國立中興大學科技管理研究所

Graduate Institute of Technology Management
National Chung Hsing University

碩士學位論文

A Thesis Submitted in Partial Fulfillment of the
Requirements for the degree of Master

營運管理與服務管理之研究

Survey on Operations and Service Management

指導教授：沈培輝 博士 Pui-Fai Sum, PhD

研究生：李育雲 Yu-Yun Lee

中華民國 104 年 6 月

Graduate Institute of Technology Management
National Chung Hsing University

A Thesis Submitted in Partial Fulfillment of the
Requirements for the degree of Master

營運管理與服務管理之研究

Survey on Operations and Service Management

Supervisor: 沈培輝 博士 Pui-Fai Sum, PhD
Students: 李育雲 Yu-Yun Lee

June 2015

國立中興大學 科技管理 研究所

碩士學位論文

題目： Survey on Operations and Service Management

姓名： 李育雲 學號： 7102026101

經 口 試 通 過 特 此 證 明

論文指導教授 沈培輝

論文考試委員 何英治

陳同孝

中華民國 104 年 6 月 5 日

中文摘要

此篇論文主要是研究在營運管理與服務管理領域中概念之演進。藉由研究後發現，它們的演進可分為以下四個趨勢：(1)生產過程越來越複雜；(2)品質的範圍不斷的擴大；(3)服務越來越受到重視；(4)科技的進步。在這四個趨勢之下，發現了兩個重要的現象。第一個現象是顧客對於產品和服務的要求增加，顧客希望產品要有更多附加的功能；第二個現象則是缺乏一套用於設計流程及組織的模型，而這些模型對企業策略實行是很重要的。缺乏這些模型，最終將會導致企業之策略層面決策與操作層面實行的落差，企業會不知道如何實行決策者所制定的策略。最後，透過研究營運管理與服務管理概念之演進，來推斷其未來之發展。

關鍵字：營運管理、服務管理、設計模型

ABSTRACT

By surveying on the history of operations and service management (OSM), it is found that the evolution of the principles in OSM is essentially governed by four major trends: (1) increasing complexity of production process, (2) expanding scope of quality, (3) increasing focus on services and (4) advancing development of technologies. Besides, two phenomena are observed. First, there is a persistent increasing demand on the product features and service contents. Customers expect products to have more additional features. Second, no suitable models have been developed for designing operations and organization. Without proper design models for operation design, a gap exists between the strategic level and the operations level. Based on the survey, the possible future trends of operations and service management can be deduced.

Keywords: Operations management, Service management, Design model

TABLE OF CONTENTS

1. INTRODUCTION

Principles of the modern operations management can be traced back to the 18th century. But the earliest literature on operations management can date back to two thousand years ago in ancient China. Generally speaking, operations management is a field of management in the design and the production of products, the business operations to efficiently use resources needed and effectively meet customers' requirements. Modern operations range from traditional manufacturing to non-manufacturing. The focuses of operations management are not limit to the planning, organization and control of the production process, but also the operations strategy, design, service delivery process, services, and quality.

Before 1960, operations management focused mainly on manufacturing. This concept has been expanded to cover the service industry since 1960s. As found by Victor R. Fuchs (Fuchs, 1968), more than half of the employed population in US in the 1960s was involved in providing services including banking, health care, retailing, and education. The percentage was kept increasing in the subsequent decades which led to the emergence of the service management. Service management was introduced in 1982 by Richard Normann(Normann, 1982). Normann and Grönroos found that traditional management which overemphasized on cost reduction efforts and scale economies may become a management trap for service firms. It might lead to a vicious circle, including lowing the quality of the service, deteriorating internal workforce environment, hurting customer relationships, and eventually affecting the interests (Grönroos, 1994).

Among many scholars, Albrecht presented the definition of service management which clearly demonstrates some of the key facets of service management (Albrecht, 1988). He indicated that service management was a total organizational approach that

made the quality of service which perceived by the customers. It was also the main driving force for the operations of the business. Generally speaking, there are two main perspectives in service management. One is managing the elements within an organization in order to deliver quality services/products to the end customers, such as the processes, the people and the tools. Another is managing the services by managing the usage and the development of the services. Since service management has emerged, the coverage of operations management has been expanded.

Objective of the thesis: While operations and service management (OSM) has been studied for many years, not much survey has been worked on the behind factors governing the evolution of the principles in the OSM. To deduce the future trends of OSM and thus provide a complete research, we survey on the evolution of the principles in the area of OSM. Through the comprehensive survey, we found that the evolution of the principles in OSM could follow four major trends. Besides, two important phenomena are found alongside the four major trends. First, there is a persistent demand for both the features of a new product and the content of a new service. We believe that it is the main factor that governs the evolution. Second, the lack of the models for operation design results in a gap exists between the strategic-level and operations-level.

Organization of the Paper: With the following Chapters in 2, 3, 4, and 5, the evolution of the principles will be introduced. We summarize the evolution of the principles in accordance with four major trends. The increasing complexity on production process is introduced in Chapter 2. The expanding scope of quality is introduced in Chapter 3. The increasing focus on services is introduced in Chapter 4.The advancing development of technologies is introduced in Chapter 5. Chapter 6 discusses two important phenomena observed and the anticipated future trends in OSM. The conclusion of the paper is presented in Chapter 7.

2. INCREASING COMPLEXITY OF PRODUCTION PROCESSES

The first trend is due to the increasing complexity on the production process. It starts from the principles of scientific management, through lean manufacturing and modularization, to global outsourcing.

2.1 Division and Specialization of Labors

One earlier concept in production is division and specialization of labor which is advocated by Adam Smith in 1776. In “The Wealth of Nations”, he described that division and specialization of labor is able to reduce the costs of production. Take making a needle as an example. To produce a needle, three steps are required: (1) chop a line of steel into small segments, (2) sharpen one end of a steel segment as the needle head, (3) hammer the other end as a flat end and finally punch at it. Traditionally, making a needle was solely done by a craftsman. So, the cost was expensive. However, Adam Smith suggested that the first and the third tasks could be assigned to low skill labors as the skill required to accomplish these two tasks are low. The craftsman only works on the second task which requires very high skill of sharpening. In such case, the product cost of a needle could be largely reduced.

While Adam Smith is the first economist advocating the concept of division and specialization of labors, the concept has long been existed in the government administration, like the ancient China government. The officers in the government were divided into different regional governments. Each regional government was responsible for the administration of a local region. Moreover, the central government was also divided into different divisions. One was responsible for census and taxation. One was responsible for the engineering projects in the country. One was responsible for policy making, law enforcement and criminal investigation. Clear division of labors had

already been implemented.

