the hindrances related to ownership/financing, operation, and risk that stop customers from buying the offering? (select from Table 1)

Figure 4. Framework for the identification of enablers and barriers.

Enablers and barriers can be identified qualitatively from Figure 4. To identify enablers, customer segments from step 2 are used. Customer segments depict different common utilities and subutilities of a product or service. The most recursive and important utility among different customer segments will be the core enabler of the product or service. For example, the customer segments of a drill machine can be machinists, carpenters, construction companies, etc. These customer segments have a common utility: drilling a hole. These customer segments also have subutilities; for instance, machinists can use the drill machine for unscrewing bolts, whereas carpenters could use it for woodcutting. These common utilities and subutilities are the enablers of the drill machine.

On the other hand, barriers of products and services are generally found to be common. These common barriers are identified and summarized empirically in Table 1. In order to identify the barriers of a particular product or service, common barriers from Table 1 can be selected at first. The remaining barriers can be identified by brainstorming hindrances that stop certain customer segments from purchasing the product or service; see the framework suggested in Figure 4. For example, a small niche of people does not want to buy a gasoline car, since it contributes to environmental pollution. The barriers with larger customer groups generally fall into common barriers, which are listed in Table 1.

Table 1. List of common barriers among different products and services.

• High procurement cost
• Procurement lag time
• Maintenance costs
• Downtime/redundancy
• Operational costs
• Depreciation costs
• Rapid technology change
• Certificates and clearances for operation
• Skilled staff required for operation
• Liabilities (business, accidental, etc.)
• Annual premiums/taxes
• Storing and handling issues
• Reselling hassle

The concept behind the identification of the enablers and barriers is that changes in enablers and barriers can increase intangibility in an offering and can result in new service opportunities; see Figure 2, Step 6. For example, customers purchase cars as products. The customer of the car is usually looking for enablers such as transportation from one location to another, flexible transportation, high availability, status symbol, etc. Similarly, there are barriers that are linked to the purchase of the car, for example, high procurement cost, road liability, maintenance costs, driving license requirement, etc. If offered to the customer in an increasingly intangible way, the enablers may forecast service

opportunities. Similarly, if the barriers are detached from the car, new service possibilities can be revealed. For example, the high procurement cost of the car can be eliminated through car lease, which is an already existing service. In the same way, road liability and maintenance costs can also be eliminated by liability insurance and maintenance subscriptions. Enablers also assist in developing new service opportunities. For instance, traveling from one location to another can be achieved in an increased intangible way, namely via public transport, taxi services, etc., which also exist in the market. Enablers such as the flexibility and high availability of transport can be achieved by shared autonomous vehicles that could be a future service.

The existing models identify service opportunities through data collection; e.g., Fargnoli et al. [36] collects data from public tenders and surveys to establish service opportunities in the medical equipment business, whereas the present study relies on systematic qualitative prediction to lessen the effort required for servitization model implementation.

Action item: Identify the core enabler, subenablers, common barriers, and product-specific barriers of the offering using the framework presented in Figure 4.

2.4. Ranking: Step 4

The identified enablers and barriers might not all have high potential for servitization and might not be of top concern. Therefore, it is important to prioritize them in order to ensure that the ones with high market demand are addressed first. There are several techniques regarding qualitative assessment in the published literature for the prioritization of market segments and business models. Similarly, a qualitative assessment tool for enablers and barriers is proposed in Figure 5, where they shall be ranked in accordance with the severity for the consumer [49,50]. The severity of an enabler is to be judged qualitatively between "essential" and "nice to have". Those enablers that are essential for the customer and without which they are likely not to buy the offering are to be top-ranked, while those enablers that the customer is interested in, but are not necessary are ranked lower in the scale. Similarly, the priority of the barriers is also qualitatively determined between "extreme" and "moderate" barriers, reflecting how strong the barrier is from the customer's perspective. Top-ranked enablers and barriers are the preferred opportunities for servitization. This does not necessarily imply that the enablers and barriers lower on the scale should be ignored altogether.

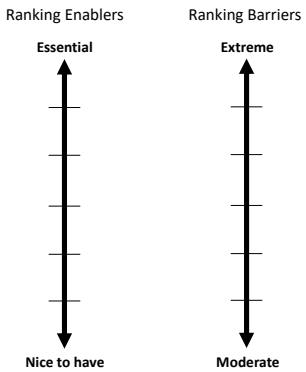

Figure 5. Ranking of enablers and barriers.

Action item: Rank the enablers and barriers identified in Step 3 qualitatively on the scale shown in Figure 5 and select the top candidates for further stages.

2.5. Locating Offering on the Tangibility Scale: Step 5

After identifying the offerings' enablers and barriers, the next step is to qualitatively judge the tangibility of that offering. This step is important in order to keep track of the performance of the

model, to answer whether the tangibility in the existing offering has reduced or not after the complete implementation of the model; see the overview of the model in Figure 2. It is to be carried out by qualitatively placing the offering on the tangibility scale shown in Figure 1. The qualitative judgement may differ between different assignees, but the purpose of this step is to evaluate the new offering predicted after going through the remaining steps of the model and assessing whether the new offering is less tangible than the existing one. So, a particular individual's qualitative judgement of the existing offering and of the predicted offering would remain consistent.

Action item: Locate the selected offering qualitatively on the tangibility scale shown in Figure 1.

2.6. Checking Options: Step 6

The first five steps of the model have the key objective of systematically understanding the selected offering. From this step onward, options for servitization are presented that can be applied to the selected offering to achieve servitization.

This step has two subcategories, i.e., incremental servitization and radical servitization. These two terms are coined in the present research to categorize servitization. These terms are analogous to incremental and radical innovation. However, instead of innovation, the focus is on reducing the tangibility of the offering, called "servitization" in this study. Incremental and radical innovation are defined as "doing better what we already do" and "doing what we did not do before", respectively [51]. Similarly, incremental servitization is referred to as a servitization approach, in which a gradual decrease in the tangibility of the offering takes place; for example, through value-added services such as maintenance services. On the contrary, radical servitization refers to the servitization approach in which the existing offering is significantly changed, such that the tangibility of the offering is substantially reduced; for example, disruption of the taxi service by Uber. It is interesting to note that servitization can also be described as an instrument for innovation. Some scholars describe servitization as the new strategy to achieve innovation; for example, reference [52]. Thus, servitization can be referred to as the subset of innovation.

Incremental and radical servitization options are further explained in the Sections 3 and 4.

Action item: Select incremental or radical servitization options presented in Sections 3 and 4.

2.7. Check Tangibility: Step 7

The last step of the model is to compare the tangibility of the offering before and after the intervention of the option or several options in Step 6. If the tangibility of the offering is reduced, successful servitization is achieved. Otherwise, the other options from Step 6 can be checked again.

Action item: Compare the tangibility of the offering with interventions to the initial offering and follow the logic shown in Figure 2.

3. Incremental Servitization

In the present study, incremental servitization is defined as the servitization approach, in which the tangibility of the product or service is gradually reduced by increasing enablers, reducing barriers, or both. Increasing enablers gradually increases the utility of the offering from the customers' perspective, and reducing barriers, on the other hand, gradually reduces hindrances preventing the customers from purchasing an offering. Therefore, it is important to investigate how an offering's enablers can be increased and barriers can be reduced in order to realize incremental servitization.

3.1. Increasing Enablers

Increasing enablers is the easiest way to servitize an offering. It is inferred that the enablers of an offering can be increased, by either

- Directly adding services, or by
- Increasing the complexity of a simple offering and simplifying the utility of a complex offering.

Directly adding services is comparable to value-added services, where additional services are added on top of an offering. They include services such as product delivery service, installation service, customer support service, operational support service, and maintenance service. These services can be directly added to a product. For example, a welding machine can be sold with two additional services: operational support service and electrode delivery service. These services add new enablers to an offering and reflect the utility of the freshly added service. In a similar fashion, the offering selected for servitization can be checked if additional services can be added. This process of offering services with products has been significantly discussed in the published literature; for theoretical details, see, for example, references [5,28,53,54].

