

The Impact of Technological Disruption on Engineering Businesses

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<p>Article history Submitted: 20 October, 2021 Revised: 23 November, 2021 Accepted: 26 November 2021</p>	<p>Abstract This research presents the impact of technology disruption on small engineering and architecture businesses in Saudi Arabia. Usually, risks and challenges are the major causes of low productivity in these small engineering businesses. In fact, innovative and advanced technologies can help them to deal with such challenges correctly and professionally. The literature suggests that managing innovation and technological disruption is not an easy task for small engineering and architecture companies. This is due to, not having the proper technical infrastructure for accommodating changes and updates in technologies. In addition, not holding enough fund to establish and manage technological disruption. The researchers would interview 60 managers from different engineering and architecture companies mostly SME companies in this regard, and they would record their responses for further analysis. The sample are managers from various small and medium engineering (SME) companies in Saudi Arabia. The research concludes that, technological disruption helps small engineering and architecture businesses to improve their financial, functional, and marketing performance.</p>
<p>Keywords: <i>Technology, Entrepreneurship, Small business, Engineering and architecture companies, Enterprise, Innovation, Leadership.</i></p>	

1. Introduction

Changes in technologies disrupt the technical aspects of businesses. Innovation and technological advancements are part of every business, and they can have positive and negative impacts on small engineering and architecture businesses [1]. suggest that additive manufacturing (AM) is innovative production technology, and it is helping small businesses to upgrade their production strategies from manual processes to automatic processes. The study suggests that additive manufacturing (AM) positively impacts these businesses value-chains. In the same manner, in another study, [2] suggests that a strong business model is essential for businesses to accommodate disruptive technologies. They conclude that, transformational organizational culture is necessary for accommodating disruptive technologies as it can cause more harm if the corporate culture is not supporting them. Moreover, [3] states that emerging technologies are disruptive for businesses and governments.

The study's primary argument is that technological disruption positively impacts small businesses worldwide [4]. The primary reason behind this is that the latest innovative technologies can help small enterprises to shift their work from manual to automatic processes and this is the current trend in engineering and architectural fields. The significant advantage of this form of innovation is that it helps small businesses worldwide to improve their productivity. Risks or challenges are the major causes of low productivity in small engineering and architectural businesses, and innovations and advanced technologies can help them deal with such challenges correctly.

However, the essential thing in this regard is the implementation cost of technological disruption in small businesses. Disruptive technologies are costly, and their implementation cost is high. Therefore, it becomes a challenge for small businesses to implement these technologies due to limited resources and funds [5]. Similarly, their staff member's skills and abilities play an essential role in implementing and using advanced and innovative technologies. They need to train their staff members to handle technological disruption appropriately, which requires extra resources. It is the primary reason most small businesses worldwide do not implement the latest innovative technologies [6].

2. Literature Review

Bakhit [3] suggested that innovative and disruptive technologies play an essential role in dealing with challenges in Lebanon's mobile telecom industry in Lebanon. The study collects data from 60 employees of the two major telecom industries in Lebanon, namely, Alfa and Touch. The study results show that disruptive innovation has positive impacts on the mobile telecom industry. These technologies help improve the revenue of the mobile telecom industry in Lebanon [3].

In another study, [15] suggest that blockchain technology can disrupt already presented business models in small organizations. The study results show that innovative and advanced technologies like blockchain technology can lower transaction costs and most of its implications in businesses. Still, their implementation needs strong skills and abilities. Likewise, [7-8] suggest that the volatility, uncertainty, complexity, and ambiguity (VOCA) technique can help small businesses in dealing with their challenges or issues regarding technological disruption. Similarly, the author uses Gartner Hype Cycle in this context for dealing with technological turbulence caused by innovative and advanced technologies. In the same context of technology and its impact on engineering and architecture, [9] emphasized that blockchain system helped a lot in the development of construction and engineering management. Since the engineering field was suffering from difficulties in the field of information automation and sharing, technology contributed to the automation of engineering processes, and how to apply these techniques in the engineering and architecture field.

Nevertheless, the overall impact of technological disruption on small businesses is positive as it allows them to improve their production capacities and risk management process in the best manner. The most important thing in this regard is supply chain management for businesses. Most of the small businesses in the world face severe issues regarding their supply chains. Low supply chains can cause serious problems while managing technological disruption. Therefore, the study emphasizes the significant of improving supply chains in small businesses to get the best results.

