A PARADIGM SHIFT: GENERATION OF OPEN INNOVATION FRAMEWORK FOR BUILDING INDUSTRY

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ABSTRACT

The building industry has been recognized for its lack of innovation. It is either globally or contextually, especially in EU with an overall innovation and R&D expenditure performance or locally in Egypt where there is an absence of R/D. Although novel materials, new business models and new ways of designing built object are emerging, yet these tangible results of much innovative works remain hidden inside projects and fail to translate to other projects and diffuse more widely. Currently, many enterprises from a range of different industries are facing increasing levels of competition from enterprises producing products and services of similar quality but with lower costs. In the process of searching for ways to enhance their competitiveness, many enterprises are making use of a newly paradigm shift in innovation named by, open innovation. Literature in this area focuses on the building industry innovation framework mainly, does not develop an open framework yet. Although a building industry framework state of art as an output of a critical review concluded that collaboration is a critical factor to improve the innovation performance in building industry. This paper looks to develop those innovative framework antecedents following a design science method to synthesize it with the open innovation antecedents and innovative collaborative activities in the building sector towards developing a new global generation of open innovation framework for the building industry.

KEYWORDS: Building Industry - Collaboration - Open Innovation - Paradigm shift - Innovation Framework

1. INTRODUCTION

The architecture and construction “building industry” is regarded as one of worldwide largest industries regarding investment and employment. It has always been slower to receive and adjust to new advancements than other worldwide divisions. Building industry is considered the largest consumer of raw materials

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globally [1]. It is also recognized for its conservatism and lack of innovation as well as burdened by poor performance [2].

Building industry enterprises manage their productivity and quality in one way or another. Some companies tend to control their costs, others tend to train their laborers, some focus on design practices and some manage their productivity and quality by controlling the quality of their services or products [3]. Even though these studies have improved the companies overall productivity and quality levels, yet they cannot mainly depend on these benefits as the competitors pressure increases rapidly. And so, as agreed by researchers, adding innovative solution in a highly competitive field to building industry is considered an important element that improves the productivity and competitive advantage of firms [4]. Innovation as well helps firms to lower their overall costs, achieve higher completion times and develop their products brand [5]. Therefore, as shall be highlighted and defined through this paper, understanding how innovation can be directed successfully is considered mandatory.

Innovation introduces new methods or a combination of methods that change the traditional way of any industry. Although every industry has its own definition of innovation [6], yet these definitions share several commonalities, namely, novelty and changes to the respective party. And so, this paper refers to Rogers definition in 1995 of innovation in building construction which is “Innovation is a result of change and involves a series of processes and actions that are new to the adopting individual or party.” [7].

Accordingly, as various enterprises are facing increasing levels of competition as previously discussed, and as innovation in building construction industry is regarded challenging. The process of searching for ways to enhance competitiveness and effectiveness is therefore considered crucial. And so, this paper investigates a new paradigm in studying innovation in building construction named by “Open Innovation in Building Construction”.

This paper aims to propose a new generation of open innovation framework incidents to be used by building industry firms for the implementation and execution of open innovation in practice. Following a “Design sciences method”, based on the
identification of commonly occurring elements and overlapping features in the reviewed theories and practice between (Building industry innovative framework antecedents, open innovation antecedents and innovative collaboration activities in the building industry sector). A synthesis towards developing a more open framework

The paper is divided into four sections. Section 1 introduces the challenges faced in building industry. Section 2 explores the innovation in building industry state of art. Section 3 goes on to describe the building industry innovation framework state of art. Section 4 explores building industry innovative framework antecedents’ state of art. Section 5 illustrates the paradigm shift “open innovation” antecedents. Section 6 represents a synthesis for the previous sections 4 and 5 with the innovative collaborative activities in building industry to draw the open generation framework antecedents. Section 7 concludes what can be learned to enhance innovation in building industry with a discussion of further research needs.

2. CHALLENGES IN BUILDING INDUSTRY

The architecture engineering and construction in the building industry have become more challenging and critical in the recent years. Clients’ changing needs, increasingly emerging complex projects, tight construction schedule and the need for more efficient construction methods. Strong competition in the architecture engineering and construction industry as well has created strong demand for advanced and new construction and architectural technologies rather than the conventional ones [1]. Challenges associated with inventions and innovations in several dimensions in the building industry sector technological, cultural, managerial or environmental development as well to reach optimized efficiency. Therefor challenges will be illustrated to drive innovation in the building industry.

