The Alignment of the Open Innovation Process and the Project Lifecycle

Abstract

Purpose –This research study aims to develop an alignment model based on a literature review that explains the association between the construction project lifecycle and the innovation process while considering the integration of all stakeholders in the process in an open innovation context.

Design/methodology/approach – The authors conduct an extensive review of the open innovation and the construction project management literature to establish an alignment model through the investigation and analysis of the current scholarly contributions. This research study is based on a theoretical framework; thus, it has not utilized any primary data. Moreover, data collected for this research study was obtained from reliable literary sources.

Findings –The study presents an alignment model that has uncovered a strong correlation between project activities, stakeholder integration, and innovation. The authors revealed critical factors that require an enhanced inter-and intra- collaboration between the various stakeholders and team members to achieve an effective innovation process in a project context.

Originality/value –This study provides a previously unexplored alignment between the project lifecycle and the innovation process. It signifies several critical factors that influence the effectiveness of innovations in a construction project context. Furthermore, it identifies different zones and knowledge transfer gates that necessitate proper leadership, stakeholder integration, and team dynamics throughout the project lifecycle.

Keywords: Open innovation; Project lifecycle; Innovation process; Construction projects; Stakeholder integration; Innovation effectiveness

Paper type: Conceptual paper

1. Introduction

Innovation has contributed a remarkable value to nations and organisations keen to enhance their competitiveness. However, innovation activities represent a significant challenge for organisations, including those operating in construction, mainly due to considerable uncertainties of its management (Jia *et al*., 2019, Betim and Rinor, 2019). Nevertheless, the construction sector is under immense pressure to develop new practices and improve the existing ones to have a less threatening impact on the environment and simultaneously achieve social and economic sustainability (Ozorhon, 2013; Golini and Gualandris, 2018). Hence, the construction industry project-based activities provide a complex network of stakeholders offering their knowledge and capabilities to produce innovations. In such a context, project management process is challenged to facilitate the cooperation, communication, and integration among those concerned with developing products and designs (Demirkesen and Ozorhon, 2017). In a significant study, Kumaraswamy and Dulaimi (2001) have argued that traditional, lump-sum contracts, and procurement strategies that favour speed, urgency, and financial benefit tend to discourage adopting non-traditional processes and products and are extremely detrimental to innovation. Consequently, these procurement strategies involve the highest cost risk for contractors, the increased occurrence of adversarial relationships, the lowest level of integration among stakeholders, and the poorest innovation outcomes.

It is essential to have a well-integrated team from an innovation standpoint since this aspect is key in driving innovation (Walker *et al*., 2003; CIOB, 2010; ICE, 2015). Therefore, it can be argued that higher levels of innovation could be delivered when the selected procurement strategy aligns with various stakeholders' interests, capabilities, and expertise in identifying the most optimal solutions for the project challenges. Due to the complex nature of the construction industry, the integration of different sectors is also necessary to achieve the innovation goal. In this industry, innovation is a relevant term for every developer and his/her team; small groups and construction agents are crucial to innovation, as they are closely related to the working sites (Forbes and Ahmed, 2010). Zheng *et al.,* (2019) argue, that leadership style and the organizational culture are the primary drivers of innovation in a construction project lifecycle, as these two factors impact the individual behaviour of employees closely linked with the project processes. This indicates that a high coordination and integration level amongst internal and external stakeholders is vital to enable effective innovations in projects (Demirkesen and Ozorhon, 2017).

According to Pliekhanova (2019), Ozman (2011), and Ozorhon *et al.* (2010), the project lifecycle usually lacks association with innovation and hence it is difficult to achieve an overall alignment of the innovation process with the project lifecycle. The development of knowledge, tools, and practices to deliver effective innovation would provide an opportunity for the management of construction projects to explore innovation across its complex network of stakeholders (Rogers, 2003). Many researchers including Rogers (2003), Hall and Vredenburg (2003), Hart and Sharma (2004), and Buchel *et al.,* (2013) have highlighted the roles of stakeholders in innovation and argued that this issue has a major influence. Therefore, there is an opportunity for researchers to investigate how project and innovation processes can be aligned in an open innovation context, especially in the context of construction projects. This research study aims to develop an alignment model that explains the link between the project lifecycle and the innovation process while considering the integration of all stakeholders during the process in an open innovation context.

