

Abbasi, Eram; Amin, Imran; Siddiqui, Shama

Article

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Towards developing innovation management framework (IMF) for ICT organizations at Pakistan

Eram Abbasi^{1*} , Imran Amin¹ and Shama Siddiqui²

*Correspondence:
eramabbasi@gmail.com

¹ Shaheed Zulfiqar Ali
Bhutto Institute of Science
and Technology (SZABIST), 100
Block 5, Clifton, Karachi, Pakistan
² DHA Suffa University, DG-78,
Off Khayaban-e-Tufail, Phase 7
Ext, Karachi, Pakistan

Abstract

Various aspects of innovation management have been discussed in literature over the past few decades. Most of the innovation management frameworks have been formulated by undertaking studies in the developed world and lack the industry/culture specific focus. In this paper, we revisit the generic innovation management studies to develop an innovation management framework for highlighting the factors affecting innovation specifically at the Information Communication Technology (ICT) sector of Pakistan. A detailed literature review has been conducted to identify the factors included in the past innovation management models. To identify the factors specific for Pakistan, senior-level professionals, working at the Pakistani ICT organizations were interviewed based on a survey. A comparative analysis of the innovation management frameworks for Pakistan against those previously found in literature revealed interesting similarities and differences. Based on the study findings, an innovation management framework is developed that highlights the present factors which are important for innovation in the ICT sector for Pakistan. This framework can be used by Pakistan and other underdeveloped countries for improving their innovation in ICT sectors in particular and other sectors in general.

Keywords: Innovation, Framework, ICT, Innovation management

Introduction

The organization's capability to innovate is regarded as one of the major driving factors for maintaining sustainability. The term innovation refers to introduction of a novel and useful method/process/technology (Granstrand & Holgersson, 2020; Keresztes & Endresz, 2020). Innovation may lead an organization to develop an entirely new product or service or to significantly modify the previously existing one. It is important to note that innovation is not only required at the starting point of any business activity, but it is crucial to continue to innovate for developing core competencies (Wu & Lu, 2011). Thus innovation provides fuel to the organization for staying competitive. On the other hand, innovation also has a vital role to play for the growth of economy (Pei et al., 2010). An important aspect regarding innovation is lack of its generalization.

Products, services or solutions performing successfully in one country do not necessarily work well in other countries. Hence, to address the local needs and have greater adaptability, the best path is to develop the products/services within that specific country. To attend this need, the global requirement is to improve the innovativeness level in underdeveloped countries especially which are at a lower ranking in the global innovation index (GII). Pakistan is one such country whose innovativeness level is quite weak according to GII and hence appropriate measures must be taken (Global Innovation Index, 2020). In this context, the best approach is to study the state of innovation at the organizations of Pakistan and to evaluate the perception of employees regarding innovation management.

ICT sector is one of the most prominent in terms of innovation and entrepreneurship for Pakistan. However, full benefit of the innovation capability of this sector has not yet been realized due to the lack of measures taken for evaluating and managing the factors which impact innovation (Raza, 2018). To the best of our knowledge, none of the previous studies have focused on identifying the factors which have an impact over innovation of the ICT sector in Pakistan. Hence, the major research question addressed in this study has been formulated as below:

"What are the factors that drive innovation in the ICT industry of Pakistan?"

In this work, we conducted a detailed literature review and survey interviews of senior professionals to identify the innovation management factors specific to Pakistan ICT sector. We categorized the factors as organizational, project/product and market related in the framework. We also present a detailed comparison of the factors included in the proposed framework against those proposed by the previous authors. We believe that this study would enhance the prevailing literature in terms of innovation in underdeveloped countries. It would help in understanding the innovation impacting factors in Pakistani ICT organizations, which would further help diagnosing the cause of lower innovation level of Pakistan and accordingly remedies can be suggested to improve the status. This knowledge can further provide a direction to evaluate organizations operating in similar industries or similar countries especially in underdeveloped countries.

The major contribution of this work is to identify the factors impacting the innovation at ICT sector of Pakistan by carrying out a detailed literature review of the existing innovation management models, followed by survey interviews of senior-level professionals working at the ICT sector of Pakistan. We performed a detailed comparison of the factors identified by the professionals with those proposed by previous studies. Finally, we developed a comprehensive innovation management framework specifically focused on the ICT sector of Pakistan.

Rest of this paper has been organized as: "[Literature background](#)" section presents the brief literature review, "[Innovation and entrepreneurship at the ICT sector of Pakistan](#)" section discusses the present state of innovation and entrepreneurship at the ICT sector of Pakistan; "[Research methodology](#)" section presents the research methodology, "[Results](#)" describes the results of literature survey and survey interviews, "[Proposed framework](#)" section presents the proposed framework for innovation management, "[Discussion and implications](#)" presents the discussion and

implication; finally, "[Conclusion and future works](#)" section concludes the paper and offers an insight into the future work direction.

Literature background

The earliest discussions on innovation can be traced back to Schumpeter's theories related to Economic Development. Schumpeter, one of the experienced authors in the area of economics, innovation, and entrepreneurship emphasizes that innovation is an important factor that impacts economic cycles through entrepreneurship. Schumpeter describes organizational growth and development as a process that is driven by innovation (Schumpeter, 1934, 1939) and involves activities like reproduction, invention and diffusion (Burton-Jones, 2001), whereas the entrepreneurial mindset lies at the core of these activities (Schumpeter, 1934). Schumpeter further deliberates that the invention aspect of innovation does not assure growth, rather growth is triggered by diffusion of innovation (Freeman, 1987). Schumpeter in his theory of creative destruction or more precisely the theory of economic innovation, expresses that innovation is responsible for the growth of an economy, whereas the entrepreneur plays the role of change forerunner (Schumpeter, 1934, 1939, 1942). This insinuates that organizations having entrepreneurial capabilities can impact economic growth from within by fostering innovation within the organization. Hence, integrating strong innovation management capabilities within the organizations has been sought as a necessity.

Following Schumpeter's concepts many researchers have further discussed innovation in terms of product development, commercialization, organization development, or resource management, etc. Drucker (1985) considers innovation as a source of equipping organizations with new or improved competencies. Researchers also regard innovation as a strategic tool and strategic weapon; a tool that helps organizations develop a strategic directions and a weapon that help organization fight competition (Hitt et al., 2001; Kuratko et al., 2005).

Realizing the importance of innovation for organizations, researchers have put forth literature that suggest methods for better management for innovation within an organization. Barnett (1953) being one of the initial pioneers who focused on innovation process, emphasized that when innovation takes place, it is always backed by a process. Thus there is a need for the management to focus of the entire process of innovation, starting from invention, and ending at diffusion.

Subsequently, researchers kept on adding new dimension to the process. Utterback et al. (1998) made efforts to present the process of innovation and integrated knowledge as a key ingredient in the process. These authors regarded the technological and market knowledge to hold pivotal importance for the innovation process.

Focusing on the management of innovation, authors further concentrated on the types of innovation. For example, Leifer et al. (2000), discussed radical and incremental as major types of innovation. Their discussion encompasses the process of innovation, players of innovation and resources of innovation. Moreover, a large a large number of other researchers also studied the processes and types of innovation. As a result many theories and models focused on innovation process and management were developed. In this context, a highly regarded series of literature is presented by Christensen and his fellows. Christensen and Overdorf (2000), Christensen (2006) in the famous Disruptive

Innovation theory describes the process that how small firms enter markets and outperform giants. This theory focuses on innovation driven growth that can be applied to any organization, but it is particularly important for entrepreneurial organizations.

In addition to their famous Disruptive Innovation Theory, Christensen et al. (2004) has also put forward the 'resources, processes and values' (RPV) theory as well. This theory states that an organization can identify its innovation-related strengths and weaknesses by focusing on three areas: Resources, Processes and Values.

