EXPLORATORY THE TRANSITIONAL IMPACT FROM LEAN PRODUCTION TO OPEN SOURCE

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ABSTRACT *Lean production and open source innovation are the two forces that drive business success today. However, some aspects of lean production may adversely affect a company's capability to be successful with open source innovations. This study aims to examine open source adoption in the government and private sectors, and to identify the factors and challenges involved in its adoption. Lean production and open source innovation are related because their application can be integrated, considering the similarity in their operational purposes such as cost reduction and expediting processes. With good communication levels, lean production and open source innovation can achieve and encourage innovation capabilities (continuous improvement) in the organization. Although more than 50% of the respondents agreed that open source provides several benefits to their organization, they do not deny the challenges that come with service adoption. Finally, this study discusses the transitional effect of open source innovation.*

KEYWORDS: *customer relationship, innovation, knowledge sharing, open source*

1.0   INTRODUCTION

Innovation pertains to the commercialization of newly designed and implemented products or processes [1]. In developing an innovative culture in an organization, preserving uncertainty, encouraging risk-taking experimentations on new ideas, and allowing enough freedom to promote creativity among individuals are important [2]. An open source refers to a virtual network in which information and resources can be shared, with the aim of creating breakthrough innovations or introducing incremental improvements to an existing innovation [3]. Creativity is often crushed unintentionally in work environments that have been established to maximize business imperatives, such as coordination, productivity, and control [4]. Numerous management practices reinforce certain mechanisms that increase productivity and control costs at the price of organizational creativity. Such practice can be observed when the lean philosophy is the only management approach followed by an organization.

Open source allows for versatility in innovation and knowledge creation, as well as knowledge management. The existing technologies promote the further development of open sources, as well as the development of new technologies that do not become a barrier [3]. In addition, the community is a key to success where open source allows for knowledge sharing, knowledge creation, and new innovations to occur in various existing social networks [3]. For this reason, manufacturers or producers prioritize the use of open source to maintain customer relationships because it allows for convenient service delivery, particularly when software applications are involved. The increase in open source adoption has been influenced by technological advancements, such as virtualization, storage, and high-speed network access, as well as the growing comfort on Internet security and reliability [5].

Aside from software adoption, community is another important factor in an open source structure. However, the creation of a sense of community and a culture of learning can be challenging. In [3], the importance of a sense of community and culture of learning was discussed from the author's perspective to create the design solution. By sharing the design in an open source community, the design community could determine an effective design that can lead toward the development of another innovation. Thus, the feasibility of the plan for new innovations and growth opportunities can be easily determined. By emphasizing the open source in every stage of product development, the green-metric as zero environmental footprints for innovation component and growth strategy is indirectly embedded.

2.0   LEAN AND OPEN SOURCE

2.1   Lean in Open Source

Introduced by Poppendick in the late 1990s, lean in open source can be explained as lean software development. By adapting lean software into the new manufacturing paradigm of cloud manufacturing, the term open source is more applicable, given that cloud manufacturing provides a direct connection between manufacturer and customer-supplier either through an open or closed cloud pool. The present study is a novel approach into lean management, particularly on how such influences and manages knowledge sharing and innovation capabilities among individuals in the cloud pool.

Lean principles in software development have been discussed in [6,7]. The lean principles in software development that the researchers reported are listed in Table 1. Poppendiecks' principles are consistent with Liker's principles, but not as concretely expressed [8]. Nevertheless, Liker's and Poppendiecks' principles had significant differences: [9] emphasizes the importance of the standardization of working methods, whereas Poppendiecks focused more on self-determination. Furthermore, Poppendiecks' principles do not describe how work should be documented and when issues should be discussed.