This study's highlights the ignorance of considering the infrastructure requirements for implementing and managing technological disruption. Most previous studies suggest different business models and solutions for managing issues regarding technological disruption in the engineering field. Still, they lack information about infrastructure requirements in this regard. In simple words, they do not suggest that IT infrastructure is the most significant need or destiny for engineering business to implement technological disruption successfully.

Another significant gap in this regard is the lack of proper training to use and manage technological disruption on small businesses. Most of the small businesses in aim to implement innovative and advanced technologies. Still, they do not target their staff members' specific skills and abilities [10-17]. It is critical to accept that the latest machines cannot increase business's productivity. They cannot ensure innovation in their business process unless skilled and trained staff are existed to deal with their issues or challenges in the best manner. Therefore, staff training is important and thus staff members have to improve their technological disruption skills.

Moreover, technological disruption can cause severe issues for engineering businesses due to employee's restriction. It is the primary reason for including staff members in the decision-making process is to incorporate technological disruption in small engineering businesses. It would help them accommodate issues or challenges regarding technological disruption when their staff members would use their skills and abilities in full swing to make their organization successful. Additionally, technology plays an essential role in improving the efficiency of businesses worldwide. Inventory management is a central issue for small businesses around. Most businesses cannot manage their inventories effectively. It is the primary reason most of their resources are used to manage their inventories [18]. Therefore, technology can help organizations in this regard. One of the most significant advantages of technology is that it helps small businesses around in improving their inventory management systems. Database technology is playing an essential role in this context. Technology is helping businesses in creating or developing a useful database.

In another study, [19] state that cloud computing technologies help businesses worldwide to improve their performance using the internet. One significant advantage of technology in this context is that it helps small businesses to manage and store their data online. Using computers and other data-keeping devices is expensive, and it becomes challenging for organizations in the world to use these technologies. Therefore, cloud computing is the best solution as it is free of cost or less expensive. It helps businesses in storing their data using the internet, which is used by most of the engineering and architecture companies.

Moreover, in another study, [20-24] argue that powerful technologies can help businesses support their marketing sections. Every organization in the world wants to improve its marketing section. Therefore, advancement and innovation technologies can help engineering and architecture in this case. Technology has also helped in many other marketing operations, which has changed and developed significantly. It positively impacts marketing small and medium-sized companies and their growth. It is possible to increase development and continue marketing at the same time [24-28]. Furthermore, [29-33] state that technology has also influenced engineering education. It has contributed greatly to the development of science and its delivery tactics to others in easier and faster ways. In a way that free innovative technological tools to harness them for these organizations to develop education in the engineering field.

Moreover, in another study regarding the impact of digital security on engineering field. This is through providing strategic economic security for enterprises to provide developed methods to raise the technology capital level. As a result,

ensuring high level of security in strategic economic security in machine-building enterprises [34]. Even more, Armstrong and [35-40] explained that technology also intervened in architecture and developed many characteristics. One of the most prominent of these new technologies in the world of architecture is BIM, which explains the physiology, characteristics, and performance of the building. BIM also helps all engineering disciplines participating in the building with ease of management and handling, and many several things.

3. Methodology

The study would use a random sampling method for collecting primary data. The sample size of the study is 60 managers from various small and medium engineering and architecture companies. The researchers would interview managers from different SMEs in this regard, and they would record their responses for further analysis. The primary reason for using the random sampling method in this context is that the sample would not have any sort of age or gender discrimination. In simple words, both male and female managers from various small and medium engineering companies would be part of this study sample. In the same manner, the study would not specify the age limit of the respondents.