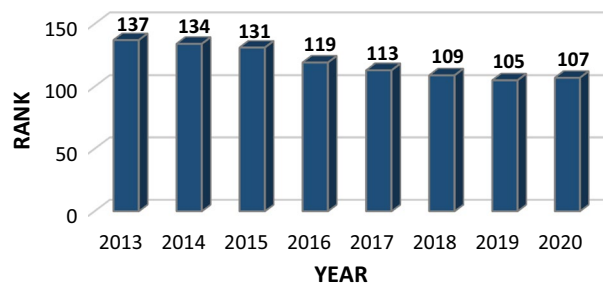
Following these scholarly views about innovation and recognizing the importance of innovation and its impact on organizations and economies, the Organization for Economic Co-operation and Development (OECD) realized the need to identify means for measuring innovation at firm level. As a result, OECD published the Oslo Manual (OCDE, 2005) which presented guidelines for collection and interpreting data related to innovation. The manual highlights the internal and external drivers for innovation within a firm and further provides guidelines for optimal use of innovation data for statistics and analysis. Although the manual deals with innovation at the firm level, it only focusses on the business enterprise sector for the four basic areas including; product, process, organization and market. The manual discusses that any activity that leads to implementation of innovation within the organization is considered as an innovation activity or process and an organization that has been involved in any such innovation activity or has implemented an innovation process during a specific period under study, would be considered as an 'innovative firm' for that specific period. The manual further states that an innovative activity can be any organization specific activity or any financial activity or it can be either scientific or technological activity.

Considerable amount of research has been done to explain the innovation management practices of organizations. In this context, many agreements and disagreements between authors have also been observed. Firstly, there is fewer literature available that focuses on innovation management practices targeted towards any particular industry or any particular country. Mostly, the literature available is generic in nature. Even there are researchers who believe that innovation-related published research is not consistent with the industry actual practices. Thus, there is a gap between the perception of innovation among researchers and the practicing community (Tidd, 2001). Secondly, there is a gap when it comes to innovation management practices for organizations operating in developing countries, such as Pakistan which is considered as a Developing Economy (United Nations, 2017). Such economies are considered as resource constrained economies. The World Economic Situation 2017 report (United Nations, 2017) has classified economies based on the per capita Gross National Income (GNI), and among this list Pakistan is placed in the 'lower middle income' economies. Due to limited resources the development in such countries also becomes slow and high-end innovations cannot be expected to emerge. Hence, the literature available related to innovations in developing countries cannot be generalized for the developed countries. Thus, there is a need to study innovation management practices in the developing countries with special focus on the factors that are impacting innovations.

As developing economies play an important role in global development, there is a strong need to evaluate the status of their innovation. Moreover, the best fit models for innovation for developing countries should be developed, which in turn would

Table 1 Imports and exports of ICT goods in Pakistan (World Bank, n.d.)

| | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|----------|----------|----------|----------|----------|
| ICT goods imports (% total goods imports) | 4.585867 | 4.900437 | 4.947979 | 4.685725 | 3.925039 |
| ICT goods exports (% of total goods exports) | 0.193982 | 0.241236 | 0.30483 | 0.195368 | 0.157045 |

**Fig. 1** Pakistan's Global Innovation Index Ranking in last few years (Dutta, 2015, Global Innovation Index, 2019, 2020)

help in the development of these economies (Schumpeter, 1934, 1939). Pakistan being a developing economy, studying innovation in relation to Pakistan can help to a certain degree, understand the status of innovation in other developing countries.

Innovation and entrepreneurship at the ICT sector of Pakistan

Growth in ICT industry of Pakistan has shown significant improvement over the past decade, yet there is a tremendous scope for growth and a strong need to promote innovation at organizational level for the ICT sector (Raza, 2018). Statistics show that Pakistan's performance in the ICT sector is quite optimistic but not exceptionally good (Competitiveness, 2020; Pakistan Ministry of Information Technology, 2018). Table 1 shows the imports and exports of ICT goods in Pakistan during past few years.

A positive point regarding Pakistan is that according to the global innovation index (GII), it is observed that Pakistan's ranking in last few years has constantly improved but at a slow pace as shown in Fig. 1. In 2013, Pakistan ranked 137, whereas in 2017, it ranked 113 and in 2019, it ranked 105. Therefore, there is a need is to take appropriate measures for improvement of Pakistan's ranking at a faster pace.

It is important to note that innovation should be studied not only at the country level, but also needs to be focused at the organizational level. Collectively, innovativeness of organizations lead to improvement of innovativeness level at the country level. Every organization and every industry has different parameters to be managed for innovation efficiency. As the innovation status of Pakistan at country level is low, therefore the need is to evaluate factors that are contributing for innovation at organizational level. In the longer run, the firm-level innovation management would translate to overall improvement of innovation at country level.

Research methodology

The research was carried out in two phases. In phase one, the author conducted a thorough literature review to clearly understand various aspects of innovation. In particular, the prevailing innovation types, process models and management models for innovation were analyzed. The driving factors for innovation in organizations were identified based on the models presented in literature. Once the factors are identified, then in phase two the factors identified were presented to ICT professionals from different organizations of Pakistan. The respondents were requested to share their perception about the factors which impact innovation. Finally, the IMF is developed based on the analysis of literature as well as finding of the interviews.

We present brief details about each phase in the following sections:

Phase one

In this phase, the major objective was to carry out the detailed literature survey to develop an insight about the previous research conducted on innovation, and specifically, on the process of innovation management. Focus of the literature review was to identify the major factors that impact innovation. An extensive systematic study was carried out that dated back to the concepts of Drucker (Drucker, 1985; Drucker & Noel, 1986) and Schumpeter (Schumpeter, 1934, 1942) while moving to the most recent concepts and models. Since numerous models, were found in literature, therefore the models that were cited by more than 200 scholars were selected and short-listed to be included for this study. The models being studied were further organized in a chronological order of publication. This helped the authors to link all the models. In this way, one model led to move to others and a chronological list of models was populated. The list of models studied is quite extensive therefore including the exhaustive list was out of scope for this paper. However, some of the famous models that mainly contributed to this research are listed in Table 2 for the reader's interest. Among this list, some models like Stage Gate (Cooper, 1990) or Generations (Rothwell, 1994) were studied to develop understanding of the Innovation Process. On the other hand, the study of other models like Compass (Radnor & Noke, 2006), Contextual Factors (Ortt & Duin, 2008) and Sustainability Oriented Innovation Model (Adams et al., 2015) were mainly focused for factors.

From the previous innovation models studied, 189 factors were identified, which had been reported to impact innovation. The factors which were proposed to impact innovation during any stage of the innovation process from idea generation to market the innovation have been studied. Previous articles which had focused on innovation management or innovation measurement were mainly focused for the study. Once an exhaustive list of all the factors that impacted innovation was prepared, the list was revisited and passed through several iterations to group and regroup the factors and develop a comprehensive framework. After several iterations, these factors are classified into 3 major groups and presented in Fig. 2. The initial 189 factors were then further filtered and 58 factors were short listed. This filtration was based on the following exclusion and inclusion criteria:

Table 2 Innovation models

| Model | Year | Author |
|---|------------------|---|
| Stage Gate Model | 1983, 1990, 2008 | Robert Cooper (Cooper, 1983) (Cooper, 1990) (Cooper, 2008) |
| Generations of Innovation Process Models | 1994, 1995 | Rothwell (Rothwell, 1994) (Dodgson & Rothwell, 1995) |
| Open Innovation Model | 2003, 2006 | Chesbrough (Chesbrough, 2003) (Chesbrough, 2006) |
| Factors contributing for success or failure of innovation | 2003 | van der Panne (van der Panne et al., 2003) |
| Innovation matrices | 2004 | Milbergs and Vonortas (Milbergs & Vonortas, 2004) |
| Innovation compass | 2002, 2006 | Radnor et al., (Radnor & Noke, 2002) (Radnor & Noke, 2006) |
| Cyclic Innovation Model | 2006 | Berkhout et al. (Berkhout et al., 2006) |
| Three-phased innovation process model | 2007 | Tiwari et al. (Tiwari et al., 2007) |
| Innovation value chain | 2007 | Hansen & Birkinshaw (Hansen & Birkinshaw, 2007) |
| Integrated idea management | 2007 | Brem et al. (Brem & Voigt, 2007) |
| Fugle model of innovation | 2008 | Du Preez et al. (Du Preez & Louw, 2008) |
| Contextual factors of innovation | 2008 | Ortt and van der Duin (Ortt & Duin, 2008) |
| Integration of market pull and technology push model | 2009 | Brem et al. (Brem & Voigt, 2009) |
| Technology and innovation radars | 2010 | Golovatchev et al. (Golovatchev et al., 2010) |
| Multi-dimensional framework for innovation | 2010 | Crossan et al. (Crossan & Apaydin, 2010) |
| Innovation Capability Maturity (ICM) Model | 2010 | Essmann & Preez (Essmann & Preez, 2010) |
| Lean innovation system | 2011 | G. Schuh et al (Schuh et al., 2011) |
| Innovation capital (InnC) | 2012 | Kijek (Kijek, 2012) |
| Innovation Maturity (IM) Model | 2013 | Berg (Berg, 2013) |
| Innovation Management Maturity (IMM) Model | 2013 | C. Nauyalis (Nauyalis, 2013) |
| Total Innovation Management" (TIM) Model | 2013 | Hajikarimi, et al. (Hajikarimi et al., 2013) |
| Innovation Audit Tool | 2013 | Joe Tidd & John Bessant (Tid & Bessant, 2013) |
| Value added corporate innovation Management | 2013 | Cohn et al (Cohn, 2013) |
| Innovation metrics framework | 2013 | Kaplan (Kaplan, 2013) |
| Sustainability Oriented Innovation Model | 2015 | Adam et al. (Adams et al., 2015) |
| Dynamic Parameter Model | 2015 | Mihola et al. (Mihola et al., 2015) |



