Impact of Virtual Collaboration on Open Innovation in Small and Medium-Sized Enterprises

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Abstract

Open innovation is a growing concern in today‟s manufacturing industries, especially within small and medium size enterprises (SMEs). Due to the resource scarcity, SMEs need to be collaborated with the objective to share knowledge and expertise to develop innovative product, which lead them to become more competitive in market segment. In this research study, generic concept and a novel framework on open innovation are elaborated. In addition, a methodological guideline to form and execute a collaborative business network is proposed. The framework and the methodological guidelines are presented to facilitate an open innovation management within the collaborative partner industries. Moreover, associated factors to manage a successful business network with open innovation are also identified along with possible challenges. Finally, within the scope of this research study, a case business network is presented, where the concept of open innovation is orchestrated within the partner organizations via web-enabled communication portal.

Keywords: open innovation, virtual business network, SMEs, methodology, framework, case business network

1. Introduction

Global business environment pushes manufacturing firms to be innovative in their product design and development processes. Firms need to develop new and innovative products in order to stay competitive [1]. Such innovative products might be breakthrough products or improved version of the existing products. Manufacturing companies, especially small and medium size enterprises (SMEs) are needed to explore product or process innovation in order to survive within competitive market place. It is critical to create collaborative business environment, where companies, especially SMEs can collaborate with each other for added benefits [2-3]. Such business paradigm is created through the active participation of individual companies by sharing their specific knowledge and expertise between each other.

The role of individual company within a business network affects the overall success and failure of the network. In order to sustain within competitive business environment, companies need to establish business network, where trust and common goals are established to avail added benefits. This network promotes innovation within companies, which might be difficult to achieve by an individual company outside the business network. This innovation philosophy facilitates companies to achieve new skills and knowledge that can be used by the companies in their future production processes [1]. There needs specific methodologies and tools to create such innovative atmosphere within the business network. Such methodologies and tools can be used depending on the nature of innovation goals and perspectives.

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The innovation can be both open and close types [4]. Both types are necessary for the growth of an enterprise and specific type of innovation is dependent on the enterprise‟s needs, processes, and capacities and on customers‟ preferences. The close innovation is generally confined within an enterprise, where core competencies are applied to develop innovative product or processes. Whereas, an open innovation is exceeded the boundary of an organization and orchestrates by the active involvement of more than one organizations [5]. Success of such an open innovation is dependent on the core competencies and sharing of skills among collaborative organizations. This kind of innovation opens up the possibility of building trust and innovation cultures among organizations.

Any innovation, which is the outcomes from collaborative organizations, is known as open innovation [5]. This kind of innovation initiates after identification of business opportunity by a partner organization, known as „broker‟ and shares the business opportunity with other partner organizations that finally form the business network. This business network nurtures the innovative idea to develop new product or new business process according to the market needs. Today‟s advancement of information and communication technology (ICT) contributes to create such collaborative business network, where the initiation of an open innovation starts up. This open innovation culture among the business network helps organizations to keep pace with competition and to retain sustainability.

In order to enrich the capabilities of manufacturing companies in open innovation activities, it is essential to merge companies‟ knowledge base through the integration of suppliers, customers and external knowledge sourcing. By this phenomenon, a company can increase its innovativeness. Adoption of other approaches such as crowdsourcing, crowdfunding, mass customization, customer community integration (e.g. Facebook, Twitter, WhatsApp, etc.), etc., promotes open innovation within companies [6].

Based on the above requirements, this research study identifies three research objectives as outline below:

- To develop a novel framework suitable to introduce open innovation in industries, especially within SMEs
- To design a methodology in order to promote open innovation within SMEs network
- To validate the designed methodology by applying it in a real life case business network

This paper is organized as follows: Section 1 introduces the research themes along with the study objectives, while, Section 2 presents the review of relevant literatures on open innovation, including accompanied challenges in open innovation. The methodology of this research is highlighted in Section 3, whereas, an open innovation model for SMEs network is outlined in Section 4. A novel framework to manage open innovation in SMEs is stated in Section 5. In Section 6, a methodology suitable for open innovation is outlined, which contains the fundamental of business network, methodology and factors for successful open innovation. A case business network, engaged in open innovation is highlighted in Section 7, while, possible managerial implications are outlined in Section 8. Overall research outcomes are concluded in Section 9 with future research directions in the field of interest.

2. Literature Review

There is currently a broad awareness of open innovation and its importance to manufacturing companies. The implementations and trends for open innovation are discussed in the literature with respect to strategic, organizational, knowledge, legal and business perspectives and its economic implications [7]. In general, today‟s business environment is not purely based on open innovation but companies are involved simultaneously in closed as well as open innovation activities. Open innovations are orchestrated between companies, which are physically or virtually connected within a business network [5, 8].

2.1. Open innovation: definition from SMEs business perspective

The innovation activities associated with closed business environment cannot often meet the growing market demand through shortening the innovation steps and reduced time-to-market. Conversely, open innovation promotes faster innovative product to the market through sharing resources between partners companies [9]. Too much open innovation often negatively effects on companies long-term success, because it damages the overall control and core competencies of companies [10]. It is therefore, necessary to maintain a balance between open and close innovation within the companies. To make the required balance, it is important to identify and to establish the cause-and-effect relationship between open and close innovations. This enables the manufacturing companies to find an appropriate effort and mechanism to integrate with each other, which ultimately explores non-economic approaches to enrich companies‟ portfolios. In addition, participatory design has become increasingly attractive to companies, where the design issue is no longer solely concerned with the workplace [11]. This phenomenon is not only a shift from work oriented productive activities but also a new strategy for production and innovation and entails a reorientation from democracy at work to democratic innovation. Such democratizing innovation practice entails is currently defined by managed and innovation research, which claims that innovation has been democratized through easy access to production tools and lead-users as the new experts driving innovation [12].

Open innovation can be defined from the business perspective as the initiative of new idea of a product or process, which occurs outside individual firm‟s boundary. In general, there are close and open innovations. Close innovation occurs within the firm‟s capacity and capability, whereas, open innovation occurs outside the firm‟s boundary.

From study, it is noticed that SMEs are less active than large firms in most innovation activities [13]. It is also studied that more innovative ideas are originated from SMEs external sources than large firms [13, 11]. The causes of less innovation within SMEs are due to little necessary and shortage of resources in spite of necessity.

Customization process is more common in SMEs than in large firms, which contributes to the necessity of innovation in SMEs. For such reason, it is often necessary for the small firms to adopt appropriate business model that supports innovation and customization [14]. In order to marketing innovative ideas to mass customer segment, SMEs need to form a network of companies [15]. This network formation supports SME‟s to publish its innovative ideas rapidly and within a wider community. Such rapid commercialization process enables SME‟s to find ways to bring its ideas to the market instead of producing customized products for individual customers.

In any innovation process, there needs training, both internal and external research and development, knowledge, capital goods (facilities, machines, tools, etc.), marketing procedure, supports for product/process innovation, etc. SMEs suffer all such resources scarcity, which can comfortably be met by initiating business collaboration [15]. Such form of collaboration triggers an open innovation. This open innovation orchestrates through sharing costly resources and technologies within the SMEs business network. In an open innovation, SMEs share the necessary knowledge and expertise across the network.