2.2 Interchangeable Parts

The first concept of interchangeability occurred in the 18th century. Around 1798, the United States was influenced by the French Revolution, Whitney entrusted by the US government to make 10,000 to 15,000 rifles for the US military in 1800. At that time, each gun from beginning to end was built by a craftsman. The components of the guns of the same model were not interchangeable. Eli Whitney thus designed a gun which is assembled by interchangeable components. In other words, the components are interchangeable (Baida, 1987). Once a component of a gun is broken, it could simply be replaced by the component of the same type. If a product can carefully be designed by interchangeable components, productivity of manufacturing such products could be improved by designing the production process as a series of assemble processes. High technical skill workers make those components and low skill labors do the assembling. The number of high technical skill workers required in production could largely be reduced. Thus, the production cost would be reduced. Repairing of a product could also be made easy, as repairing is simply done by replacing the defective component by a non-defective spare part. The concept of interchangeable part had been kept expanding in the subsequent decades to other industries, such as automobile and computer industries.

2.3 Scientific Management

Around 1910s, the scientific management was advocated. Frederick W. Taylor and Henry L. Gantt developed a scientific method for operations management (Bamford & Forrester, 2010), with focuses on managing and improving the productivity of workers. Taylor collected data which were the time of spending for workers in the job performance,

analyzed these data, and used them to improve operation. Gantt created Gantt charts which helped managers and workers to arrange their schedule and quickly know whether production was on schedule or not. The target was optimizing performance and simplifying the jobs so that the workers could be train to perform their sequence in the "best" way, thinking how to do, and finally teaching other workers to do. In conclusion, the concepts in scientific management focused on being systematic and efficient.

2.4 Assembly Line

The appearance of assembly line could be traced back to 1901, when Ransom Olds utilized assembly line in car manufacturing. Later in 1913, Henry Ford practically applied the concept of assembly line with driven conveyor belts in car manufacturing. According to Henry Ford, assembly line is based on three principles (Ford, 1922).

(1) Place the tools and the men in the sequence of the operation so that each component part shall travel the least possible distance while in the process of finishing.

(2) Use work slides or some other form of carrier so that when a workman completes his operation, he drops the part always in the same place--which place must always be the most convenient place to his hand – and if possible have gravity carry the part to the next workman for his operation.

(3) Use sliding assembling lines by which the parts to be assembled are delivered at convenient distances.

As a result, it led Ford Motor producing Model T in ninety-three minutes. The cost of car production was reduced and the selling price of a car dropped. Eventually, automobile became popular in USA.

2.5 Modular Production

Owing to increasing demands on the variety of products from customers, traditional production methodology which focused on producing high volume and low variety of products could be ineffective. Therefore, Martin K. Starr introduced a concept of modular production in 1965. Generally speaking, modular production is divided a product into parts and manufactures each part separately. Subsequently, workers assemble these parts to compose a product. These different parts can be manufactured in one place or different place (Starr, 1965).

Since this new concept for production can reduce cost, improve quality and speed up the innovation, many manufacturers adopt this new concept as their production method. One of the most famous examples is automobile industry. We take Volkswagen as an example. The new truck factory of Volkswagen in Resende, Brazil, divided the truck into many modules provided by different suppliers. The suppliers had to get their materials and hired their workers to build independent modules. Volkswagen only established the architecture of the production process and modules, set the standards of quality for every supplier, and tested each module and truck in every stage of production in Resende (Carliss, Baldwin, & Clark, 1997). In conclusion, the concept of modular production has been well established in manufacturing and computer industries, but in recent years, this concept has become an emerging force in service industry, too.

2.6 Lean Manufacturing

After many years, the production process became more complex than before. The term of lean was derived from the Japanese manufacturing industry. Lean manufacturing is a management philosophy derived from the Toyota Production System (TPS), and it is also called Toyotism. This principle was first coined by John Krafcik for his master's

thesis in 1988. Later, James P. Womack and Daniel T. Jones continued his research and co-authored a book titled “The Machine that Changed the World” in 1990. The book pointed out that the key success of Toyota’s high quality products and high performance production is based on in its "Lean“. It extends from the concept of mass production manufacturing by adding two new ideas — waste elimination and rapid response to customer needs. Toyota identified seven types of waste which are needed to be eliminated. They include transport, inventory, motion, waiting, overproduction, over-processing, and defects (Womack & Jones, 2010). Transport[1] waste refers to moving products that are not actually required during the production process. Inventory waste refers to all components, works, and finished products not being processed. Excessive storage of the raw materials and semi-products are clearly a waste. Motion waste refers to the movement of people or equipment more than required during the production process. Waiting waste refers to the time spending in waiting for the next production step, interruptions of production during shift change. As the name implies, overproduction waste refers to production ahead of demand. Over processing waste refers to the waste due to poor tool or product design creating activity. Defects waste refers to the effort involved in inspecting for and fixing defects.

As a result, elimination of waste could lead to reduction in production cost and hence the reduction in selling price of car. Rapid response to customer needs could thus improve the customer’s perceived quality of services associated with car selling and hence enhance the customer relationship. Moreover, rapid response to customer needs could lead to rapid response to the market and introduce new products to the market earlier than other car manufacturers.

[1] http://en.wikipedia.org/wiki/Lean_manufacturing

2.7 Mass Customization

The motivated reason for introducing mass customization is similar to the reason why Martin Starr introduced modular production (Starr, 1965). There is an increasing demand on the variety of products. In accordance with Pine II, Victor & Boynton (Pine II, Victor, & Andrew, 1993), mass customization refers *to the use of highly skilled, flexible work force to make varied and often individually customized products at the low cost of standardized, mass-produced goods*. The concept of mass customization was first introduced by Alvin Toffler in 1970. Toffler (Toffler, 1970) thought that mass customization would be a trend after 1970. In 1993, B. Joseph Pine II *et al.* in "Making Mass Customization Work", in Harvard Business Review (Pine II et al., 1993) confirmed Toffler speculation by introducing the success of various manufacturers, including Toyota and Motorola, in mass customization. For example, Motorola's pager factory in Boynton Beach, Florida can produce pagers in lot sizes based on the order from a customer within hours.