One of the founders of the Lean Software and Systems Consortium promoted lean in different domains, including software [10]. Their current preliminary principles are as follows:

Follow a systems thinking and design approach

i. Influence emergent outcomes by designing the context of a complex adaptive system
ii. Respect people (as part of the system)
iii. Use the scientific method (to drive improvements)
iv. Encourage leadership (in contrast to management)

v.   Generate visibility (into work, workflow, and system operation)
vi.   Reduce flow time
vii. Reduce waste to improve efficiency

Andersson's principles are more practice-oriented, and more focused on issues in project management. Liker's principle dictates that only reliable, thoroughly tested technology that serves one's people and processes should be used. Such a perspective differs from both Poppendieck and Andersson, who come from agile environments where technology turn-around times are very fast. For safety-critical applications, such principles are relevant [8].

Furthermore, [6, 7] identified wastes in software development, as shown in Table 2. The primary wastes in software development include the rapid response to customer demand. Lean software development requires agile steps toward customer value and efficiency of the lean enterprise. Agility is mainly a response against document-heavy, plan-driven approaches for software development that are often unsuccessful [11]. Therefore, a lean software process can provide the following benefits:

i.   The statistical process control in lean software can allow for the quantification of the software development process, which may enable them to achieve Capability Maturity Model Integrated certification.
ii. Employing lean for both manufacturing and software development processes would provide a common approach for speech communication, thus simplifying operations management.
iii. If lean easily allows for an intrinsically lower risk and a more generative approach to software training, earnings can be increased.

2.2   Open source

Typically, open source is created for open sharing, with the purpose of developing, debugging, and improving software [3]. Open source is a high-priority subject in the research agenda for the implementation of eGovernment services under the eEurope 2005 programme [12]. Open source can be defined in terms of its characteristics: free of cost, and free to read and modify the software code [13].

Owing to the philosophy behind it, open source software has gained popularity. Open source welcomed knowledge sharing in a community. Thus, knowledge sharing has influenced the development of open source innovation. Open source innovation is a virtual network composed of the product developer, customer, supplier, and the user, among others. Such a virtual network allows for the sharing of information and data resources in order to attain innovation development and improve existing innovations [3]. This study explores the effect of the transition from lean production to open source, with focus on the effects on customer relationship, knowledge sharing, and innovation capability. These three elements are the critical factors for the success of lean implementation.

An open source community primarily aims to build and exchange knowledge resources. In online discussions, some community members cannot guarantee that others would respond to their question, or if the information provided will be useful. Their intention is either the problem was solved or not. Some of the community exhibit conversation protocols that are similar to social interactions in a community. Through knowledge exchange, the community can be involved in activities that differ from the other users, as well as perceive other benefits [14].

Open source development requires an understanding of the problem, the computer application that is attempting to work out, and the maintainer must assimilate patches with diligence [15]. Open source development enables companies to implement innovations and collaborate with other members of the community. Companies using open-source software benefit from many advanced technology solutions that they otherwise could not afford to develop. Such companies still deliver the alternative to steer development if they prefer.

2.3   Open Source Innovation

Open source allows knowledge sharing among the community. Knowledge sharing leads to innovations on new products and product improvement. Innovations, including concepts, studies, design, engineering, testing, and mass production, should be closely guarded to create value for the organization involved in the invention process [16]. Open innovation is defined as a paradigm that assumes that firms can and should use external ideas as easily as internal ideas, as well as internal and external paths to market, in order for firms to upgrade their technology [17].

The purpose of user and developer communities is to build and exchange knowledge. The involvement of successful communities helps with self-selection, together with passion, commitment, and identification with group's expertise [3]. Such elements indicate community competence and qualities of innovation communities. According to [16], the collaboration between smart people inside and outside the company is important for building a better business model, as the utilization of internal and external ideas will make them succeed in the market. Furthermore, profits can be gained from the other uses of manufacturer internet properties (IP) and can be used to buy another IP whenever it advances the business model. The external research and development (R&D) can create significant value, whereas the internal R&D is needed to claim a portion of that value.

The success of a company's innovation effort can be measured by the total number of ideas generated. Innovation requires collaboration among people and processes in order to develop an innovative product [18]. People or employees thus become the source of innovation, while process is a method for innovation. However, innovation can only occur in a conducive environment where its focus on internal culture and behavioural culture. Innovation is not a part-time activity and not only for small or new companies; it is merely the myth of innovation. Innovation may occur when there is a strong relationship among leaders and workers, and all levels contribute to the development of innovative ideas for product and service.

