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The Role of Servitization and Smart Product-Service Systems in the Industry

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ABSTRACT

In the current decade of digitalisation, industries are focusing on product customers and its services to please customers with better performance and security and fulfilling their commitment to make the market smart as well as its customers. In that case, this study has aimed to investigate the servitization and smart product-service systems influence in the industries by using information and communication technologies (ICT), Cyber-Physical System (CPS), smart connected product (SCP) and Internet-of-Things (IoT). The study finds out that, servitization transforms the traditional business model into the digital or online business model and helps the customers to link with the technology. It also provides benefits and profits to the manufacturers of the industries, has been proved from the overall study that was the main curiosity point of the researcher behind choosing the topic. Hence, the discussion has added a value creation feature to the whole study while aiming and discussing the most relevant factors of servitization.

Contribution/Originality: This study contributes to the existing literature by clarifying the role of servitization and smart product service system for making customers please with satisfied services

1. Introduction

In this decade of Industry 4.0, industries and their constituting companies are transforming their operations from product-oriented businesses into service-oriented businesses. It is hard to launch a product by meeting the needs of every individual

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customer as their tastes are different for any industrial product. In that case, the dominant logic of products through the Smart Product Service System (PSS) is bringing an innovation by which the organisations can personalise the products as per customers' needs with various specifications (Chiu & Tsai, 2020). Organisations from any industrial belongings are now focusing on serving better performance rather than just a product with a large number of specifications so that making customers pleased has been found more effective than before time. As per the views of Zheng et al. (2018), the bundle of pay-per-performance and pay-per-use are focusing on the development of information and communication technology (ICT) for obtaining better performance paradigms. It is helping in aiding the value-added services as an error-free solution of digital services.

Moreover, ICT consists of Cyber-Physical System (CPS) and Internet-of-Things (IoT) by ensuring the smart connection of product information with dense information. The unique characteristic of prevailing digital transformation is making smart connected products (SCPs) enabled to embed IT in the product itself meanwhile of this digital edge (Zheng, Xu, & Chen, 2020). In 2014, Smart PSS was introduced for the first by emerging IT-driven business paradigms at system perspectives. Safety challenges and tackling security are the most found challenges regarding this Smart PSS, which have been discussed in this research paper alongside the benefits of using ICT in industries for enhancing product services. While focusing on the better and secured performance of services, industrial organisations are seemingly gaining numerous advantages and negative results in a similar manner. This study has focused on exploring a clear concept about the significance of smart servitization along with its development processes so that identification of gaps and future strategic measures would be easier.

1.1. Problem Statement

There are several differences between key technologies and the service performances from previous PSS and new Smart PSS. According to Ghosh et al. (2019), after 2014, the situation in global IT-driven industries changed rapidly and that is going through several stages of formation for getting an efficient outcome. Therefore, the research paper has focused to clarify the role of servitization and smart product service system for making customers please with satisfied services as per their requirement and chosen this field as the main problem statement. The digital platform has enabled the firms to enable IoT-PSS that is ensuring better digital transformation. The development process of smart servitization is seemingly proceeding with several stages with proper online-offline intelligence through- launch of Smart PSS, digitalized PSS, Big Data servitization and Cyber-physical PSS (Zheng, Wang & Chen, 2019). The adaptation of IoT has been triggered with the prevailing usage of IoT enabled PSS. With a fewer digitized consideration of information delivery, the internet related e-service environment has found to follow several basic principles.

SCP is a single solution for IoT-driven product-service level, system-level and system-of-systems level that is generating services that are supporting the infrastructure of businesses. Hence, it is helping in obtaining individual customer's needs from product services. System-level is important to optimise entire performance while system-of-system-level is important to extend the industrial boundaries of external auxiliary systems (Ghosh et al., 2019). Product service level defines the generating process of services for making customers satisfied. This study has focused on the clear overview of Smart PSS performance for the betterment of industrial growth in an efficient and safer

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process. As per Wang et al. (2019), framework of Smart PSS from product-service level, system level, and system-of-systems level, works in a collaboration to make the services worthy and easy assessable for the users. Here after, it is seen that for obtaining the major problem statement of the research work, the paper has also evaluated about the relevant factors to get a clear concept.