Information and communication technology (ICT) plays a vital role to accelerate open innovation within the SMEs network. ICT enables SMEs network to communicate with each other in order to decide for any business agenda. It also supports real time information exchange within SMEs network and creates cross channel communication among customers, suppliers and various stakeholders. There is a strong correlation between the number of innovation and the external information usages in the SMEs network [16].

2.2. Role of ICTs to manage knowledge within open innovation

In order to implement open innovation strategy successfully, it is necessary to adapt up-to-date information and communication technology (ICT). ICTs are nowadays used not only for internal use but also in distributed innovation, where

they must be leveraged by business and organizations from internal to external sources. These sources can be from vendors, suppliers and customers to employees. The ICT tools enable the innovation process from idea creation to development phase, through conducting experiment and testing and finally to commercialization of the ideas [16]. It promotes flexible collaboration, which is the base for successful open innovation. It argues that technological changes have augmented open innovation strategies, especially associated to new product development [17]. ICTs enable information exchange within distributed resources in the open innovation process.

ICTs imply an extensive use of inter-organizational relationships and knowledge from in-source ideas to external market channels. This indicates the need to establish collaboration and cooperation between varieties of partners in similar business field. Such inter-organizational relationships might be established with an explorative external knowledge. For instance, the innovation network of Nokia establishes the inflow of external knowledge, which is considered as outside-in dimension of open innovation. The innovating firms require implementing an open innovation to act on a number of external knowledge to improve innovation management performance. Organizational managers therefore need to intervene on knowledge management systems to favor the introduction of the innovation management paradigm [18].

In open innovation, the leveraging and exploiting knowledge, which is generated inside or outside the firm, is required to develop and exploit within the innovation process. To adopt knowledge management system, it is necessary to foster diffusion, share and transfer knowledge within the firm and between the firm and external environment. The acquired knowledge within inter-organizational needs to secure as intellectual property (IP) protection system to allow to transfer knowledge assets that spring from the firm‟s inventive activity [18]. A better understanding between knowledge sharing and protection system is important to enhance the field of open innovation. The overall research synthesis on open innovation can be highlighted in Table 1.

Table 1 Selected literature synthesis on open innovation in collaborative business

Author(s)	Application	Methodology	Key finding(s)
Fuller [19]	To promote virtual co-creation projects	Case study	Research stated that consumer want to participate in virtual co-creation projects. It also offered helpful recommendations for designing virtual co-creation platform.
Huizingh [20]	To understand open innovation concept	Quantitative case study	Study found that open innovation has been a valuable concept for so many companies and in so many contexts, that it is on its way to find its final place in innovation management.
West and Bogers [4]	To promote commercialization of innovation	Review of literature	Literature review on open innovation stated that there is tendency to ignore importance of business models within inter-organizational collaboration in innovation.
Elmquist, et al. [21]	To understand growing fields of innovation	Review of literature and expert opinions	Study found a number of key themes of the innovation process and the extent of collaboration to further understanding of how open innovations develops.
Dahlander and Gann [22]	To analyze different forms of openness in innovation	Review of literature	The research is motivated by a desire to clarify the definition of openness used in the literature on open innovation.
Sieg et al. [23]	To solve research and development challenges	Case study	This case study research explained three identified managerial challenges, which are needed to solve the research and development challenges for open innovation.
Bianchi et al. [24]	To explore technologies and knowledge for open innovation	Case study	This research is investigated the adoption of open innovation through entering into relationship with different types of partners with the aim to commercially exploit technologies and knowledge.
Parida et al. [25]	To adopt open innovation in SMEs	Literature review	This study has investigated the implications of SMEs adoption of open innovation. It addressed the effects of four inbound open innovation activities on innovation performance of SMEs.
Love and Roper [26]	To recommend policy implications for SMEs innovation	Research synthesis	This paper summarizes and synthesis the evidence on SME innovation, exporting and growth between innovation and exporting in SME growth.
Slater et al. [27]	To promote radical innovation in organization	Meta-analysis on various studies	This research focuses on to develop a testable model of the antecedents to radical product innovation success.
Becker and Dietz [28]	To promote diversity of partnership	Case study	Research indicates that business network with different partners enhance innovation due to shared knowledge and skills.
Metcalfe [29]	To support diverse knowledge and skills	Literature review	Study finds that diverse sources of knowledge and skills support collaborative firms to create new combinations of technologies and knowledge.

2.3. Challenges of open innovation within SMEs business environment

From literature review, it is noticed that there are various challenges to establish open innovation in SMEs. Some of the challenges are very critical, which cause the open innovation unsuccessful [21, 23]. Major challenges for open innovation are highlighted in Fig. 1. From Fig. 1, it is seen that the challenges are categorized in four sub-sections such as market environment, resources, research and development and information management.

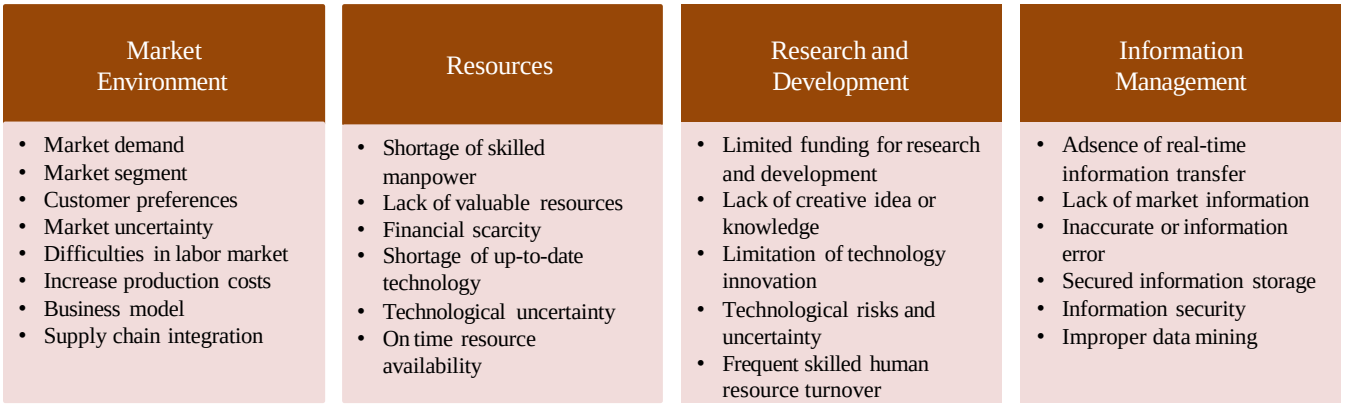

Fig. 1 Highlights of major challenges of open innovation

The challenges within the market environment concerns with market demand, market segment, customer preference, uncertainty in market demand, limitations in labor market, increased production costs, necessary business model, integrating supply chain, etc. [10, 12, 24]. In case of resources, the associated challenges are shortage of skilled manpower, lack of valuable resources, scarcity of finance, shortage of up-to-date technology, technological uncertainty, on time resource unavailability, etc. [9].