The second approach for increasing enablers is related to utilizing modern technology. We can increase the enablers of a product and its attractivity by implementing features of technological development into the products. There are a number of innovative technologies around us, but there should be a strategy to fully exploit these technologies, otherwise even innovative technologies may fail. The framework to utilize technologies in order to increase the enablers of an offering is shown in Figure 6. It has two dimensions: increasing the complexity of a simple product and simplifying the utility of a complex product through the utilization of technology; the options to increase the enablers of an offering are presented in Figure 6. The complexity of a simple product can be increased by applying options such as hardware that can process data, sensors that can monitor different parameters, connecting the product over the Internet, and interpreting data with smart algorithms. For example, the enablers of a simple product such as a chair can be increased by making that product complex by installing computer hardware, sensors, and algorithms, so that it can monitor the user's body temperature, keep track of the user's weight, and predict health susceptibilities. With these interventions, the complexity of the chair has been amplified, increasing its enablers and thus servitizing it. In this way, the enablers of a simple offering can be increased by increasing the complexity of that offering. However, this approach works primarily for simpler products.

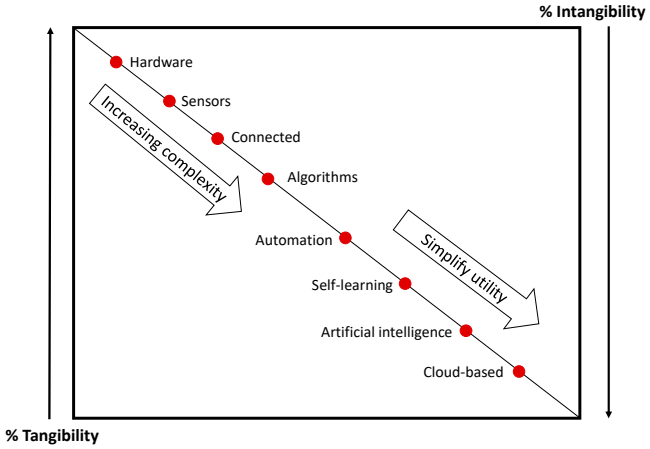

Figure 6. Options for increasing the enablers of an offering, by increasing the complexity of a simple offering and simplifying the utility of a complex offering, on a tangibility scale.

Similarly, for complex products, further increasing complexity becomes challenging. However, in this case, enablers can be increased by simplifying the utility of that offering. Utility simplification implies that the utilization of the offering is to be made easier for the consumer. Several options for utility simplification are mentioned in Figure 6; they include the automation of processes, self-learning products, artificial intelligence, and cloud-based architecture. To understand these options, consider the example of a lawn mower, which is a complex product and can have increased enablers if its utility is simplified. The utility of a lawn mower can be simplified: by automating it, so that it can cut

grass automatically; by making it self-learning, so that it can adapt to the ground terrain; by including artificial intelligence features, so that it can stop operation in rainy weather conditions; and by having a cloud-based architecture, so that the user can control or monitor performance from anywhere.

A case study of servitization of a lawn mower is presented in reference [33], where services opportunities such as maintenance, financing, life extension, and the recycling of materials are successfully predicted. However, the servitization model lacks the anticipation of service opportunities related to increasing complexity and simplifying utility as mentioned above.

The options for increasing complexity and simplifying utility are sorted on the tangibility scale, in accordance with the tangibility change they can bring to the offering when applied. There can also be other technological options that can be included in Figure 6; however, the ones listed are the most significant and general enough that they can be applied to any product or service.

As mentioned previously, servitization is a continuous process. Therefore, it is possible to apply all the options mentioned in Figure 6 to a particular offering. If the product is simple in the first place, it can be made complex, and after that, its utility can be simplified.

3.2. Reducing Barriers

The next phase in the servitization model is to reduce barriers. Unlike enablers, the barriers of most offerings are common, as mentioned earlier. The common barriers listed in Table 1 can be categorized into ownership/financing barriers, operation barriers, and risk barriers. However, there are barriers that are unique to each offering and are known as product-specific barriers. They are observed to be less important in the servitization process. The ownership/financing category covers high procurement cost, procurement lag time, operational cost, depreciation cost, and annual premiums/tax barriers. Similarly, the operation category covers maintenance cost, certificates and clearances for operation, skilled staff required for the operation, and storing and handling barriers. The risk category covers liabilities from products and rapid technological change barriers.

These four categories of barriers have overlapping features and are subsets of each other. They are systematically arranged in Figure 7, where the size of the circle depicts the tangibility associated with each category. Ownership/financing has the highest tangibility among the others.

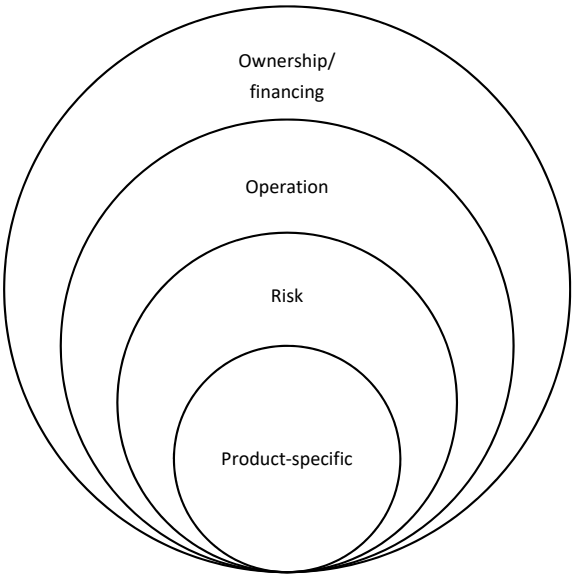

Figure 7. Types of barriers in accordance with the servitization potential and interdependence. The size of the circle depicts the tangibility associated with each category.

The barriers identified and ranked in Steps 3 and 4 of the model can be reduced by checking options for various categories of barriers in this section. Each category of barriers is addressed separately as follows.

3.2.1. Ownership/Financing Barriers

The key aspects that a customer considers while purchasing an offering are its ownership and financing. This category of barriers has the highest tangibility associated with it. Therefore, in order to servitize an offering, it is vital that it is addressed. In their study, Olivia and Kallenberg [15] analyzed different companies which were shifting from products to services and discovered that the transition involved no technological difference, but a different business model. In the present study, it is inferred that the major difference in that business model is the ownership and financing method. For example, a car is a product if owned by a user, but becomes a service if rented. This involves only a difference in ownership and financing. From the service perspective, ownership and financing are primarily analogous to each other, as the type of financing scheme directly affects the ownership of the product. The proposed methodology to reduce these barriers consists of two stages:

(1) Reducing ownership duration;
(2) Transferring or diversifying ownership.

The first stage concerns how the duration of ownership of the product can be reduced. In order to achieve this, several options are presented in Figure 8. These options are sorted on the tangibility scale in accordance with their potential to servitize an offering. The potential to servitize an offering is higher for the options lower on the scale and they can eliminate more barriers. However, some options may not be relevant for every offering. Therefore, options need to be gradually checked from the top of the scale to the bottom. For example, consider a car as an offering, whose ownership duration is to be reduced, which will reduce its barriers and thus servitize it. From Figure 8, it can be observed that the loan option is high up on the scale and has an ownership duration of almost a lifespan. It can reduce some of the car's barriers, such as high procurement cost, which is the key barrier to purchase for most customers. Similarly, the lease option is lower on the tangibility scale, next to the loan option, and can reduce the ownership duration of the car from lifespan to years, which will eliminate barriers such as reselling hassle for the customer. Furthermore, the renting option can reduce the ownership duration to only days and weeks, which eliminates several other barriers such as maintenance costs and rapid technological changes. This is because renting the car will mean it will be owned for a shorter period of time, thus servitizing the car.