Operating IoT-driven technologies are crucial and complex if not found in a clear direction of uses that is the major gap of this research work and therefore, the researcher needs to collect information from authentic resources. In that case, the consequences might be wrong and create security challenges that can result in a high pay-off for the organization and customer losses as well. Resource sharing and optimal configuration found with an improved experience that is helping industrial firms for value-co-creation and smart interaction with mutual cooperation (Liu et al., 2018). In addition to this, cyber-physical PSS is reducing resource inputs while optimizing operation regularly. As technologies are changing along with customers' demand to be satisfied, the researcher has found curious enough to attain maximum effective data by preventing the gaps.

1.2. Research Objectives

It is seemingly changing the scenario of IT industries based on smart services that is helping in bringing better performance, security and satisfied outcomes in a form of innovation. Therefore, by aiming this concept and its impact on current industrial situation, below-mentioned objectives have been illustrated,

i. To define the significance of smart product and servitization in industrial growth
ii. To explore the differences between PSS and Smart-PSS with their different impact
iii. To represent advantages and challenges faced by the industries regarding its development process

1.3. Research Questions

i. What is the significance of smart products and servitization in the growth of industries?
ii. What are the differences between the impacts of PSS and Smart PSS?
iii. What are the challenges and advantages faced by the industries regarding its development processes?

2. Methodology

Selection of adequate methodological tools or methods for conducting a research work successfully is highly required. In that term, this research work attending a positivism philosophy has been found advantageous as the topic is well known to the high-tech world and people are continuously adopting the changes that is enforcing researchers to do random studies over it. By taking into account the knowledge pool over the research purpose, a deductive research approach along with descriptive research design are found compatible to make a sense and represent the entire analysis. Research methods must be designed in a proper sequence that can help in understanding the need of the selected topic and its significance throughout the discussion (Snyder, 2019). A data collection has been followed from secondary resources such as online available

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materials- previous research papers, newspaper journals, articles and other reliable knowledge bases. Resources have been selected based on the key-terms- Smart Product, Servitization, Service system, Business, PSS and more, that can meet the focal points of the study adhesively and make a clear sense. All the real-time data have been collected to make the study reliable and validate alongside of properly maintained ethical norms so that no questions can be raised in the near future.

3. The Role of Servitization and Smart Product-Service Systems in The Industry

3.1. Servitization

In simple words, the word or term servitization can be defined as the industries who sell their "outcome or result as a service '' rather than selling it one to one. In the 1988's the term servitization was produced by the authors *Sandra Vandemerewe* and *Judan Rada.* The author has an argument that the manufacturers require a better way to stand out themselves in comparison with the competitors. In addition to this, the manufacturers need this more crucially to retain or maintain the customer base and improve the differentiation levels from the competitors. According to the reviews of **Kohtamäki**, Parida, Patel & Gebauer. (2020), the term servitization can also be traced when *Bristol Siddeley* made a servitization plan for the Viper engines *"Power by the hour"* in the 1960s. Moreover, this plan was a total accessory and engine replacement service that charged a fixed fee by hour flying. Along with this, instead of purchasing the engine, the manufacturers the power that is required to work and this provides the same power.