There are also several challenges to perform research and development within SMEs for adopting open innovation, which are lack of necessary funding for research and development, lack of creative knowledge, limitation of technology innovation, technological risks and uncertainty, frequent skilled human resource turnover, etc. [17, 37-38].

In addition to research and development, there are limitations related to information management. The challenges for information management can be mentioned such as absence of real-time information transfer, lack of market information, inaccurate or information error, storing useful information, improper data mining, lack of secured information, etc. [4, 25]. The above-mentioned challenges are the major challenges for open innovation within SMEs business network. There are however, other challenges, which are specific to the types and nature of business networks, such as commercializing products, developing customized products, managing supply chain networks, geographical locations of the SMEs, government rules and regulations, etc. [31].

The challenges as mentioned in Fig. 1 can be overcome with various ways such as through building collaborative networks among companies, forming industrial clusters, development of business ecosystem, etc. [26, 36]. For instance, building collaborative networks, companies would be able to share valuable resources and expertise, which help them to extend market share with reduced risks and uncertainties. In a similar way, industry cluster and business ecosystem also support companies to achieve competitive business environment through sharing knowledge and expertise [2, 8, 10].

2.4. Identified research gap within open innovation

From literature review, it is noticed that most of the open innovations are conducted within large technology-based companies and not within SMEs. Innovation within SMEs is also common practice, but in a limited scale, which often may not be enough to commercialize it successfully. In any innovation, commercialization plays an important characteristic. In general,

SMEs consider to the formation of business network as a means to getting access to marketing and sales channels in addition to open innovation. It is therefore, necessary for the managers within SMEs to develop a novel framework to encourage to form the intended business network, which supports the notion of open innovation in SMEs. This collaboration can be orchestrated aside from the size of the companies and expert knowledge. This research gap is identified and attended within the scope of this research study.

3. Research Methodology

This research study followed both theoretical and practical aspects with the objective to fulfill its objectives. In the theoretical part, extensive literatures in the field were reviewed, analyzed and categorized depending on the identified issues, factors and challenges of open innovation. The focus of the literature review was mainly to define open innovation, influence of ICTs on innovation, application of innovation in various industrial domains, impacts of open innovation on different industrial sectors, especially on SMEs, etc. Necessary research gap is also identified and tried to attend within the scope of this research study. In addition, various benefits related to collaborative business network on open innovation are critically identified and analyzed.

The practical part of the methodology was concentrated to define a case business network, where various aspects of creating a business network were illustrated. The case network was formed by different partner organizations from various countries within the same business domain. The product of the case business network was an innovative shoe, which was designed and fabricated collaboratively within the partner organizations in the network. In order to facilitate the communication and real-time information exchange, a web-based communication portal was designed and developed within the scope of this research. This web-portal was implemented to monitor and manage every aspects of the open innovation from customer requirements to the final product.

4. Open Innovation Model for SMEs Network

There are always resources limitations within SMEs, which reduce their ability to develop innovative products or services. As discussed, business networking can increase potential for SMEs to be innovative that ultimately contributes to sustain within the competitive business environment. In order to be innovative with the help from the business network, there needs to define specific model, which supports to open innovation. This research proposed a model that will support open innovation within SMEs network. Different phases of the proposed model are highlighted in Fig. 2. From Fig. 2, it is seen that there are six phases within the model, namely primary research and development, incubation innovative idea, formulate supportive technology and tools, product design and development, production process and distribution and warranty and after sales service.

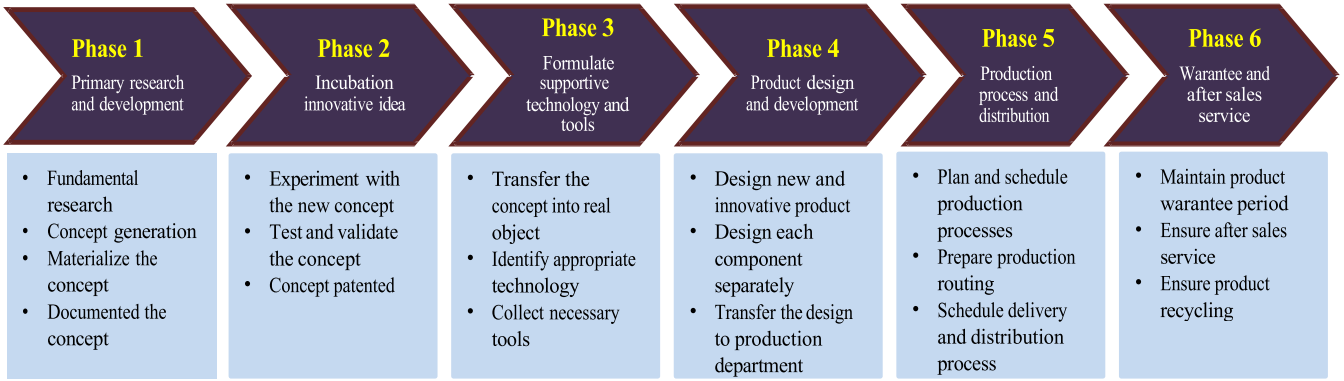

Fig. 2 Open innovation model suitable for SMEs

The first phase of the model concerns with initial research and development, where an idea of a new and innovative product comes from. At this phase, fundamental research is conducted along with concept generation, materializes the concept and documented the concept of the product. In the second phase of the model, the concept of the product as generated in the first phase is incubated through experimentation, testing and validation and the concept is patented finally. In the third phase, required supportive technology and tools are identified. In case of tools scarcity it is recommended to collect them at this phase.

In the fourth phase of the model, design of the new and innovative product is initiated. Each component of the proposed new product is design separately at this phase. When the design is done, it is forwarded to the next phase as production process and distribution. At phase 5, necessary planning and scheduling of the production processes are performed. In addition to planning and scheduling, necessary production routing is prepared, along with schedule for delivery and distribution processes are also accomplished at this phase. Product warrantee and after sales service are maintained at phase six of the model for open innovation as seen in Fig. 2. Product recycling is also ensured at this phase as well.

It is believed that the presented model will be beneficial for the SMEs to initialize their plans to achieve innovative products. It provides SMEs to step-by-step guidance to formalize an innovative product from conceptual design phase to an end. The model is divided into two categories such as pre-production phase and post-production phase. At the pre-production phase, required research and development, incubation of innovative idea and supportive technology to develop innovative product is included. On the other hand, product design and development, production process and distribution and warrantee, after sales service and product recycling are involved in the post-production phase.

5. A Framework to Manage Open Innovation within SMEs

The concept of open innovation mainly relies on the enthusiasm and commitments from the partner organizations. Without successful collaboration, it is almost impossible to success in any innovative work, whether it is closed or open innovation. To be successful in any innovation project, it is critical to select the appropriate partners and to establish trust among them. Any form of collaboration is orchestrated after collecting the customers‟ requirements. In business network, there is always a concern to get profit margin, which depends on the sales and marketing strategy of the partners [30].