This research study has primarily focused on the development of a conceptual model, and its basic structure is different from that of an empirical research study. In the following sections, we describe methodology, literature review, and findings have been elaborated. In the last section, the conclusion, implications, and limitations.

2. Methodology

Despite the revived popularity of project lifecycle studies and innovation processes research, there are no alignment studies of these two processes, although their dependency and association are evident, not least in the context of their application in construction projects. The purpose of our theoretical contribution is to establish an alignment model through the investigation and analysis of the existing scholarly contributions by performing a comprehensive review of the current literature. Every research study is based on different or specific concepts; this study is based on a particular category of qualitative research *i.e*., conceptual analysis. Many researchers have concluded that conceptual research is entirely different or opposite from an empirical study (Weibelzahl and Weber, 2002; Gagnon, 1982). Such types of studies are prevalent nowadays, but the criteria of quality for conceptual studies are not clearly defined or explained (Leuzinger-Bohleber and Fischmann, 2006). In a relevant study, Stenbacka (2001) has highlighted that the validity of qualitative research has several problems and is very difficult to predict. Therefore, to maintain the reliability and validity of this research study, the collected data had been acquired from many reliable resources. The model provided by this research study is based on a search string to explore the body of literature regarding the main phases, activities, and stakeholders in the lifecycle of projects and innovations that had been addressed by 10 books and 70 articles derived from the search engines of electronic databases. These databases include Scopus, Web of Science, EBSCO, and Emerald Full Text. Moreover, no particular journal or database was specified for this research. All the research articles from various databases were derived after searching keywords, such as project lifecycle, innovation, open innovation, and project management and stakeholder integration. These keywords were searched individually, and also by creating the linkages among them, *e.g.,* project lifecycle and open innovation. The sorted articles after keyword search were organized to align in the study. The aligned research is further compared based on similarities in the key variables and their utilization in the innovation process. The difference in the working categories and various sources of innovation are the vital points that are considered while evaluating the qualitative results.

Many conceptual studies and literature review papers initially perform the bibliometric analysis by using the Bibliometric software tools, which include Bibliometrix, VOSviewer, and CitNetExplorer. These software tools provide relevant data on one factor or variable; thus, they are more significant for the Systematic Literature Review (SLR) papers. While performing this conceptual research study, our primary focus was on multiple factors and their mapping was difficult with the help of software tools. Therefore, instead of utilizing any software, data was organized and classified manually to indicate the results. These results were derived by a comparative analysis of literature and the findings were systematically compiled. It should be noted that innovation in the construction industry is an ongoing process; hence, this research is focused on quantifying similar variables and merge them to evaluate the results.

3. Literature review and knowledge gaps

3.1 Innovation and Construction

Innovation in general terms implies that a new idea is implemented. According to Peansupap (2004), innovations in construction can be categorized into *innovation in materials, equipment, and methods, innovation in Management, and Information Technology (IT) innovation*. Davis *et.al* (2016) and Bygballe and Ingemansson (2014) pointed that these innovation outcomes can be characterized into *technical innovation* and *organizational innovation.* Manley (2008) refers to the utilization of technical approaches in either product or process innovation as technological innovation. Organizational innovation, on the other hand, entails the application of business practices, such as when a new method is introduced into a system and replaces an existing pattern of previously accepted products and processes. Improvements in construction procedures that are created or developed for the completion of routine operations or the increase of the efficiency of a regular operation are known as process innovations (Tatum,1989). On the contrary, product innovation, refers to the introduction of a new concept that is then converted into a new component of a manufactured product with economic, technological, or functional value (Nam and Tatum, 1989).

Several large-scale empirical surveys have found a low level of such innovations in the construction industry (Ozorhon *et al.,* 2010). Many of the inherited cultures, processes, and practices of construction projects are the main obstacles to the innovation process (Kumaraswamy and Dulaimi, 2001). Much of the innovation in construction remains hidden, as it is co-developed at the project level and occurs daily on construction sites to deal with design, construction and organizational problems and challenges. However, this paper is focused on innovations that are formally sanctioned and contractually agreed by the main project stakeholders.