The second stage is to reduce barriers through transferring and diversifying the ownership of the offering, and the relevant options are presented in Figure 8. The first option is pay per use, which has the possibility of improving the utilization of a particular product because the product will be used by several users. Therefore, pay per use can transfer and diversify the ownership of any product. It is suitable for products that have less utilization, such as bikes, tractors, diving equipment, and lawn mowers, for example, and it can eliminate barriers such as annual premiums and storage requirements.

Similarly, the subscription option is the next on the scale; this is where the customer subscribes to an offering against an agreed periodic fee. This option can be applied to products such as smart phones, which are subject to barriers such as rapid technological change and high depreciation rates. This option is suitable for electronics or for larger products such as cars; for example, Mercedes is testing a car subscription model in the United States [55]. It is also a very relevant option for servitizing less-tangible products, such as movies and songs, through subscription to a database instead of individual sells. The crowdfunding option is suitable for various offerings, especially those that are capital-intensive. In this option, a group of people jointly finance an offering. For example, people in a common neighborhood can crowdfund a training facility.

The last option in Figure 8 is the freemium option, which is suitable for offerings that are to be used by a large customer base. Freemium models are abundantly applied to offerings that are low in

tangibility, for example, mobile and web applications. However, in the future, the freemium option could be applied to more tangible items such as smart phones against user data exchange. Freemium models for cars with self-driving and sharing features also seem possible.

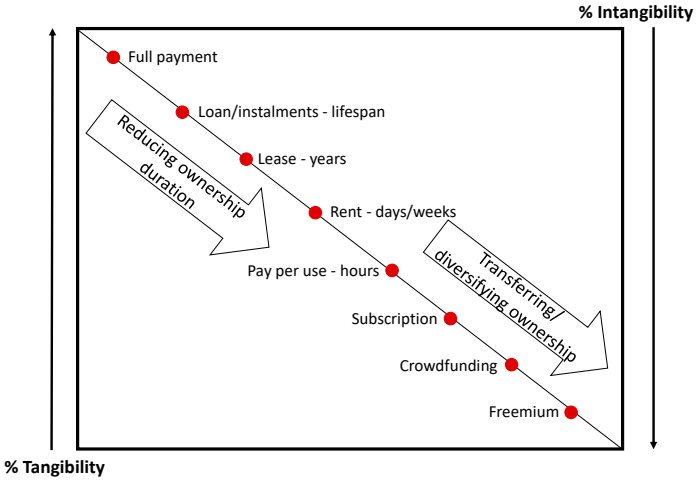

Figure 8. Options for ownership/financing barrier reduction.

3.2.2. Operation Barriers

Aspects related to the operation of products are the next type of barriers. These barriers can be lowered by reducing manual operation and by transferring parts of the operation to suppliers. The operation of a product is here meant to cover the aspects of storage, operating, maintenance, certificates for operation, and so on; thus, the physical handling of the product. Options for lowering these barriers are shown in Figure 9.

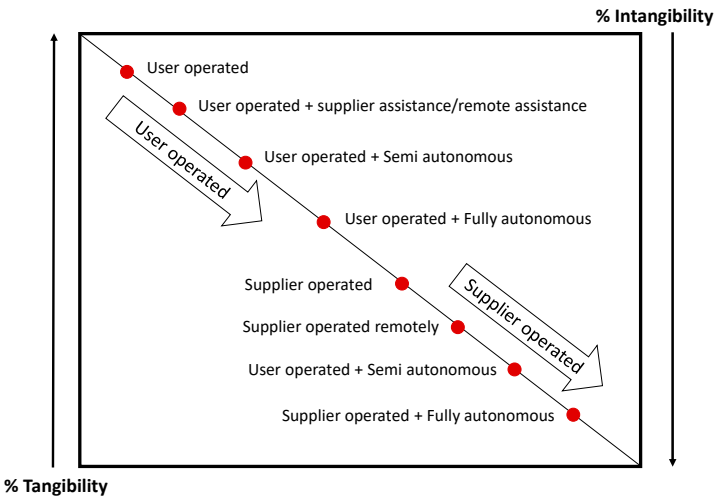

Figure 9. Options for operation barrier reduction.

Reducing the operation barrier is closely linked to increasing enablers by increasing the technological complexity. By adding hardware and sensors and connecting the product, opportunities open up for suppliers to remotely support the product. It can be monitored and often debugged from

afar. Examples range from software support to complex offshore oil drilling operations. In the early days of the computer, all program failures had to be brought up with the internal IT department, which showed up in the office and made (often futile) attempts at correcting the failure. With increasing processing power and a new level of connectedness, we can now get assistance directly from either the internal IT department or the supplier and they can fix problems remotely, as we see it happening on the screen.

Many heavy industrial products require highly skilled personnel for the operation of the equipment. Others require certificates and clearances for operation. By adding more sensors and being able to monitor operations from afar, the required inputs, skill set, and training are reduced. In offshore operations, an expert engineer can sit at headquarters onshore and monitor simultaneous operations at many offshore locations. This reduces the need to have an expert on board at all these locations. The necessary skill set can be held by one person, and operation offshore can be reduced from interpreting input and deciding what to do to just doing.

The next step will be to make many of these expert judgements automatic. For many situations, algorithms are now becoming better than humans at making the optimal decisions. This leads to more tasks and the handling of the product becoming autonomous: both the physical operation and the decision as to what physical operation to carry out.

As we go from user operation via supplier support to automation, we also enter the choice of transferring the responsibility for the operation to a supplier. Also, after such a transfer, there can be steps leading to automation, and all the steps may not be on a straight line of decreasing tangibility. There are, however, opportunities to increase servitization, both from developing the product along the lines of sensors, connectivity, and autonomization and from the transfer of parts of the operation to suppliers.

There are opportunities for many products to increase the level of services in this way, but at the same time, this requires the company to pay attention to the developments happening in several technological areas.

3.2.3. Risk Barriers

Risk barriers vary according to the offering and are typically linked to product breakdown, liabilities, technology change, depreciation rate, etc. These risks hinder various customers from buying an offering. They can, however, often be lowered in a similar fashion to that of the previous barriers, by reducing risk and then, potentially, further transferring risk. Various options for reducing risk barriers are presented in Figure 10.

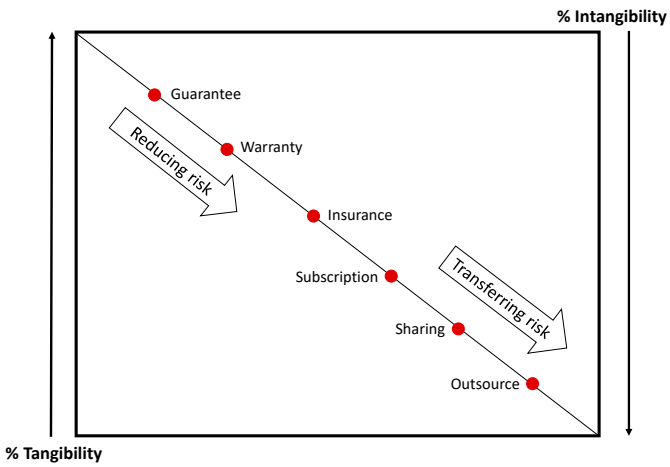

Figure 10. Options for risk barrier reduction.

Breakdown Risk

As an example, for a customer, a potential risk would be the breakdown of the product shortly after purchase. This risk can be reduced by including a guarantee or a warranty with the product. These are less-tangible features, and through their inclusion in the offering, the total tangibility of the offering is reduced and the risk for the customer is also reduced. Hence, the barrier that potentially prevents the customer from buying is reduced through this increase in intangibility.

Liability

Similarly, insurance can reduce liability risks. Insurance can be related to many aspects of a product or service. Potential negative events and their financial consequences can be protected against for a fee. Including different types of insurance in the offering of a product or service can be either a direct reduction in the potential risk exposure or the transfer of risk to a third party, collectively lowering the tangibility of the offering.