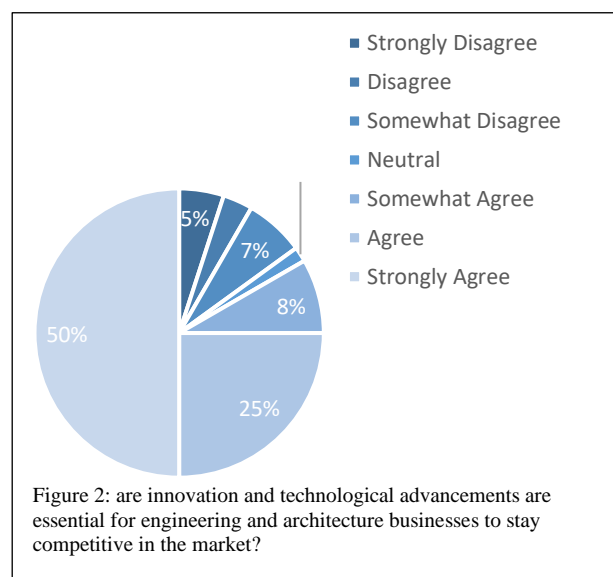
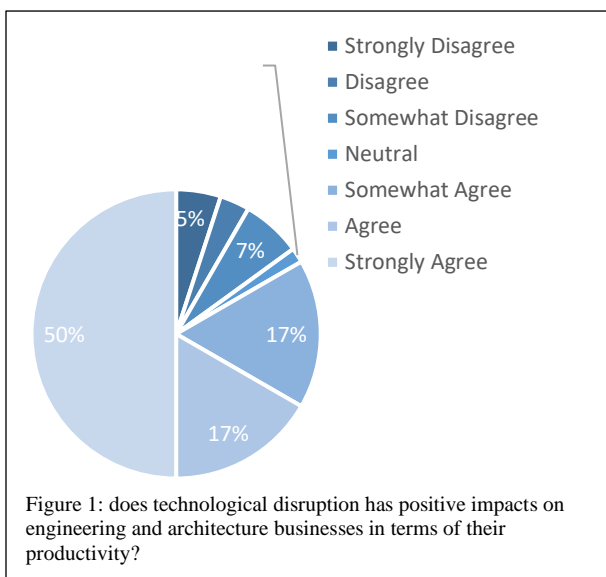
The researchers have used different methods for contacting respondents to collect their responses. The researchers cannot approach managers physically, therefore an email with the developed questionnaire was sent to each of the select managers from different small and medium-sized engineering companies. They would fill the questionnaire in their free time and return to the researchers with their responses. The researchers would collect the questionnaires and analyze the reactions in this context to draw valuable conclusion. The close-ended questionnaire includes 10 questions with Likert scale that allows respondents to select the option of their choice.

4. Results

This section includes the results of each question with an analysis of each case and presenting the relevant charts or graphs.

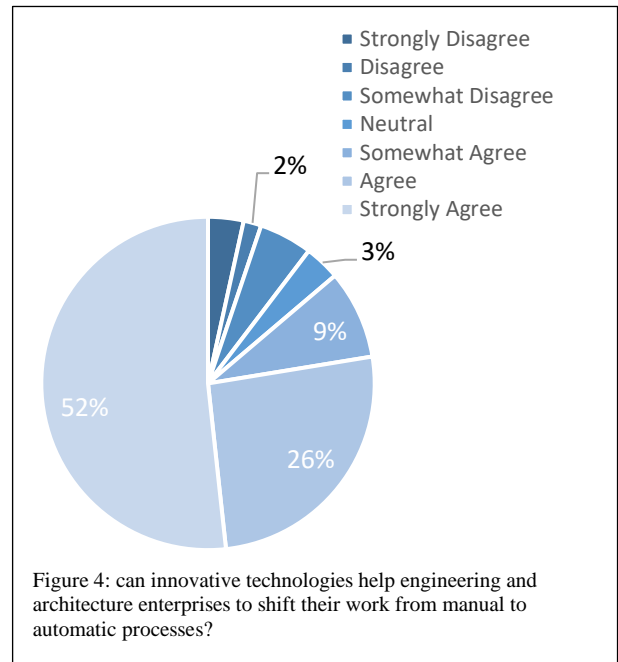
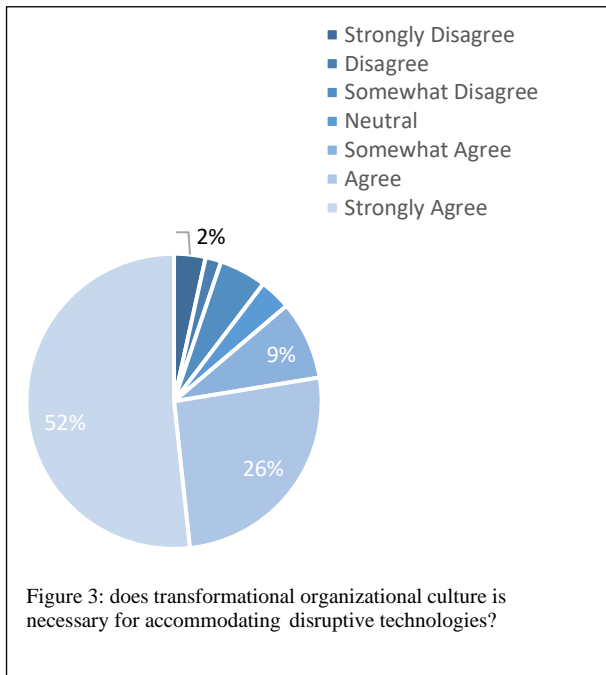
Question one asks, does technological disruption has positive impacts on engineering and architecture businesses in terms of their productivity? The result suggests that thirty out of sixty managers strongly agree that technological disruption has positive impacts on SMEs’ productivity. The graph shows that ten managers agree and other ten managers somewhat agree that technological disruption has positive impacts on engineering businesses in terms of their productivity. Only one manager is neutral, four respondents somewhat disagree, two disagree and three strongly disagree.