Fig. 2 Factors impacting innovation identified through literature review

- 1) There were several factors that were given different names by researchers, but they referred to the same concept. To avoid overlapping and repetition, factors having similar context, but different name were removed from the list.
- 2) There were certain factors that numerous authors had referred and repeated in multiple models. Also, a large number of past authors had discussed and verified these factors, therefore they were selected for this study. On the other hand, the factors which were only verified by a couple of authors were excluded.

Phase two

Once the factors impacting innovation were identified in Phase one, the authors then consulted senior-level professionals from reputed ICT organizations in Pakistan. These respondents were senior-level professionals, which included either C-level executives, founders or directors at the organization. Each respondent belonged to a different organization. A total of 16 respondent were approached out of which 10 agreed to participate. Considering the time constraints and convenience of the respondents, they were presented with the 58 factors that were identified during literature survey. They were asked to rate each factor on a scale of 1 to 5 (where 1 = highly agreed, 2 = agree, 3 = neutral, 4 = disagree, 5 = highly disagree) based on their own views, experience and understanding that whether it has an impact over innovation. This data collection was carried out by personally meeting the professionals and discussing each factor and collecting responses on a scale of 1–5. Thus the data collection method was survey interviews which is mainly a survey but conducted in an open ended interview format. The responses gathered on a scale of 1–5 were then analyzed using weighted average method. The reason for conducting these survey interviews was to identify how much agreement or disagreement prevails among the published literature and the actual perceptions of professionals about the organizational innovation factors.

Results

Based on the first phase literature survey, an extensive list of 58 factors highlighting the factors affecting innovation has been prepared, as shown in Fig. 2. These factors were then assigned priority based on the criteria that if a factor was discussed by more than 50% of the researchers, it was considered as a strong factor and was considered a weak factor otherwise. After applying this filter, 27 factors were identified as ‘Strong Factors’ (presented as bold in Fig. 2). The list has been categorized into three major groups; these three groups are:

- A. Organizational factors
- B. Project/product factors
- C. Market factors

All the factors identified in the paper impact innovation during any stage of the innovation cycle, starting from the idea generation (for product or service) ending at the acceptance of proposed innovation in the market. Therefore, we classified some factors as organizational factors, whereas some are specific to product and some are related to the market. The factors identified from the literature review were then used to conduct survey interviews of senior professionals working in ICT organizations at Pakistan. The respondents were presented with all the 58 factors and were required to rate them on a scale of 1 to 5. The findings or responses obtained were further analyzed using weighted mean method. The results obtained during survey interviews are summarized in Fig. 3. It has been shown that none of the respondents ‘Highly disagreed’ with any factor. However, they did ‘Disagree’ with 2% of the factors

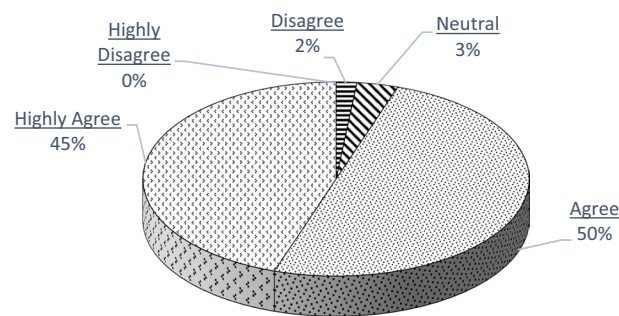


Fig. 3 Summary of results obtained by the ICT professionals

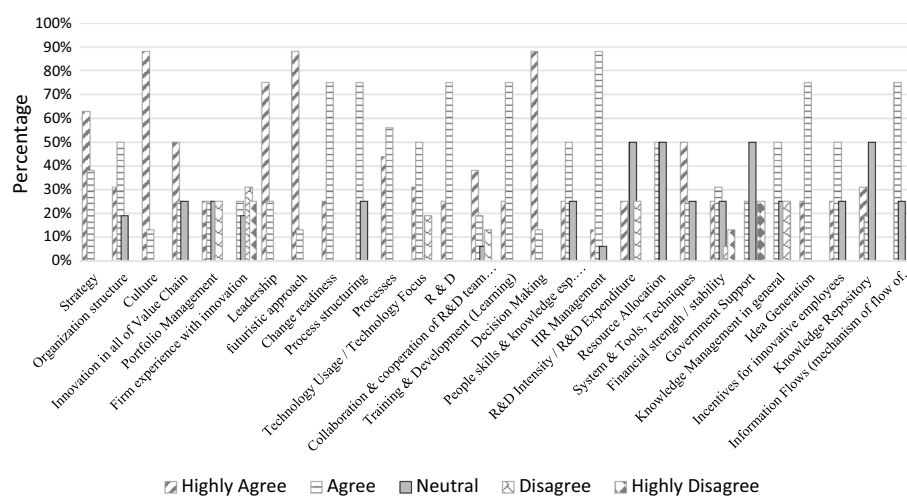


Fig. 4 Survey results related to organizational factors

and showed neutral response for 3% of the factors. The good sign is that they were in agreement with 95% of the factors with 50% ranked as 'Agreed' and 45% being 'Highly Agreed'. These observations indicate that ICT professionals are mostly in agreement with the factors presented by research researchers in the previous literature.

As previously described, the factors impacting innovation have been grouped into three categories related to: organization, product/process and market. Results obtained for each category are presented below:

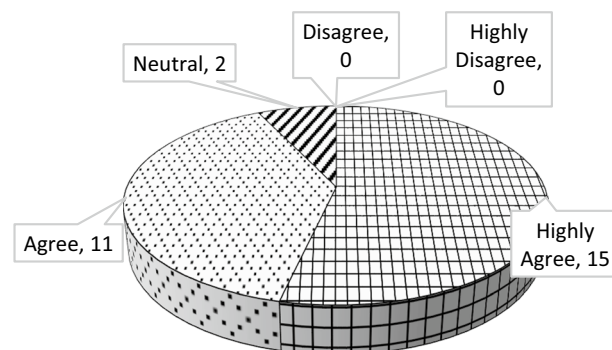
Organizational factors

Out of 58 total factors identified during literature review, 28 fell under this category. Figure 4 and Table 3 present the results obtained from the survey interviews.

