The Impact of Innovation on Lean Production: The Mediating Role of Continuous Improvement at Mining Companies in Jordan

Dr. Sayel Mesbah Daifallah Al-nethami

Abstract

The aim of this study is to identify and analyze the technological and managerial dimensions of innovation and their effects on the dimensions of lean manufacturing (workplace organization (WPO), Total Productive Maintenance (TPM), Just-In-Time (JIT), Value Stream Mapping (VSM) and cellular manufacturing (CM)) through the role of an intermediate variable Continues Improvement at Mining Companies in Jordan.

The study population consists of (370) directors, from all levels of management in these companies where the study was applied to. Moreover, descriptive and analytical method has used, (370) questionnaires are also designed to collect primary data and only (290) questionnaires have been performed for analysis at a cumulative average 90.6%. As a result, arithmetic means, standard deviations, and path analysis using the Smart PlS3 software, have been carried out as statistical means and methods for analysis.

The study has revealed a statistically significant impact of technological and administrative innovation on the dimensions of lean Production(Worksite Organizing (WO), Total Productive Maintenance (TPM), Just-in-time (JIT) manufacturing, Value Stream Mapping (VSM) and cellular manufacturing).. This shows the importance of innovation and how enhances the realization of lean manufacturing dimensions in the companies which the study applied to. Furthermore, a statistically significant "effect" plays an important role in continuously improving lean Production.

This study shows the importance and the necessity of continuing to maintain the adoption levels of technological and administrative innovation, employing modern technology, keeping up with the technological changes that can constantly improve manufacturing quality and production lines. It also sheds light on establishing an efficient organized worksite, total productive maintenance, improving employee innovation, and involving them in taking decisions. Thereby, it's vital to train the employee in innovation at all levels, which will give them a greater understanding of their responsibilities towards the importance of innovation and lean Production.

Key words: **Innovation, Lean Production, Continues Improvement, Mining Companies**

Article Received: 18 October 2020, Revised: 3 November 2020, Accepted: 24 December 2020

Introduction:

The scientific development and rapid changes in the business environment and the economic environment, especially the industrial business environment, have pushed organizations to adopt new methods that would help these organizations keep pace with the rapid developments and changes, and improve production activities and processes, through advanced and modern manufacturing systems in order to achieve their desired goals which are It improves product quality. And reduce costs, reduce waste, and improve work flow to raise the level of performance and improve its competitive position.

It is certain that the astonishing progress that the world is currently witnessing in various fields of industry, trade, services, agriculture and means of communication could not be achieved except through creativity, innovation,

innovative thinking and a renewed holistic view of things. Flexible production is considered one of the most important methods used in companies and organizations, and many organizations have responded to the adoption of the concept of flexible production.

The importance of study:

The scientific importance lies in shedding light on an important aspect of modern management practices, namely studying innovation and its impact on flexible production in extractive companies in Jordan through the mediating role of continuous improvement, which

contributes to eliminating forms of waste and loss and organizing the work site for the optimal use of resources And improve work flow during production.

The importance of the study highlights the extent to which the concept of innovation contributes to flexible production in the extractive companies in Jordan, and highlights the importance of continuous improvement as a mediating variable between innovation and flexible production and the ability of these companies to provide high-quality products that are able to compete globally and meet the needs of customers. The study derives its importance from the importance of the companies researched and the importance of this industrial sector that it deals with, as it is considered one of the important sectors that support the national economy, as the phosphate company and the potash company are among the major companies that actively contribute to the national economy and the gross domestic product.

The objectives of the study

- Know the relative importance of innovation in its dimensions (technological innovation, management innovation) and the continuous improvement of flexible production in its dimensions (organization of the work site, comprehensive productive maintenance, production on time, value flow map, and cellular manufacturing) in the extractive companies in Jordan.
- Identify the impact of innovation in its dimensions (technological innovation, management innovation) on flexible production and continuous improvement in the extractive companies in Jordan.
- To identify the impact of continuous improvement in flexible production in the extractive companies in Jordan.
- To identify the mediating role of the continuous improvement variable in explaining the impact of innovation on flexible production in the extractive companies in Jordan.