Question two asks, are innovation and technological advancements are essential for engineering and architecture businesses to stay competitive in the market? The result indicates that fifty percent of managers strongly agree that innovation and technological advancements are essential to compete in the market. The graph shows that fifteen managers agree whereas five respondents somewhat agree. However, one manager is neutral, four respondents somewhat disagree, only two managers disagree, and three strongly disagree.



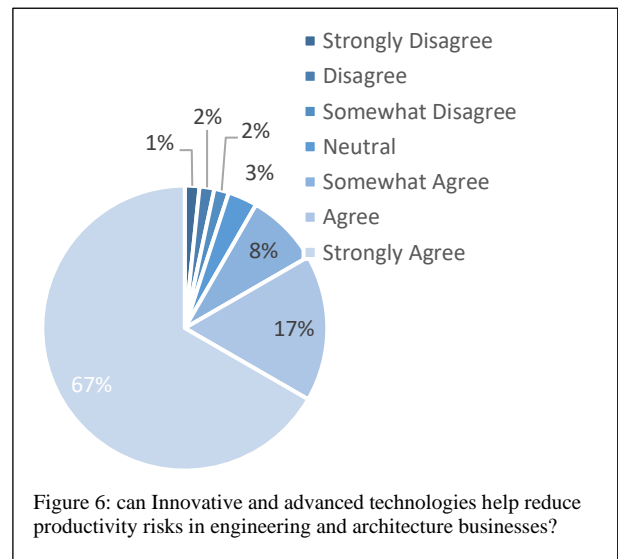
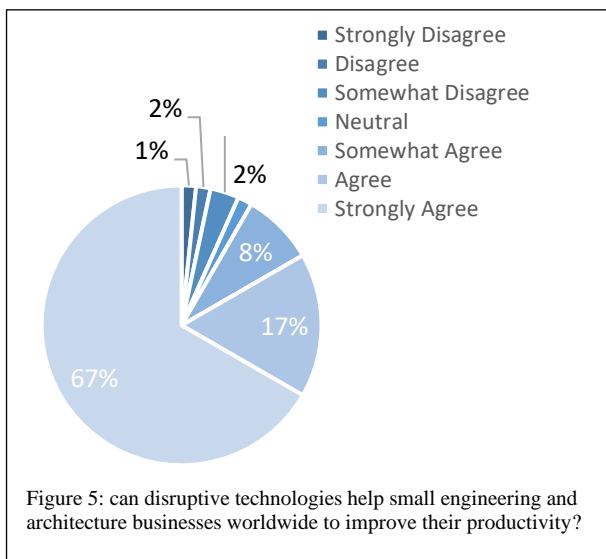
Question three asks, does transformational organizational culture is necessary for accommodating disruptive technologies? The result shows that fifty percent of managers strongly agree, and fifteen managers agree that the transformational organizational culture is necessary for accommodating disruptive technologies. Five respondents somewhat agree, two managers are neutral. Three respondents somewhat disagree, only one manager disagrees, and two respondents strongly disagree.

Question four asks, can innovative technologies help engineering and architecture enterprises to shift their work from manual to automatic processes? It can be seen that, thirty managers strongly agree, and fifteen managers agree that innovative technologies can help enterprises to shift their work from manual to automatic processes. Five respondents somewhat agree and two managers are neutral. Whereas, three respondents somewhat disagree, only one manager disagree, and two respondents strongly disagree.