2.4   Transitional Effect in Open Source

This study investigates the transitional impact from lean production into open source. Generally, an open source product requires the contribution from every manufacturing and management angle to make it successful. The study on

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the transitional impact is broadly discussed because of the characteristic, agility. However, the focus on the transition is narrowed down to knowledge sharing, innovation, and customer service in a secure environment in a particular community. Figure 1 shows the relationship among the three factors, namely, knowledge sharing, innovation, and customer service, with community in an open source. Compared with innovation, customer service and community, knowledge sharing have a larger circle or network because of the increased possibilities of providing beneficial effects on open source.

Figure 1: The relationship between transitional effect and community with open source.

Knowledge sharing occurs when the community pool is occupied from management and manufacturing person. Furthermore, the community can likewise be filled by customer and supplier person to make knowledge sharing worthwhile. Knowledge sharing also promotes the capacity to generate an idea for innovation. Based on customer complaint or prototype reviewer, product improvement occurs with minimum cost of investment. Thus, knowledge sharing is significant in open source applications, similar to lean principles.

Knowledge sharing in every company is very important in optimizing production activities. Knowledge sharing is not restricted to training sessions, but should be welcomed in every production activity. By cultivating an environment that encourages knowledge sharing, the employee development program can be reduced or eliminated slowly, thus leading to cost reduction. Results showed that both sectors exhibited a learning environment to support knowledge sharing occurred in both sectors. Nevertheless, the government showed that they have a good relationship when they know each other very well and also tend to wish for the success of their member. By contrast, in the private sector, there is a boundary between employees; communication is limited in order to control the secrecy from outside and the bottom level of employee. Although such companies use open source products, only certain types of data and information can be shared with others.

Customer service is an important factor in the success of a business. Good customer service delivery contributes to sustained business and profits for the manufacturer. In open sources, customer service should likewise be emphasized. Figure 2 shows how customer service and pull production are emphasized. Every customer needs to agree with the terms and conditions for every order that they place in order to prevent any losses during data and manufacturing process. Likewise, customers can provide feedback or complaints in a convenient environment. As such, customers can constantly engage marketing or service personnel, and every customer feedback or complaint can be addressed in a timely manner. Open source quality depends on the quality of the community and the ideas that are discussed in it. The entities involved in the community can include anybody whom the provider (open source organizer) wants to, or it cannot be controlled. However, to avoid any risk and issues in the future, many providers choose to control every data transfer or introduce limits and boundaries. One method to help such companies to control every data transfer is by allowing only authorized person access to the community. The community may include the supplier, manufacturer, engineer, designer, executive, customer, and end user, among others. The larger the community, the more valuable idea is created.