Researchers tend to focus less on project level innovation dynamics and more on the firm level due to the difficulty of tracking various activities undertaken by heterogeneous stakeholders during the multiple stages of a construction project (Ozorhon, 2013; Ozorhon *et al*., 2010; Murphy *et al*., 2011). Due to the fragmented supply chains, difficulties to bring stakeholders to agreements, and poor cross communication and knowledge management in construction projects, it is difficult to generate, adopt, implement, and diffuse the innovation process (Aouad *et al*., 2010). Brockmann et al. (2016) indicates that innovation is more prevalent in megaprojects because of their complexity, type, and size. Hence, a distinction between the different types of projects while reporting on innovation in construction is crucial. In the context of megaprojects in construction industry, it is not enough to deal with the supply chain as it is widely known; an extensive intra and inter-organizational coordination is required. Hence, the recognition of changes in the competitive environment and accordingly structuring the resources and supply chain to effectively meet the customers' real demands is imperative. Furthermore, it is significant to ensure effective integration and coordination of various parties in the supply chain for achieving an outstanding performance (Fawcett & Magnan 2002; Ozorhon *et al*., 2014).

According to Murphy *et al*., (2011), innovation in construction projects is often co-developed with various stakeholders, each with a specific role in the innovation project. By considering the multidisciplinary and multiparty environment in the construction industry, an analysis of innovation at the project level across organizational boundaries could be produced. Similarly, communication is a source of innovation that is crucial for the execution of mega projects. The alignment of project lifecycle and innovation must be correlated with the effective communication from leadership to the companies dealing with the small chunks of work (Usman & Said, 2012). This analysis can offer more relevant knowledge to identify the conditions under which innovation can be delivered effectively (Murphy *et al.,* 2011).

3.2 Open innovation

Bogers *et al.,* (2019) argue that many factors are involved to make the protection of intellectual property (IP) extremely difficult. These factors include the growth of companies in the 20th century, the increasing number and mobility of knowledge workers, globalization and greater ease of knowledge transfer, and private venture capital markets. This have encouraged more organizations to consider the adoption of the concept of *open innovation*. Although the idea of open innovation is not entirely new, it was not termed as such. Various forms of open innovation have been utilized in the construction industry, as the nature of projects requires cross-boundary collaboration within the supply chain (Bogers *et al*. 2019). Nevertheless, traditional ways of collaborating in the supply chain often concentrate on the primary stakeholders of the construction work, while ignoring the secondary and invisible stakeholders, which can have a detrimental influence on the project performance and the final innovation product (Bogers *et al*., 2019). According to Edelbroek *et al*., (2019), since the last decade, open innovation has become "*one of the hottest topics in innovation management*" (Edelbroek et al. 2019, p.5-6). Consequently, several literature reviews and surveys on open innovation have been published (*e.g.* Lichtenthaler 2011; West and Bogers, 2014). However, evidence of the practical implications and benefits of open innovation is still very inadequate and in the developmental stage (Edelbroek *et al*., 2019).

March (2008) realized the need to chase the external intellectual sources of knowledge; he proposed the concept of exploration/exploitation during the early 1990s, which resembles open innovation. Hruby (1999) argued the significance of cutting-edge enterprises adopting the innovation methodologies generated outside their limits. Hamel (2000) and Hagel III (2002) acknowledged the importance of new models of open innovation, as was later explored by Chesbrough (2006), who recommended that enterprises should develop or redesign their business models in an open format to produce new value logic.

The open innovation model exhibits three different processes: The first one is the *outside-in process (inbound)* which depends on escalating the organization's knowledge base through the integration of stakeholders, which can lead to an increase in the innovativeness of the organization (Lettl *et al*. 2006; Piller and Walcher, 2006). The second process of open innovation is the *inside-out process* (outbound) which refers to profiting through bringing ideas to markets, selling intellectual properties, and multiplying technologies through ideas transfer (Enkel *et al*. , 2009). Finally, revenue is received through licensing fees, joint ventures, and spinoffs, which Gassmann and Enkel (2004) and Lichtenthaler and Ernst (2009) claim to be more profitable as compared to innovation.

The last open innovation process is *the coupled process* that promotes co-creation with complementary partners, which is achieved by establishing alliances, cooperation, and joint ventures as means of stakeholder integration (Enkel *et al.* , 2009). This process integrates the first two processes (*i.e., outside-in* and the *inside-out*) to develop and commercialize innovation at the same time. Hence, it can be concluded that the innovation process focuses on communities, consumers, lead users, universities or research organizations, and partners from other industries (Enkel *et al.*, 2009).

The networked nature of open innovation allows for more innovation opportunities, as argued by Saint-Paul (2003, p. 3). Similarly, Koschatzky (2001) shares the same viewpoint by claiming that enterprises without participating in the network have to deal with serious competitive disadvantages. Consequently, they may have their knowledge base reduced, making it more challenging for them to continue in exchange relations with other organizations.