In open innovation, there is a continuous need to improve product, process, human resources, knowledge and technologies. All such needs are directly depend on each other like a chain reaction. If any of them are missing then the innovation activities become invalid. The basic requirement of open innovation is to develop innovative product or process that contributes towards business benefit by reducing developmental lead-time and to gaining profit margin. In open innovation, the accompanied business model describes a cognitive strategy to convert technical aspects of a product or process into economic value [31].

To be innovative, partner organizations should use external ideas as well as internal knowledge and expertise for the purpose to accelerate internal innovation and expand the markets for external use of innovation. It is also necessary to adopt required business model before introducing open innovation within firms. This business model is used to bring any ideas to market. A dynamic innovation idea cannot be implemented overnight. It needs time to develop and to nurture dynamic open innovation capabilities. Successful open innovation requires an integrated design process, where the design of the product or process is interfaced with new technologies. Such integrated design approach demands good collaboration and must be assisted by appropriate knowledge management techniques and tools [32].

Manufacturing companies which are involved in innovation usually have managed innovation as an internal process, depending on individual knowledge, skills and capacities and capabilities. However, in open innovation such closed approach

to innovation is no longer justified in today‟s fast diffusion of commercially valuable knowledge. It is therefore, necessary to maintain the intellectual property right within inter-firms collaboration. Such an approach ensures to protect the use of research and development both outside and inside of an individual firm. Patent and copyright plays a crucial role in open innovation, which is result of inflow and outflow of knowledge [33]. Although open innovation by nature open, collaborative companies still see patent and copyright issues as highly relevant to the protection of their innovative capabilities.

In order to be successful in open innovation through the business network, global SMEs need to follow a framework with the objective to manage the business network efficiently. This framework can be a guideline for collaborative companies within a business network to move forward to adopting open innovation environment. Fig. 3 displays such a framework with the objective to execute the open innovation within SMEs. From Fig. 3, it is noticed that open innovation is the central theme, which is interfaced with many critical factors. Such factors can be categorized as firms or SMEs external forces and internal capacities and capabilities. In addition to external and internal factors, open innovation is also interconnected with different technologies and tools, which are essential to ended up to designing the final product.



Fig. 3 Framework for managing open innovation within SMEs

One of the domains within the framework is the firms‟ external factors, which are consisted of sub-factors such as partners profile, profit margin, financial issues, sales and marketing and customer demand. Each of the sub-factors is to be defined properly to achieve successful outcomes. In the partners‟ profile, all the collaborative partners‟ details are stored. The partners are selected based on the predefined criterions such as details of the capacities and capabilities, products, market segments, etc. [34]. In the framework financial issues are highly concerned, which are directly depending on the sales, marketing, and profit margin. The objective of collaboration is to achieve financial gain that is achieved through satisfying customers [35]. The customer demand and financial issue are directly associated with open innovation.

Similar to firms external forces, there are several sub-factors directly interfaced with the firms internal capacities and capabilities. Major sub-factors are resources and liabilities, research and development, trade secrets, patent and copyright issue. The sub-factor resources and liabilities are concerned with firms‟ internal resources and liabilities that is influenced collaborative innovation [36]. Often such factors are need to measure through periodic research and development to find out critical bottlenecks if there are any. In addition to monitor and measuring the resources with required research and development, firms need to maintain their trade secrets. In order to maintain trade secret, collaborative partners should ensure the patent and

copy right issues of their developed products or processes. These issues maintain partners core competencies within the business collaboration [37].

The central domain of the proposed open innovation framework consists of several critical sub-factors such as technology and tools, knowledge management, personnel, production process and product design. As seen from Fig. 3, first sub-factor technology and tools is necessary to manage acquired knowledge properly. The knowledge management is a key to the central domain of the framework that directly affects over the personnel capacities and capabilities. If the personnel acquired sufficient skills and knowledge, it acts as an aiding agent to production improvement. The final target to any open innovation is to develop innovative product, which directly interacts with improved production processes as visualized within the framework in Fig. 3. The overall success and failure of this framework is highly dependent on the necessary interfacing or integration of all the three domains and their associated sub-factors. To be successful by implementing this framework, it is necessary to monitor it and update in a regular intervals.

6. A Framework to Manage Open Innovation within SMEs

6.1. Fundamental to business network

Business network can be formed by collaborating two or more industries with the objective to achieve specific business opportunities. Trust is an essential element to form such a network. There exist different types of business networks within manufacturing industries. Specific network is suitable for industries, which is dependent on the nature of business goals, market segments, products portfolio, duration of network etc. Examples of such collaborative networks can be industrial cluster, business community, virtual organization breeding environment, business ecosystems, etc. [15]. Based on the administrative and managerial perspective, business network can be classified as hierarchical and non-hierarchical. In hierarchical network usually partner with biggest size control the network, while non-hierarchical one, each of the partners enjoy equal right and control over the network. In general, SMEs are involved in hierarchical network, while network with large and small companies are followed hierarchical business network [15, 38].

The key to business networking is to establish a mutually beneficial relationship among partners. The objective to develop such a network is to increase revenue from one way or another. It facilitates to exchange business information, ideas and support. The business network influences the organization‟s capabilities and performances of achieving excellence through innovation. It can be both local and international level. Localized business network usually communicates with partners physically, whereas international network partners are connected virtually using web-based communication platform. This online-based business-networking may have additional benefit of being able to connect their partners that are globally distributed as well as locally.

Business network influences the organizational performance through enhancing the capabilities of achieving excellence through open innovation. It defines the dynamic relationships among collaborating partners for time being, which can be shorter term or longer term depending on the business objectives. Business network always does not mean to interaction with other farms, but it can be with other actors such as professionals, educational institutions, local leaders, etc. [38]. In general, business network is commonly confined in supplier-purchaser value chains, supply chain networks, industrial clusters, etc. However, in today‟s concept its boundary is more than that.

Nowadays business network is widely spread, where it is mentioned as the collaboration between companies, which are distributed globally and connected virtually. This virtual relationship is formed by the direct support from ICT, clearly speaking Internet technology. The Internet technology makes the business network more flexible and easily manageable. This

technology basically supports business network through developing web-based communication platform through which partner organizations within the network communicate with each other to know the process update. The best business networking groups operate through exchanging business information, ideas, and support.

6.2. Methodology for business network to be innovative

There needs specific methodology to form the business network. This methodology can be defined as the systematic procedure starting from formation phase to dissolution phase of the business network. Similar to the types of business networks, there exist different methodologies to form and dissolve a business network. The nature of different methodologies depends on the network types, duration, management style and collaborators preferences. The methodology provides the necessary guidelines to form and executes a successful business network.

Any methodology to form and execute business collaboration should be flexible and adaptable in order to cover the acceptance of any changes during the execution process. It is always recommended to collaborate with possible partners before adopting the network methodology. There must be option to improve and adapt the methodology. The methodology within the business network usually covers each aspects of the business collaboration, which might be aroused during the execution process. The methodological outline as provided in this research is especially suitable for open innovation within mutually collaborative partners. Fig. 4 provides such specific methodology for open innovation.