The study problem and its questions:

Thus, the problem of the study is represented in the following main question: What is the impact of innovation (technological innovation, management innovation) on flexible production (5s work site organization, comprehensive production maintenance, on-time production, value stream map, and cellular manufacturing) in light of the existence of improvement Continuous as a mediating variable in the extractive companies in Jordan?

The main question emerges from the following sub-questions:

1. What is the relative importance of the dimensions of innovation, flexible production and continuous improvement in the extractive companies in Jordan?
2. What is the relative importance of the extractive companies in Jordan?
3. What is the impact of innovation in flexible production and continuous improvement in the extractive companies in Jordan?
4. What is the effect of continuous improvement in flexible production in the extractive companies in Jordan?
5. What is the effect of innovation in flexible production through the mediating role of continuous improvement in the extractive companies in Jordan?

Hypotheses of the study:

To achieve the objectives of the study, the researcher developed a set of hypotheses as follows:

The first main hypothesis:

Ho1: There is no statistically significant effect at a significant level ($\alpha \leq 0.05$), of innovation in its dimensions (technological innovation, management innovation) on flexible production in its combined dimensions (work site organization, productivity maintenance, value flow map, timely production, and cellular manufacturing)) In extractive companies in Jordan.

The first main hypothesis stems from the following sub-hypotheses:

Ho1-1: There is no statistically significant effect, at a significant level ($\alpha \leq 0.05$), of innovation in its dimensions (technological innovation and management innovation) on organizing the workplace in the extractive companies in Jordan.

Ho1-2: There is no statistically significant effect, at a significant level ($\alpha \leq 0.05$), of innovation in its dimensions (technological innovation and management innovation) on productive maintenance in the extractive companies in Jordan.

Ho1-3: There is no statistically significant effect, at a significant level ($\alpha \leq 0.05$), of innovation in its dimensions (technological innovation, management innovation) on time production in the extractive companies in Jordan.

Ho1-4: There is no statistically significant effect, at a significant level ($\alpha \leq 0.05$), of innovation in its dimensions (technological innovation, management innovation) on the value chain in the extractive companies in Jordan.

Ho1-5: There is no statistically significant effect, at a significant level (α≤ 0.05), of innovation in its dimensions (technological innovation, management innovation) on cellular manufacturing in extractive companies in Jordan.
The second main hypothesis:
Ho2: There is no statistically significant effect at a significant level (α≤0.05) of innovation in its dimensions (technological innovation, management innovation) on the continuous improvement of the extractive companies in southern Jordan.
The third main hypothesis:
Ho3: There was no statistically significant effect at a significant level (α≤0.05) for continuous improvement in flexible production in the extractive companies in southern Jordan.
The fourth main hypothesis:
Ho4: There is no statistically significant effect at a significant level (α≤0.05) of innovation in its dimensions (technological innovation and management innovation) on flexible production through continuous improvement in the extractive companies in Jordan.

Conceptual and procedural definitions

The procedural terminology for all independent, dependent and mediating variables and their dimensions used in this study were adopted, namely:

Innovation

It is defined procedurally as the employment of Jordanian extractive companies, new ideas and processes, and their application to provide new products that give these companies a competitive advantage. It was measured in the study questionnaire in statements (1-15).

Technology Innovation

The process of employing extractive companies in Jordan is defined as technology and new processes or developing products that contribute to achieving competitive advantage. It was measured in the study questionnaire in paragraphs (1-7).

Administrative Innovation

It is defined procedurally as a set of elements, procedures, processes and behaviors that lead to improving the work environment in the extractive companies in Jordan, and improving innovative performance by encouraging workers to solve problems and make decisions in an innovative way and unusual ways of thinking, and it was measured in the study questionnaire in the questions (8-15).

Lean Production

Procedurally, a system that uses fewer resource inputs to achieve higher performance leads to customer satisfaction and to gain a larger market share from competitors in the market by eliminating waste in all its forms, and producing high-quality and low-cost products for the extractive companies in Jordan, and it was measured in the study questionnaire in the questions (45-16).

Five-S-Workplace Organizing (5s)

It is procedurally defined as the philosophy and method of organization that the extractive companies in Jordan follow to organize work and take advantage of the workplace to develop a safe production environment and make full use of machinery, equipment, material and human resources, and reduce waste and waste, and it has an important and decisive role in completing work as quickly as possible. And it was measured in the study questionnaire in statements (16-21).