The factors listed in Table 3 have been arranged in the order of the highest to the lowest preference, as selected by the respondents. It is clearly evident from results that the respondents were mostly in agreement with the factors obtained through literature. There are a few factors that received disagreement as well, but the overall percentage of disagreement is quite low. The highest disagreement was received for the factor, 'Firm experience with innovation' for which 31% of the respondents 'Disagreed' and 25% 'Highly Disagreed', whereas for 'Financial strength/stability' 6% have 'Disagreed' and 13%

Table 3 Survey results in percentage of response related to organizational factors

| | Highly agree (%) | Agree (%) | Neutral (%) | Disagree (%) | Highly disagree (%) |
|--|------------------|-----------|-------------|--------------|---------------------|
| Culture | 88 | 13 | 0 | 0 | 0 |
| Futuristic approach | 88 | 13 | 0 | 0 | 0 |
| Decision-making | 88 | 13 | 0 | 0 | 0 |
| Leadership | 75 | 25 | 0 | 0 | 0 |
| Strategy | 63 | 38 | 0 | 0 | 0 |
| Innovation in all of value chain | 50 | 25 | 25 | 0 | 0 |
| System and tools, techniques | 50 | 25 | 25 | 0 | 0 |
| Processes | 44 | 56 | 0 | 0 | 0 |
| Collaboration and cooperation of R&D team with other teams | 38 | 19 | 6 | 13 | 0 |
| Organization structure | 31 | 50 | 19 | 0 | 0 |
| Technology usage/technology focus | 31 | 50 | 0 | 19 | 0 |
| Knowledge repository | 31 | 19 | 50 | 0 | 0 |
| Portfolio management | 25 | 25 | 25 | 25 | 0 |
| Change readiness | 25 | 75 | 0 | 0 | 0 |
| R&D | 25 | 75 | 0 | 0 | 0 |
| Training and development (learning) | 25 | 75 | 0 | 0 | 0 |
| People skills and knowledge esp. characteristics/nature of R&D team and size of R&D team | 25 | 50 | 25 | 0 | 0 |
| R&D Intensity/R&D expenditure | 25 | 0 | 50 | 25 | 0 |
| Financial strength/stability | 25 | 31 | 25 | 6 | 13 |
| Idea generation | 25 | 75 | 0 | 0 | 0 |
| Incentives for innovative employees | 25 | 50 | 25 | 0 | 0 |
| HR Management | 13 | 88 | 6 | 0 | 0 |
| Firm experience with innovation | 0 | 25 | 19 | 31 | 25 |
| Process structuring | 0 | 75 | 25 | 0 | 0 |
| Resource allocation | 0 | 50 | 50 | 0 | 0 |
| Government support | 0 | 25 | 50 | 0 | 25 |
| Knowledge management (KM) in general | 0 | 50 | 25 | 25 | 0 |
| Information flows (mechanism of flow of knowledge) | 0 | 75 | 25 | 0 | 0 |

**Fig. 5** Survey response of organizational factors by Pakistani ICT professionals

‘Highly Disagreed.’ Another factor that received disagreement is ‘Government Support’ to which none ‘Disagreed’ but 25% respondents ‘Highly Disagreed’.

Figure 5 shows summarized results of the organizational factors that were obtained after carrying out weighted mean analysis on the results presented in Table 3. In Fig. 5, it is clearly evident that out of 28 organizational factors, the respondents ‘Highly Agreed’ with 15 factors, ‘Agreed’ with 11 factors and showed neutral response to 2 factors. This figure shows that none of the factors were ‘Disagreed’ or ‘Highly Disagreed’, whereas in Table 3, there are some factors that showed low percentage of disagreement. This difference is due to the fact that though some factors were being disagreed upon, but at the same time for the same factor, some respondents had either Agreed, Highly Agreed or showed neutral response. Due to these responses, when the weighted mean was applied, the already low impact of disagreement was nullified.

Product/project factors

Out of 58 total factors identified during literature review, 16 factors are categorized as related to either the Product that the organization develops, or the project in which it is involved. Figure 6 and Table 4 present the results obtained through the survey interview responses related to this category.

The factors listed in Table 4 have been arranged in order of the highest to the lowest preference, as selected by the respondents. In this category, it is again evident that the respondents were in agreement with most of the factors. The respondents did not ‘Highly Disagree’ to any of the factor. However, 19% ‘Disagreed’ to the factor “Complementarity”. Here, the term ‘Complementarity’ is referred to as a ‘project’s compatibility with firm’s core competences and available resources’. Other factor where the respondents showed a lower degree of disagreement are; ‘Tools & Process (invest time & effort) to evaluate projects’ (like; measurement tools for performance, quality, etc.), ‘Price’ (of the product or the overall project cost), ‘Technological advancement’.

After applying weighted mean on this group of factors, the summarized results are presented in Fig. 7. In this group of factors, even better results are achieved as compared to the previous group. Here, out of 16 factors the respondents have shown agreement to 8 factors and were ‘Highly Agreed’ with 8 factors. The respondents did not select any

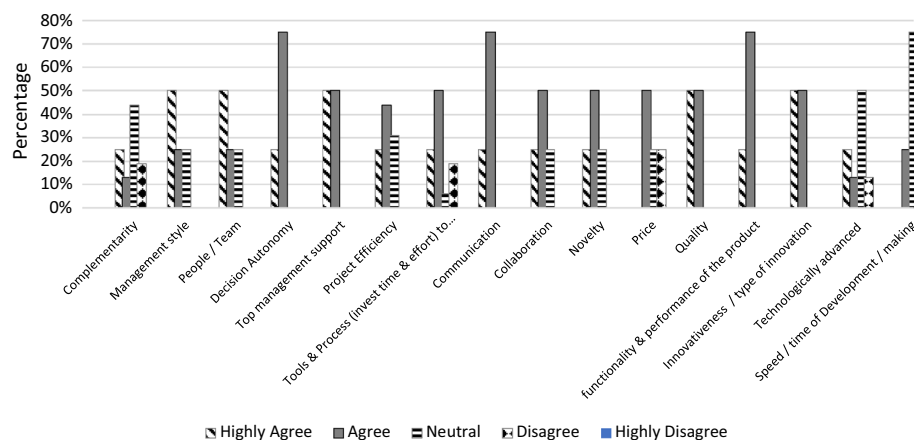
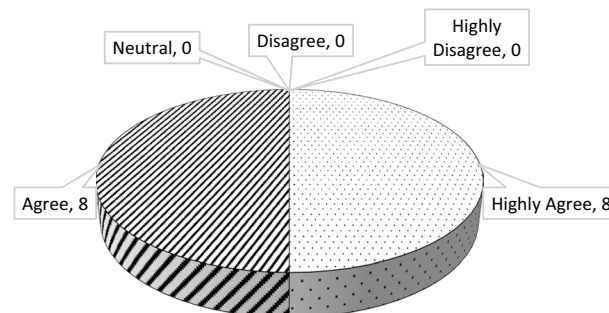


Fig. 6 Survey results related to product/project factors

Table 4 Survey results in percentage of response related to product/project-related factors

| | Highly agree (%) | Agree (%) | Neutral (%) | Disagree (%) | Highly disagree (%) |
|---|------------------|-----------|-------------|--------------|---------------------|
| Management style | 50 | 25 | 25 | 0 | 0 |
| People/team | 50 | 25 | 25 | 0 | 0 |
| Top management support | 50 | 50 | 0 | 0 | 0 |
| Quality | 50 | 50 | 0 | 0 | 0 |
| Innovativeness/type of innovation | 50 | 50 | 0 | 0 | 0 |
| Complementarity | 25 | 13 | 44 | 19 | 0 |
| Decision autonomy | 25 | 75 | 0 | 0 | 0 |
| Project deficiency | 25 | 44 | 31 | 0 | 0 |
| Tools and process (invest time and effort) to evaluate projects | 25 | 50 | 6 | 19 | 0 |
| Communication | 25 | 75 | 0 | 0 | 0 |
| Collaboration | 25 | 50 | 25 | 0 | 0 |
| Novelty | 25 | 50 | 25 | 0 | 0 |
| Functionality and performance of the product | 25 | 75 | 0 | 0 | 0 |
| Technologically advanced | 25 | 13 | 50 | 13 | 0 |
| Price | 0 | 50 | 25 | 25 | 0 |
| Speed/time of development/making | 0 | 25 | 75 | 0 | 0 |

**Fig. 7** Survey response of product/project factors by Pakistani ICT professionals

factor as 'Disagreed', 'Highly Disagreed' or 'Neutral', whereas in Table 4 it is clearly visible that the respondents had selected these options as well. As discussed earlier, the difference is due to the fact that though some factors were being disagreed upon, but at the same time there were some respondents who had either Agreed, Highly Agreed or showed neutral response. Due to this pattern of responses, when the weighted mean was applied the low impact of disagreement got nullified.

Market factors

Out of 58 total factors identified during literature review, 14 fell under market-related factors category. Figure 8 and Table 5 present the results obtained through the survey interviews.