Risk Related to Technological Change

In many areas, the rate of technological development is very high and potential customers are worried about the risk of the product they may be interested in buying becoming obsolete or outdated shortly after purchase. Risk associated with rapid technological change can be lowered by subscription options. This has already been discussed in the ownership/financing barriers section, as these barrier categories have some overlapping features, demonstrated in Figure 7.

Depreciation Risk

Depreciation risk can be lowered through product sharing. Products such as a shared car would have increased utilization and, therefore, reduced investment and depreciation.

Outsourcing can also be another way to take away major risks. It can be done in relation to producing a product and in that way, reduce risks associated with quality and production capacity, for instance. It can also be done in relation to the execution or provision of a service.

Many different options exist for decreasing the risk barriers. A combination of these options can be applied to a product or service to reduce these barriers.

3.2.4. Product-Specific Barriers

Most barriers of varying importance are covered in the aforementioned categories. However, there are barriers that cannot be covered through a generalized approach. These barriers have to be addressed independently in order to eliminate them. They are probably less significant for servitization and are also difficult to address. For example, few customers are less willing to buy an automobile due to environmental concerns. This barrier is specific to combustion engine automobiles. Therefore, it is difficult to eliminate it through a generalized approach.

4. Radical Servitization

Radical servitization is described as a phenomenon where the core enabler of an offering stays the same, but the peripheral enablers and barriers are significantly changed. This implies that the offering must be radically changed, such that the core purpose of that offering prevails, but the process of providing that offering radically changes.

In incremental servitization, enablers are increased and barriers are removed relatively incrementally; therefore, the tangibility scales of servitization options appear to be continuous. On the contrary, in radical servitization, enablers and barriers are changed considerably; hence, the tangibility scale is a stepwise descent. Various options of radical servitization that have practically transformed numerous offerings in the market and can transform other offerings are illustrated in Figure 11. They

can radically servitize an offering and are not limited to those shown in Figure 11. However, the most important ones are assembled in Figure 11.

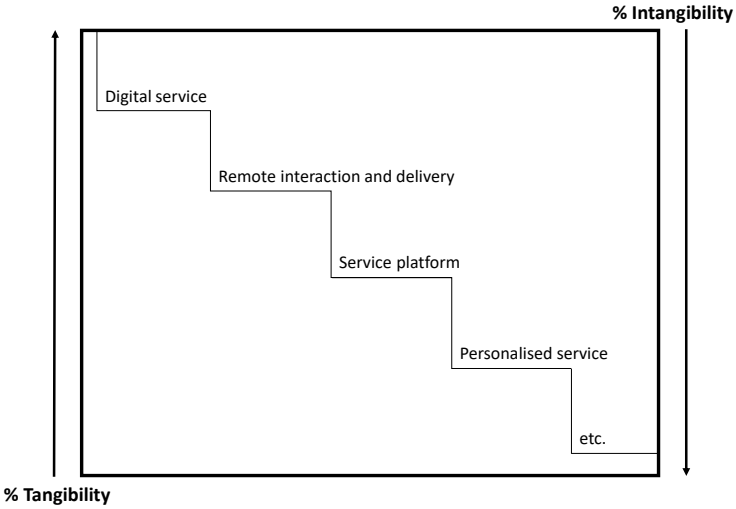

Figure 11. Radical servitization strategy.

These days, digitalization is the most important aspect of business, as stated by a number of studies. It is inferred that digitalization can also contribute towards the servitization of an offering. The direct effect of digitalization is that it reduces the tangibility of an offering by digitizing some of the features. For example, digital parking solutions can servitize manual parking spaces, where the number plates of the vehicles can be scanned by cameras and parking fees can be digitally charged to the owners. This transformation brings a step change in the tangibility of the parking space, and the service level for the users also drastically increases. A similar approach can be applied to any offering in order to come up with servitization ideas.

Similarly, remote interaction and delivery is also an option for radical servitization. As the name suggests, the interaction and service delivery can take place remotely. For example, we can purchase goods through digital platforms and they are delivered at our doorstep. Services such as health services can be radically servitized by remotely interacting with medical practitioners such as remote doctors and through the delivery of medicines to the doorstep. This transformation is also a step change towards servitization and can be applied in a similar fashion to various existing offerings.

The service platform is a service delivery architecture, where matchmaking between people from the open market, providing service and accessing service, takes place. Service platforms can also radically servitize existing offerings: for example, the hotel service being replaced by the service platform "AirBnB". Likewise, personalization of the offering is also important for servitization, where the offering is transformed in accordance with the customer's desire: for example, personalized web pages based on customers' browsing history and the personalization of physical products such as garments and cars.

These options need to be inspected for the offering which is to be servitized, and one or several of them may be relevant to the offering and may substantially reduce the tangibility of the offering.

5. Discussion and Conclusions

Rapidly shrinking product lifecycles and an increasing demand from business leaders for sustainable substitutes for highly competitive products provide the impetus to study the servitization of products. Various servitization models have been published that lay the foundation of the servitization

discipline. Through the literature review, it has been found that the existing approaches are at an advanced level that neglects the requirement of SMEs for practical approaches [25,33]. The existing studies require users to have a deep understanding of the servitization discipline and be able to gather sales data, collect customer feedback, apply sophisticated software tools and complicated methodologies, and so forth to achieve successful servitization. It is difficult for business owners of SMEs to invest that many resources in developing services. They are looking for a simplified approach that can be independently applied and provide useful insights about the servitization of their product range. A model for the servitization of products and services specifically addressing the needs of the managers of SMEs is developed that is at a practical level and can be applied to a range of products. The model differs from existing studies because of its ease-of-use. It consists of seven steps where the managers of SMEs can follow these steps chronologically and generate a service idea. No additional effort such as data collection or customer feedback is required. The present approach is also time-efficient, since it requires qualitative judgements from the user. The existing methodologies lets the user generate service ideas mainly by comprehensively evaluating data, although different methods are applied to do so. In contrast, the present approach presents established servitization options to the user to select from instead of idea generation, which significantly reduces the time required to apply this model. However, the time efficiency is gained against the tradeoff that this model provides less contribution in developing entirely unique services.

The model comprises seven sequential steps. The initial steps let the user understand the offering to be servitized through the breakdown of the offering into its utility features, which is in accordance with Drucker's [4] perspective on services. Subsequently, two major dimensions of servitization, namely incremental and radical servitization, are explored. Incremental servitization can be achieved by directly adding services to products, which is in agreement with the viewpoint of PSS literature, increasing the utility of the offering through technological developments and by lowering the customers' purchasing hindrances by changing the ownership, operation, and risk aspects of the offering. The perspective of achieving servitization through analyzing options of increasing utility and lowering hindrances of a product is a state-of-the-art contribution of the present study. This approach is analogous to the case study of Haber and Fargnoli [33], where "critical-to-quality elements" are used. However, "critical-to-quality elements" are collected through a customer survey in that study, which makes the servitization model more demanding. Similarly, Noh et al. [26] have suggested technology trees and functional analysis to generate service ideas. However, it requires input from technology engineers. In contrast, the present approach is independent of any data collection requirements. Various options for achieving the radical servitization of an offering are also presented in the model.

Theoretical contributions include understanding services and the servitization discipline in a comprehensive manner. A new definition of servitization with respect to the tangibility scale is proposed and is classified into incremental and radical servitization. Furthermore, a model is presented for the reduction of the tangibility of an offering and examining an offering through the lens of enablers and barriers such that the utility features of the offering are better understood. The existing studies primarily emphasis on generating service ideas through brainstorming, customer feedback, and data analysis, whereas in the present study, servitization options are presented as an alternate idea generation methodology.