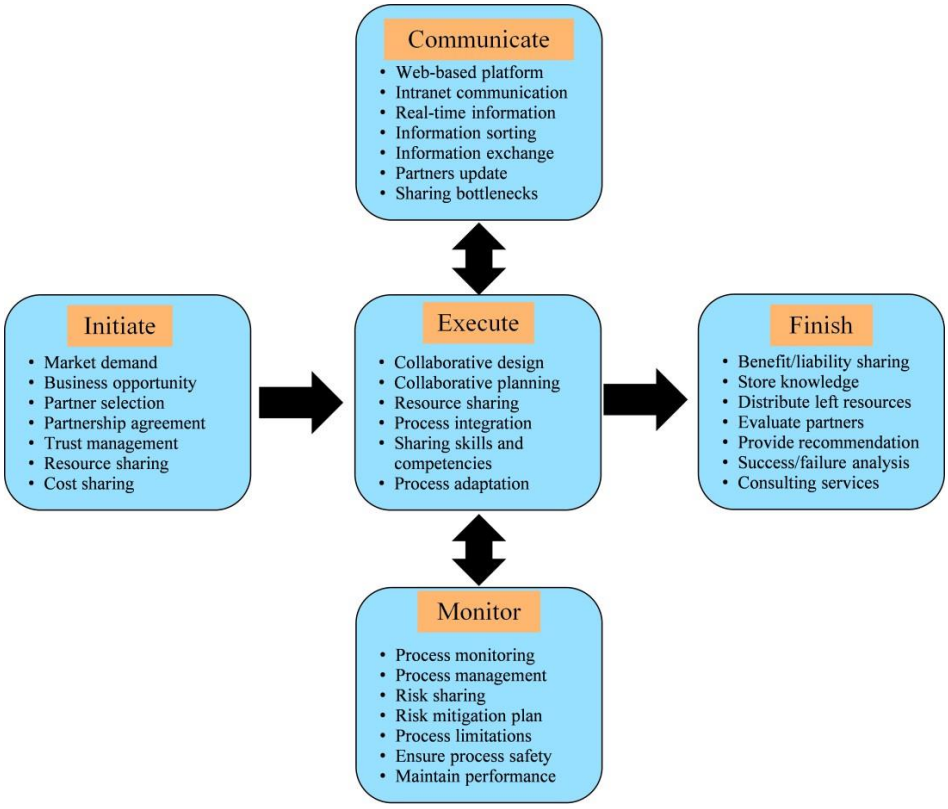

Fig. 4 Proposed methodological outline for open innovation within SMEs

From Fig. 4, it is seen „Initiate" is considered as the first phase of the methodology that can be used to form a business network. At this phase, it is critical to survey the market demand by interviewing customers both online and offline before initiate to form the network. Based on the market demand, business opportunities are identified initially. In order to achieve the identified business opportunities, possible partners within the proposed business network are selected through predefined selection criterions. There needs to establish a partnership agreement among network partners with respect to sharing resources and skills. Of course, at this stage trust are established and managed due to successful accomplishment of the partnerships.

In the second phase of the methodology, the business network as initiated is started to execute or to implement, where collaborative designs of the proposed products are performed based on the pre-identified business opportunities. The necessary planning is done collaboratively to integrate all the business processes. The partners‟ resources, skills and competencies are shared at this phase in order to execute the planning process and to achieve the network‟s goals. In case of process abnormality, necessary process adaption is orchestrated for smooth process execution. During the process execution the business network partners need to communicate with each other for required information sharing. In order to facilitate such information exchange a web-based platform is needed to develop. This web-enabled platform ensures intranet communication and real time information exchange between collaborative partners. Necessary information sorting helps partners to update their status and shares bottlenecks if there is any within the collaborative business processes.

In addition, to establish communication channel during execution processes of the network it is also critical to monitor the business processes within the collaborative network. This monitoring process always interacts with the execution process as displayed in Fig. 5 in order to get the update of processes. It helps to manage processes and identifies process abnormality if there is any. In case of process abnormality, associated risks are shared within the partners and necessary risk mitigation plan is finalized to overcome them. This monitoring process also needs to identify the process limitations and ensure process safety in order to achieve better process performance during execution.

The final phase of the proposed methodology is „Finish‟. At this phase, various benefits as well as the liabilities within the business network are shared among the network partners. Before ending the business network, the knowledge and expertise as achieved during executing such network are stored within the database for future use. The left resources are shared within the partners and evaluation of individual partners is also performed at this stage in order to improve their performances if there are any laggings of performances. Different success and failure rates are also analyzed. Before dissolving the network some partners are selected to offer consultancy services to the customers for their sold products as developed and sold during the network‟s duration.

6.3. Business network management: factors for success in open innovation

It is very important to manage the business network after it is successfully initiated. The success of any business network mostly depends on its management policy. Such management policy depends on several factors. Some of the most important factors to manage a business network successfully are outlined in Fig. 5. The factors are categorized in several subgroups such as formation, technology, evaluation, database and culture. Each of the subgroups contains specific factors in it.

In the formation of subgroups, many factors such as market trend, partners profile, partners‟ capacity, trust management, risk management and business model are involved. This categorization can be considered as the starting point of a business network, where potential market trends are studied before initializing the network. To achieve the identified business opportunity, it is necessary to form the business collaboration after selecting the potential partners based on their profiles and capacities and capabilities. To manage any business network there needs to establish trust among the potential partners. Risk management is also critical to avoid failure within the network. Before forming the business network, partners need to sign an agreement to adopt the specific business model.

To establish a business network it is very important to get support from up-to-date technology. This technology management issue can contributes to the communication channel within the network. Effective technology management and transfer between the partner organizations bring the success of a business network. Such technology transfer promotes skill sharing and real-time information exchange between the collaborative business processes.