2.1 Competitiveness Challenge

The remarkable speed of developments in science and technology in recent years has contributed to an interest in enterprises’ investments in innovations and their impact on competitiveness. A research observed that it is increasingly necessary for
the construction industry to engage in or continue with persistent R&D due to the increased competitiveness in the industry. However, a contradictory evidences was found that a substantial number of construction firms do not recognize the generation of new knowledge as crucial to their competitiveness [8].

2.2 Culture Challenge

Motivational culture is regarded as the main force for new ideas generation [9]. It is a phenomenon that has generated a lot of theoretical models. Although there is no common approach, yet the main question managers’ face is: how to support employees to maintain cultural behavioral energy throughout the innovative process time frame. To find adequate answer to this question, the employee’s behavior must be considered at first and how to provide him with a sense of self-worth and wellness [10]. In addition, it is recorded that employees can exceed their designated role and get innovative involvement if they experience behavioral satisfaction [11].

Organizational culture plays a crucial role in innovation development. Although it is discovered that it influences construction innovation processes [12], yet few studies studied this relationship. It was also found that investigated innovative organizations show variant cultural characteristics such as tolerance of risk, communication flexibility and knowledge share [13].

2.3 Project Delivery Challenge

Delay is a serious and coming problem in the building construction industry. Even thought, various reasons for the delay occurrence are due to stakes material shortage, equipment failure etc. Yet, in some cases, delays are interconnected and make the situation more complex [14].

Delaying of a project is the major cause of construction claims. A detailed investigation is needed to identify the delay factors and choose correct actions to minimize the adverse effects of delays on time and cost. The effect of delay is different for parties involved in the project although the common problems are the
loss of time, money and facilities. To the owner, delay is the loss of revenue through production facilities and rentable space. To the contractor, delay means the loss of money. To the public it means that buildings and facilities are not available for use as planned. Therefore, in conclusion, identifying the critical delay factors and innovative solutions to overcome them is regarded crucial [15].

2.4 Sustainability Challenge

The whole world is undergoing rapid and massive urbanization. This comes with social, economic and environmental challenges especially in developing countries. With more than 50 percent of the world population living in urban areas, it is expected that by 2050 this percentage will reach 75 percent. In addition, cities are facing major challenges to keep global warming below 2°C; this is to achieve zero annual emissions to stabilize atmospheric concentrations of greenhouse gases. Accordingly, achieving carbon neutral assets, reducing wastes during construction and making infrastructure and buildings resilient against climate change and natural disasters are important objectives [16].

3. INNOVATION IN BUILDING CONSTRUCTION STATE OF ART

Recalling to what’s previously discussed, as building industry innovation is still in its undeveloped stage, theories and practices are based on other industries’ to develop innovation in the building construction field [8]. And so, seven core attributes draw the innovation in building industry. These attributes are materials, machinery, components, time, ecology, product performance and management; this section will introduce that classification.

3.1 Materials

Material innovation is one of the main debates in building construction and architecture design through history. The discoveries of new materials have helped to transform ideas of materiality from monolithic to ever more ethereal constructions
From here, research and development on materials have a main role in the innovation process. For instance, India developed technologies in materials that are targeting sustainability materials, for instance, materials concerned with the utilization of industrial and agricultural waste. In South America, experts are working with renewable materials such as sugar-cane straw panels and bamboo applying such innovative construction-waste recycling processes to deliver an innovation in the building industry [18].

3.2 Machinery/Production Technology

Innovation in construction productivity deals with equipment development as per the machinery conditions. Novel design methods are applied to develop reliability, machine control, safety and cost reduction. According to the incremental innovation model in production technology, improved robotic cranes or excavators can be regarded as temporary short term solutions. An empirical study shows that minimizing costs and enhancing the building quality could be reached by using machinery robotic technologies in onsite constructions [19]. MIT’s latest invention is the latest 3D printer. It is mainly designed to work in the near future construction sites. It recently printed the biggest built structure in a time of thirteen hours. According to a publishing in the Science Robotics Journal; these new innovative constructions might help humans construct houses on other planets [20].

3.3 Components

Innovation in components can be applied through the construction of modular architecture designs. This achieves cost-effective and time saving in construction eventually. However, there is still shortage in engineering research and success samples dealing with the performance of this technology [1]. Even though, it is applied in many building constructions, yet they cannot be categorized as exclusively modular structures because of the core structure that carries the lateral loads. Furthermore, cooperation between Japanese companies and Toyota Home were
innovated a three-dimensional space frames equipped with all finishing and installations to develop this promising innovative attribute [16].