The factors listed in Table 5 have been arranged in order of the highest to the lowest preference, as selected by the respondents. It is evident from results that

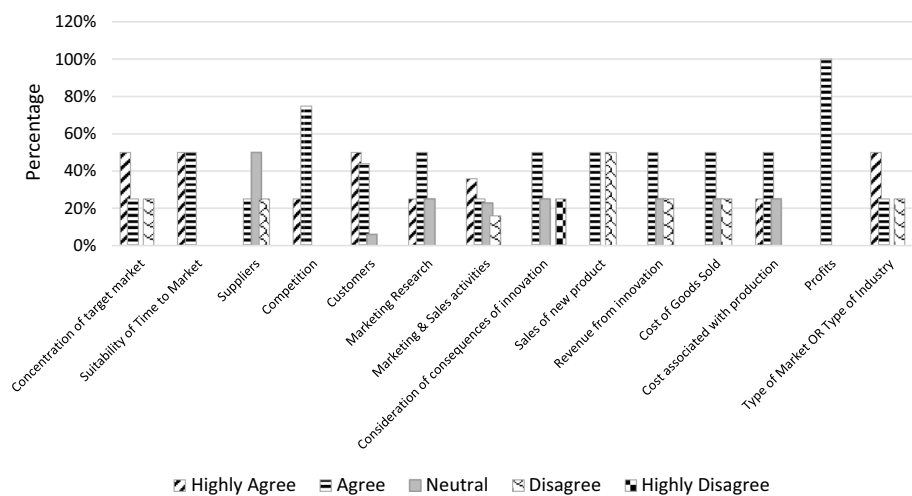


Fig. 8 Survey results related to market factors

Table 5 Survey results in percentage of response related to market-related factors

| | Highly agree (%) | Agree (%) | Neutral (%) | Disagree (%) | Highly disagree (%) |
|---|------------------|-----------|-------------|--------------|---------------------|
| Concentration of target market | 50 | 25 | 0 | 25 | 0 |
| Suitability of time to market | 50 | 50 | 0 | 0 | 0 |
| Customers | 50 | 44 | 6 | 0 | 0 |
| Type of market or type of industry | 50 | 25 | 0 | 25 | 0 |
| Marketing and sales activities | 36 | 25 | 23 | 16 | 0 |
| Competition | 25 | 75 | 0 | 0 | 0 |
| Marketing research | 25 | 50 | 25 | 0 | 0 |
| Cost associated with production | 25 | 50 | 25 | 0 | 0 |
| Suppliers | 0 | 25 | 50 | 25 | 0 |
| Consideration of consequences of innovation | 0 | 50 | 25 | 0 | 25 |
| Sales of new product | 0 | 50 | 0 | 50 | 0 |
| Revenue from innovation | 0 | 50 | 25 | 25 | 0 |
| Cost of goods sold (COGS) | 0 | 50 | 25 | 25 | 0 |
| Profits | 0 | 100 | 0 | 0 | 0 |

the respondents are mostly in agreement with the market-related factors obtained through literature. There is only one factor, ‘consideration of consequences of innovation’ for which the some respondents have ‘Highly Disagreed’ for having impact on innovation. On the other hand, some respondents have shown agreement to the same factor. Similarly, some respondents have also ‘Disagreed’ for certain factors like ‘Concentration of target market’, ‘Suppliers’, ‘Marketing & Sales activities’, ‘Revenue from innovation’, and ‘Cost of Goods Sold (COGS)’, but such respondents are in a lower proportion. It is also observed from the data that ‘Sales of new product’ is a factor that received a higher percentage (50%) disagreement, but on the other hand the same factor received 50% agreement as well.

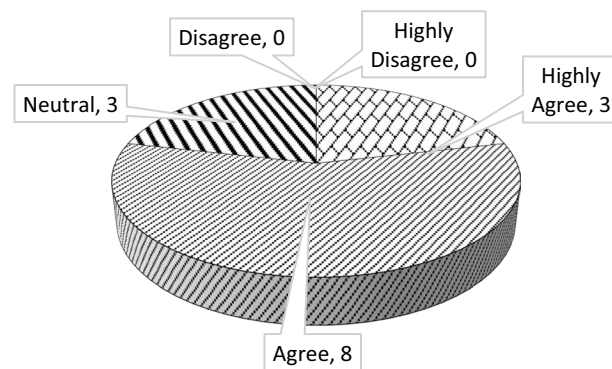


Fig. 9 Survey response of market factors by Pakistani ICT professionals



Fig. 10 Proposed innovation management framework (IMF)

Summarized results of the market factors after applying weighted mean analysis on the results are shown in Fig. 9. This figure indicates that the respondents have ‘Highly Agreed’ to 3 factors, ‘Agreed’ to 8 factors and selected ‘Neutral’ for 3 factors. It has also been found that none of the factors turned out to be ‘Disagreed’ or ‘Highly Disagreed’.

Proposed framework

Based on the literature survey and survey interviews of the ICT professionals based in Pakistan, we present a framework illustrating the major factors that impact innovation. The innovation management framework (IMF) is illustrated in Fig. 10.

The framework presented in Fig. 10 shows 13 factors divided into 3 categories that were either ‘Agreed’ or ‘Highly Agreed’ by the respondents and found to be the most relevant for the innovation management at ICT sector of Pakistan. These factors were also treated as ‘Strong Factors’ based on the literature review as previously discussed.

As noted by van der Panne et al. (2003), the professionals often select the innovation factors based on their previous experience with the innovation at their organizations. Hence, while managing innovation specifically in Pakistan the factors detailed in Fig. 10 need to be taken care of.

For the organizational factors it has been found that the professionals value strategy, culture, leadership, technology usage/focus, training and development, system tools/techniques and idea generation. From these factors it has been evident that professional perceive that innovation is only possible when they are provided with the healthy workplace environment and culture. The management should focus on developing innovative strategies where there is enough room for the employees to generate and practice new ideas. The employees should be provided with an opportunity to use advanced technology, systems, tools and techniques so they may experiment in order to validate and improve the most innovative ideas. Furthermore, the visionary leadership along with the satisfactory level of training and development opportunities must also be available in order to improve the innovativeness level of the ICT sector at Pakistan.

The second category of factors illustrated in Fig. 10 is project/product factors. In this part of the framework, we included the factors of management style, people/team, top management support, communication and quality. This category reveals that majority of the professionals believe that they could only achieve innovation when they are provided with effective management style. Clearly, the projects can only be smoothly executed when the teamwork is encouraged throughout the project lifecycle. Likewise, the communication between the team members as well as the team members and management has also been regarded as a key factor for boosting innovation. The innovation here relates to the communication and the relationship between team members and with management because when people are allowed to share their ideas openly, there would be increased chances of conceiving novel product and project ideas. On the other hand, in case the management is not willing to change or if it does not allow the employees to bring their expert opinion on the table, it is highly likely that such organization will only continue with their past practices and would not be able to innovate at a large scale. Only when people are encouraged to share their novel ideas and suggestions with everyone in the team and relevant management stakeholders, it will be possible to innovate.

Finally, only single factor, 'suitability of time to market' has been included under the category of market factors. This factor relates to the market and consumers readiness/acceptance for the innovative product/service being launched. This factor is particularly relevant for the technology sector of the underdeveloped countries as customers are not aware/ready to adopt new tools and technologies initially. Therefore, if the product/service is based on a significantly new concept, even then it could fail if suitable time to market is not considered,

The IMF, overall presents an insight into the present trends and perceptions of the professionals working in the ICT sector. In future, it is expected that this framework will be enhanced as more factors will be included with the increasing awareness and knowledge about technology, innovation and entrepreneurship at Pakistan.

Discussion and implications

Innovation has been a subject of debate among researchers for the past few decades. Joseph Schumpeter is one of the pioneer researchers in this area, and his work on innovation and its impact on economic growth are highly cited by researchers (Sweezy, 1943). Though Schumpeter was mainly an economist, he was interested in the role of an entrepreneur in economic growth and considered an entrepreneur as an innovator (McDaniel, 2005). Schumpeter also considered entrepreneurship and innovation as the driving force for the growth of an organization (Hagedoorn, 1996). Another ingredient that plays a vital role for economies and firms is 'Technology'. Bringing out new and innovative products into the market with technology being the core ingredient helps in organizational growth and sustainability (Sood & Tellis, 2005). In this context, entrepreneurs who work in the technology industry play a central role in technological advancement and improving the innovativeness of economies.

The focus of this research is to identify the most prominent factors that impact innovation at the ICT sector of Pakistan. The research has been conducted by carrying out a thorough literature review followed by survey and analysis of the findings.