With reference to Pine II, mass customization could be categorized in four types(Pine, 1993). The first type is collaborative customization. A manufacturer co-designs with customer the specification of a product that best meets the customer's need. Subsequently, the design specification will be sent for manufacturing the product. The second type is adaptive customization. A manufacturer produces a standardized product with various combinations that can be programmed. Thus, a customer can alter the product features based on his/her own interest. The third type is transparent customization. Each customer can get from a firm a particular product/service that fits for his/her need. The customer never knows that the product is in fact a customized product. One example is the cloud storage services. The service providers normally

need to customize the resources to different users. However, users do know how the service providers allocate the resources to them. They simply connect to the Internet and get the services. The last type is cosmetic customization. A manufacturer produces a large variety of standardized products to different customers. It happens usually in cosmetic industry. Normally, different ladies would like different colors and odors of a lipstick. So, a cosmetic manufacturer produces different colors and odors of the same model of lipstick in order to fit for the needs of the customers.

2.8 Global Outsourcing

The term "outsourcing" can be traced back to 1980s. In order to maintain the core competitiveness, the enterprise will delegate non-core business process to other enterprises. The reason is that outsourcing can reduce operating costs and labor costs. According to the geographical distribution of suppliers, outsourcing can be classified into two types. One is onshore outsourcing, which refers to the suppliers come from the same country as the outsourcers, and completes the work in their country. Another is offshore outsourcing, which refers to the suppliers come from different countries from the outsourcers, and completes the work in different countries. The offshore outsourcing first emerged in 1990s. Subsequently, due to the thriving of globalization and the development of technology, the enterprises increasingly outsourced to the suppliers in different countries. Finally, here comes the generation of global outsourcing.

3. EXPANDING SCOPE OF QUALITY

The second trend is due to the evolution of the concept of quality. It starts from the narrow definition of quality which focuses only on product quality, to a broader definition of quality which focuses on both product and process (product process, marketing process and service delivery process) qualities. Thus, it leads to the evolution of the principles from quality control to the total quality management, and the ISO 9000 series.

3.1 Quality Control

According to the definition from Juran, quality control is *a universal managerial process for conducting operations so as to provide stability—to prevent adverse change and to "maintain the status quo"* (Juran, 1995*)*. The concept of quality control has been used for a long time. It can be traced back to year when *The Principles of Scientific Management* by Fredrick W. Taylor was published. Taylor, in this book, has explicitly suggested that at least one boss called inspector has to be assigned for quality inspection.

> *The inspector is responsible for the quality of the work, and both the workmen and speed bosses [who see that the proper cutting tools are used, that the work is properly driven, and that cuts are started in the right part of the pieces] must see that the work is finished to suit him. This man can, of course, do his work best if he is a master of the art of finishing work both well and quickly* (Taylor, 1914).

Taylor's notion of process analysis and quality control by inspection of the final product still apply by many firms today (Ross, 1994).

Later, in the 1920s, W. Shewhart applied the statistical methods into quality control which is called the statistical quality control (SQC) for managing the qualities of the

products and the business processes(Reid & Sanders, 2012). One of the key tools used in SQC is control chart. It is a tool used to determine if a manufacturing or business process is in a state of statistical control. The control chart is simply a time series chart recording the changes of quality measures of the products/processes of concern in a daily basis with reference to (1) the range (specified as the upper control limit and the lower control limit) of the values in which the quality measures should fall in and (2) the expected value (specified as the control limit) of the quality measure. From the control chart, the manager is able to anticipate if there is a trend the quality is dropping. If it is, appropriate action can be done in advance to correct the production. While Shewhart's laid the techniques foundamental for SQC, Deming advanced the method by introducing 14 principles, also called the Deming 14 Points Program, ammended to the orginal scope of Shewharts' SQC (Deming, 2000). For instance, one principle (Point 9) is that *barriers should be removed between departments and the staff areas*. Another pricnciple (Point 13) is that the organization should *institute a vigorous program of education and encourage self-improvement for everyone. What an organization needs is good people and people who are improving with with education. Advancement to a competitive position will have its root in knowledage.* In 1947, Deming was involved in early planning for the 1951 Japanese Census. The Allied powers were occupying Japan, and he was asked by the United States Department of the Army to assist with the census. While in Japan, his expertise in quality control techniques, combined with his involvement in Japanese society, brought him an invitation from the Japanese Union of Scientists and Engineers (JUSE)[2]. JUSE members had studied Shewhart's techniques, and as part of Japan's reconstruction efforts, they sought an expert to teach statistical

[2] https://deming.org/theman/timeline

control. From June–August 1950, Deming trained hundreds of engineers, managers, and scholars in statistical process control (SPC) and concepts of quality (Noguchi, 1995). Since then, SQC began to applied by Japanese industry.

3.2 Total Quality Control

Previously, quality control was mostly based on the statistical analysis, and it was only considered in the manufacturing activities, limited to the manufacturing and inspection department. It only can conduct a remedial work after finding a faulty product. In 1951, Feigenbaum proposed the concept of total quality control (TQC) (Feigenbaum, 1951). It extends the concept of quality which focuses only on product quality to both product and process (product process, marketing process and service delivery process) qualities. TQC is a system which integrates the concept of quality development, quality maintenance, and quality improvement together, and indicates that all people in the organization should focus on the quality, in order to make the production and service delivery process on the most economical ways to fully satisfy customers' needs. In 1968, Kaoru Ishikawa applied the concept of TQC in Japanese industries, and he termed this concept company wide quality control (CWQC).

3.3 Total Quality Management

In 1970s, American manufacturing focused on quantity instead of quality, and they ignored the quality of products and services. In 1980, American manufacturing was suffered from the Japanese product and lost the international market. The National Broadcasting Company (NBC) launched a column in 1980, which is "If Japan can... Why can't we?", and it raised to the climax of learning and reflection. In 1985, the United States Navy Air Systems Command and Naval Air Depot brought up the term of total quality management (TQM). It illustrated how to apply Japanese management

approach to improve the Navy's operational effectiveness and quality, and reduced aircraft maintenance costs. TQM indicates that an organization should continuously improve its ability to deliver high quality products and services to customers. It adds the concept of management into TQC. Although TQC mentions staffs participation in the whole process, it doesn't indicate how to do. On the contrary, TQM guides it by emphasizing staff training and the support from executives. It can be said that TQC is a concept and TQM is a system which combines the practice and approach.