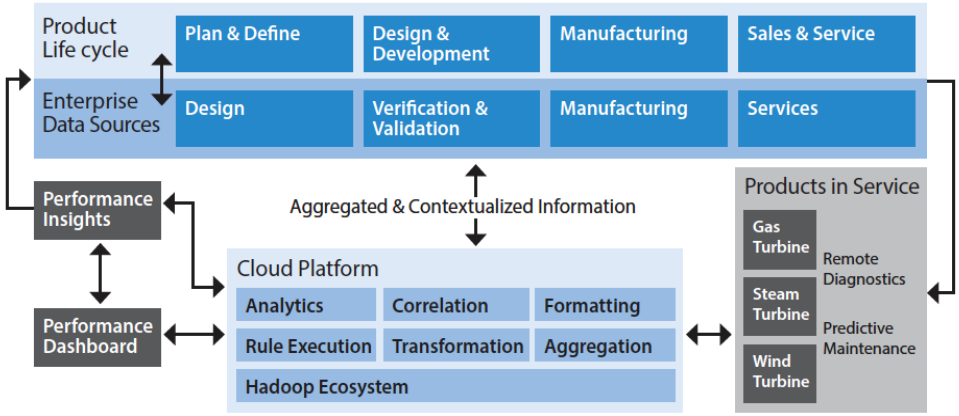
This power helps the manufacturers to operate with greater accuracy and forecasting as well as it also relieves the manufacturers from the costs of capital like maintaining the engine stock and its accessories. The best suitable example of servitization are Spotify and Netflix**,** where it protects or prevents the customers from buying or purchasing DVDs and CDs and delivers media like a service that produces the same outcomes (Kohtamäki et al. 2020). However, the businesses of media streaming are different from the normal businesses and the manufacturing businesses may also get the benefits or advantages from servitization. Along with that, the businesses of manufacturing may offer additional optional services to support their traditional products like maintaining a collection of automobiles on the roadway and maintenance as a service. Servitization is nothing but a model of subscription and may be followed in one or another way to many industries.

According to the assumptions, this subscription model may charge the customers $10 amount per month for music, $20 amount per month to maintain a collection of vehicles or automobiles on the street or $30 amount per month for all other services, all the services in one platform. As per the opinion of West et al. (2018), this model helps the businesses to remain profitable and become the needs of the businesses in the age of competitive market. In addition to this, the modern era where the manufacturing and the design financial aspects are becoming very challenging in the emerging markets. The developed products' life cycle (PLC) increases and the technology that helps to manufacture them also improves and are replacing the needs in small numbers. In order to improve performance and increase profits of the products, the necessity should be developed. In the manufacturing three servitization phases are available. The first is provision of the product, which are the fundamentals of manufacturing business such as make and sell.

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The second one is maintenance, servicing and repairing of products after sales which contribute to revenue generation. Along with that, the advanced services which improves the relationship of the customers and service provides as well as helps to become customer centric rather than selling products. The servitization model has many advantages for the business such as advanced innovation of the product, making of revenue strategy, setting more restrictions to the competition and growth in profit and revenue. Figure 1 below illustrates the steps for implementation of servitization model.

Figure 1: Implementation of servitization model



Source Calabrese et al. (2019)

3.2. Smart Product Service Systems (Smart PSS)

In the modern world of spontaneously changes taking place on the market, the companies also change their product sales into services. The smart products can be defined as the smart device that is connected with the internet through which it can exchange the details of its users, its atmosphere and itself. In addition to this, the products may range from motors of automobiles and medical instruments as well as for the smart packaging that will report the product's condition. Many of the firms have made a model for transforming the product sales into "product service systems (PSS)". According to Tauqeer and Bang (2018), the firms are combining the products with its services into PSS, which aims to stand out from the competitive crowd in the business market. The PSS model has many applications on the companies such as strategy, R&D practices, marketing and sales approaches, organizational and operational settings and profitability. In the competitive market most of the companies have made the PSS model to search out the ways to innovate and enhance their solutions but surviving seems to be very difficult with the PSS.

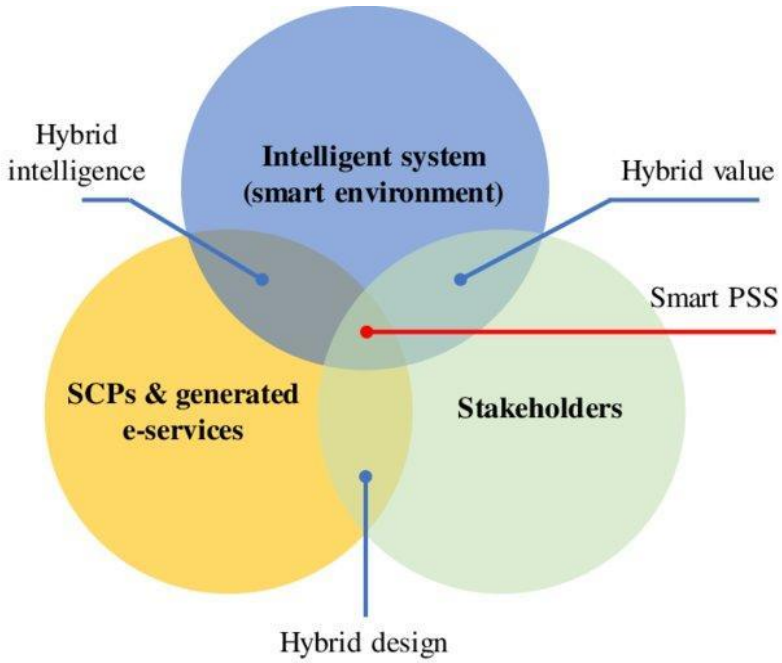
The smart elements or components like machine software's, control systems and sensors have made a different environment of the rivalry. The challenges associated with the technologies have forced the manufacturers to develop most innovative solutions to their consumers in spite of depending on the traditional business model. As an example, the big motor companies such as General and Toyota Motors have installed smart advanced technologies in their many high-end automobiles. These smart and high-tech technologies will enable the designing media and offer various services like assistance during driving to prevent accidents, automatic diagnostics from unexpected failures and at the time of theft. Along with that, due to change and transformation in the industrial machines, it is very important that manufacturer's need to determine the