The role of networks in innovation has been at the center of attention of many research studies on innovation. Allen and Cohen (1969), Kilduff and Krackhardt (1994), and Sparrowe *et al.,* (2001) are various scholars that studied the influence of networks on performance, power, creativity, and R&D. Recent research studies focus their attention on the way network structures impact innovation (Björk and Magnusson 2009; Gould, 2012). However, there is still very limited research analyzing the inter-relationships between social networks and innovation. Therefore, there is a need for more empirical work in this research field, especially in the construction sector.

The challenge here is to investigate and manage the most appropriate stakeholders and motivate the internal stakeholders towards achieving the common innovation goal(s) (Blok *et. al*, 2015). These networks must be time-aligned with the project lifecycle and the innovation process. For supply chains that aim to deliver innovations, it is imperative to align the motivation of the various parties working on the innovation and on the project itself. These parties may have varying interests that must be integrated towards a satisfactory level of mutual agreement to ensure successful innovation development and implementation (Blok *et. al*, 2015). The following section analyses the construction project lifecycle and the innovation process to better understand the mechanisms that can be aligned in both approaches to achieve a good innovation outcome.

3.3 The construction project lifecycle and the innovation process

Understanding the phases involved in construction projects is vital to the current study. Following this discussion, the phases are mapped with the innovation process to highlight the stages in the project lifecycle that must be aligned to enhance and influence innovation.

Researchers have referred to the project lifecycle as the construction period from conception to completion (Jugdev and Muller, 2005). Various authors have described the phases of a construction project somewhat differently in their studies. In his book, '*The Management of Construction: A Project Life Cycle Approach*', Bennett (2003) identified six phases in the construction project lifecycle, each with its purposes and characteristics. These phases include the pre-project phase, planning and design phase, contractor selection phase, project mobilization phase, project operations phase, and finally, the project closeout and termination phase. This order best describes the traditional design-tender-build method of project procurement. Moreover, Kagioglou *et al.* (2000) reduced the construction project phases to include the pre-project phase, preconstruction phase, construction phase, and post-completion/construction phase, which better suits the various types of procurement methods. In their study, Aaltonen and Kujala (2010) divided the lifecycle of an investment project in construction into the following three main phases: *investment preparation*, *project execution*, and *operation*.

Insert Figure1a

First, in the *pre-project phase*, the project begins with an idea, a need, and a desire to improve the productive capacity or provide services that are more efficient. At this phase, the appraisal and the design brief are developed. A general outline of requirements, constraints, and future actions plan is established in the design brief. Moreover, it also involves identifying the suitable procurement method(s), procedures, structure, and range of consultants and other stakeholders to be engaged during the project (Bennett 2003; RIBA 2013).

According to RIBA, two key factors should be accomplished early in *the planning and design phase*. *First*, there must be a well-defined understanding of the project's concept. *Second*, a relationship between the client/owner and the project delivery organization or personnel must be recognized, with clearly defined roles and responsibilities (RIBA, 2013). At this phase, a brief can be developed (or enhanced). The brief can be prepared by the client/owner even before the project manager or design professionals are engaged, or it can be prepared with the help of the project manager or design professionals after they are engaged. The input of experienced and innovative consultants can assist the owner in identifying and clarifying project needs and setting forth the project's scope (Bennett, 2003).

Following the brief, a comprehensive programme is developed (Bennett, 2003). This phase is considered critical in identifying, recognizing, evaluating, and formulating the innovation goal and objective, and integrating essential and influential stakeholders are necessary (Thomson and Munns, 2010). The planning stage usually involves considerable back-and-forth deliberations of several alternatives, modified and refined options, to find the '*best solution to the stated programme objectives*.' Feedback is an integral part of this process, as the various parties evaluate the alternatives, suggest modifications, and reach tentative decisions. Subsequently, this stage is followed by design and specifications preparation, which starts with specifying a schematic design consisting of drawings and a written report.

In the *construction phase,* which is also referred to as the project mobilization phase, the contractor is appointed and issued information. Subsequently, arrangements are made to hand over the site to the contractor. After a number of activities, including securing bonds, insurances, licenses, budget, and the worksite preparation, the actual field construction commences (Bennett, 2003).