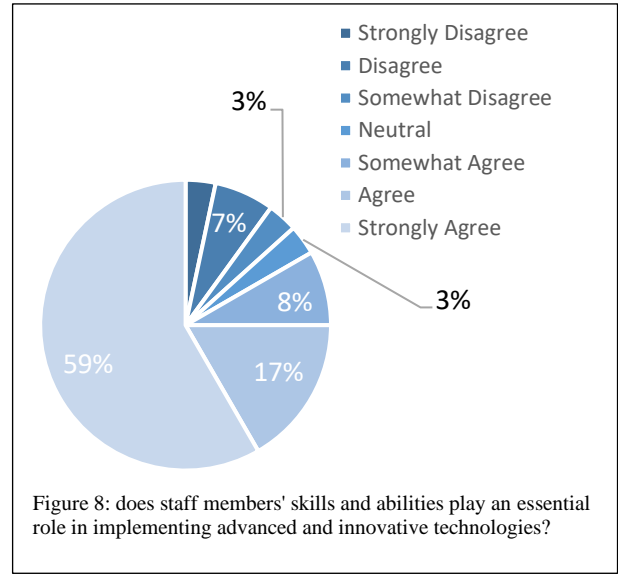
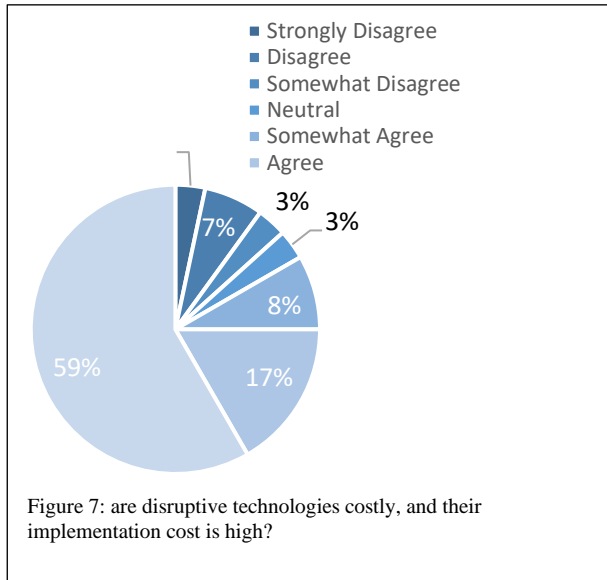
Question five asks, can disruptive technologies help small engineering and architecture businesses worldwide to improve their productivity? It is obvious that forty out of sixty managers strongly agree, ten managers agree, and five respondents somewhat agree that disruptive technologies can help small engineering businesses worldwide improve their productivity. Moreover, two respondents somewhat disagree, only one manager disagree, and 1 respondent strongly disagrees.

Question six asks, can Innovative and advanced technologies help reduce productivity risks in engineering and architecture businesses? The result shows that forty out of sixty managers strongly agree, 10 managers agree, and 5 respondents somewhat agree that innovative and advanced technologies can help reduce productivity risks in engineering businesses around the globe. However, 2 managers are neutral in this, 1 respondent somewhat disagrees, 1 manager disagree, and 1 respondent strongly disagrees.



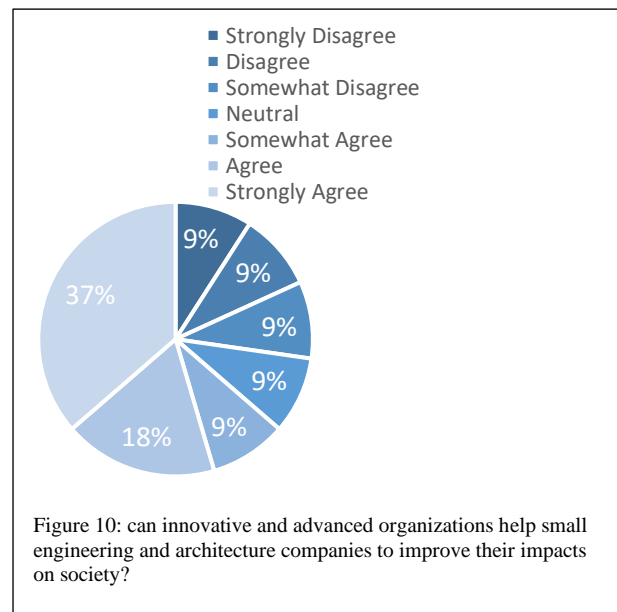
Question seven asks, are disruptive technologies costly, and their implementation cost is high? It is shown that thirty five out of sixty managers strongly agree, ten managers agree, and five respondents somewhat agree that disruptive technologies are costly, and their implementation cost is high. However, two managers are neutral, two respondents somewhat disagree, four managers disagree, and two respondents strongly disagree.