For industry, the present model can act as a tool to derive service ideas that can eventually lead to the transformation of their product spectrum. The model presents options to achieve servitization on the tangibility scale such that it is intuitive and easy to implement for the industry managers. The model is developed specifically to address the need of SMEs and will be applied further in various industry segments to validate its practicality. However, the efficiency of the model, when applied in the industry, needs to be investigated. Furthermore, the quality of the service ideas generated, realization potential of these ideas, and changes in the business model of the company in order to implement these ideas also need to be studied.

The present study is conceptual in nature and has not been verified; however, further research will include verifying this study by implementing it in the industry. The study presents service options, and therefore the ideas generated in the present model are limited by the presented service options, which may compromise radically new ideas. Another aspect that has become clear during the work on this model is that the potential for servitization is closely linked to the developments occurring in technology and the inclusion of these in the products underlying the services. The more sensors, processing power, and connectivity included in a product, the greater the potential there is for servitizing the product. Therefore, studying servitization together with the developments in technology and the effect of these service options on the business model of the companies are the future research directions.

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INTEGRATION OF VALUE ADDING SERVICES RELATED TO FINANCING AND OWNERSHIP: A BUSINESS MODEL PERSPECTIVE

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ABSTRACT

It is an agreed fact among scholars that services are more sustainable compared to the products. By offering services, traditional companies can lock their customers into a long-term and sustainable revenue generation settlement. Available academic literature is abundant with methodologies related to service development. However, this study investigates various value adding service options related to financing and ownership of a product that can be offered on top of the existing products. It is important to understand these options from the consumer as well as supplier perspective. The most well established options available for financing/ownership are compiled, and sorted with respect to intangibility, ownership, financing and value addition scale. The study argues that the identified options incrementally add value to the existing offering by increasing the purchasing power and reducing the ownership obstacles for the customers. However, for the supplier, the decision depends on the trade-off between value addition for the customers and the business model changes required.

Keywords: Service design, Product-Service Systems (PSS), Business models and considerations

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1 INTRODUCTION

According to Vargo and Lusch (2008), a paradigm evolution has taken place concerning businesses that they are shifting from selling products to offering services. Globally, services are not only larger than any other segment but also more sustainable (Chesbrough, 2011). This dominance is due to the fact that customers, in general, are not interested in the products but in the utility that the product provides to them, (Druker, 1975) which is called as a service (Tauqeer and Bang, 2018). The product life cycle has also significantly reduced in the present era and companies are increasingly competing against each other to launch new products. It is difficult for many companies to participate in this race and therefore, a tentative solution is needed. One of the solutions to this dilemma is to shift the business model from selling products only to offering services together with the products (Chesbrough, 2011). According to Olivia and Kallenberg (2003), service integration does not primarily involve any technological changes but includes modifying the business model. This implies that it is not mandatory to have technological advances in order to integrate new services.

Existing literature on service development includes service development process cycles with idea generation, design, development, testing, and launch stages (e.g. Johnson *et al*., 2000; Aurich *et al*., 2006). Similarly, studies by Olivia and Kallenberg (2003); Gebauer and Fleisch (2007); and Kowalkowski *et al*. (2015) have mentioned levels of services that are product-related (i.e., first level), installed base (i.e., second level) and integrated solutions (i.e., third level). Several studies have applied the product-service system models in industrial applications, e.g., by Van Halen *et al*. (2005); Sakao and Shimomura (2007); Vasantha *et al*. (2012); Pigosso and McAloone (2016); and Fargnoli *et al*. (2018) to develop new service concepts. According to Sun *et al*. (2009), the product needs to be designed in a way that additional services can be added. Scholars have also emphasised the relationship between services and business model (Chesbrough, 2011; Eggert *et al*., 2011; Visinjic *et al*., 2014).

Companies around the world are increasingly looking for service opportunities that can increase their revenue from their current product ranges. Not much research has been done on this topic and available literature provides marginal assistance in this regard. This study looks into the financing/ownership service options from the consumer and supplier's perspective. In addition, changes in the business model that the business owners need to make while perusing any of these options are investigated. In principle, services can be offered in various ways for instance, as technological services, value-adding services, after sales services, product-service system etc. However, due to the limited scope of this study, only value-adding services related to financing and ownership of the product are discussed.

From the literature review, the research question identified is:

What changes financing/ownership options bring to the business model of the company while transforming the product into service?

The remaining paper is organised as: First, the financing/ownership value adding service options collected through literature review are presented proceeded by, studying the impact of these options on the business model of a company.

2 SERVICE INTEGRATION OPTIONS

The service options related to financing/ownership that can be selected by a company are collected through rigorously reviewing the literature and are shown in Figure 1. They are sorted with respect to intangibility, ownership, financing, and value addition. In the present context, intangibility is the measure of ownership of the product therefore; intangibility, value addition, financing and ownership are coupled parameters. The higher the intangibility, less the ownership of the product, which eases financing of the product for the customer and results in value addition for the customer. Correlation of these parameters is shown in Figure 1.

Financing reflects the channels that the customer can pay through in order to purchase an offering. Whereas, ownership implies various challenges that the customer faces after purchasing an offering such as operational cost, depreciation cost, annual premiums/tax, liabilities, and product storage. From the service perspective, financing and ownership are primarily analogous to each other, as the type of financing scheme directly affects the ownership of the product.

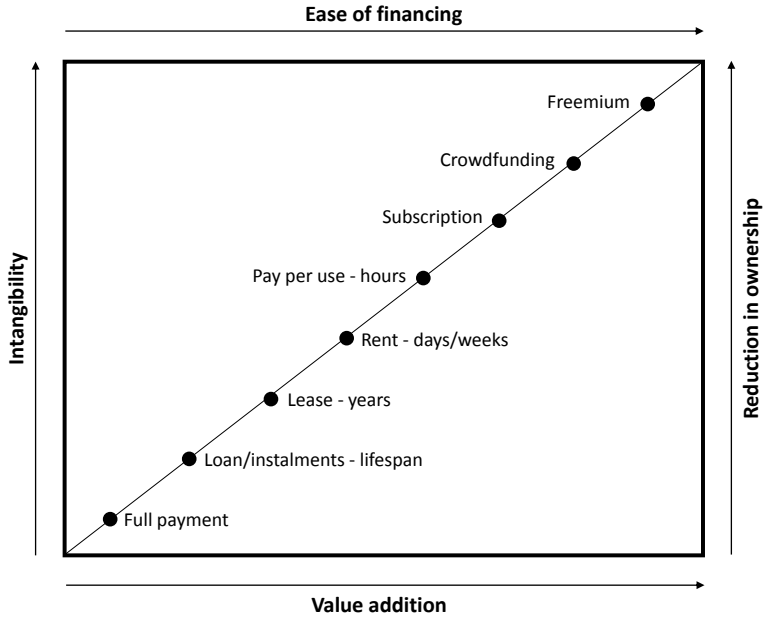

Figure 1. Financing/ownership options sorted with respect to intangibility, ownership, financing, and value addition capability for the customers

A company can increase the value of its existing product by gradually offering the options on top of the product (Figure 1). These options are sorted in accordance to their potential to servitize an offering. The options higher up on the scale eliminates more ownership traits from the offering compared to the rest. Options up on the scale may not be applicable to all products, however, those low on the scale can generally be applied to all products. Hence, options need to be gradually checked from the bottom of the scale to the top. Figure 2 shows the effects of integrating the financing/ownership service options listed in Figure 1, on the product. At each step on the scale shown in Figure 1, company adds value to the customers, resulting in increased company's sales. This will also give a competitive advantage and raise the general standing of the company and by that the prospects.

Although adding to the offering may add value to the customer and increase the competitive strength of the company in the market, this might not directly lead to added revenue. Added customer value might lead to more sales, but the basis to generate revenue may change. By offering financing of the product, revenue basis is expanded to include interest on loans or from leasing. However, by not setting up financing options as the new business processes but instead co-operating with other companies in order to provide the expanded services, the company may not fully capitalise in the revenues resulting from these options. However, cooperation can lead to higher sales and the company will then neither be exposed to the risks associated with these added services. This is one of the major trade-offs that has to be done. Adding to the offerings by adding new processes will also add to the competence and capital requirements.