The *operations and completion phase* is where contractors monitor and control, manage resources, and work on documentation and communication to ensure that the project goals are appropriately fulfilled. This is performed while the contractor ensures that everything is properly documented and communicated effectively among the team members (Bennett, 2003).

Figure 1a highlights the construction project life cycle, which includes identifying the need, appraisal and strategic briefing, formulation of the design concept, resolution of the detailed design, formulation of production information, mobilization and project planning, operations site and completion, and project termination.

Murphy *et al.* (2011) argued that many researchers still view the innovation process elements established by Marquis (1968) as the seminal piece of work in specifying the innovation process. Thus, they used Marquis's (1968) six-stage innovation process in their construction-specific research study and supported their choice by various industry-specific studies (*e.g.,* Slaughter, 2000; Tatum, 1987; Winch, 1998) that employed the same approach. These six stages include the recognition, idea formulation, problem-solving, solution, development and utilization, and diffusion. After conducting a study using three case studies, they linked generic procurement stages with the innovation process as follows:

i. Development of brief/intention to innovate.
ii. Formulation of design/innovation conceptualisation.
iii. Resolution of meticulous design/innovation development.
iv. Formulation of production information/manufacture of specification.
v. Mobilisation of the works/preparation to implement innovation.
vi. Implementation of building design/implementation of innovation.
vii. Complete building/commercialisation of the innovation.

Insert Figure 1b

Figure 1b, highlights the innovation process based on seven stages including, intention to innovate, innovation conceptualization, innovation development, preparing for implementation, implementation process of innovation, and handover.

Moreover, Thomson and Munns (2010) have also attempted to map the innovation process with the construction project lifecycle by conducting a longitudinal case study approach using three cases. The study revealed the following three *decision gates* in the process 1) decision to develop the concept; 2) decision to implement; and 3) decision to complete the implementation process. Two different levels of management control arise in this process, the first is related directly to the internal function of the phase, whereas the second level is related to the overall management of the innovation process and its integration needs with the project. The selection of an appropriate team emerged as a significant element.

Similarly, Thomson and Munns (2010) have argued that for preparing the project for the first decision gate, the following two activities must be undertaken. *First*, the assessing the suitability, viability, and the initial implications of the concept in practice. *Second*, presenting the idea to the team and ensuring that a plan is developed for an initial methodology for the process. This first step is vital as the owner and the top management team have to promote the idea to the rest of the team (*i.e.,* the design team) to assess and consider its suitability for the project. This first phase must be aligned with writing the brief and formulating the design concept. At this stage, the importance of stakeholder integration and the development of the right team members arises to support the innovation process. This stage is also critical in identifying how to internally quantify the effectiveness of the innovation as the project evolves. Furthermore, several essential factors, such as dialogue, conversation, and knowledge sharing play critical role to clarify the innovation's objective and set clear goals regarding the innovation process (Slaughter, 2000; Ozorhon *et al*. 2014).

Following the first phase, the formulation and development phases represent the transfer process of the concept from philosophy into implementation (Thomson and Munns, 2010). Here arises the need to convince the decision-makers that the innovation has been developed sufficiently for final implementation process. This is performed through several activities of assessment (*i.e.,* feasibility, technical, financial, risk, and impact assessments) and planning activities (*i.e.,* planning and development for implementation or practical application). In this regard, Thomson and Munns (2010) have stressed the significance of these activities for the success of the innovation process. In their study, they discussed that the thoroughness with which the respective idea champions assessed the overall suitability of the project and planned its implementation presented the rest of the project team (*i.e.,* designers, contractors, and maintenance) with an obvious case for its inclusion and a detailed understanding of its implications for their role within the project. The integration of team members and significant stakeholders has been further supported by an important research study undertaken by Ozorhon *et al*. (2014).

During the implementation phase of the innovation process, the developed concept is usually transformed into its practical function. In this phase, the inclusion of all of the stakeholders within the process, notably the integration of contractors, subcontractors, and catering for wider stakeholders is necessary for the success of the project (Thomson and Munns, 2010).

Lendel *et.al* (2015) argued that for a successful implementation of an innovative project, an enterprise must create a management team capable of effectively solving problems and tasks arising during the change. This team should include managers of those departments in which the innovative activities are performed. Furthermore, this management team should coordinate its work with the first-level managers and the heads of the main divisions of the enterprise. This collaboration can determine the main parameters of the expected results of the change (Lendel *et al.* 2015).