Question eight asks, does staff members' skills and abilities play an essential role in implementing advanced and innovative technologies? The result shows that thirty five out of sixty managers agree, ten managers agree, and five respondents somewhat agree that staff member's skills and abilities play an essential role in implementing advanced and innovative technologies. On the other hand, two managers are neutral, two respondents somewhat disagree, four managers disagree with the statement or question, and two respondents strongly disagree.



Question nine asks, does disruptive technologies help organizations in improving their marketing sections? The result indicates that twenty out of sixty managers strongly agree, ten managers agree, and five respondents somewhat agree that disruptive technologies help engineering organizations in improving their marketing sections. In contrary, five managers are neutral in this case, five respondents somewhat disagree five managers disagree, and five respondents strongly disagree.

Question ten asks, can innovative and advanced organizations help small engineering and architecture companies to improve their impacts on society? It is seen that twenty out of sixty managers strongly agree, ten managers agree, and 5 respondents somewhat agree that innovative and advanced organizations can help small engineering companies improve their impacts on society. However, five managers are neutral, five respondents somewhat disagree, five managers disagree, and five respondents strongly disagree.



The study used a random sampling technique for primary data collection. The sample size was 60 managers from various small and medium engineering and architecture companies. The data collection strategy was well-structured questionnaire. It is evident that 60 managers from different engineering and architecture companies agree that technological disruption has a positive influence on their businesses' financial output. It means that technological disruption helps these small businesses to improve their sales and profit through implementing advanced technologically innovative and business strategies.

However, the results show that technological disruption can increase small engineering and architecture businesses' operational costs. The primary reason behind this fact is that these small businesses have limited resources, and technological disruption cost them a lot. Implementing advanced innovative technologies requires a robust technical infrastructure and various other resources such as human resources [17]. Furthermore, innovative and advanced technologies require improved skills and abilities of workers or operators for taking advantage of these technologies. Therefore, small engineering businesses have to train their staff in this regard. Training staff also increases the cost of implementing advanced innovative technologies for these small businesses.

Moreover, the result suggests that leadership must play a critical role to successfully incorporating technological disruptions in small engineering and architecture businesses. Identifying the desirable technology for this small business is the most important thing in this regard [23]. It requires significant skills and abilities. Small business leaders have to play an essential role, cause a wrong technology selection can cost a small business a lot and cause more harm than advantage. Similarly, small business needs to train employees to deal with advanced and innovative technologies. Therefore, providing relevant training to these small business' staff is another significant responsibility for leadership.

Furthermore, the results suggest that technological disruption can cause more harm than benefit to small engineering and architecture businesses due to their limited resources. It means that small businesses have limited funds versus other technical infrastructure and highly skilled and trained staff members. This is the primary reason why technological disruption can cause more harm or damage than an advantage to small businesses [34]. In the same manner, data interpretation suggests that technological disruption has an overall positive impact on small engineering and architecture businesses despite its various challenges and limitations. The major reason behind the fact is that technological disruption helps small engineering businesses worldwide improve their operational efficiency and productivity. Advanced technologies and strategies can help small businesses compete in the local and national markets through optimizing their product quality and resolving their significant defects or challenges [21].

Quality improvement is another significant advantage of technological disruption in small engineering and architecture businesses. The primary reason behind this fact is that technological disruption helps these small businesses to fix their errors. A reduction in mistakes can help an organization to improve the products and services quality. In addition, implementing technological disruption in these companies poses another major challenge due to the lack of skilled employees. The primary reason is that machines cannot incorporate innovation unless they are operated by skilled and trained operators. Therefore, the operators' skills play an essential role in this regard. Small engineering companies are struggling to hire qualified people, as no highly skilled person would prefer working in a small and young engineering business.