2.5 Open Source Adoption

This study also reviewed the existing approaches to open source adoption in both sectors. The criteria include cost reduction, speed to adoption, new market entry, business process transformation, and improved alignment/interaction with customers. As shown in Figure 3, the current approach to open source adoption in the private sector is better than that in the government sector. However, the government is better prepared for business process transformations, owing to the global demand for expediting all processes. The global demand has forced the government to hasten the rate of adoption in order to maintain its competitiveness in the international setting. Moreover, this survey showed that the private sector is always ready for new entry to the market, which is slightly higher that the government sector. Capturing the end usage patterns is important in achieving optimal pull production. Through several open source products such as Mozilla, WikiHow, and Facebook, online surveys can be conducted to determine the current demand. Lean production emphasizes manufacturing speed, market entry speed, and the rate of adopting an open source environment. Considering these criteria, the private sector may optimize its cost savings, attain low manufacturing costs and high profit, as well as the other benefits of having an open source environment.
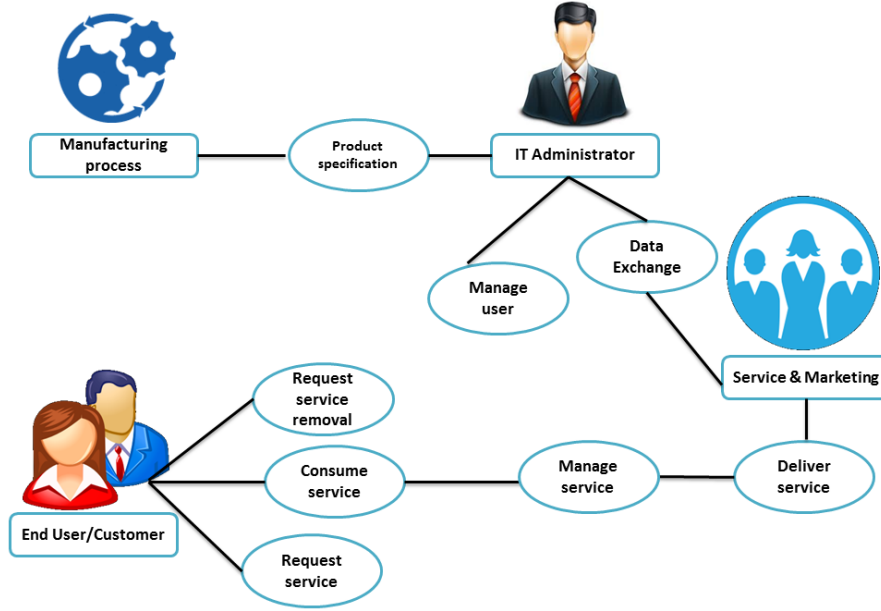
Figure 2. Customer service and pull production in open source

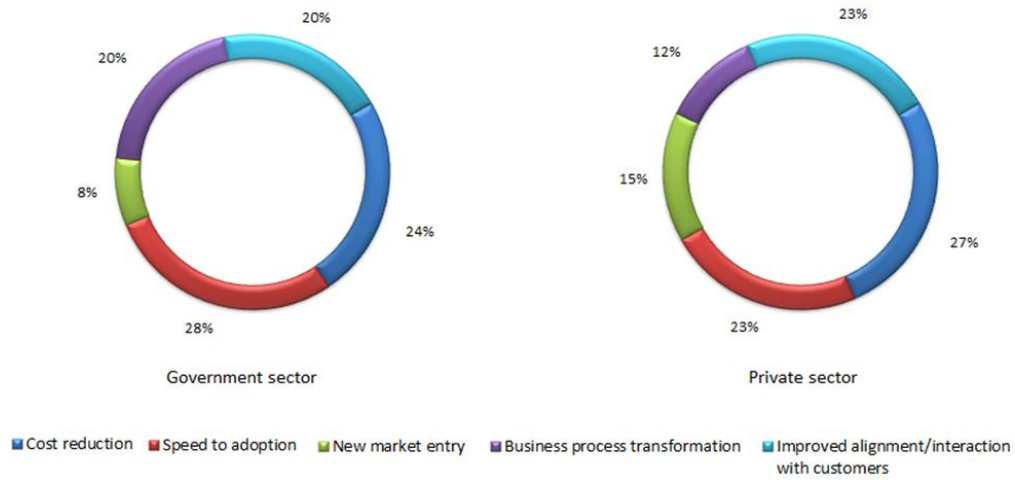**Figure 3. Current approach to open source adoption**
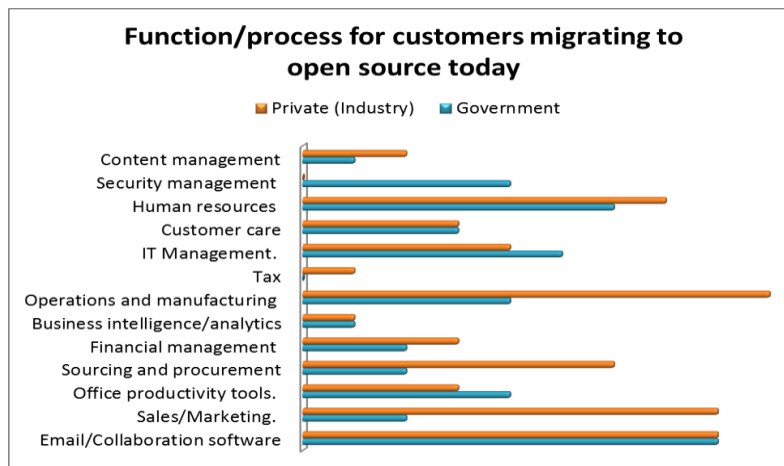
Figure 4. Function/process for customers migrating to open source today