Aziz and Hafez (2013) suggested that during the implementation phase of an innovative project, it is advisable to establish measures to prevent and overcome staff resistance to innovation to reduce the likelihood of discrediting, delaying, or opposing workers concerning the changes. The organizational mechanism for the implementation of an innovative project should be based on the project management structure.

Following the implementation phase, the final phase of the process is the handover or commissioning phase. In this phase, the performance is evaluated, and the requirements for the future of the innovation are considered. According to Thomson and Munns (2010), this stage must incorporate two types of the review process: One is the informal stemming from discussion amongst the team members about their experience and the second is the formal exercise based on a post-evaluation meeting. This phase plays a significant role in maximizing the transfer of knowledge and facilitating learning amongst those involved before the process completion.

Chursin *et al.* (2016) explained that the progressiveness of the fixed assets, the degree of mechanization, automation and robotization of production, energy and technical equipment of labor are indicators to the effectiveness of innovation at the end of the project. R&D should also reflect the results of exploratory and fundamental theoretical research. Similarly, Demirel and Kesidou (2019) measure the effectiveness of innovative projects by the presence of demand for innovation and orders for R&D.

Cooke-Davies (2002), on the other hand, mentioned that performance predicts and drives success. Similarly, Takim and Akintoye (2002) further added that an effective performance measurement strategy could indicate the degree of success of the implementation of the innovation and consequently its effectiveness. However, the true nature of benefits from innovation may not be easily captured by the traditional financial metrics alone, and standards for measuring innovation effectiveness should extend beyond financial measures (Sawang *et al*. 2007). The positive perception of the benefits of the innovation is imperative because programmes and projects implementing innovations are usually risky and tentative. Perceiving the direct benefits of implementing the innovation in terms of money, time, and effort is necessary for future innovation adoption (Sawang *et al.* 2007; Chursin *et al.* 2016).

Sawang *et al.* (2007) argued that performance measurements in terms of outputs and resources should be quantified at different levels. Outcomes are measured to determine whether they help accomplish goals (effectiveness) and resources are measured to determine whether a minimum number of resources is used to produce outputs (efficiency). They add that there should be long-term relations with the various stakeholders in the project and the wider broader community for their project to remain competitive in construction projects and the performance measurement must incorporate the interest of the stakeholders, economically and morally.

Correspondingly, Rese and Baier (2012) studied two different dimensions to quantify the performance of their innovation project, without considering the financial measures as their projects were under construction at the time of their data collection. These dimensions include the comparison of the original innovation project goals relative to the adherence to budget and schedule (efficiency), and the achievement of set goals and/or expectations, especially regarding the quality of the outcome (effectiveness).

4. Findings and the alignment model

Considering that this paper is focused on innovations that are formally endorsed and contractually agreed by the main project stakeholders, and going back to the project lifecycle, the innovation process and the open innovation model; important research studies undertaken by Murphy *et al*. (2011), Thomson and Munns (2010), and Chesbrough (2003) have revealed a linear process closely aligned with the stages of the overall project lifecycle as presented in the following model.

Insert Figure2

Figure 2 depicts the alignment of the stages of construction project lifecycle with the strategy of innovation. It represents that all the stages of the construction project lifecycle are associated with the innovation process.

In this process, there must be an overall innovation leadership layer to supervise the various phases of the innovation process by monitoring and providing both influence and feedback between the stages, and between the innovation process and the broader project across its lifecycle (Ozorhon, 2014; Thomson and Munns, 2010). This is performed through directing, guiding, and monitoring the overall innovation process to ensure that the innovation is aligned with the general strategic objectives of the project (Mudassar *et al.* 2021). According to Froese (2010) and Farokhad *et al*. (2019), innovation is closely linked with the leadership intent, norms and values, aims, culture, and strategies. Although having a culture of innovation and strategies complimenting cultural values is imperative, the personal level of innovation that is reflected in skill and performance, especially in outsourced work, is essential (Froese, 2010).

This becomes more significant, while dealing with open innovation. The notion of open innovation became famous after the contribution of Chesbrough (2003, 2006), who focused on the possibilities and limitations for the enterprises to move from a rather closed approach (*i.e.,* where innovation is performed in-house, often in an isolated R&D department) to a more open approach. In the latter case, the innovation is performed in association and partnership with other companies and through the combined use of internal and external concepts.

Insert Figure3

Figure 3 presents the alignment of various stages of the construction project lifecycle with the process of open innovation. Moreover, it also highlights the effects of external sources of knowledge.