3.4 Time

This attribute refers to the time necessary for planning and setting up the site. Changes in the planning time or the construction duration cannot be implemented without affecting other dimensions in the project [16]. Completing projects on time is an indicator of efficiency. Yet, the construction process is subject to many variables and unpredictable factors such as, performance of parties, resources availability, environmental conditions and contractual relations. It is important to observe that, it is likely uncommon that a project is submitted within its baseline time schedule [21]. A problem solving method is to use lean construction. It is a technique to design production systems to minimize materials, time and effort for ultimate value [14].

3.5 Ecology

This attribute refers to ecological factors related to the construction as a process or as a product. Some countries construction firms, for example the Japanese are currently deploying automated deconstruction sites. This allows them to reduce construction time and recycle all building materials. [16]. It diverted the government and contractors to the ecological performance impact of construction [22].

3.6 Product Performance

Studies on performance measurement are mainly applied at the project level. However, recently an increasing demand for performance evaluation at the enterprise level has rose [16]. A study measuring the performance in Saudi Arabia indicated that the financial indicator can no more be the main determinant of any firm’s success. Other performance indicators such as customer satisfaction, safety, business, efficiency and effectiveness of planning are becoming more important aspects of this time. Consequently, Saudi Arabia introduced an innovative benchmarking system is introduced to enhance the performance of construction firms [23].
3.7 Management

According to researches, any minor changes affecting construction and the organization affects the management attribute as well [24]. Outputs of a recent survey stated that utilizing Building Information Modelling (BIM) technology in projects will have a major influence on reducing claims, like design drawings errors and quantity variation. Also, it is recorded that BIM helps productivity as well. Yet, it is noted that some construction claims will not be reduced by only a small margin [25].

4. INNOVATIVE FRAMEWORK ANTECEDENTS

A recent literature review on construction innovation is provided to investigate the state-of-the-art of innovation in building industry as well as to explore the knowledge regarding design and construction innovation. This is to discover areas that require further investigation. It is presented in a form of framework antecedents divided to factors, inputs and drivers towards an innovative output.

4.1 Factors

Construction innovation researches deal with collaboration as an innovation prime factor. The construction industry involves a lot of parties and each is with independent interests and expected incentives from the project. Therefore, there is a significant problem with coordination and integration among different organizations. In addition to collaboration, organizational culture is a critical factor as well. Also, innovation climate is considered a prerequisite factor. Many scholars state that companies and design studios should create a positive climate to stimulate innovation [2].

4.2 Drivers

The drivers of innovation were investigated and studied from different levels of organizations in construction projects and classified them to four categories. These categories can be classified to: environmental pressure, technological capability,
knowledge exchange and boundary spanning. Also identified the levels where the drivers aid and facilitate innovation [2].

4.3 Inputs

Inputs are defined as the strategies and resources used for different kinds of innovations, such as enterprise strategies, R&D and human resources. At first, strategies: is defined as the specific innovation strategy of every company, such as marketing and employees’ strategies. Secondly, for resources: it can be identified through the human resources example. Other examples are external knowledge resources and scientific and technology resources [2].

It is clear now after that critical review that successful innovation happens according to collaboration, external resources, communication, exchange and culture. And so, some building construction industries are recorded not on the right track because they didn’t succeed to transfer, collaborate or share knowledge [26].

5. OPEN INNOVATION ANTECEDENTS

Innovation as a term is regarded as a closed process that relies on each company’s own resources and knowledge. A transfer in this meaning was introduced in literatures aiding for more open innovation. And so, with the increasing levels of competition, industries started to enhance their competitiveness by making use of this new paradigm and by collaboration in specific as previously discussed [27].

*Open innovation is expected to be the dominant innovation model of the twenty-first century* [28]. The open innovation model focuses on the possibilities and limitations for companies to transfer from a closed innovative approach where innovation is done in-house to a more open approach, where innovation is done in collaboration with other parties.

Through internal and external ideas, scholars emphasize that external linkages is more vital for companies to enhance their product innovation [27]. The open innovation process redefines the boundary between the firm and its surrounding
environment, making the firm more absorbing and individually acting towards new knowledge [29]. Absorptive capacity is defined as the “ability to recognize the value of new, external information, assimilate it, and apply it” [30].