Total Production Maintenance

It is procedurally defined as a group of operations that seek to apply a pre-prepared schedule to reduce the stoppage of machinery and equipment, so that the maintenance of the production process is achieved with high efficiency in the extractive companies in Jordan, and preventive and curative maintenance measures are taken to reduce sudden stops and the spacing of periods between faults, to move maintenance operations Just the burden of cost to the profit centers of the organization. It was measured in the study questionnaire in statements (22-27).

Value Stream Mapping

Procedurally it is defined as all the processes followed by extractive companies in Jordan to convert raw materials into finished goods or services, including non-value-added activities. In addition to tracking the causes of waste, measuring the current production situation, and then comparing it with the expected future in order to achieve the desired goals. It was measured in the study questionnaire in statements (33-28).

Just-in-Time Production (JIT)

Procedurally, it is defined as a system that works to reduce waste during the purchase period, avoid the accumulation of stock and the arrival of the order in the production processes on time and in the necessary quantity and meet the needs of customers in the right time and in the appropriate quantity in the extractive companies in Jordan. It was measured in the study questionnaire in statements (39-34.

Cellules production

It is defined procedurally as a method used to take advantage of machinery and equipment and arrange them in a manner similar to a cell to facilitate the work of these machines and equipment in the extractive companies in Jordan and to benefit from this arrangement in the efficient and effective exploitation of these material and human energies. It was measured in the study questionnaire in statements (45-40).

Continuous Improvement

It is defined as an administrative philosophy and a group activity aimed at working to continuously develop the processes and activities related to machines, materials, people and production methods in the extractive companies in Jordan. It was measured in the study questionnaire in paragraphs (55-46).

Previous studies in the Arab environment

The study of Araqawi et al (2020) entitled: "Management Innovation and Entrepreneurial Strategy: Relationship and Impact, Case Study in the Islamic Palestinian Development Company"

This study aimed to find out the relationship and impact between the application of management innovation and the entrepreneurship strategy in terms of (creativity, offensive competition, anticipation, and risk adoption) in the Islamic Palestinian Development Company as a case study.

The results of the statistical analysis proved that there is a correlation and impact between administrative innovation and entrepreneurship strategy for the employees of the Islamic Palestinian Development Company. In addition, the results of the statistical analysis showed acceptance of sub-hypotheses between the managerial innovation dimension and the entrepreneurship strategy dimensions in terms of (creativity, offensive competition, anticipation, and risk adoption).

The study of Kabajah and Jaradat (2020) entitled: "The Impact of Innovation on Achieving Competitive Advantage in Industrial Companies Operating in Hebron Governorate"

This study sought to achieve a number of objectives, including, identifying the impact of innovation (product innovation, process innovation) on achieving competitive advantage in industrial companies operating in Hebron Governorate. The study was based on the descriptive and analytical approach, and an intentional sample was chosen from working directors, members of the board of directors, company directors, directors of departments and heads of departments in industrial companies in the Hebron governorate. The questionnaire was used to collect and analyze data. The study recommended the need to increase interest in the concept of innovation and competitive advantage to enhance survival and growth in highly competitive markets, in addition to the need to provide the appropriate environment for creating innovation, and also to increase the allocations for scientific research by the companies under study.

The study of Kasasbeh and Abu Baqi (2020) entitled: "The Impact of Deming's Methodology on Learning and Innovation on Islamic Banks in Jordan"

This study aimed to measure the effect of the Diming methodology on learning and innovation in Islamic banks in Jordan. The study adopted the descriptive and analytical approach through a field study, to obtain the results of testing the hypotheses of the study, and to arrive at results that show the effect of Deming's methodology on learning and innovation. The study population consisted of Islamic banks in Jordan, which numbered four Islamic banks, and the sampling unit consisted of workers in Islamic banks in Jordan. The study also recommended the necessity of increasing attention to documenting the results of the changes occurring in the improved operations, the necessity of notifying the employees of the importance of being guided by their proposals towards change or improvement, and that Islamic banks should be keen on the continuity of the practical application of the benefit achieved from training courses for employees and monitoring the progress in the level of their performance.