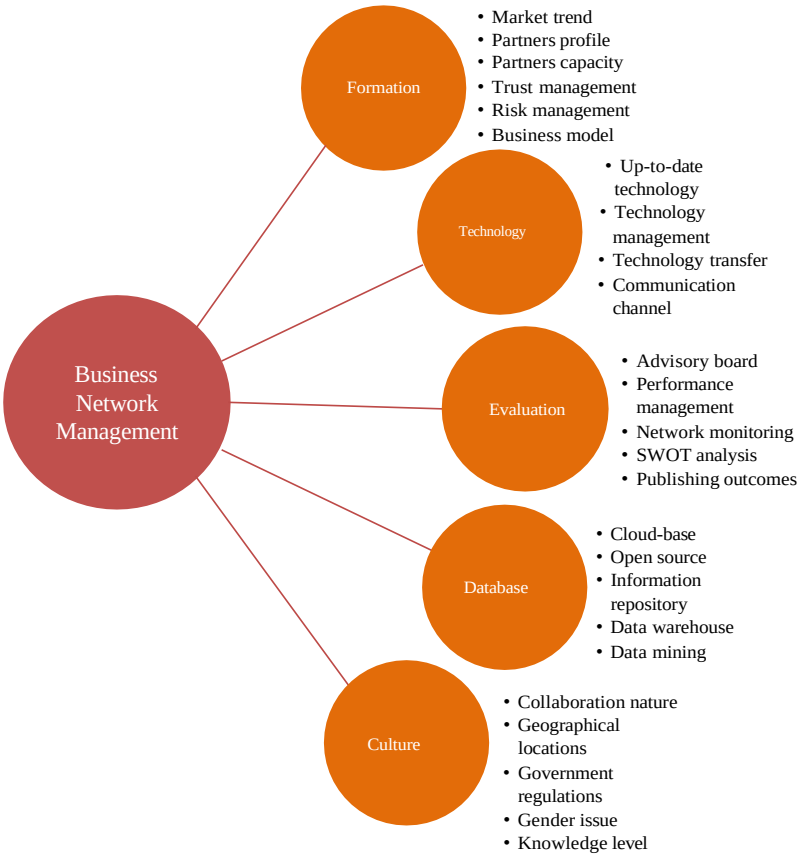

Fig. 5 Factors affecting successful business network for open innovation

The attitude to initiate business collaboration is also dependent on culture. This culture factor varies depending on the nature of the proposed collaboration, geographical locations, government regulations, gender issue and knowledge level of the community.

To manage a business network, it is critical to maintain a suitable database. This database can be cloud-based and open source-based that needs to be secured and easily accessible. All the information associated to the network partners and business processes should be stored and retrieved from such database. Often data warehouse and data mining are also suitable to execute the business network efficiently.

In any form of business network, it is necessary to evaluate it before coming to an end. Such evaluation process depends on the performance management and monitoring processes, SWOT (strength, weakness, opportunity, threat) analysis within the network. An advisory board that consists of several experts evaluates the overall performances of a business network depending on its publishable outcomes.

7. Open Innovation within the Collaborative Network: A Case Study

With the objective to illustrate the open innovation concept within the collaborative business environment, a case business network was studied within the scope of this research. In this network, partner companies from different countries were collaborated with each other to design and develop innovative shoes. Obviously all the partners were from the domain of fashion business. Based on the identified business opportunity, partners form the partnership network following the methodological steps such as Form, Operate and Dissolve. A web-based communication portal was designed and developed after forming the business network, which is displayed in Figure 6. All the methodological steps are seen in Figure 6, in addition to performance management and reviewing the performance of the network. This case business network was identified as virtual organization (VO), „Safe-201“.

In the developed web portal, all the important customer requirements were populated, which were collected during the identification process of the business opportunity. Collected requirements are sorted out based on their importance and suitability to produce the innovative shoes. Some of the requirements such as lasting, stitching, etc. are populated within the web-portal as seen in Fig. 6. This web-portal also includes with risk definition, risk resolution, product concept, aggregate planning, quotation, etc., along with the broker name, who initiated the collaboration.

In order to design the innovative pair of shoes, a configurator tool is used to configure the shoes based on the customer requirements, which is also displayed in Fig. 7. From Fig. 7, it is seen that the specifications of the shoes such as model number, material, color, etc., are displayed along with the shoes sketch with price. This configurator is integrated with the required bill-of-materials and bill-of-operations. Eventually, the information within the shoes configurator is exported to the operational phase of the collaborative production processes to finalize the product.

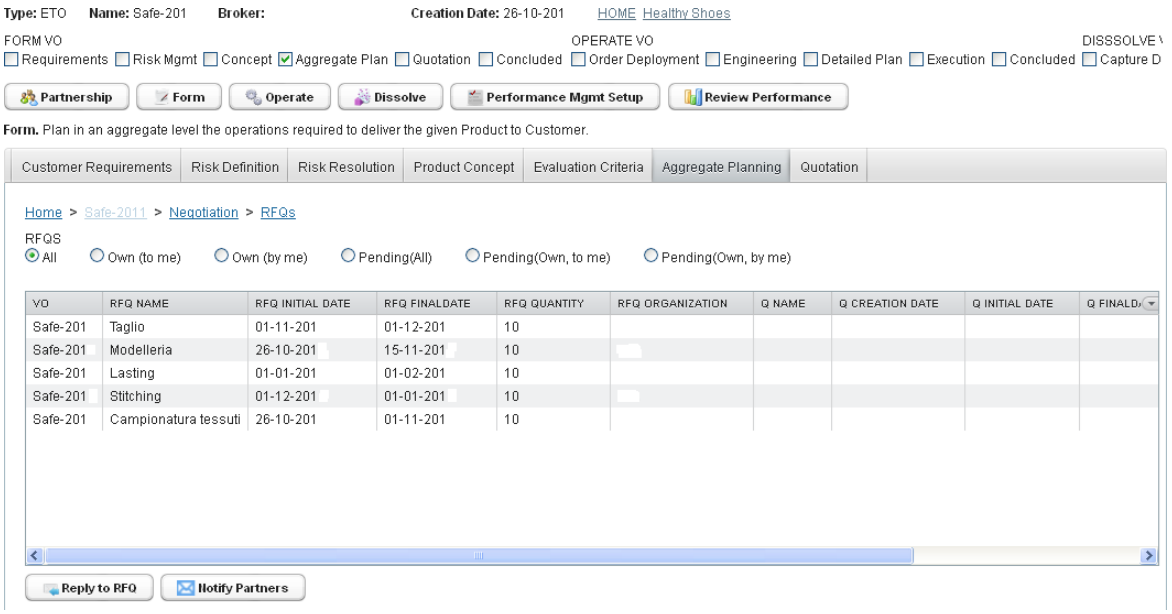

Fig. 6 A web-based communication portal for the business network

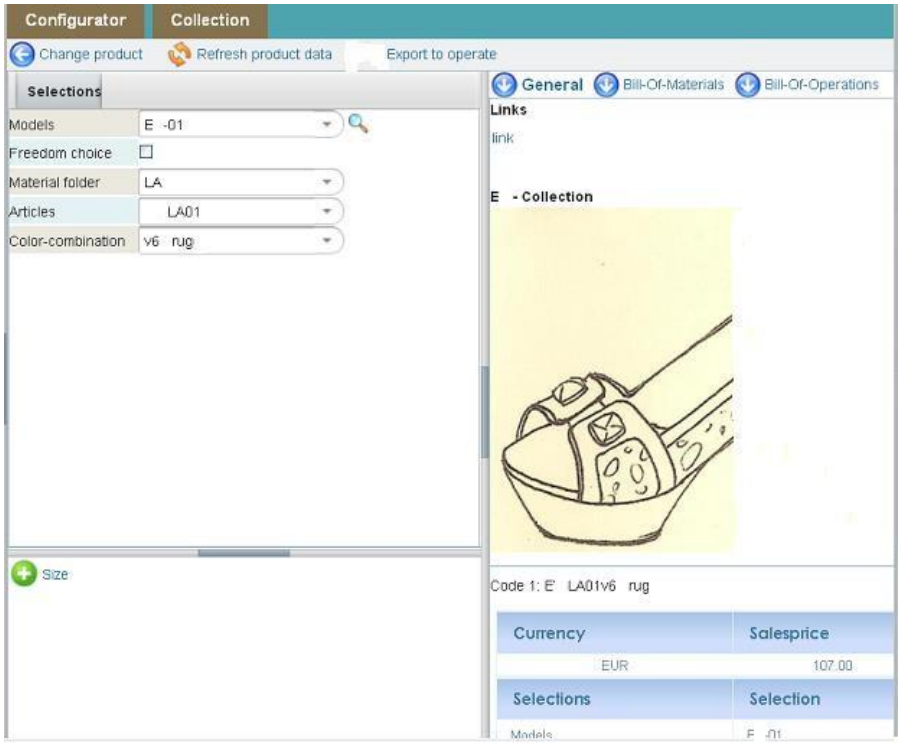

Fig. 7 Display of configurator tool as used to configure the shoe based on the customer requirement