The preciseness and complexity of technology made firms recognize the need for more resources to enhance and develop their activities. This includes financial resources and human resources [31], as the high costs and lack of finance are from the most serious innovation obstacles. The availability of financial support will assist partners to share and innovate upon collaboration [32]. International collaboration has become vital for enterprises that want to stay at the top edge of innovation [33]. Multinational companies are exposed to richer knowledge paradigm and broader social networks than others. Moreover, foreign ownership requires higher innovation output and higher labor productivity. This concludes that affiliation between foreign multinationals provide higher values than domestic enterprises [34].

6. OPEN INNOVATION BUILDING INDUSTRY FRAMEWORK

The diagram below illustrates the “antecedents of building industry innovation framework”, following a design science method. It is according to commonly occurring elements identification and features in the reviewed theoretical frame and practices as well between the following (Building industry Framework antecedents, open innovation antecedents and innovative collaboration activities in building sector) towards shifting the state or art framework from closed to open innovative framework.

Commonly occurring and overlapping (Synthesis)

<table>
<thead>
<tr>
<th>Building Industry Framework Antecedents</th>
<th>Open Innovation Antecedents</th>
<th>Innovative Collaboration in Building Industry</th>
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<tbody>
<tr>
<td>Output</td>
<td></td>
<td>Open Innovative Framework Antecedents for Building Industry (Factors – Inputs – Drivers)</td>
</tr>
</tbody>
</table>
6.1 Factors

They are factors that contribute to collaborative innovation, the influence of the organizational environment, and the impacts of individual roles on the innovation process.

6.1.1 Absorptive capacity factor

Construction has been described as a sector with weak levels of Absorptive Capacity. The knowledge absorptive ability is identified as the ability to recognize the new information value, readjust it and finally apply it. It is defined as well as the evaluation and outside knowledge utilization abilities [35]. Absorptive capacity is finally described as the individual capabilities and acquisition, transformation and exploitation of knowledge [36].

Policies and regulations play an important role to the knowledge absorption process to create a positive environment that requires the implementation of new knowledge. The enforcement of regulations and standards are often complex and not clear. A client can act as an enabler or as a barrier towards knowledge absorption process and its implementation. A client with high level of expertise will have a high demand and expectations for the project. On the other hand, a client that lack technical competencies and have a conservative practice of construction is viewed as a barrier towards knowledge absorption process [37].

6.1.2 Technological intensity factor

A study researched the role of the key individuals in ten successful innovation projects in the construction industry in the United States and concluded that technological competence is an important factor for effective leadership in construction innovation. Technological capabilities of organizations in the industry aid the implementation of the new solutions and ideas in their construction projects [38].

The building industry has tools to decrease project cost, increase productivity and reduce delivery time. BIM contains adequate geometry and data needed to support
the design, procurement, fabrication, and construction activities required. This model can be used for operations and maintenance after completion [39].

6.1.3 Financial support factor

As technologies became more complex, firms need more resources as previously discussed to develop and improve them [40]. Economic cost and the lack of finance are considered the most serious innovation barriers in developing countries. And so, the financial support availability will assist resources to collaborate [41]. Innovation could be stimulated as well by financial support for innovative pilot projects where technologies are tested and evaluated prior to market launch [42].

6.1.4 Trust factor

As open innovation mainly depends on the collaborative learning, idea generation and idea realization practices of stakeholders in an organization. Trust is considered a capital factor in the relationships between people in collaboration. To create a trustable social environment, the leaders within a stakeholder community must be very successful at constructing and maintaining trusting relationships between stakeholder groupings (staff, clients, suppliers and competitors in some cases). When this is achieved, ideas can be generated easily from within, or beyond, stakeholder networks and innovation strategy can be executed successfully with authentic commitment [43].

6.1.5 Internationalism and ownership structure factor

Several studies have shown a significant positive relationship between multinationality and performance [44]. They concluded that operation in more than one country and the multinational experience employees can positively impact innovation performance and success. Moreover, the foreign ownership requires higher innovation output and higher labor productivity. It is also concluded that affiliates of foreign multinationals show higher propensity to partner than domestic enterprises [45].
6.1.6 Research and development factor

In order for firms to profit from the innovation external sources, it must be integrated into the firm’s R&D activities. This requires a matching culture to overcome ideas like “not invented here”, as well as the technical capability to apply innovations obtained from external sources. External sourcing innovations could change the R&D ideas of the firm directly and indirectly. On the one hand, external resources allocated could directly lead to a reduction of the resources made available for internal innovation. Also, external sourcing can improve internal R&D c [46].