Figure 1 shows us two important points. First, there are options available for further servitization of the product by offering value adding services. Second, there might be several major consequences to the business model of the company by pursuing those options. What we see from Figure 2 is that when a company adds a service to an offering, it adds value to both customers and the company. The consequence is that as a company it may not have a choice. If the competitors are increasing attractivity of their products by adding these services, a company that is not doing it will fall behind in the competition, hence cannot afford that to happen. This can mean that if there are opportunities for further servitization of the products, they must be pursued to stay ahead in the competition. There is really no choice, and it may be one of the contributing factors in driving the increase in services. The choice is more on whether the new offerings should be provided through new processes internally or set up through co-operation with other companies. This consideration depends on the increased

revenue versus the increased risks, and the availability of resources and financing for building the processes.

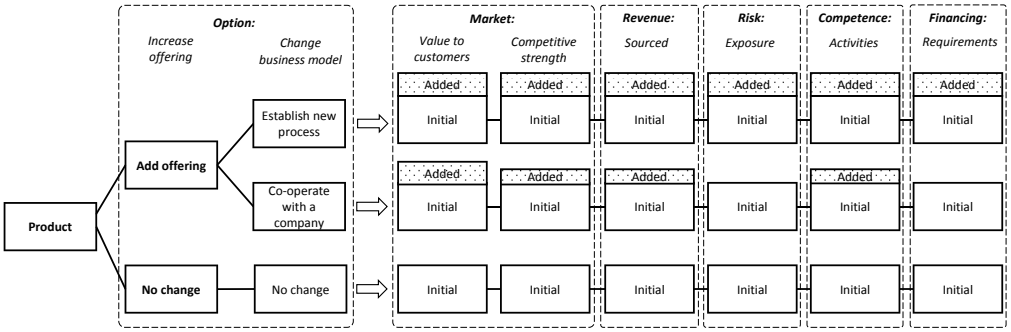

Figure 2. Decision tree for the implementation of the financing/ownership options in the business model

3 EFFECT OF THE SERVICE OPTIONS ON THE BUSINESS MODEL

In their study, Olivia and Kallenberg (2003) analysed different companies, which were shifting from products to services, and discovered that the transition primarily involved a change in business models. In the present study, financing/ownership options are inferred to be the major difference in the business model of the companies shifting from products to services. For example, a car is a product if owned by a user but becomes a service if rented. This involves only the difference in ownership and financing of the car. In the previous section, the effect of the options listed in Figure 1 is observed from the consumers' perspective and it appears that the offering becomes more likely to be purchased if it is offered through the options up on the scale. Therefore, in order to grow customer base, companies need to transform their business models so that they offer rent, lease or subscription services on top of their products. However, it is important to investigate what changes are required in the business model, revenue model, financial requirements, competence requirements, regulatory requirements, and risks in order to offer these services. These changes are summarised in Figure 3.

3.1 Sales

A Sale is selling of products to the customers at the agreed price. The customer pays in full for the product and fully owns that product. Sales are the most common mode of revenue generation for the sellers. However, as discussed earlier, sales of the products are not sustainable in the present rapidly evolving market. Therefore, alternative methods need to be studied so that the product offering is transformed towards service side for a sustainable revenue stream. Nokia was the world leader in cell phone business (Surowiecki, 2013) but it was unable to compete against the rapidly evolving product businesses. Contrarily, Google offers most of its products as freemium, which are resulting in long-term sustainable revenue stream.

The remaining options shown in Figure 3 are studied in comparison to sales so that the relative difference can be understood.

3.2 Loan

The largest barrier for many customers is the cost of the product. Many companies (like GM and GM money bank) have moved from not only providing products but also enabling customers to buy the products. Such a strategy definitely effects the company's business and revenue model, yet, it offers a competitive advantage in its primary market of selling the products in comparison to companies that do not provide these extra-integrated services. Providing loan along with the product is one of the option to reduce purchasing barrier for the customer and it is a well-known approach. However, we see fewer examples of companies that consider providing loan as an alternate option to the consumers.

For most consumers buying expensive products with full payment is a challenge. To tackle this issue, business owners have two possibilities to offer loans in parallel to their product sales. Either they can co-operate with a bank or they can change their business model from production only to production plus

banking. This will change their revenue model from sales only to sales plus interest earnings. It is interesting to investigate what new resources the company would require when its business model is changed from production only to production plus banking. Theoretically speaking, the financial requirements to provide loans is the same as production with an estimated ten percent of the sales value. This implies that the company need not to establish a large bank with significant customer deposits. Ten percent of the sales is manageable by most of the companies. However, new banking competence would be required to setup customer contracts managing the loan collection system. Similarly, the company will require banking licenses. This option has debt recovery risks associated with it but the risk is low considering the recovery rates of banks in the present time. Considering these requirements, it should be possible for small business owners such as grocery stores and hardware stores to provide loans. IKEA a furniture seller also offer loans to the customers (IKEA, 2019).

3.3 Lease

The lease option is identical to loan option in many aspects, however, differs in terms of ownership. The leased product has distributed ownership between customer and supplier contrary to a loan where the product is fully owned by the consumer. The lease is time-bound where the consumer partially owns the product during the lease period.

In order to provide leasing service, companies can either establish a co-operation with existing leasing company or establish a leasing company. The business model will transform into production plus leasing and generate revenue through sales as well as leasing. Leasing requires increased capital requirement than rental since the consumer pays only during the lease period. Higher competence is required to capitalise the products received at the end of the lease agreement. In addition to rental risks, it also includes uncertainty risk of the remaining life of the product. For example, the value of smartphones exponentially decreases over time and therefore, it is difficult to estimate the rest value after the maturity of the lease agreement. Traditionally, houses and cars were leased. Nowadays smartphone and computer lease options are also available in the market. However, considering the increased customer requirements, it should be possible to lease lawn movers, household equipment and simple items like kitchen electronics.

3.4 Rent

Next on the scale is renting option. It shares many similarities with the lease option but differs based on duration. This option is typically availed by the users for relatively shorter durations. The business and revenue models require renting competence in addition to the existing competence. The financial requirements are higher in order to meet the operational expenses. Generally, it is possible to maintain the renting business with additional working capital of roughly 20%. The regulatory requirements essentially remains same however, there is significant change in the risk level. The service provider needs to incorporate maintenance and depreciation risks in the business model.

3.5 Pay-per-use

In pay-per-use, the consumer is charged for a short period only when the service is availed. For example Taxi service where the consumer only pays for the ride. Similarly, jet engine manufacturers (e.g., Rolls Royce and GE) have also started charging their customers by ‘pay-by-hour’ where the operations and maintenance activities are kept by the supplier and consumer is charged for the utility provided.

Pay-per-use implementation would require the addition of facilitation activities in the business model (i.e., operation, maintenance etc.). It requires higher capital to own products and operate them. Increased competence in operation and maintenance activities are essential and involves associated risks. An additional risk of demand fluctuations is also present. Pay-per-use model is useful for products that have low utilization by the consumers. For example, a welding machine. Pay-per-use is not suitable for products that have high utilization such as smartphones.

3.6 Subscription

Altering the business model to subscription requires subscription facilitation unit in the company, which can be either developed by the company or a co-operation can be set up within the existing company. Subscription is a source to generate a long-term revenue stream for the company. Subscription is similar to pay-per-use but the consumer is engaged into a long-term periodic revenue-providing stream. It is

equally suitable for less tangible offerings such as digital library subscription and tangible offerings like car subscription. However, subscription option is also vulnerable to rapid demand change risk. Demand increase is manageable in the case of intangible offerings where replicability is not a problem but if the offering is disliked by the consumer, less revenue is generated compared to sales. For tangible offerings, both demand increase and decrease have consequences. Therefore, the subscription option is suitable for market verified and accepted products.