From the findings, it is observed that all the respondents agreed that innovation is taking place in Pakistan. However, the respondents also believed that high-end or totally new ideas are not emerging from the country, rather the ideas are either imitative or inspired from those which have already implemented in other countries. However, it has been found that in many cases, instead of totally imitating the ideas, organizations tweak the ideas according to their own environment or they at least add some required feature on top of it. So, creative mindset definitely exists at the ICT sector of Pakistan, but totally out of the box ideas is quite rare in the country.

With the established fact that innovation is taking place and its rate is also gradually improving in Pakistan, the next step ahead is to take measures to accelerate innovation. In order to improve the pace of innovation at any country one of the best routes is to identify the sources of innovation. Firms serves as a major source and another source is the universities, with government playing the monitoring and funding role (Etzkowitz, 2003). For this research, the author has focused at the organizational level and studied factors impacting innovation. Focusing on the ICT industry, this study has made efforts to study the innovation status in terms of the contributing factors at organizational level within the ICT industry of Pakistan.

Past literature highlights the fact that innovation acts as a vital factor for economic growth but at the same time, it is also suggested that measuring the innovativeness capability of organizations to manage innovation is extremely difficult. Many efforts have been made by past researchers and organizations to define indicators for measuring innovation. However, no comprehensive model for measuring innovation could yet be developed. Some reasons attributed to this issue include technological diversity among different industries or dynamicity of technological innovations. Literature also reveals that innovation-related published research knowledge is not consistent with the actual practices in industry. There is a gap between the perception of innovation among researchers and practicing community (Tidd, 2001), whereas some researchers are of the view that the focus of research on innovation has diverted in the recent few years (Fernandes Rodrigues Alves et al., 2018). Adam et al. (2006) suggest that current innovation

management models do not much focus on innovation measurement and even if they do, there are many variations. Though some similarities do exist among these models, they are to a limited degree.

To address this issue the author through this research has made efforts to study innovation management in depth and focused the study on a particular industry in a specific country. The research focused on studying innovation management in ICT organizations operating in Pakistan. Having a focused approach would further help in defining better innovation management strategies for targeted industries/countries. As there are many aspect to innovation management practices and studying all would be quite a lengthy process. Therefore, this paper focused only on identifying factors that directly or indirectly impact innovation. Once these factors are identified, for a specific industry, better management techniques and models could be defined.

Although most responses from ICT professionals are in agreement with the previous literature for most of the factors impacting innovation, there are a few factors where disagreement is observed. Firstly, 'Firm experience with innovation' is a factor that the ICT professionals were not much in agreement. A major reason for this disagreement is that in Pakistan, the ICT industry is quite new and is progressing at a rapid pace. Most of the organizations are relatively new in this sector and they have been in operation for 10–12 years, whereas a large number of organizations are even newer than this. There are only few organizations that are in operation for more than 15 years. Therefore, most of the organizations do not have past experience of breakthrough innovations, but they have now been involved in innovative projects. Van der Panne et al. (2003) are of the view that organizations' previous experience with innovation indicates their technological capabilities and skills that are required for initiating and carrying out innovative projects. In order to innovate, organizations need to capitalize on their experiences and involve themselves in innovative projects that are aligned with their organizational skills (Bessant, 1993). An organization's previous experience with innovations develops organizational expertise, and this in turn has an impact on reduction of time to market the innovation (Wind & Mahajan, 1988).

Secondly, researchers in literature endorse governments' role in promoting innovation, but the Pakistani ICT professionals did not rate this factor high. One of the reasons might be unstable situations at the governmental level due to which business professionals have lost confidence in governmental policies. Government plays an important role in shaping the innovativeness level of economies. Government policies should be shaped in such a way that they provide a conducive environment for business to flourish and provide opportunities for new entrepreneurs to enter the market. This business environment would allow organizations to operate at ease and bring in new innovations (Aidis, 2003). Government can play a strong supporting role in the growth of entrepreneurs and business organizations (Esmaeeli, 2011). For the growth of entrepreneurs bringing in innovations, the government can take actions like providing help at pre-seed level for either the prototype development of their innovations and also further support their steps towards commercialization of the invention. Government can also promote education to train entrepreneurs bring in innovations to the market specially technology entrepreneurs (Pei et al., 2010). On the brighter side, in the data presented by Global

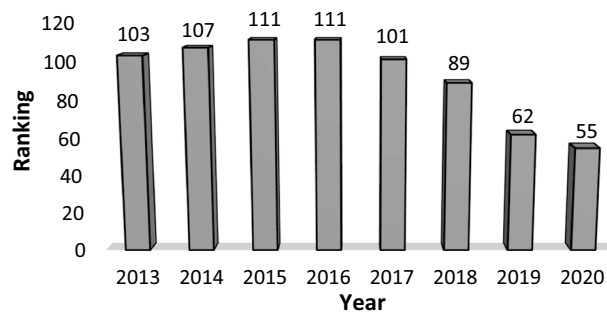


Fig. 11 Global ranking of Pakistan in terms of business environment (Global Innovation Index, 2019, 2020)

Innovation Index, as shown in Fig. 11, Pakistan's ranking in terms of Business Environment has improved quite well in 2018 and 2019, which is a positive sign.

Literature suggests that 'suppliers' play an important role for innovativeness level of an organization. According to Rothwell's (1994), the fourth generation of models focus on linkages/alliances and particularly emphasizes on integration within firm, its suppliers & customers. Cohn (2013) in their innovation management framework have included 'suppliers' as one of the parameters for assessment of innovation. On the other hand, the Pakistani ICT professionals did not give 'supplier' a higher rank as a factor that impacts innovation. The rationale behind this disagreement is that the innovations taking place at Pakistani ICT organizations are not of significant novelty. Moreover, most ICT organizations are not yet involved in high-end innovations for which they may need to involve suppliers in the projects. This is a major reason why most professionals, did not ranked suppliers higher. However, a small number of professionals agreed with the fact that suppliers are one of the factors that impact innovations. Such professionals, belong to those few organizations which are involved in R&D projects and have some high-end projects being executed due to which they realize the importance of suppliers.

"Sales of new product" is yet another factor where almost fifty percent of the ICT professionals disagreed to have impact on innovation but fifty percent respondents also agreed to it. These results clearly indicate that organizations who are not yet at a level of high-end innovations would not foresee this factor impacting innovation, whereas organizations that are involved in innovation have agreed for this factor to impact innovation. Anthony (2013) considers profits from sales of new products or services as an important factor that impacts innovation. In his model of innovation measurement, it is suggested that return on innovation investment can be measured by comparing the profits from sales of new products or services to various expenditures occurred while producing them. Mihola et al. (2015) in their method of evaluating firm-level innovation, considered cost, revenue and profits as basic parameter for innovation and suggested to measure firms innovativeness by applying time series analysis of these parameters.

Finally, it has been observed through this study that there is significant agreement between the published literature and the actual perceptions of ICT professionals about factors impacting innovation at organizational level. This interesting finding indicates that if the perceptions about impacting factors are similar, then the reasons for low performance on innovativeness level in Pakistan might be due to other reasons. These areas

could be external to organizations like, public or private infrastructures, governmental policies, quality of other organizations in industry, or level of knowledge workers available or any other factors (Omar, 2019).

At present, there is a need to study the performance of organization in terms of how well they manage the factors proposed in the IMF presented in this paper. This will in turn reflect a better understanding of the low performance of innovativeness in organizations. In fact, a serious involvement and commitment of higher management/leadership in driving innovation in the organization and developing the right strategies and policies from top down is the key to success (Adegbile et al., 2017). The need for organizations is to apply appropriate innovation management techniques that are suitable for their organization. Such innovation management techniques would influence the innovation performance of firms and would have a definite positive impact on the firm's innovation outputs (Albors-Garrigos et al., 2018). For the organizations in underdeveloped countries, based on the factors identified in this research, certain recommendations are prescribed for better management of innovation within their organization and improve their innovativeness level.