3.4 ISO 9000 Series

ISO 9000 is a powerful instrument, which cannot be disregarded. It is one of the most influential initiatives that grew from the quality management of the late 1980s. The ISO 9000 requires users to document their quality assurance system and implement the activities that, when followed, should ensure appropriate management of quality assurance. Enterprise, once the documentation has been complied, can get from the third party the certification of the quality standard ISO 9000. In the earlier inception of ISO 9000, three standards are included[3].

ISO 9001:1987 *Model for quality assurance in design, development, production, installation, and servicing* was for companies and organizations whose activities included the creation of new products.

ISO 9002:1987 *Model for quality assurance in production, installation, and servicing* had basically the same material as ISO 9001 but without covering the creation of new products.

ISO 9003:1987 *Model for quality assurance in final inspection and test* covered only the final inspection of finished product, with no concern for how the product

[3] http://en.wikipedia.org/wiki/ISO_9000

was produced.

In its 1994 version, ISO 9000:1994 emphasized quality assurance via preventive actions, instead of just checking final product, and continued to require evidence of compliance with documented procedures. The 2000 version sought to make a radical change in thinking by actually placing the concepts of process management, continual process improvement and tracking customer satisfaction as the focuses. In accordance with ISO 9004:2009, eight quality management principles are defined.

Principle 1 – Customer focus

Organizations depend on their customers and therefore should understand current and future customer needs, should meet customer requirements and strive to exceed customer expectations.

Principle 2 – Leadership

Leaders establish unity of purpose and direction of the organization. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives.

Principle 3 – Involvement of people

People at all levels are the essence of an organization and their full involvement enables their abilities to be used for the organization's benefit.

Principle 4 – Process approach

A desired result is achieved more efficiently when activities and related resources are managed as a process.

Principle 5 – System approach to management

Identifying, understanding and managing interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its objectives.

Principle 6 – Continual improvement

Continual improvement of the organization's overall performance should be a permanent objective of the organization.

Principle 7 – Factual approach to decision making

Effective decisions are based on the analysis of data and information

Principle 8 – Mutually beneficial supplier relationships

An organization and its suppliers are interdependent and a mutually beneficial relationship enhances the ability of both to create value

Following these eight principles, an enterprise can compile a document submitted to a third party for certification. The main document to be submitted is the ISO 9001:2008 *Quality management systems — Requirements.* It is supplemented by two other documents: ISO 9000:2005 *Quality management systems — Fundamentals and vocabulary* and ISO 9004:2009 *Managing for the sustained success of an organization—A quality management approach*. Only ISO 9001 is directly audited against for third party assessment purposes. The other two standards are supplementary and contain deeper information on how to sustain and improve quality management systems. They are therefore not used directly during third party assessment.

3.5 Six Sigma

In 1986, Motorola developed the principle of Six Sigma. Unlike ISO 9000 series only provides the management principles for companies to follow, Six Sigma comprehensively demonstrates how to improve process quality by a set of statistical techniques and tools, such as ANOVA gauge R&R and regression analysis. It seeks to improve process quality and avoid product variation through identification and

elimination of defects. Jack Welch, a CEO of General Electric, adopted Motorola's Six Sigma quality concept as one of his business strategies in 1995. After Six Sigma has been implemented, the defect rate of GE's products decreased to thirty four per ten million. Apart from improving product quality, Jack Welch also applied the concepts of Six Sigma in designing tools to improve the quality of the business processes in GE. After that, Six Sigma was widely adopted by many companies around the world.[4]

[4] http://en.wikipedia.org/wiki/List_of_Six_Sigma_companies

4. INCREASING FOCUS ON SERVICES

The third trend is due to the increasing awareness on the concept of service and the paradigm shift from goods-dominant logic to service-dominant logic. It starts from the advocating of service economy to the development of service blueprint and gap model, and finally to the area of service science, management and engineering (SSME).

4.1 First Self-service Store

Before we describe the service, we need to know the story of the first self-service store. Piggly Wiggly was the first self-service grocery store open in 1916 in Memphis, Tennessee. Like contemporary supermarkets, shopping carts were provided for the customers. The prices of the items to be sold in the store were marked or tagged. Customers could thus collect the purchased items, put them in the cart and carried them to the checkout counter for payment. Before Piggly Wiggly, to buy some items in a grocery store, a customer asked the staff for the items. Then, the staff fetched, collected and packed them up. Finally, the customer paid and then got the pack of items. In this process, customer did not involve in fetching, collecting and packing. Everything was done by the staff. The staff served for the customer. To further improve the efficient of the purchasing process, the foods being sold in Piggly Wiggly were wrapped in standardized size. So, customer could select the right sized foods to purchase and no need to spend time waiting for packing of the items. Because of the success of Piggly Wiggly, many other grocery stores changed their retail operations to self-service in the subsequent years.

4.2 Service Economy

Before 1960, operations management focused mainly on manufacturing, but this concept has been extended to other industry since 1960s. Since the 1960s, the global

economy underwent a structural change. The service sector has occupied more than 60% of GDP (Fuchs, 1965). For this change, the American economist Victor R. Fuchs called "service economy" as a term in 1965. In 1968, he focused that more than half of the employed population is involved in providing services including banking, health care, retailing, and education (Fuchs, 1968). Besides, the proportion is kept increasing. The GDP generated by these service workers is also kept increasing. Thus, “service economy” indicates a new phenomenon.

4.3 Production Line Approach to Service

In 1960s, McDonald improved their service operation by applying the logic and tactics of manufacturing, which resulted in their sales rose from approximately 54 million to 587 million. This improvement has been termed “the production line approach to service” by Theodore Levitt in 1972. Theodore Levitt described how service operations could be made more efficient by applying the concept manufacturing. The characteristic included (1) simplification of tasks, (2) clear division of labor, (3) substitution of equipment and systems for employees, and (4) employees were afforded to do little decision-making (Levitt, 1972). McDonald's is a good example to illustrate this approach. Here is the purchase process in McDonald's. Employees are taught how to greet customers, and ask for their order. Employees will follow a set procedure for assembling the order (for example, cold drinks first, then hot food), placing various items on the tray, and giving the tray to customers. Next, there is a script and a procedure for collecting money and giving change. Finally, there is a script for saying thank you and asking the customer to come again. This production-line approach lets the organization control over the interaction between customers and employees. It is easily to learn, so employees can be quickly trained and put to work (Bowen & Lawler

III, 1992).