3.7 Crowdfunding

Crowdfunding is the practice of using crowd to finance a project. The business model for crowdfunding can be comprehensively called integrated consumer development. The unique advantage in crowdfunding is that customer feedback and sales can be made prior to the completion of the project. Therefore, it is also a tool for customer validation of the supplier's concept. The revenue model includes sales as well as upfront payments. Crowdfunding is primarily a sourcing model; therefore, the capital requirements are less than any other option due to the upfront payment by the customers. It also drastically reduces financial and market risks as the customers are paying before the production of the products. It is very suitable for untested and high-risk products and require a platform where the crowd can be gathered. Companies can use existing platforms or establish their own platforms in order to crowdfund products or projects.

3.8 Freemium

Freemium is a pricing approach by which an offering is provided free of charge, but capital is generated on additional benefits or through an alternate source such as an advertisement or data subletting. The business model required for freemium to work is integrated customer development through indispensable relationship. For smaller companies, it is difficult to manage indispensability with customers. However, large companies like Google have freemium as the principal revenue generation model where the end users are essentially paying nothing. Services that are free of cost and yet valuable for the customers make the indispensability possible.

Considering the sustainability of all the options compiled in Figure 1, freemium is the most sustainable ensuring long-term revenue generation financing model. However, managing indispensability with the customer is the key challenge. Currently, freemium is mostly applicable to intangible offerings. However, in the future, it would be possible to offer air rides as freemium. Through electrification and complete automation of the aviation industry, maintenance and fuel costs can be reduced close to zero thriving the possibility for aviation industry to operate on freemium model.

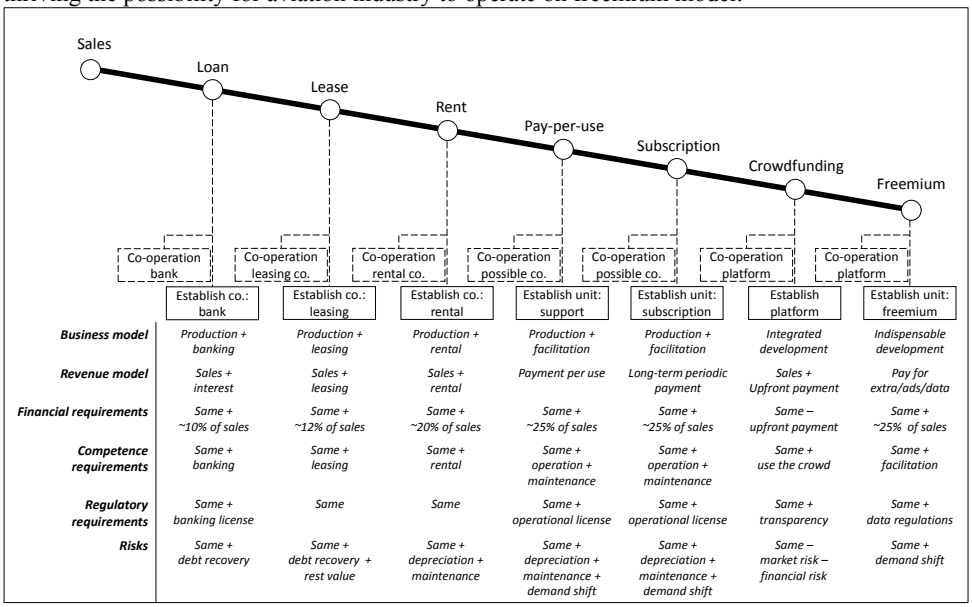

Figure 3. Summary of options for financing/ownership selection from supplier's perspective

4 CONCLUSIONS

This study presents service development options related to financing and ownership, which do not require any technological development or product alteration. The options presented are well established previously but business owners do not consider all of them in a systematic way and may select a less suitable financing model for their business. Therefore, the compilation of all these options allow the user to go through them one at a time and assist them in selecting the options that can add value to their offering. Further, changes in the business model that needs to be carried out while implementing these options are also highlighted. The study shows that the options listed low on the scale appear difficult to implement but require significantly fewer resources such that they can be implemented to almost any product, e.g., it is possible to lease or rent any everyday product. Contrarily, options that are high on the scale are relatively difficult to get to work, for example, freemium option. Therefore, business owner needs to establish a trade-off between implementation complexity and the consumers' ease as the governing criteria to select the options.

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Outsourcing Business Activities: A Decision Tree for Systematic Evaluation

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Abstract

In today's rapidly evolving market, it is difficult for startup companies to survive if they do not have a high-growth profile. Scholars believe that either the startups expand rapidly to capture major market segment or they slowly die out. Large companies usually outsource non-core activities to invest additional resources in the core activities, whereas, expanding startups have limited flexibility and have to outsource business activities in order to survive the high-growth expectation of the market. With limited resources at the entry level, startups certainly have no other choice except outsourcing business activities. There are various advantages and disadvantages of outsourcing depending on the business the company is operating in. Various companies fall into the trap of outsourcing activities that are important to keep inhouse. The present study offers a decision tree comprising the most critical parameters that enables the user to differentiate activities to be kept in-house from those to be outsourced. These parameters include measuring the business activity on the basis of standardisability or specifiablity, receiving input for innovation, establishing proper barriers to entry in place, and keeping correct contract agreements setup with the suppliers.

Keywords
Outsourcing, Decision tree, High-growth startups

1. Introduction

Business owners have been practicing outsourcing for a long time. Managers outsource business activities not only to capitalize on labour costs (Tate et al., 2009) but also on offering products and services that are not within their capability. Activities that are not core activities are outsourced to gain maximum competitive advantage (Sharpe, 1997). Companies hire suppliers that manage non-core activities; therefore, the overall efficiency of the organization increases that provides the possibility to invest more of the available resources in the core activities. Thus, it is important for organizations to consider the option of outsourcing (Tayles and Drury, 2001).

Outsourcing is dissimilar compared to other major business trends such as servitization (e.g., Tauqeer and Bang, 2018), personalization (e.g., Kavadias et al., 2016), and sharing economy (e.g., Zervas et al., 2017) etc. because outsourcing primarily focusses on organisation capability whereas other business trends are customer oriented.

Our literature review reveals various advantages of outsourcing business activities. Outsourcing enables companies to become agile to market disruptions and provides the capability to quickly adapt to market changes (Dess et al, 1995; Moore and Barnett, 2004). It enhances the core capabilities of the organization and the overall competence level (Blumberg, 1998; Quinn, 1999). Cost efficiency through offshoring (Oshri et al., 2015) and avoiding vertical organizational bureaucracy is achieved (Lei and Hitt, 1995; Robinson, 2001). On the other hand, the demerits include the dependency on suppliers, and losing control such that the suppliers become the bottleneck and start controlling the business (Cullen et al., 2006). In several cases, suppliers become competent enough and started marketing the products and services independently. Hence, companies need to trade-off between these merits and demerits, to decide what to outsource.

Established companies generally have the manoeuvrability to strategically inhouse or outsource business activities. However, many startup companies have to primarily rely on outsourcing in order to become a high-growth company.

Kutcher et al. (2014) emphasised that in the modern time high-growth is necessary for startup companies to remain in the market; else, they would eventually lose their marketplace. For startup companies, achieving the required independent high-growth is nearly impossible and outsourcing is a viable option that can contribute in achieving the set target. Several scholars discuss demerits of outsourcing and recommend businesses to avoid it (e.g., McIvor, 2000). However, startup companies do not necessarily have a choice. The authors of the present study believe that outsourcing is nearly essential for startup companies to achieve high-growth but the startups need to systematically determine what activities to outsource in order to avoid pitfalls that can prove detrimental for the company at a later stage.