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ways or strategies to overcome the challenges that arise for the digitalization in the digital era (Mastrogiacomo et al. 2020).

Thus, the manufacturing companies have climbed on the journey of implementing advanced technologies in the installation of PSS or Smart PSS in their businesses. According to the trends, the use and demands of digital systems and automated machines are increasing by the industries to offer new products to the customers. Additionally, the Smart PSS combines the online services and the smart products into one solution. The smart products use the technology of communication and information to accumulate, process and obtain the information. On the other hand, online services such as apps, websites make a connection of communication between the customers and the service providers (Ryu et al., 2018). The model of Smart PSS is very rare on the marketplace but the relevance and presence are increasing day by day. Figure 2 below highlights the structure of smart product service system.

Figure 2: Structure of Smart PSS



Source: Wang et al. (2020)

4. Discussion

From the above-mentioned discussion, it seems that Smart PSS is emerging in an IoT-driven business strategy that is helping in the value co-creation of businesses. Smart PSS is a larger chapter with a vast concept that has been tried to meet in this entire research work with a brief overview. The findings have been found from different aspects as ICT is influencing the performance of industrial organisations and their performances in major 3 aspects- technical aspect, business aspect, and social and environmental aspect. Along with smart remanufacturing, smart recycling, the lifecycle of products has been increased, which is also overwhelming the efficiency of product performance along with services (Wang, 2019). Different implementation use of Smart PSS along with engineering life cycling is improving the decision-making of computing systems and further service delivery. Analysis and retrieved cloud computing layers are found beneficial for engaging stakeholders in a value-generation manner.

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4.1. Technical aspect

By taking into account the data-driven platform-based awareness through various approaches, Smart PSS development has been noted in a wider perspective. In this context, both machinery and human intelligence have been covered with a proper conversation that is providing solutions regarding inverse design and solution design. By implementing advanced technologies, especially Cloud computing by considering IaaS, PaaS, and SaaS as the prime drivers with applications of smart living, smart distribution, smart manufacturing and smart predictive maintenance. Smart PSS system is a closed-loop that enables all the stages of smart operations with appropriate usage (Li et al., 2020). The ubiquitous connectivity has been enabled in industrial organisations where IoT serves as a smart foundation from IT perspectives. The digital twin has been assured by CPS and AR with its digitalisation processes by taking into account A.I. techniques. Besides, Big Data analytics has ensured successful business intelligence with proper decision-making skills of serving Smart.

4.2. Business aspect

Digital servitization is reflecting in a unique way with the help of Smart PSS by aiming at value perspectives. In this regard, e-services are getting generated through SCPs in the form of media tools for influencing both products independent services and product dependent services. Organisations for improving their performance level are seeking towards the adoption of product-oriented and user-oriented services smartly while the concern towards the overall business model would be found in little. The service platforms like Mobile APP in a Smart PSS context have been found to engage stakeholders actively that is converting the overall services into an effective value co-creation (Zheng, Wang & Chen, 2019). In this situation, both users and service providers are found to contribute in an environment where open innovation can be assessed efficiently. Product-service innovation, organisational changes, customer relationship management, human resources and value-chain process must be considered with high priority as well as digitalisation capabilities at the aspect of managerial implementation perspectives through Smart PSS.