Analyzing most of the studies, it is evident that technological disruption positively impacts small engineering and architecture businesses. One of the significant challenges that most of these businesses are facing low productivity and poor business performance. These small businesses are not able to offer automatic systems as they are tightened to limited resources. Therefore, they use manual techniques, these systems have low productivity, and changes or errors are higher in such scenarios. Therefore, technological disruption plays an essential role in offering low-cost yet effective technologies for small businesses to improve their operational efficiency and economic output. For instance, various lean manufacturing tools such as JIT and others apply to every industry and every size of business. It means that small, medium, and large engineering and architecture companies can use these tools for improving their productivity and efficiency. These tools are easy to offer, and they can help the businesses to improve their overall production speed or capacity. An increased production capacity makes it easier for businesses to increase their sales and profit eventually.

Another significant advantage of technological disruption is that it improves businesses' response time and makes it easier for them to be disruptive towards a change. In simple words, changes are the part of every market or industry. Businesses need to cope with these changes or adopt these changes to achieve their goals and stay competitive in the targeted markets. Therefore, they need to be responsive to innovation, and it is almost impossible for them to do so without incorporating technological disruption successfully. Consequently, it is fair to say that technological disruption makes small businesses responsive, and it is becoming easier for them to adopt changes in the latest technologies.

5. Conclusion

Table (1) shows some similarities and differences between the survey results and the literature.

Table (1) similarities and differences between the survey results and the literature.

Similarities of Survey and Literature	Differences of Survey and Literature
Technological disruption has positive impacts on small engineering businesses in terms of productivity.	Innovative technologies can help small engineering enterprises to shift their work from manual to automatic processes.
The transformational organizational culture is necessary for accommodating disruptive technologies.	Innovative and advanced technologies can help reducing productivity risks in small engineering businesses.
Innovation and technological advancements are essential for businesses to stay competitive in the market.	Disruptive technologies help engineering organizations in improving their marketing sections.
Disruptive technologies can help small engineering businesses worldwide to improve their productivity.	Innovative and advanced organizations can help small engineering companies improve their impacts on society.
Disruptive technologies are costly, and their implementation cost is high.	Even though the cost there are other economy options of disruptive technologies.
Staff members' skills and abilities play an essential role in implementing advanced and innovative technologies.	It is challenging for small companies to attract skilled staff members as they are not promising at this stage.

To conclude, the study highlights the significant impacts of technological disruption on small engineering and architecture businesses. The study collects primary as well as secondary data to support its arguments. The main source of primary data collection for the study is a well-structured and well-organized questionnaire. This questionnaire's sample size is 60 managers of various small engineering and architecture businesses. The sampling strategy used in this case is random sampling. Similarly, the study uses the literature review to collect secondary data for the study. The report contains various peer-reviewed journal articles in this regard. The study results suggest that technological disruption positively influences small engineering and architecture businesses in multiple dimensions.

Technological disruption helps small engineering and architecture businesses to improve their financial performance. Moreover, technological disruption helps these small to improve their productivity and operational efficiency [18]. Likewise, the study suggests that technological disruption helps these small businesses to resolve issues or errors in their products and services. It is the major reason that technological disruption makes it easier to improve products and services quality.

Moreover, the study results suggest that technological disruption is causing some challenges as well. One of the important requirements for incorporating technological disruption in small businesses is having a solid technology platform. A small engineering business cannot implement technological disruption unless it has a required platform or infrastructure for incorporating innovation. It is the primary reason companies have to increase their budget, and they need to invest more in improving their technological infrastructure. It increases the operational cost and reduces its profit margin at the early stages. Moreover, most small engineering businesses cannot even think of implementing technological disruption. The primary reason behind this is that these businesses do not own enough resources to do that.

Furthermore, the study's data interpretation makes it evident that employee resistance is a significant obstacle for implementing technological disruption in small engineering and architecture businesses. The study states that highly skilled and experienced workers do not prefer working in such businesses. It is the primary reason that people in small engineering businesses have limited skills. Moreover, they have limited education, and they are luddite. It is the major reason they show resistance towards change and technological disruption in small engineering businesses.

Moreover, the study shows that technological disruption can cause more damage to small engineering and architecture businesses more than advantages due to their limited knowledge of advanced and innovative technologies. They have to train their employees to improve their skills to deal with advanced and innovative technologies. It increases their operational cost and reduces their profit margin. Therefore, businesses have to use less skilled and experienced workers. In conclusion, the study highlights the positive and negative impacts of technological disruption on small engineering and architecture businesses and suggests that technological disruption has more advantages than limitations for small businesses worldwide.

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