In order to complete the case product „innovative pair of shoes", each of its parts is assigned with specific partner within the case business network based on partner"s skills and competencies. Each of the items has its item identification. The task assignments are uploaded in the web-portal, where each partner can see specific partner"s assigned part. Fig. 8 displays the different parts of the shoes with sequence numbers, product name, partner/supplier name, quantity, cost, etc. This portal works as a dashboard to monitor the progress of the parts and notify corresponding partner if there is any delay from the predefined scheduled or deadline.

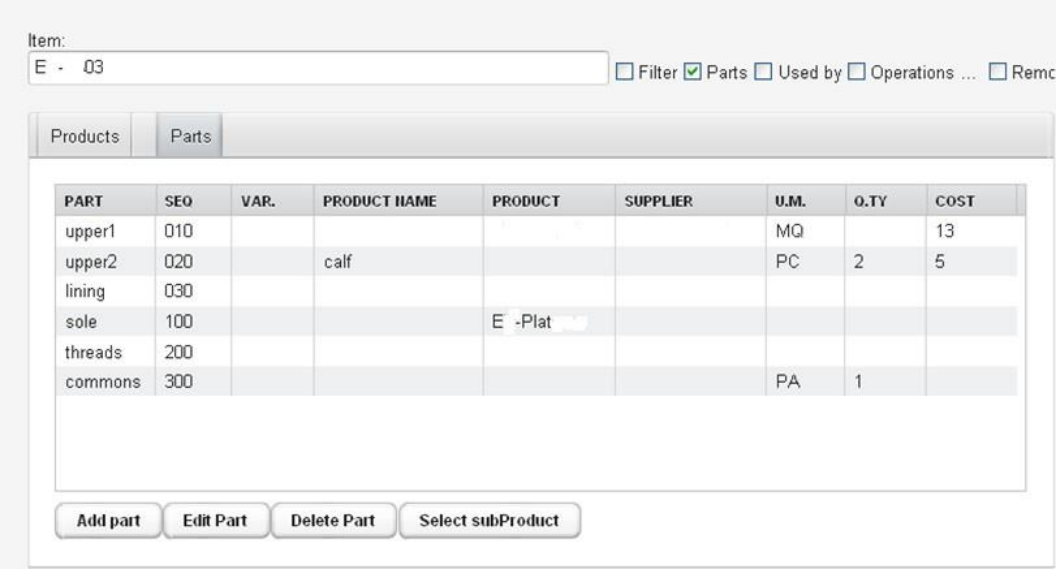

Fig. 8 Display of different parts of the shoe with sequence numbers, product name, partner/supplier name, quantity, cost, etc.

The case business network is also monitored with respect to define possible risks within the network with possible remedial plan. Fig. 9 shows the web-portal to manage risks with accompanied risks, deviations, resolutions, notify partners, etc., tabs, which carry their individual assignments. For instance, resolutions tab corresponds to necessary plans as required to mitigate any risks or deviations from the predefined schedules. The „basic information" tab contains relevant information such as event name, related activity, description, status, priority, source partner and effect range as displayed in Fig. 9. This portal also visualizes the priority level with different color codes such as red for high risk, yellow for medium risk and green for no risk.

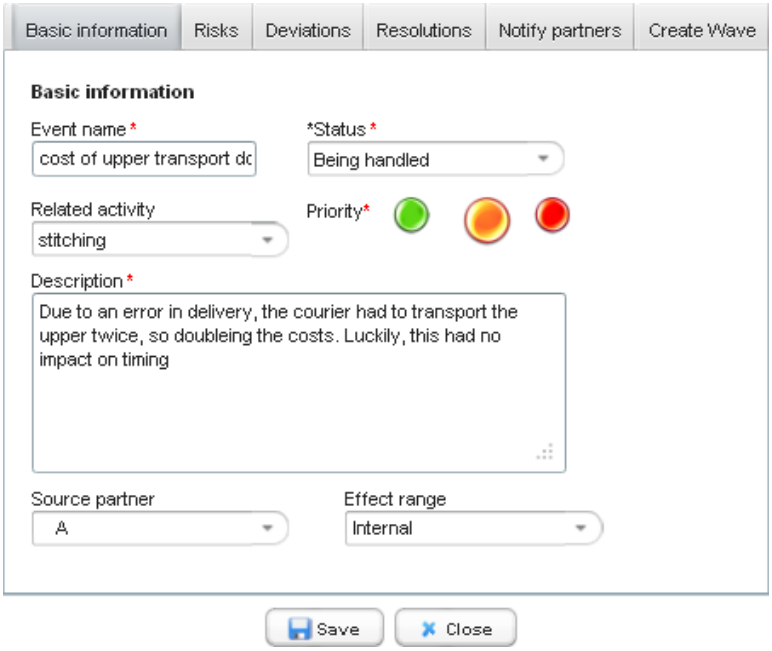

Fig. 9 Display of the web-portal to manage risks with accompanied risks, deviations, resolutions, notify partners, etc.

Eventually, overall performance of the case business network is measured with the objective to evaluate individual partners‟ commitment to the network. Fig. 10 displays the portal with the performance evaluation criteria. The performance is measured based on the approved criterions by the partner organizations. The criterions can be for instance, quantity of products, cost, lead-time, due date, etc., as seen in Fig. 10 too. Each of the criteria is also given weight, type, minimum and maximum value depending on its importance within the overall evaluation process. The performance was measured based on initial date, due date, quantity produced, total cost, etc.