4.4 Service Blueprint

Service blueprint was first introduced by Lynn Shostack in 1984. Before 1980s, service was perceived as an intangible asset. Systematic method for design and control was missing. Service blueprint was thus introduced as diagram (also as a tool) describing the service delivery process in detail. People involving in the service delivery process could thus understand their tasks to be done in the service delivery process. Communication between different levels or departments involving in the service delivery process could become more effective and efficient. Evaluation and review of the service delivery process could make easier.

Service blueprint illustrates service delivery process in five issues. Customer action defines what customer will do during the delivery process. The interaction between customers and employees is divided into two parts, the onstage action and the backstage action. Face to face interaction is described by onstage action. The invisible interaction is described by backstage action, such as the telephone or Internet service. In service blueprint, customers evaluate the quality not only from the interaction but also from the physical entity in the service delivery process. This is what physical evidence defines. For example, during a dining service in a restaurant, the physical evidences include the cleanness of the table, the menu, or the wiring of waiters. Support process is the necessary actions which are taken by the staffs that don't interact with the customers. Without these actions, the service won't be delivered successfully.

4.5 Service Quality Model

Service Quality Model was also called Gap Model, and it was developed in 1985 by Zeithaml, Parasuraman and Berry to measure quality in the service sector. The

authors found there was a big gap between customer expectations and service provider, and they identified five factors of service quality, including reliability, assurance, tangibles, empathy, and responsiveness. Finally, the authors found five gaps that may cause customers to experience poor service quality. The first gap is between consumer expectation and management perception. The second gap is between management perception and service quality specification. The third gap is between service quality specification and service delivery. The fourth gap is between service delivery and external communication, and last gap is between expected service and experienced service (Parasuraman, Zeithaml, & Berry, 1985).

4.6 Servitization

The servitization was first presented by Vandermerwe & Rada in “Servitization of Business: Adding Value by Adding Services”, in 1988. It is the increased offering of fuller market packages or ‘bundles’ of customer-focused combinations of goods, services, support, self-service and knowledge in order to add value to core corporate offerings (Vandermerwe & Rada, 1988). In this period, the concept of servitization in the service industry is as same as manufacturing. Here is an example from the paper “Servitization of Business: Adding Value by Adding Services”. We assume that the customer is the company who wants to buy computers, and the provider is a computer supplier. The provider sells several computers to the customer and also provides maintenance service, teach customer some knowledge about computer, and provide the training course to use computers. The computers also have the software which can let the customers diagnose the computers when there are some problems.

Servitization is an innovation of an organization capability and process to create future value through a shift from selling the product to selling product service.

Nowadays, there have been a lot of definitions of servitization brought up by many scholars, such as “Adding extra service components to core products.” (Verstrepen, Deschoolmeester, & van den Berg, 1999), and “A trend in which manufacturing firms adopt more and more service components in their offerings.” (Desmet, Dierdonck, & Looy, 2003)

4.7 Service Productization

The term “service productization” was firstly defined by Sipilä, J. in 1996. He indicated that service productization is a method that aims at developing and producing a service in a way that maximizes the customer value and ensures the profit targets of the organization are met. The purpose of service productization is to clarify the service offering by adding product-like features to it, leading to the service offering is easy to buy and sell. The more detail description of service productization practice has been defined by Elina Jaakkola in 2011. He emphasized the details and the procedures on the practice of service productization, which includes (1) specifying and standardizing the service offering, (2) tangibilizing and concretizing the service offering and professional expertise, and (3) systemizing and standardizing processes and methods (Jaakkola, 2011).

4.8 Experience Economy

The concept of experience economy was firstly introduced by B. Joseph Pine II and James H. Gilmore in an article published in 1998, titled "The Experience Economy". They claimed that experience economy will be the next economy following the agrarian economy, the industrial economy, and service economy. Experiences create added value by engaging and connecting with the customer in a personal and memorable way (Pine & Gilmore, 1998). A famous example is Disneyland. Disneyland lets an adult feeling

like going back to his/her childhood and getting into the world of fairy tales. Disneyland not only has many facilities like Roller Coaster and Pirate Ship for customer to get excitements, but also has many theme parks in which a customer could imagine himself/herself as an actor in such fairy tales.

Another exemplar company which values the most of customer experience is a Taiwan-based bookstore called the Eslite. Eslite not only sells books but also provides high quality reading environment for the readers. Each chain store of Eslite must have comfortable lights, sofas, and counter for coffee and tea. Moreover, different chain store could have different style of decoration letting customers have different kinds of experiences. Like Eslite Xinyi in Taipei, the store is decorated with a lot of artworks to let customers feel like reading books in a historical European university library. Owing to fit for the theme of the Sonyan Cultural & Creative Park, Eslite Sonyan is decorated with lot of lifestyle artworks and targeted to sell products particularly in movie, music and other creative artworks. Besides, exhibitions and entertainments related cultural & creative lifestyle stuffs are organized frequently. All these activities aim at providing customers wonderful cultural experiences.

From Disneyland to Eslite, one can observe that shifting focuses of the economy, from manufacturing to service, and then from service to experience, has been underway. Likely, Apple and Tesla would follow to produce products that can let customers to have wonderful experiences, such as “being connected” and “amazing driving”, while they have bought such products.

4.9 Service Outsourcing

Service outsourcing means that companies outsource their non-core service operation to the external professional organization. Therefore, they can focus on their

core operation, and result in reducing the cost, improving efficiency, and reinforcing competitive advantage. Service outsourcing includes business process outsourcing, information technology outsourcing, and knowledge process outsourcing. Start from around 2000s, since the raise of the Internet and the emergence of the globalization, service outsourcing is not limited to local organization, more companies outsource their service overseas. For example, Taiwan's McDonald outsources the telephone ordering service to Hong Kong.

4.10 Emerging Area of Research

In 2003, IBM started to advocate a new discipline termed service science, management and engineering (SSME). The main purpose is to provide an interdisciplinary approach to the study, design, and implementation of service systems, like health care, telecom service, Internet service, cloud service, logistic services, public transportations, finance, education, travel, hotels and restaurants, and technology consultant services. As has been observed that SSME is closely related to another discipline called service design, which was advocated since 1991 in Europe[5], the scope of SSME has been extended by included design as one focus and thus the name of the discipline SSME is changed to SSME/D (Service Science, Management, Engineering & Design). However, this change creates a little confusion in the definition of the area. As learned from software engineering, it is noted that design is one of the task to be done in engineering. Highlighting design in SSME/D could lead to an over-emphasizing of design to engineering.