Jonas *et al.* (2018) argued that intra-collaboration and engagement of stakeholders are essential to produce better results, especially, innovation. In their research study, George *et al*. (2019) indicated that when stakeholders have inter- or intra-collaboration, their organization produces better outcomes and a high degree of ownership among its members. Another study by Colombo *et al.* (2011) pointed that inter and intra-firm networks could influence innovation. This can be achieved by creating a better ecosystem of the organization, thereby understanding the requirement of clients and valid external and internal knowledge (Jonas *et al*., 2018).

Many scholars have emphasized that external linkages are vital for the enterprises to enhance their innovation (*e.g.,* Lichtenthaler, 2011; West and Bogers, 2014; Ozorhon *et al*. 2014). This approach to innovation adds an external input to the corresponding process and the overall project lifecycle. Therefore, it is imperative to integrate the external sources and stakeholders along with the primary stakeholders of the construction project, especially at the initial and the design stages. Table I summarizes the main decision gates in which the stakeholders that influence the decision has to undertake, and the stakeholders that are influenced by the decision and must be integrated at that stage, the critical factors that influences the innovation through this integration, and the means to do so.

Insert Table 1

The decision to opt for open innovation and which part of the innovation process to open up requires a thorough understanding of the potential opportunities, challenges, and risks of open innovation. The changing boundaries of the innovation process and creating and maintaining partnerships over a period of time must be managed appropriately to maximize the potential value and decrease potential risks (Vanhaverbeke, 2006; West and Bogers, 2014). Hence, these issues further inspire us to evaluate the stakeholder theory and understand their various types, capabilities, and mechanisms to identify, understand, and integrate them for the sake of innovation.

5. Conclusion

In this research study, through the literature analysis, an alignment of the project lifecycle and the open innovation model was performed. The literature review has determined the correlation between the project activities and the innovation process. Moreover, the study has revealed that understanding the factors that enhance inter-and intra- collaboration between various stakeholders and team members is crucial to achieving effective innovation in a project context. For the study, we observed that innovation process in construction could only be achieved through the interpretation of the client requirements and their integration and collaboration throughout the project lifecycle. Moreover, the alignment of the project lifecycle and the innovation process with an inclusive leadership level must be ensured that facilitates the integration of both processes. The alignment model highlights the significance of understanding stakeholders, facilitating their mutual interactions, and adapting to their behaviour bearing in mind the various types of internal and external stakeholders and their associated power, legitimacy, and urgency.

6. Implications

This research study reveals many new elements, such as the *outside-in* and the *inside-out* processes, and the transfer of knowledge gates of the open innovation model and stakeholder integration at the various stages of the construction and innovation lifecycle. Undoubtedly, most past research studies such as Thomson and Munns (2010), Ozorhon, (2013); Ozorhon *et al.* (2010); and Murphy *et al.* (2011) on construction innovation have instilled an invaluable knowledge about the current state of innovation and the critical factors affecting innovation projects in the construction industry. However, the correlation among these factors at the different phases of the project needed a more systematic approach to provide a comprehensive view of how and when they affect the project. This research study has focused on developing an alignment model to illustrate the association between the construction lifecycle and innovation process considering stakeholder integration at different phases in the project lifecycle. Leadership for innovation was also found to be a major factor in influencing the alignment between the innovation process and the project lifecycle and a systematic stakeholder integration throughout the project lifecycle which further supports the arguments of Ozorhon et al. (2014), Edelbroek *et al*. (2019), Mudassar *et al.* (2021) and Zheng *et al.* (2019). The realization of various integration zones or areas in the alignment model is also necessary to explore a suitable mechanism for integrating diverse types of stakeholders at various stages of the project lifecycle to enhance innovation. Therefore, this research can be considered as a building block for future research to empirically test the alignment model and identify various integration zones and the factors that can affect such integration to achieve successful innovations.

7. Limitations and Future Recommendations

This research study has highlighted the broader concepts but it still has several limitations. Here, we specify these limitations, so that they can serve as the recommendations for future studies. First, this research study is based on a conceptual model, which has not been validated empirically. In the future, the same model can be tested empirically or by using interviews. Secondly, the study has aligned the project lifecycle with the innovation process but ignored several other types of innovations common in small and medium construction enterprises (*e.g.,* frugal innovation). One potential future study could be to explore various other types of innovation process in other industries, or investigate other types of project lifecycles.

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