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Table 3. Challenges for open source adoption by customers and innovation capabilities

Adopting the service by customer	Innovation Capabilities
Transparency of operational controls and data	Financial constraints
Data loss and privacy risks	The urgency of day-to-day business demands
Risk of intellectual property theft	Lack of skill within an organization
Legal and regulatory compliance	Inadequate understanding of market demands

2.6 Customer Relationship as influencing factors

Customer relationship is studied to identify the influencing factors on open source adoption. Some organizations have been influenced by their customers to facilitate the management and manufacturing process. World-class customers require fast action and fast results of decision making. In this regard, it is parallel to lean manufacturing, which emphasize management and manufacturing speeds. Such a perspective was affirmed by the private sector, which found that customers have migrated from conventional management and manufacturing to open source management and manufacturing, as shown in Figure 4. Furthermore, customers use email and collaboration software and sale and marketing in their operations. However, the government observed that their customers adopt email, collaboration, and human resource operations as an open source medium.

2.7 Key Challenges and Influencing Factors

Key challenges and influencing factors should be studied to determine the degree of adoption. The key challenge has been focused on customer relationship and innovation capability. More than 50% of the respondents believe that their organization has a successful innovation rate and prioritizes strategic innovation properties. Therefore, innovation capabilities can be always observed in their organization to achieve internal and external satisfaction. Influencing factors for open source adoption are determined based on customer relationship. Over 25% of the respondents agreed that the customer influenced them to adopt open sources into their operation. The primary reasons for such adoption are to enhance the communication levels and to expedite the operations.

Table 3 lists the challenges for open source adoption as perceived by customers, and innovation capabilities that agreed by both sectors. The challenges faced by the customer are mostly related to the lack of an open source system that would not overwhelm an expert. The primary challenges in open source adoption are the transparency of operational controls and data, data loss and privacy risks, risk of intellectual property theft, and legal and regulatory compliance. However, these factors do not impede an organization from using the product at the minimum level to improve their operations. Meanwhile, the challenges include financial constraints, the urgency of day-to-day business demands, the lack of skill within the organization, and inadequate understanding of market demands.

3.0 CONCLUSION

The current study found that open source can be adopted even at the initial stage. Some organizations were not aware that they actually use open source, realizing it only after the survey had been conducted. Such organizations agreed that open source considerably benefited their operations and expedited the evolution process. Through this study, we found that the transitional impact resulted in knowledge sharing, improvement of customer service, and occurrence of innovation in a control community. Those factors have helped perfect their operation and management. Furthermore, open source allowed for the virtual management to be able to encourage the application of the lean principle, which resulted in savings and efficient utilization of all assets and equipment in the operations.

By identifying the key challenges and influencing factors in open source adoption, we conclude that customers have a wide exposure in technology invention, as some respondents agreed that they have been influenced by their customer to use open source products. However, the lack of skills for using open source products prevents them from using it. Furthermore, the lack of skill within the organization contributes to their inadequate understanding of market demands. Finally, the biggest obstacle for innovation capabilities through open source is financial constraint, as organizations need to invest in training employees and buying the open source product and equipment for better applications.

In addition, we found that the respondents used open source products, such as email, Facebook, Mozilla, and Yahoo as their medium of communication. The open source product is generally used for a variety of meetings, cross-functional meetings, board meetings, annual conferences, special interest groups, management meetings, and networking technology. Such communication media were equivalent to the lean concept, which reduced the time required for delivering meeting notifications and increased the rate of knowledge sharing with the employee.

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