Conclusion and future works

In this paper, we presented a comprehensive innovation management framework (IMF) with a specific focus at ICT sector of Pakistan. We conducted a detailed literature review to evaluate the process and types of innovation along with the famous innovation models as developed by previous authors. Subsequently, we conducted survey interviews of senior professionals from ICT sector of Pakistan to identify their perceptions about the factors that impact innovation at their organization. Subsequently, we compared the findings of survey interviews against the previous literature to identify the most prevalent factors for the ICT sector of Pakistan. Finally, we developed the framework highlighting the innovation management factors related to organization, project/product, and market. It has been observed that the factors identified by the professionals in Pakistan are well aligned with those previously proposed by the prominent researchers working in the area of innovation management. The framework developed in this study shall not only offer guidance to the ICT managers in Pakistan, but also to those willing to innovate at other underdeveloped countries.

In future, the present work can be extended in several directions. Firstly, the focus of the present study is only on the ICT sector. In future, similar studies can also be conducted for other technological sectors of Pakistan. A comparison can then be conducted to identify the similarities and differences between the perceptions of professionals belonging from different sectors, which would result in enhancing the framework presented in this work. Secondly, the study can also be updated for other underdeveloped and developing countries; this would help the researchers and managers to incorporate the demographic and cultural differences while designing the innovation management strategies.

Abbreviations

| | |
|-----|--------------------------------------|
| ICT | Information Communication Technology |
| IMF | Innovation Management Framework |
| GNI | Gross National Income |

| | |
|------|--|
| GII | Global Innovation Index |
| RPV | Resources, Processes and Values Model |
| OECD | Organisation for Economic Co-operation and Development |
| ICM | Innovation Capability Maturity |
| InnC | Innovation capital |
| IM | Innovation Maturity Model |
| IMM | Innovation Management Maturity Model |
| TIM | Total Innovation Management Model |
| KM | Knowledge management |
| COGS | Cost of goods sold |

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Author contributions

All authors read and approved the final manuscript. This paper is co-authored and is a joint effort of three authors. This paper is developed based on PhD research where the first author EA is the PhD candidate, whereas IA is the internal supervisor and SS is external advisor. So in this case the guidance and direction for research was provided by IA. Further, throughout the research they provided input wherever needed. Further, the manuscript was also evaluated by the SS. Whereas EA carried out the research work and manuscript development in IA and SS supervision. All the authors agree to be personally accountable for this contribution.

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Availability of data and materials

All relevant data are presented in the paper. However, any details regarding the datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests

The authors declare that they have no competing interests.

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References

- Adams, R., Bessant, J., Adams, R., Bessant, J., & Phelps, R. (2006). Innovation management measurement: A review. *International Journal of Management Reviews*, 8(1), 21–47. <https://doi.org/10.1111/j.1468-2370.2006.00119.x>
- Adams, R., Jeanrenaud, S., Bessant, J., Denyer, D., & Overy, P. (2015). Sustainability-oriented Innovation: A Systematic Review. *International Journal of Management Reviews*, 18(2), 180–205. <https://doi.org/10.1111/ijmr.12068>
- Adegbile, A., Sarpong, D., & Meissner, D. (2017). Strategic foresight for innovation management: A review and research agenda. *International Journal of Innovation and Technology Management*, 14(4), 1750019. <https://doi.org/10.1142/S0219877017500195>
- Aidis, R. (2003). *Entrepreneurship and Economic Transition* (No. 03–015/2).
- Albors-Garrigos, J., Igartua, J. I., & Peiro, A. (2018). Innovation management techniques and tools: Its impact on firm innovation performance. *International Journal of Innovation Management*, 22(6), 1850051. <https://doi.org/10.1142/S1363919618500512>
- Anthony, S. (2013). *How to really measure a company's innovation prowess*. HBR Blog Network.
- Barnett, H. G. (1953). *Innovation: The basis of cultural change*. McGraw-Hill.
- Berg, R. (2013). *The innovation maturity model*. <http://bergconsulting.com.au>
- Berkhout, A. J., Hartmann, D., Van Der Duin, P., & Ortt, R. (2006). Innovating the innovation process. *International Journal of Technology Management*, 34(3/4), 390. <https://doi.org/10.1504/IJTM.2006.009466>
- Bessant, J. (1993). The lessons of failure: Learning to manage new manufacturing technology. *International Journal of Technology Management*, 8(2), 197–215.
- Brem, A., & Voigt, K. I. (2007). Innovation management in emerging technology ventures - The concept of an integrated idea management. *International Journal of Technology, Policy and Management*, 7(3), 304–321. <https://doi.org/10.1504/IJTPM.2007.015113>
- Brem, A., & Voigt, K. I. (2009). Integration of market pull and technology push in the corporate front end and innovation management-Insights from the German software industry. *Technovation*, 29(5), 351–367. <https://doi.org/10.1016/j.technovation.2008.06.003>
- Burton-Jones, A. (2001). *Knowledge capitalism—business, work, and learning in the new economy*. Oxford University Press.
- Chesbrough, H. W. (2003). Era of Open Innovation. *MIT Sloan Management Review*. <https://doi.org/10.1371/journal.pone.0015090>
- Chesbrough, H. W. (2006). *Open innovation: The new imperative for creating and profiting from technology*. Harvard Business Press.
- Christensen, C. M. (2006). The ongoing process of building a theory of disruption. *Journal of Product Innovation Management*, 23(1), 39–55. <https://doi.org/10.1111/j.1540-5885.2005.00180.x>