McIvor (2000), through his systematic model, highlighted not to consider outsourcing as a short-term cost reduction method, rather embed it in the strategy of the company. The four stages of the model include defining core activities, evaluating value chain, total cost analysis, and relationship analysis. Rouse and Corbitt (2004) determined outsourcing as a nearly irreversible process. It is difficult for organisations to insource processes that are already outsourced. Ruiz-Torres and Mahmoodi (2008) have proposed a model for manufacturing supply chain. They conclude that the outsourcing decision is sensitive to the supplier reliability, cost of lost production, and the replacement ability of the manufacturing network.

Won (2015) studied the influence of entrepreneurship related to insourcing and outsourcing in decision-making. Doval (2016) has reviewed key strategic aspects of outsourcing and concluded that geography, competition, IT development, organisational structure, fiscal regulations, and cost of human resource are the six factors that facilitate in carrying out decision for outsourcing.

The objective of the present study is to propose a tool for startups to evaluate business activities that can be outsourced.

2. Decision tree for outsourcing evaluation

The most critical factors that need to be taken into consideration while deciding to outsource business activities by startup companies are shown as a decision tree in Figure 1. This tree has been established conceptually by considering academic literature and the cases of various companies. It starts with the selection of a business activity that is to be evaluated. Common business activities in a company, as described by Porter's value chain (Porter, 2008) are marketing, production, logistics, research and development etc. The present study argues that the most important factors that need to be kept into consideration while outsourcing business activities are measuring standardisability or specifiablity of the activity, receiving input for innovation, having barriers to entry in place, and correct contract agreements setup with the suppliers. The decision tree is explained as follows.

2.1 Standardisable or specifiable

Standardisable activities are the ones that can be explained through a set of instructions and can be communicated to the potential vendors. For example, the accounting of a company is a fairly standard activity and the activity follows defined rules that should give the same results independent of who actually does it. Various companies have outsourced standardised production processes to the vendors. The objective behind standardisability is that the standardised activities can be well communicated to various vendors, and the performance of the vendors can be monitored and compared. Standardisability is directly linked to vendors' capability enhancement. Outsourcing of known standardised activities such as accounting, IT support or the production of commoditised products does not enhance capabilities of the vendor significantly, and such activities can be outsourced with less concerns. Contrarily, manufacturing of highly sophisticated equipment should not be outsourced as their production processes have not been standardised and can probably significantly enhance vendors' capabilities. This could result in vendors themselves become competitors or introducing new competitors. Therefore, standardised or standardisable activities can be outsourced with less concerns compared to nonstandard activities as strategically they may lead to introduction of new competitors. Another challenge is that non-standardisable activities cannot be well communicated to different vendors and the performance is difficult to monitor which may be leveraged by the vendors. Non-standard activities include for example research and development. It is difficult to assess the performance of a vendor carrying out research and development. Some aspects within research and development can be standardised and thus outsourced for example data collection or conducting experiments.

Activities can alternately be outsourced based on the agreed specifications. For example, marketing can be outsourced with the specification of number of customer acquisitions at an agreed price. Similarly, production can be outsourced against delivery of number of products with the agreed specifications. Specifiable outsourcing is comparable to procurement. However, procurement is generally attributed to procuring commoditised items available off the shelf whereas specifiable outsourcing is the process of reaching out to vendors and get them to deliver specified output.

For activities that are neither standardisable nor specifiable, like the mentioned research and development, there can sometimes be other options for leveraging. Establishing partnerships is a potential way to outsource such activities but it generally emanates with distribution of equity in the company. It also lacks the flexibility outsourcing gives. Normally standardisability or specifiablity ensures quality of the output from the suppliers and the suppliers that cannot deliver as per agreed standard or specification can be changed out.

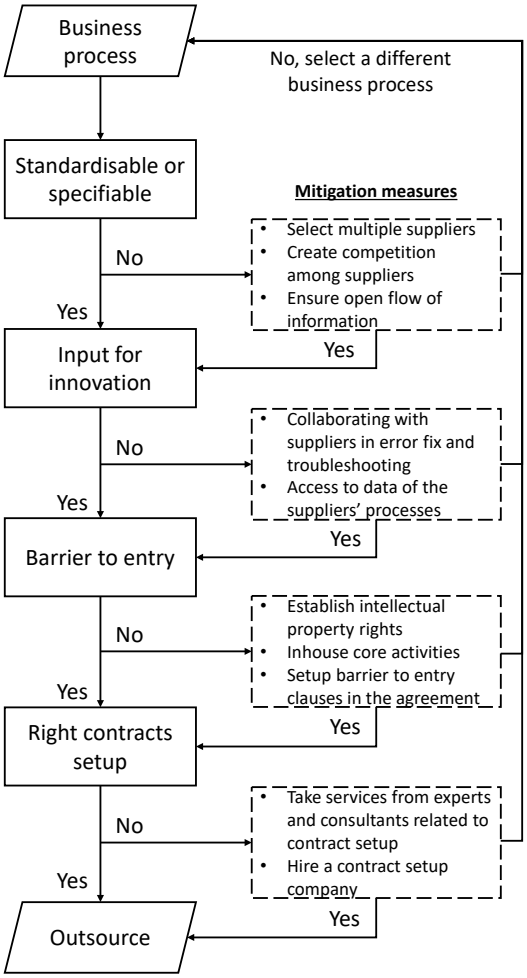

Figure 1. Decision tree to evaluate business processes that can be outsourced

2.2 Input for innovation

Studies significantly regard innovation as the forefront of sustainability of the companies. Outsourcing can be a key hindrance to innovation especially when major business processes are outsourced. Generally, organisations innovate by acquiring tacit knowledge of the business processes. Therefore, ensuing input for innovation is a key concern while outsourcing business activities.
Input for innovation becomes irrelevant if non-core activities are outsourced e.g., IT support. However, when major business processes like production are outsourced, input for innovation becomes a significant concern. Recently production intensive companies like automakers have adapted to acquire input for innovation despite outsourcing production by obtaining data from the vendors and deploying their engineers at various levels of the production facilities of the vendors (Becker and Zirpoli, 2017). Before deciding to outsource a business process, input for innovation shall be addressed. Else, the company may lose competitive advantage over time.

2.3 Barrier to entry

Another concern while outsourcing business processes is barrier to entry. Vendors can gradually become better and can originate as potential competitors. Various examples in electronics industry exists where the suppliers started offering the same products and services as their clients. This challenge can be lowered through intellectual property rights such as patents, trademark and brand. However, strictly speaking, patents provide some protection to the potential entrants but it is often possible to go around them. A portfolio of patents around the business may serve the purpose. Protection in terms of brand also requires massive marketing costs and significant duration to be well established. Barrier to entry is business dependent and varies across businesses and business activities. Therefore, the major concern is that the barrier to entry shall be carefully considered before outsourcing a business activity.

2.4 Right contract setup (other risks)

Contracts setup is among the critical concerns while outsourcing. Through the establishment of a suitable contract, barriers to entry and input for innovation can be ensured. It is vital to set up a contract with the vendors that provides protection against various other risks. Such risks include for instance, sharing data or information to third parties and/or exploitation of intellectual property rights. For startup companies, hiring consultants that have expertise in contract setup can be a useful way to mitigate various unknown risks associated with outsourcing of the activities.

3. Conclusion

Outsourcing has various advantages and disadvantages. However, for startup companies aiming to become a high growth company, outsourcing is nearly vital. The present study highlights four major parameters to be considered while determining to outsource business processes. They are parameters like measuring standardisability or specifiablity of the activity, receiving input for innovation, having barriers to entry in place, and keeping correct contract agreements setup with the suppliers. The present study has emphasised that startup companies cannot overlook these foremost parameters while outsourcing business activities. These parameters are arranged in a decision tree with easy ‘yes’ and ‘no’ options so that they can be applied by the leaders of startup companies to decide which activities to outsource and which to keep inhouse.

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A tool for idea screening by assortment of existing literature

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