Besides IBM, Service Research & Innovation Initiative (SRII) is another famous

[5] The design works accomplished in that time are not limited to product design. They include the design of public services and the design of a city.

academic institution for service research. SRII is led by senior leaders from major IT companies like Google, Amazon, Apple, Facebook, Intel, Microsoft, IBM, etc., in close partnership with academia, research institutes, as well as government organizations from around the world. Its mission is to *Drive Research & Innovation for "IT Enabled Services" for a Better World*.[6] There are two main purposes of SRII. One is driving innovation for the growth of "Service Economy" at the global level. Another is driving innovation for "IT as a Service and Solution" for major sectors of the economy.

From these new activities, it is clear that the scope of "services" has been evolved to an ever existed large area and this area is multi-discipline. The works related to services are almost everything, from public services to professional services, from dinning service to manufacturing. Researches in services are emerging.

4.11 The 2nd Generation of Servitization

In 2000, many traditional manufacturing companies chose to refocus their attention from manufacturing to developing integrated product solutions with a large service component. This trend has been termed the second generation of servitization, which was perceived by many traditional manufacturers as a strategy for survival. The main driven of this trend is the thriving of globalization and the increasing of price competition. As the companies outsourced their manufacturing processes to low-cost location, the domestic resources were freed up. Thus, the companies could turn the resourced into the utilization of high-value activities, where the service component is likely to occur. Through the trend of servitization, most traditional manufacturing companies will undergo four stages, from the pure manufacturing–oriented companies to the companies with services to support the product. Subsequently, they will transfer

[6] http://www.thesrii.org/index.php/about-srii/srii-mission/what-s-srii

to the companies with services to extend the product, and finally the service-oriented companies, which service outweighed the product (Slepniov, Waehrens, & Johansen, 2014).

5. ADVANCING DEVELOPMENT OF TECHNOLOGIES

The last trend is due to the advancement of technologies. We divide this chapter into two parts. One is the automation, which changes the way of manufacturing. Another is the information technologies, which influence lots on our life and business operations.

5.1 Automation

Automation refers to automatic control a process to run with minimum operator intervention and it started when Watt invented an advanced steam engine in 1788. The term “automation” was introduced in 1947 when Ford Motor Company vice president Del Harder set up an automation department (Rifkin, 1995) aiming at applying technologies – hydraulic, electromechanical, and pneumatic – to speed up operations and enhance productivity on the assembly line. Later in the 1950s, the emergence of the programmable computer led many radical restructuring of operation design in the industry to fully automate as much of the production process as possible (Rifkin, 1995). With the advance of electric motors, electric circuits and computer, computerized automatic control systems could be made and help in almost every step in production. Furthermore, the advance in robotic technologies has also made many production works simpler and faster. For instance, car manufacturers install a lot of robotic arms in painting the car frames and assembling components. While the major advantage of automation is not to change the management practice, it does change the quality management style from monitoring a labor intensive factory to an almost laborless working factory. The team to be managed would be a team of knowledge workers who are able to design, analyze and control those high tech robotic arms.

5.2 Information Technologies

Technologies have been booming and influenced our life and business operations for many years. In this section, we will introduce three information technologies which influence most in our life and business operations, including personal computers & network, Internet, and mobile & wireless communication.

5.2.1 Personal Computer & Network

The first computer was invented by John W.Mauchly and J.Presper Echert in 1946. They created the first automatic computer which was called ENIAC. After long-term development and improvement, in 1970s, the microprocessor-based computer was invented. A notable model is the Apple II personal computer. Its size is smaller. Moreover, the price was so cheap that could be affordable by most small & medium enterprises (SME) and families. Therefore, computers rapidly spread everywhere, starting the generation of personal computers.

With the emergence of the computer, business operations are simplified. In the past, managing information in a company, like the business and customer information, was accomplished by paper documents. With personal computer, paper documents are replaced by electronic files so that all the information can easily be stored and retrieved. In addition, the physical space for storing information is largely reduced.

With network technology in the late 1980s, computers can be connected to form a local area network. In this regard, the productivity of a company can be improved by incorporate and re-design some of the core processes. For instance, memorandums are replaced by emails. Informal discussions on the issues related to works can be accomplished by emails. With a file server, documents can be shared within the company. New policies and decisions to be sent from the top manager to the staffs could

be arrived instantaneously. Administration can be done more effective than before.

Nevertheless, software like enterprise resource management (ERP) system and decision support system (DSS) is widely used by the companies. With ERP systems, operations management can also be done effectively. Operations managers can obtain information from the ERP to monitor the operating status of the organization. Suppose an operational staff has entered a wrong number on the price of a product. Some ERP systems are able to identify the suspected error and alert the manager in charge. Then, the manager can take action immediately to confirm with the staff the correctness of the number. With DSS, executives can resolve some unstructured, strategic issues to enhance the quality and speed of decision-making.

5.2.2 Internet

In the early 1960s, packet switching technology was invented for communication between different computers. In 1969, the project Advanced Research Projects Agency Network (ARPANET) was launched and was the first packet switching networks connecting selective universities and research laboratories in the US. In subsequent decades, different networks were then emerged all around the world. Owing to facilitate the inter-connectivity among different networks, technologies for inter-networking were developed and eventually the Internet formed in late 1980s. In the late 1980s and early 1990s, commercial Internet service providers (ISPs) began to emerge, following by the decommissioned of ARPANET. The Internet became fully commercialized in the U.S. As a result, the size Internet started to expand rapidly in the world as a lot of commercial firms install their own network servers with dedicated IP addresses and connect them to the Internet.

The impact of Internet on business management can be summarized into three

main issues, including communication, collaboration, and business transaction.

For communication, technologies combined with the Internet have given a new dimension to collect and disperse the information. One example is human resource management. Nowadays, most human resource managers collect the resumes through e-mail or human resource agency websites instead of mails or in person. Another example is marketing management. Through the Internet, overwhelming price and product information can be distributed to the buyers. The manager needs to figure out what content of information can attract customers.

For collaboration, Internet facilitates collaboration among employees from different geographical regions (different time zones) in an organization. Managing a project involving employees from geographical regions is possible. Take Verifon, an American electronic payment and transactions corporate, for example. It locates its R&D and manufacturing department in Taiwan, Department of system development in India, and service department in North America and West Europe. Though the departments are scattered around the world, Verifon can still manage each department effectively through the Internet (Applegate, 1996).