6.2 Inputs of Collaborative Innovation

Inputs are defined as the strategies and resources used for different kinds of innovations development, as client and external knowledge and business models.

6.2.1 Innovative business model

A business model describes “how a firm organizes itself to create value in a profitable manner”. Consciously, every firm has at least one business model [47]. The business model was taken as a given for a long time, as it represents the ‘dominant logic’ of doing business in the firm’s industry. For instance, Ikea’s furniture retail strategy is frequently copied [9]. As a result, the business model has changed its place in executives’ attention, and so established firms realize that product and process innovation alone are not sufficient to stay competitive in today's fast-moving economy [5]. Instead, innovation efforts must also be applied to a firm's core logic of doing business, its business model.

With the mandating of building information modeling, it is possible for building industry enterprises to control costs using SaaS (software as a service) models for instance and for transforming inventions to innovations.
6.2.1 Client knowledge

Important knowledge can be obtained using customer’s knowledge and is beneficial for firms' innovative performance. However, it also can have an important downside as customers may often be conservative, forcing producer firms to search for new solutions along established paths. Customers’ knowledge has very often proven to be critical for innovation success [48].

A classic approach in product development is to identify the degrees of involvement: design for users, design with users, and design by users. Customer collaboration will stand as the next game changer in driving innovative sustainable product. While some might argue that relying on clients to innovate is not accepted in the construction industry. Yet, evidence shows that clients have a major role to play in driving construction industry reform, improvement and innovation. In Singapore, for example, the Building and Construction Authority has played an important role in driving change and developing an industry innovation strategy, while in the UK, the British Government and major UK client groups such as the British Property Federation and Construction Clients Group have done the same. In Australia, some leading clients are playing an important leadership role in driving construction innovation [49].

6.2.3 External knowledge transfer

Company's’ internal resources are not the only way to drive innovation. External knowledge also plays a significant role. Exchanging existing knowledge stimulates the development of new knowledge about innovation. Another researcher came to the same conclusion and stated that the core sources of knowledge clients, consultants, and suppliers enhanced innovation. Therefore, innovations are not only influenced by the individual behavior of participants but also by the knowledge transfer that results from the collaborative relationships among them [50].

An innovative way to get data from external sources named by “open data”, for instance, some research centers share their knowledge with manufacturers of materials
and technology, creating innovative products together, with the support of organizations such as, the General Government Policy Service policy area - Sustainable Development Team and the Flemish Energy Agency can also help to support open innovation [16].

While for governmental approach the data.gov.sg portal was launched by the Info comm. Development Authority of Singapore in 2011 to serve as a first-stop portal where publicly accessible government data can be found. Information contained in these datasets includes locations of hospitals and medical clinics, census data, weather information and real-time road traffic information, provides a centralized platform to search and access these data and as an open innovation platform. This helped in overcoming legal and policy concerns among government agencies in openly sharing their data on the portal [51].

6.3 Drivers of Collaborative Innovation

As mentioned before those certain drivers can initiate the innovation process, the study illustrates the influence of collaboration upon drivers towards innovation, apparently the external, environmental, technological and client drivers.

6.3.1 Demanding

The American construction industry found that the market’s client demand for innovation stimulates the development of innovation. Clients’ ideas and experiences are a vital source of innovation. Some organizations already use client demand to drive and influence how they innovate, while other organizations are missing out these opportunities to involve users early in the innovation process. By taking advantage of these opportunities, organizations can gain advanced insight from clients and maximize their competitive advantage. A report of Communities Innovation Survey found out that organizations and are missing out on such opportunities to involve clients early in the innovation process to gain advanced insight from them [42].

Not only clients but also employees within firms increased demand for innovative office spaces which are conducive to collaboration and teamwork has seen
a massive drive in the architecture and interior design and design industries. This is according to specialist office furniture engineers that the workplace environment is changing as companies adopt a more holistic approach to doing business, with a focus on team integration and participation. Not only clients and employees but also suppliers and subcontractors drive and open innovation beyond expectation [52].

6.3.2 Environmental pressures

Many stakeholders are concerned to fulfill environmental requirements either for green records, regulations or accreditations. BIM is the perfect model for this, where all stakeholders integrate and optimize their information. It is also called Green Building Information Modeling. Sustainable architecture means meeting the needs of the present without compromising the ability of future generations to meet their own needs. Some examples are energy for heating, cooling, lighting and equipment of buildings [41].