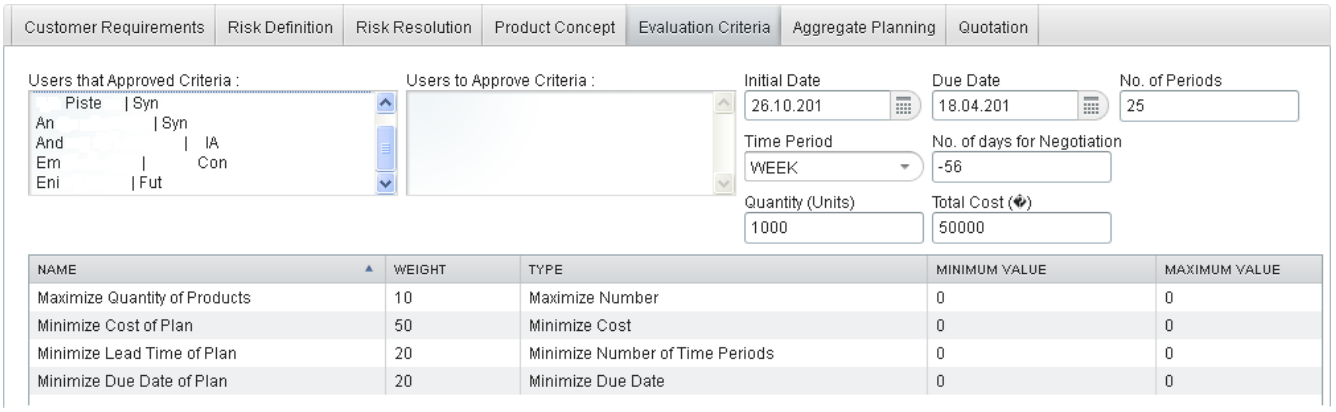

Fig. 10 Display the web portal of the performance evaluation criteria within business network

The case study as presented above highlights the overall requirements and tasks as necessary to develop an innovative product collaboratively. It demonstrates the development of a successful product (innovative shoes) with sharing valuable resources among partner organizations. Although this kind of business collaboration has added benefits but it has several limitations too. For instance, this kind of collaboration does not support the individualism and confidentiality of partner companies. Collaborative companies might achieve economic benefit temporarily but lose their core competencies due to share them with partners. Collaborative partners often face difficulties to bring interoperability among their existing ICT systems with other ones. In addition, collaborative partners, especially SMEs tend to prefer to adopt outsourcing strategy rather business collaboration, perhaps because of the higher risks and uncertainties and cost of managing such a partnership.

8. Managerial Implications

Innovativeness is the most critical factor for a company to increase profitability and growth in each sector that ultimately helps company to sustain in business competition. This innovation activity is traditionally concentrated within single company, which is nowadays decentralizing due to the advancement of internet technology and mobility of knowledge worker. Today‟s extension of internet technology and broadening the scope of possible external suppliers has undermined the effectiveness of the traditional innovation system. Till-to-date innovation activities in many companies, especially SMEs are inefficient and unexplored. To support SMEs, they need to take initiative to start and coordinate business collaboration that offer them the opportunity to explore open innovation within the holistic innovation strategy.

In case of forming a collaborative network for open innovation, SMEs need to be cautious to share expertize in technology inside the company or commercializing in partnership. In such situation, SMEs made considerable efforts in terms of trust creation, information sharing, procedural learning and know-how transfer that are contributed substantially to the network‟s success. In a collaborative work, mutual trust is essential for its success and it is the duty of each network partners to take continued effort to develop it. In addition, if SMEs use too many sources of external knowledge and expertise for their innovation activities, negative results might be turn out. It is therefore, necessary to make a tradeoff between open innovation and close innovation within companies, especially within SMEs.

Co-creation, which is a form of open innovation initiates through alliances, cooperation and joint ventures among complementary partners. This strategy is widely researched in the open innovation management literature. Through this business model, companies combine the outside-in process that contributes to gaining external knowledge with inside-out process to bring ideas to market. It focuses on peer-production through integrating business communities, consumers and lead users. The co-creation strategy can be seen as an increasing awareness of corporate venturing activities, where new business models, such as new ventures and spin-offs are evolved along with cross-company innovation.

Furthermore, to adopt open innovation strategy manufacturing companies, especially SMEs need to be selective in order to get the best partners within their business network. Successful business network demands for uninterrupted sharing of resources and skills between the network partners. In order to get an optimum benefit from the network, manufacturing companies should be cautious about the partnership, which is generally the only option to be innovative in general. In case of innovation whether it is open or close, it is almost impossible for SMEs to have a complete set of expertize in technology, investment and commercialize their products and therefore marketing their innovations are too limited.

9. Conclusions

Today‟s increased competitive pressure within the business community acts as the driving force for companies to introduce higher quality innovative products in faster and cheaper ways than the competitors. To meet such challenges and to be innovative, companies need to adopt different mechanisms and strategies that help them to achieve innovation with high levels of novelty. In order to be innovative, companies may not simply depend on skills that they can find and exploit in-house, but need to gain access to external sources of technological knowledge and skills. Such technological knowledge and skills are not easily accessible in the market and difficult to accumulate and organize. With collaborative agreements between companies, can be a good solution to accumulate pool of resources and exploit complementarities. This business collaboration contributes to technological innovations in the form of open innovation between partner companies.

The open innovation within the manufacturing companies brings prosperity for them with respect to achieving business competition through economical advantage. This open innovation concept is especially necessary for SMEs in compare to large companies due to the sizes and scarcity of resources. From various studies, it is noticed that most successful open innovation examples are formulated from large companies due to their higher investment level in research and development (R&D) and to make partnerships with other companies. On the other hand, due to limited resources SMEs generally cannot invest sufficient resources to the R&D and stay behind from any kind of innovation activities. In such circumstances, it is appropriate for SMEs to move towards open innovation, where they can form a business network with the view to share resources between each other.

The business collaboration within SMEs acts as the driving force to introduce products with a higher degree of novelty. Studies found that the greatest positive impact on the degree of innovation novelty initiates from business collaborations as are orchestrated by different types of partners [38]. However, to select appropriate partner with necessary resources and skills is not an easy task. Partner selection is considered as an important part of business network, where possible open innovation activity is taken place. Partners‟ work as external actors within SMEs innovation process and it also helps to identify the barriers to open innovation. This cross-functional collaborative network contributes SMEs to compete against large firms [15].

This study fulfilled three main objectives as set before conducting the research. First objective was met by introducing a novel framework for SMEs open innovation that covers the requirements of SMEs to initiate open innovation strategy. Second objective was satisfied through proposing a methodological guideline to support the formation of collaborative business

network, which is the key to open innovation principle. It is also included to identify the associated factors as necessary to manage a successful business network in order to be innovative. The third and final objective was satisfied through implementing the open innovation principle within a case business network, which was formed by the SMEs in several countries, engaged in fashion business.

This research supports the concept of open innovation in SMEs through providing methodological guideline and state-of-the-art frameworks. Nevertheless, future research can be continued to improve the understanding of open innovation and motivate companies, especially SMEs to achieve mutual benefits. Furthermore, suitability of various collaborative network models in the form of strategic alliance, virtual organization, industry cluster, co-operation, networking, business eco-system, etc., are needed to be clarified with the objective to avoid confusion from one format to the other one. In addition to, future research can also be focused to study the ratios of success and failure of business networks for open innovation and to investigate the factors behind these outcomes.

Author Contribution Statement

Ahm Shamsuzzoha: Conceptualization, Methodology, Investigation, Data curation, Writing – original draft, Project administration. **Mahmood Al-Kindi**: Investigation, Formal analysis, Visualization, Writing – review and editing. **Nasr Al-Hinai**: Supervision, Validation, Resources, Writing – review and editing.

Declaration of Competing Interest

The authors declare no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

Data Availability

Data will be made available on request.

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Ethics Approval and Consent

This study does not involve human participants, animals, or sensitive personal data. Ethical approval was therefore not required.

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