With Internet, a business firm is able to sell the products directly to the customers. Customers access the website, surf for the products, place an order and pay by some online payment systems. The process is convenience and effective. For many firms, online selling has even become significant revenue of the firms. As an increasing number of customers willing to buy online, the structure of the marketing channels could be simplified as compared with the traditional marketing channels. Intermediaries can largely be reduced. Clearly, managing marketing activities will be more effective. Direct marketing could be made possible.

5.2.3 Mobile & Wireless Communications

Wireless communication is the transfer of information by radio signals. The technologies have been applied in television/radio broadcast, mobile telecom networks, WIFI and WIMAX. Wireless communication technologies have mainly impacted on two management issues, collaboration and mobilization.

The first issue is clearly collaboration, in which we have discussed in Section 5.2.2, as wireless communication is one technology supporting the Internet. The second issue is mobilization. By that, the work to be done by the operational staff can be accomplished easier and more effective than before. The management activities to be done and the decision to be made by the manager could be accomplished efficiently. With wireless communication technologies, more workers are able to work in a café, in a car, in a ferry, in an airport departure hall and even in a toilet. Before a marketing presentation to a client, a salesman could use iPad to access the information from the company database and modified the slides while having a coffee at Starbucks. Thus, the work to be done by an operational staff would be improved. Similarly, if a manager is on a business trip, he can inspect the progress of a project at any place and at any time. If necessary, the manager can also hold a meeting, via social network systems like Facebook and Line, with his team members and make decision on any critical issue. Clearly, other management activities could be accomplished effectively in similar way.

6. FINDINGS AND FUTURE TRENDS

Through the comprehensive survey, we have figured out two important phenomena. For the first phenomenon, one could note from the evolution of the telephone. In the early days, the telephone was simply a device for dialing number and making phone calls. Since the launching of iPhone, the telephone can let many people enjoy different services. Apart from making a phone call, it can access the Google map for searching restaurants. Also, people can listen to the music through iTunes. Besides, people can save a lot of photos/videos and messages in the phone and enjoy other services which are made available by other apps. We believe that this increasing demand on the product features and the service contents is the main reason that governs the evolution of OSM and it will continue in the future. As a result, the processes of development, production, and service delivery of a new product/service will become more complex. New management principles would likely be evolved in the future.

For the second phenomenon, all the knowledge presented in textbook, many of them mainly focus on principles. But after the principles in actually in design on the operations, as well as the organization structure, has not been mentioned much. Unlike in soft engineering, many principles in soft engineering also require lots of design diagram in order to let soft engineering really design systems. For example, UML is one set of diagrams which consists 14 diagrams for presented the design of the system from different perspective. However, in OSM, there is lacking of suitable models for operation design. Therefore, it results a challenge in the management. *How could those management principles and strategies be actually implemented and realized in the operations?* In other words, a gap exists between the strategic levels and the operation levels.

From the evolution and two phenomena in operations and service management, we deduce four possible future trends on (1) increasing complexity on production processes, (2) expanding scope of quality, (3) increasing focus on services and (4) advancing development of technologies.

6.1 Increasing Complexity on Production Processes

Predicted from the point of increasing complexity on the production process, the production process will become more complexity in the future. From machines substitute manual labor, mass production to automating production, the production schedules need to be determined before producing. However, in the future, we do not need to determine the production schedule anymore. The machines will determine it by its own through analyzing the performance of each machine, the quantity of the raw material, and other related factors. In order to satisfy the needs of diverse customer orders, the production processes have to be more flexible. The enterprises will flexibly adjust the production processes under different condition. Apart from this, the enterprise will become an intelligent factory which integrates customers and business partners into the production processes through the high technologies, such as cyber-physical systems and the concept of the Internet of Things.

6.2 Expanding Scope of Quality

For the future trend of the quality, the scope of quality will likely be expanded from total quality (organizational-wide quality), to supply chain quality (suppliers-oriented quality), and finally to customer quality (customers-oriented quality). Customers have to be chosen so as to ensure the best service quality. Since there are many researches on the quality of supply chain, we focus on the quality of customers, which has been put less attention on. In the future, the quality of customers will also be

considered in the estimation of the overall quality of the service. With poor quality of customers, it will probably debase the quality of the whole service.

Take the restaurant as an example. Nowadays, the behavior of customers in having a meal is different from before. In the past, customers spent within average 10 minutes reading the menu and make an order. When a course had been served, customer started to enjoy the food. Once a customer had finished the meal, he/she left within five minutes. Nowadays, many customers would take photos by using their smartphones once they have been seated and the menus have been served. So, the time spent in making an order is definitely more than 10 minutes. Sometimes, if there is problem in WIFI connection, extra time will be needed for making an order. When the meals have been served, some customers are excited to take photos of the foods and share them on the FaceBook or the Instagram. Sometimes, some foods will be cooled down after the photos have been taken. The customers will request reheating the foods. Nevertheless, after the meals have been finished, some customers would like to ask the waiters helping them taking group photos. In the end, it is not difficult to see that the time of having a meal nowadays is longer than before. The workload of a waiter is much more than before. As being interrupted from the customers, the waiters could hardly focus on their works. It could reduce the quality of the service. Some restaurants ban customers taking photos of food, do not provide WIFI connections and even do not allow customers using smartphones in the restaurants. They think that better service quality can be achieved if the customers are of high quality. Though there are only a few restaurants consider customer quality, we believe that more restaurants will follow this trend in the future.

6.3 Increasing Focus on Services

We anticipate that there will be an increasing demand on product features and service contents as what we have observed from what Apple was doing in the last couple of years. Steve Jobs, while the iPhone was released in 2007, had mentioned that iPhone can let the user to (1) listen to the music by using iPod app, (2) make a phone call by using the telephone app and (3) access the Internet by using the browser app. Only a few technologies, like multi-touch and proximity sensors, were introduced in the press conference. iPhone is just a device for the customers to enjoy these services conveniently. It is not treated as a product. Then, in the subsequent years, Steve Jobs presented the Apple products, like iPad, in similar way. The product is not treated as a product. They are treated as devices for users to enjoy various different kinds of services. Apple makes profit from delivering the services to the customers rather than selling the products alone. To deliver high quality of services, Apple even partnered with Google to develop the Google Map app used by the customers to search for restaurants, theaters and others.