6.3.3 Technological capabilities

The evaluation of new products, processes, and technologies before market launch considered to be as an instrument to guarantee the quality of innovations. [36]. One of the factors they described was construction technology fusion, which means that diverse technologies from various disciplines are integrated to develop a new construction technique, construction object or process. Firms that want to be innovative should follow a technology leadership strategy, a study in the United States concluded that technological competence is a prerequisite for effective leadership in construction and that effective leadership is essential for technological innovation in building industry [42].

6.3.4 Competition

Competition in industries is the dominant actor to show a positive change. If businesses are competing together, it means that they are aiming to hit the market with
the latest innovation to hit the market. A survey stated that 80% of CEOs believed innovation leads to a competitive advantage and efficiency. In open and competitive markets, firms are driven to offer new and improved products and services to customers [53].

### Open innovation Framework in building Industry

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Factors</th>
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<tr>
<td>Innovative Business Model</td>
<td>Absorptive Capacity</td>
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<td>Analytical tool</td>
<td>Collaboration</td>
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<tr>
<td>Cost Control</td>
<td>Policies and regulations</td>
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<td>Inventions to Innovations</td>
<td>Client</td>
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<tr>
<td><strong>External Knowledge Transfer</strong></td>
<td>Type of knowledge</td>
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<tr>
<td>Open data</td>
<td>Technological Intensity</td>
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<tr>
<td>Crowdsourcing</td>
<td>Research and Development</td>
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<td>Innovative Platforms</td>
<td>Financial</td>
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<td>Spinoffs</td>
<td>Trust [innovative culture]</td>
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<th>Drivers</th>
<th>Environmental Pressure</th>
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<tr>
<td>Demanding</td>
<td>Regulatory Pressure</td>
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<tr>
<td>Suppliers</td>
<td>Accreditation</td>
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<tr>
<td>Sub-contractors</td>
<td>Economical intention</td>
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<tr>
<td>Clients</td>
<td>Green intentions</td>
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<tr>
<td>Co-workers</td>
<td>Technological Capabilities</td>
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<tr>
<td><strong>Competitors</strong></td>
<td>Competitions</td>
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7. **CONCLUSION**

Innovation, at the current time, occurs in building industry through different incidents; building materials, architecture design, smart systems, building technology, construction systems etc. While, as discussed, it is shown that innovation lacks in building industry. Accordingly, the state of art framework of innovation in building industry should be reshaped through an open innovation approach; it is also discussed that the framework would be synthesized by open innovation incidents and collaborative theories and applications in building industry field that draws the new open generation of innovation framework.
This study investigated innovation framework incidents factors, inputs and drivers through a collaborative theories study. It was clear that the dominant nature of successful innovation always follows collaboration factors, inputs and drivers of innovation. Absorptive capacity and trust towards collaboration are considered two main pole factors accordingly they are the access doors to connect with external knowledge and collaborate with others. Accordingly establishing an innovative culture followed by other secondary factors, research and development, technological, financial and research and development factors is considered important.

Innovative business model is the framework campus towards innovation, it is the dominant logic of being innovative or not, so it is the first step following by other inputs. While external knowledge either from clients or culture communities have been proven to be critical to innovation following some open innovative collaborative techniques as open data, platforms, and innovative hubs. Policies and regulations may be barriers towards innovation as factors while it is different when being drivers. Environmental pressures even technology capabilities shortage in factors may be barriers while they can be driving forces towards innovation.

The findings successfully drew the attention to the importance of open innovation in the building sector and its collaborative factors, inputs and drivers as driving forces to accelerate the innovative process. This paper paves the way for future researchers in investigating and promoting open innovations in architecture design and building industry as a whole in our Egypt context.

REFERENCES


تحول النموذج: جيل من إطار الابتكار المفتوح لبناء صناعة المنشآت

صناعة البناء الإنشائي تبدو وكأنها منحصرة في الهياكل والتقنيات التقليدية عالمياً و محلياً منذ القدم و حتى الآن ، لذلك فمن الضروري أن تفتح صناعة البناء بأكملها باباتها إلى نهج ابتكارية جديدة. وهكذا ، توضح هذه الورقة البحثية النقطة النوعية في "الابتكار المفتوح" وفقًا لقطاع البناء. تم تقترح هذه الورقة عناصر إطار لاستخدامها من قبل شركات صناعة البناء والاستوديوهات المعمارية و تطبيق الابتكار المفتوح في ممارساتها. سيتم اتباع طريقة علم التصميم من خلال مراجعة نظريات الابتكار التعاوني التي تجذب عناصر إطار الابتكار المفتوح.