4.3. Social and environmental aspect

The utilization of disruptive technologies is widening up an ecosystem-centric view along with open innovation towards social perspectives. It is helping in bringing sustainability by solving societal challenges with high profitability. Alongside sustainable prosperity, Smart PSS is evolving in the improvement of human well-being and shared value to the utmost vision. Meanwhile, the involvement of human beings is also found in the value generation loop with adequate knowledge of innovation driving focusing on their experiences. Furthermore, in this environmental aspect, achieving sustainability at the cost of a circular economy is the main goal of privatization. As smart PSS has the great potential to identify sustainability-related issues, surveys have revealed its usage in lifespan expansion, enhancement of resource efficiency, loop closure and several other measures. Hence, the human-centric Smart PSS is capable of contributing information through digital channels that help in extracting cognitive knowledge along with value generation purposes.

As this era is following a hybrid cloud-edge computing infrastructure, providing knowledge management solutions based on fusion techniques of data collection in an

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industrial organization have noted with highly efficient performances. Cloud-edge computing infrastructure is enhancing the capabilities of CPS to collect heterogeneous information by gaining full advantages. In that case, data storage, computing offloading, service delivery and distributing requests is leveraged to the users by cloud computing. It seems that from personal to professional level of use have been done dramatically with the help of Smart PSS that is adopting sensors of data-driven awareness with top-notch services where highly secured performance is the main motive to be served. Two major components- social sensors and hardware sensors are getting assessed easily by taking Smart PSS principles in an adaptable design. Hence, the concept has been made clearer in this overall study that is showing the significance of Smart PSS in the current date of innovation.

5. Conclusion

As the customers always expect more benefits and the lasting connection with their service providers, many manufacturing firms will add the options for service in the product sales. In addition to this, the industry keeps moving forward and highlighting the requirement of the best customer support and management system. The servitization model improves the overall performance of the industries and improves the relationship with the customers stable for long lasting. With this model, the manufacturer also provides the product related services to the customers which improves the customer base. Therefore, the customers will be bound to purchase the services of the products and profit from the manufacturer. The Smart PSS model enhances the innovation for the product and changes the design and installation in a better way.

Along with that, the communication and information technology systems transform the traditional way of business into the digital way and bring many challenges and opportunities. It also enhances the strategies of competitive integration and offers improved customer relationships. The Smart PSS model takes part in the various activities of the manufacturing process that increases the revenue turnover of the company. The digitization of the methods arise many problems for the business and technologies will make it easy to resolve these problems.

6. Contributions and Future Directions

The servitization and the Smart PSS model contribute in the various activities and operations of the manufacturing businesses such as alerting, monitoring, fleet management, maintenance of database, and remote control. In addition to this, the other contributing activities are data processing, scheduling of the resources. It also includes process and input optimization, customer and services support; assert mapping and revenue generation plan. According to the reviews of Reim et al. (2019), the Smart PSS model enhances the application of smart homes in various fields. Smart homes are the best source for the implication of Smart PSS. Research over this topic is clarifying the need of smart PSS on daily lives of population across the globe.

This research study has elaborated a clear concept about how smart connected devices works and make the lifestyle innovative. In this edge of Industry 4.0, changes are found in a rapid manner that is seeking beneficial development from Smart PSS applications. Therefore, this research work would help future industrial activities as well to bring improvement and betterment the whole productivity for getting better ROI. In has been

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noted that with the changing technologies and their application methods, the research works have resulted differently that has created a gap. In this study, focusing on those gaps, research methods have been chosen so that a bridge can be made to get an overview about the topic.

Focusing on maximum information has made this study worthy that would help in future researches and contributing relevant measures to evaluate more. As this study has focused on a clear differentiation between PSS and Smart PSS, it would enhance the interest level of future readers to explore more new ideas over the topic and a deeper concept to make innovation. The research work, in a whole, is widening up the way of core research over the chosen topic to get better ideas about both positive and negative consequences.

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Conflict of Interests

The authors declare no conflict of interest in this study.

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