According to this anticipation, we believe that there will be a paradigm shift from product-orientation to service-orientation in the future. A lot more enterprises while design a product would focus more on the services the customers can enjoy. It makes a big difference to nowadays enterprises. Many of them provide services only for supporting the product, like enquiry service in a retail shop and after sales service. Service was regarded as an added valued service with no tangible benefit to the enterprise. Enterprises make profit by focusing on producing customer-preferred products. So, nowadays, product focus has been changed to service focus. This service focus will be continuous in the future.

6.4 Advancing Development of Technologies

Internet of Things (IoT) will be the future trend of the technologies development. It means that every device is connected to the Internet integrating computing capabilities and using data analysis to extract meaningful information. As devices are connected to each other, they can become an intelligent system of systems sharing data over the cloud. It will then transform the business, our lives and our world in countless way, such as creating better products faster with lower development costs, or optimizing energy generation and consumption. More intelligent personalized services could be deployed in the future.

Here is an example of a big picture of IoT. There is a smart traffic camera and the camera can monitor the road for congestion, accidents, and weather conditions with data from other cameras, creating an intelligent citywide traffic system. The intelligent traffic system will also be connected to other transportation systems, which get data from their own intelligent devices. If a traffic accident occurs near the airport or school, they can be notified by these smart systems, so that the airport or school can adjust their schedules. Also, people can be notified to drive optimal routes around the accident and the system will send instructions on the city's digital sign system to guide drivers around the accident.

7. CONCLUSION

In the thesis, we have given a comprehensive survey on the evolution of the principles in operations and service management. By the survey, we can summarize the evolution of the principles in four major trends. In addition, we find two important phenomena alongside with these four major trends. The first phenomenon is an increasing demand on the product features and the service content. It will make the development, the production, and the service delivery process of a new product/service become more complicated. The second phenomenon is that the concept of management mostly focuses on the principles. Less attention has been put on the operation design. It results a big problem in the management, which is people do not know how to implement and realize the management principles and strategies in the operations.

Finally, we can deduce the possible future trends of operations and service management. For production process, as the machines can determine the production schedule by themselves with integrating with other high technologies, the factory will become an intelligent factory. For quality, the quality of customer will be required in order to provide better service in the future. For service, there will be a paradigm shift from product to service, as the enterprise will consider the service as their main priority. For technology, we believe that we will enter the world of Internet of Things. Everything will be connected to the Internet and thus become an intelligent system of systems sharing data over the cloud.

According to this survey, we believe that the possible reason of less attention on operation design is lacking of suitable design models. If there are proper models for operation design, we believe the gap between the strategic levels and the operation levels could be reduced.

REFERENCES

Albrecht, K. (1988). *At America's service: How corporations can revolutionize the way they treat their customers*: McGraw-Hill Professional Publishing.

Applegate, L. M., F.W. MaFarlan & J.L .McKenny. (1996). *Corporate Information Systems Management: Text and Cases* (4th ed.): Irwin.

Baida, P. (1987). Eli Whitney's Other Talent.". *American Heritage, 38*(4), 22.

Bamford, D., & Forrester, P. (2010). *Essential guide to operations management: concepts and case notes*: John Wiley & Sons.

Bowen, D., & Lawler III, E. (1992). Facing the Customer: Empowerment or Production Line. *Sloan Management Review, 33*(3).

Carliss, Y., Baldwin, C., & Clark, B. (1997). Managing in the age of modularity. *Harvard business review, 75*(5), 84-93.

Deming, W. E. (2000). *The New Economics for Industry, Government, Education* (2 ed.): Mit Press.

Desmet, S., Dierdonck, R. V., & Looy, B. V. (2003). Servitization: or why services management is relevant for manufacturing environments *Services management : an integrated approach* (pp. 40-51): Financial Times/Prentice Hall.

Feigenbaum, A. V. (1951). *Quality control: Principles, practice and administration: An industrial management tool for improving product quality and design and for reducing operating costs and losses*: McGraw-Hill.

Ford, H. (1922). *My life and work*: Cosimo, Inc.

Fuchs, V. R. (1965). INTRODUCTION to" The Growing Importance of the Service Industries" *The Growing Importance of the Service Industries* (pp. 1-4): UMI.

Fuchs, V. R. (1968). The service economy. *NBER Books*.

Grönroos, C. (1994). From scientific management to service management: a management perspective for the age of service competition. *International Journal of Service Industry Management, 5*(1), 5-20.

Jaakkola, E. (2011). Unraveling the practices of “productization” in professional service firms. *Scandinavian journal of management, 27*(2), 221-230.

Juran, J. M. (1995). *A history of managing for quality: The evolution, trends, and future directions of managing for quality*: Asq Press.

Levitt, T. (1972). Production-line approach to service. *Harvard business review, 50*(5), 41-52.

Noguchi, J. (1995). The Legacy of W. Edwards Deming. *Quality Progress, 28*(12), 35-38.

Normann, R. (1982). *Service management: strategy and leadership in service business*: Wiley.

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1985). A conceptual model of service quality and its implications for future research. *the Journal of Marketing*, 41-50.

Pine, B. J. (1993). *Mass customization: the new frontier in business competition*: Harvard Business Press.

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

Pine II, B. J., Victor, B., & Andrew, C. B. (1993). Making mass customization work. *Harvard business review, 71*(5), 108-117.

Reid, R. D., & Sanders, N. R. (2012). *Operations Management: An Integrated Approach*: Wiley.

Rifkin, J. (1995). The end of work: The decline ofthe global labor force and the dawn ofthe post-market era. *New York: Putnam*.

Ross, J. E. (1994). *Total quality management: Text, cases and readings*: Kogan Page

London.

Slepniov, D., Waehrens, B. V., & Johansen, J. (2014). Servitisation in Danish Manufacturing Firms: A Strategy for Survival? *Global Operations Networks: Exploring New Perspectives and Agendas* (pp. 183-202): Aalborg University Press.

Starr, M. K. (1965). Modular production–a new concept. *Harvard business review, 43*(6), 131-142.

Taylor, F. W. (1914). *The principles of scientific management*: Harper.

Toffler, A. (1970). Future shock. *Amereon Ltd., New York*.

Vandermerwe, S., & Rada, J. (1988). Servitization of business: adding value by adding services. *European Management Journal, 6*(4), 314-324.

Verstrepen, S., Deschoolmeester, D., & van den Berg, R. J. (1999). Servitization in the automotive sector: creating value and competitive advantage through service after sales *Global production management* (pp. 538-545): Springer.

Womack, J. P., & Jones, D. T. (2010). *Lean thinking: banish waste and create wealth in your corporation*: Simon and Schuster.