- Christensen, C. M., Anthony, S. D., & Roth, E. A. (2004). *Seeing what's next: Using the theories of innovation to predict industry change*. Harvard Business Press.
- Christensen, C. M., & Overdorf, M. (2000). Meeting the challenge of disruptive change. *Harvard Business Review*. <https://doi.org/10.1002/rwm3.20019>
- Cohn, S. (2013). a firm-level innovation management framework and assessment tool for increasing competitiveness. *Technology Innovation Management Review*, October, 6–15. <http://timreview.ca/article/731>
- Competitiveness, E. (2020). *Pakistan economic policy for export competitiveness*. 1–62.
- Cooper, R. G. (1983). A process model for industrial new product development. *IEEE Transactions on Engineering Management*, 30(1), 2–11. <https://doi.org/10.1109/TEM.1983.6448637>
- Cooper, R. G. (1990). Stage-Gate systems: a new tool for managing new products. *Business Horizons*, 33(3), 44–54. [https://doi.org/10.1016/0007-6813\(90\)90040-I](https://doi.org/10.1016/0007-6813(90)90040-I)
- Cooper, R. (2008). Perspective: The Stage-Gate idea to launch process—Update, what's new and nexgen systems. *Journal of Product Innovation Management*, 25(3), 213–232. <https://doi.org/10.1111/j.1540-5885.2008.00296.x>
- Coopers, R. G., & Kleinschmidt, E. J. (1995). Benchmarking the firm's critical success factors in new product development. *Journal of Product Innovation Management*, 12(5), 374–391.
- Crossan, M. M., & Apaydin, M. (2010). A multi-dimensional framework of organizational innovation: A systematic review of the literature. *Journal of Management Studies*, 47(6), 1154–1191. <https://doi.org/10.1111/j.1467-6486.2009.00880.x>
- Dodgson, M., & Rothwell, R. (1995). *The handbook of industrial innovation*. Edward Elgar. <https://doi.org/10.4337/9781781954201>
- Drucker, P. F. (1985). *Innovation and Entrepreneurship*. <https://doi.org/10.2307/3101027>
- Drucker, P. F., & Noel, J. L. (1986). Innovation and entrepreneurship: Practices and principles. *Journal of Continuing Higher Education*, 34(1), 22–23. <https://doi.org/10.1080/07377366.1986.10401060>
- Du Preez, N. D., & Louw, L. (2008). A framework for managing the innovation process. *PICMET: Portland International Center for Management of Engineering and Technology, Proceedings, August*, 546–558. <https://doi.org/10.1109/PICMET.2008.4599663>
- Dutta, S. (2015). The Global Innovation Index 2015. In *Stronger Innovation Linkages for*. 978-2-9522210-8-5
- Esmaeli, H. (2011). The study of effecting factors on digital entrepreneurship. *Interdisciplinary Journal of Contemporary Research in Business*, 12(2), 163–172.
- Essmann, H., & Preez, N. (2010). An innovation capability maturity model—development and initial application. *International Journal of Human and Social Sciences*, 5(1), 44–55. <https://doi.org/10.1142/S1363919611003696>
- Etzkowitz, H. (2003). Innovation in innovation: The Triple Helix of university-industry-government relations. *Social Science Information*, 42(3), 293–337. <https://doi.org/10.1177/05390184030423002>
- Fernandes Rodrigues Alves, M., Vasconcelos Ribeiro Galina, S., & Dobelin, S. (2018). Literature on organizational innovation: past and future. *Innovation & Management Review*, 15(1), 2–19. <https://doi.org/10.1108/inmr-01-2018-001>
- Freeman, C. (1987). *Technology policy and economic performance: lessons from Japan*. Frances Pinter Publishers.
- Global Innovation Index. (2019). *Global Innovation Index 2019: summary*. <https://www.globalinnovationindex.org/gii-2016-report#>
- Global Innovation Index. (2020). *Global Innovation Index 2020*. In S. W.-V. Soumitra Dutta, Bruno Lanvin (Ed.), *Organización Mundial de la Propiedad Intelectual*. WIPO. https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2020.pdf
- Golovatchev, J., Budde, O., & Kellmerit, D. (2010). Technology and innovation radars: Effective instruments for the development of a sustainable innovation strategy and successful product launches. *International Journal of Innovation and Technology Management*, 7(3), 229–236. <https://doi.org/10.1142/S0219877010002008>
- Granstrand, O., & Holgersson, M. (2020). Innovation ecosystems: A conceptual review and a new definition. *Technovation*. <https://doi.org/10.1016/j.technovation.2019.102098>
- Hagedoorn, J. (1996). Innovation and entrepreneurship. Schumpeter revisited. *Industrial and Corporate Change*, 5(3), 883–896.
- Hajikarimi, A., Hamidzadeh, M. R., Jazani, N., & Hashemi, S. M. G. (2013). A comprehensive systemic model of innovation management: Total Innovation Management (TIM). *Interdisciplinary Journal of Contemporary Research in Business*, 4(9), 1078–1088.
- Hansen, M. T., & Birkinshaw, J. M. (2007). The Innovation Value Chain. *Harvard Business Review*, 85(6), 121–130.
- Hitt, M. A., Ireland, R. D., Camp, S. M., & Sexton, D. L. (2001). Strategic entrepreneurship: Entrepreneurial strategies for wealth creation. *Strategic Management Journal*, 22(6–7), 479–491. <https://doi.org/10.1002/smj.196>
- Hull, J. T., & F. M. (2003). Service Innovation: Organizational responses to technological opportunities and market imperatives. In *World Scientific Publishing Co. Pte. Ltd*
- Kaplan, S. (2013). *Measuring Innovation to Drive Business Growth*. Innovation Point. <http://www.innovation-point.com/innovationmetrics.htm>
- Keresztes, G., & Endresz, M. G. (2020). Innovation and models of innovation: A brief insight into the definition and different models of innovation. *Innovation*, 55(2), 53–55.
- Kijek, T. (2012). Innovation capital and its measurement. *Management and Innovation*, 4, 52–68.
- Kuratko, D. F., Ireland, R. D., Covin, J. G., & Hornsby, J. S. (2005). A Model of Middle-Level Managers' Entrepreneurial Behavior. *Entrepreneurship Theory and Practice*, 29(6), 699–716.
- Leifer, R., McDermott, C. M., O'Connor, G. C., Peters, L. S., Rice, M. P., & Veryzer, R. W., Jr. (2000). *Radical innovation: How mature companies can outsmart upstarts*. Harvard Business Press.
- McDaniel, B. A. (2005). A contemporary view of Joseph A. Schumpeter's theory of the entrepreneur. *Journal of Economic Issues*, 39(2), 485–489.
- Mihola, J., Wawrosz, P., & Kotěšovcová, J. (2015). Is the most innovative firm in the world really innovative. *International Advances in Economic Research*, 21(1), 41–54.
- Milbergs, E., & Vonortas, N. (2004). Innovation Metrics: Measurement to Insight. *Center for Accelerating Innovation and George Washington University*. <https://doi.org/10.1108/02580540910943550>
- Naualis, C. (2013). *A New Framework For Assessing Your Innovation Program: Introducing the Innovation Management Maturity Model by Planview*. 1–9.

- OCDE. (2005). Oslo Manual. In *OECD, Eurostat: Vol. Third edit* (3rd ed.). <https://doi.org/10.1787/9789264065659-es>
- Omar, N. S. (2019). Innovation and economic performance in MENA region. *Review of Economics and Political Science*, 4(2), 158–175. <https://doi.org/10.1108/revps-12-2018-0042>
- Ortt, J. R., & Van Der Duin, P. (2008). The evolution of innovation management towards contextual innovation. *European Journal of Innovation Management*, 11(4), 522–538. <https://doi.org/10.1108/14601060810911147>
- Pakistan Ministry of Information Technology. (2018). *Digital Pakistan Policy*. 1–28.
- Pei, L. K., Noordin, K. A., Ting, Y. P., & Baharudin, A. S. (2010). Failure factors of The Malaysian IT technopreneurship. *IEEE Explore, International Conference Science on Science and Social Research (CSSR)*, 686–690.
- Radnor, Z. J., & Noke, H. (2002). Innovation compass: A self-audit tool for the new product development process. *Creativity and Innovation Management*, 11(2), 122–132. <https://doi.org/10.1111/1467-8691.00244>
- Radnor, Z. J., & Noke, H. (2006). Development of an audit tool for product innovation: The innovation compass. *International Journal of Innovation Management*, 10(1), 1–18.
- Raza, H. (2018). ICT Businesses of Pakistan: An Ignored Sme Subsector. *Educational Research International*, 7(4), 1–11.
- Rothwell, R. (1994). Towards the Fifth-generation Innovation Process. In *International Marketing Review* (Vol. 11, Issue 1). <https://doi.org/10.1108/02651339410057491>
- Schuh, G., Lenders, M., & Hieber, S. (2011). Lean innovation-introducing value systems to product development. *International Journal of Innovation and Technology Management*, 8(1), 41–54. <https://doi.org/10.1142/S0219877011002192>
- Schumpeter, J. A. (1934). *The theory of economic development: An inquiry into profits, capital, credit, interest, and the business cycle*. London: Transaction publishers.
- Schumpeter, J. A. (1939). *Business cycles: A theoretical, historical, and statistical analysis of the capitalist process*. McGraw-Hill.
- Schumpeter, J. A. (1942). *Capitalism, Socialism and Democracy* (Vol. 11, Issue 41). Harper and Brothers. <https://doi.org/10.2307/2549943>
- Sood, A., & Tellis, G. J. (2005). Technological Evolution and Radical Innovation. *Journal of Marketing*, 69(3), 152–168. <https://doi.org/10.1509/jmkg.69.3.152.66361>
- Sweezy, P. M. (1943). Professor Schumpeter's theory of innovation. *The Review of Economic Statistics*, 93–96.
- Tidd, J. (2001). Innovation management in context: Environment, organization and performance. *International Journal of Management Reviews*, 3(3), 169–183. <https://doi.org/10.1111/1468-2370.00062>
- Tid, J., & Bessant, J. (2013). *Managing Innovation: Integrating Technological, Market & Organization* (5th ed.). Wiley.
- Tidd, J., & Bessant, J. R. (2020). *Managing innovation: integrating technological, market and organizational change*.
- Tiwari, R., Buse, S., & Herstatt, C. (2007). Innovation via global route: Proposing a reference model for chances and challenges of global innovation processes. *Technology*, 49, 451–465.
- United Nations. (2017). World Economic Situation and Prospects 2017. In *World Economic Situation and Prospects* <https://doi.org/10.1007/BF02929547>
- Utterback, J. M., & Afuah, A. N. (1998). The dynamic 'diamond': A technological innovation perspective. *Economics of Innovation and New Technology*, 6, 183–200.
- van der Panne, G., van der Beers, C., & Kleinknecht, A. (2003). Success and failure of innovation: A literature review. *International Journal of Innovation Management*, 7(3), 309–339. <https://doi.org/10.1142/S1363919603000830>
- Wind, Y., & Mahajan, V. (1988). New product development process: A perspective for reexamination. *Journal of Product Innovation Management*, 5(4), 304–310.
- World Bank. (n.d.). *World Bank Data for Pakistan*. <https://data.worldbank.org/country/pakistan>
- Wu, J., & Lu, W. (2011). An empirical research on the entrepreneurial risks in undergraduate entrepreneurship. *International Conference on E-Business and E-Government (ICEE)*.

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