The study of Al Monasra (2020) entitled: "Critical Elements for Continuous Improvement and Their Role in Impacting the Organizational Performance in Industrial Companies in Jordan"

This study aimed to reveal the impact of the critical elements for continuous improvement represented in its dimensions: leadership support, process control, customer focus, and employee immersion on organizational performance in industrial companies operating in Sahab Industrial City in Jordan. The study used the questionnaire as a tool to collect data and measure variables, and the study recommended spreading a culture of continuous improvement at the administrative levels in industrial companies in Jordan.

The study of Khalil (2019) entitled: "The Impact of Strategic Vigilance on the Continuous Improvement of Organizations"

This study aimed to identify the effect of strategic awareness on the continuous improvement

of organizations. Therefore, a questionnaire was built as a main tool for collecting data and information, as well as for personal interviews at the level of (managers, heads of departments, heads of divisions, and a group of engineers, managers and technicians). The research sought to test a number of main and sub-hypotheses related to correlation and influence relationships through a set of statistical means using the SPSS statistical program. The study used a descriptive analytical method to achieve the objectives of the study.

Innovation

The Industrial Revolution led to a great transformation in the lives of nations, and some countries benefited from this revolution, becoming advanced and developed, rich, powerful and effective, and some of them lagged behind this progress, so they became backward and poor, suffering many problems and woes at home and abroad. Today's institutions have become aware that innovation has become the single most powerful source in achieving competitive advantage, in institutions that adopt the innovation approach to lead the industry or institutions that use improvement innovation within their strategies, and the institution that makes innovation the focus of its success is one of its pivotal skills or distinctive capabilities that reject methods The traditional business which constantly supports its competitive position. Innovation has become a distinctive feature of institutions in an environment characterized by many challenges and globalization, which requires the provision of creative capabilities capable of facing the rapid change taking place in the ocean (Rahal, 2017).

Lean Production

Flexible production is one of the most important systems on which contemporary companies and organizations are based because it reflects on the benefit to the organization's interest, reduce its expenditures, reduce production costs, increase its production, reduce the incidence of potential errors, and gain customer confidence, satisfaction and support for the organization. Where the application of the flexible manufacturing system works to reduce the amount of loss and loss of available resources and use them in the best way to manufacture a high-quality product that enables the organization to enter strongly in the labor market, and be the fastest in responding to the needs and desires of customers, and that these factors are the basis for the survival and success of these companies, and is able to Competing with other companies in the market (Dabbagh and Hassan, (2010).

The emergence of flexible production

Japanese companies had a major role in the emergence of this concept, as this concept developed in the forties of the past century, and after World War II, there became an urgent need by Japanese industrial companies for raw materials and human resources as a result of the effects of World War II (Mahendran et al., 2016). In the fifties, (Eiji Toyoda) visited the American company, Ford, for the automobile industry, to find out the reasons for its success, and to find ways to solve the problems that Toyota was suffering from (Alves et al., 2012).

Study community

The study community consisted of all employees of the upper, middle and lower levels of administration, represented by a position (general manager, deputy - assistant general manager, department manager, department head, and division head) in the extractive companies in Jordan, or the equivalent of these job titles. Because they differ from one company to another, according to the company's records, human resources, and reports of these companies published on the Amman Financial Market website (Amman Financial Market 2020,).

Statistical treatment

The study uses statistical packages program (SMART - PLS, 3) using Least Squares Analysis (PLS). To analyze the direct and indirect impact of the study variables and their dimensions, and to process the data; In the statistical analysis process, the researcher relied on the structural equation modeling method, which is an assumed pattern of direct and indirect linear relationships between a set of study variables, specifically using the path method because this method has many statistical advantages.

Discuss the results

Results of the descriptive analysis of the study variables (the relative importance of the study variables)

1. Results related to the first study question: What is the relative importance of innovation dimensions in extractive companies in Jordan?

The results of the descriptive analysis of the independent variable (innovation), which indicates that the level of innovation from the point of view of the study sample (technological innovation, management innovation) came at a high degree in terms of relative importance, as the arithmetic mean reached (4.21), and occupied the dimension (technological innovation).) Ranked first with mean of (4.39) whereas, the (management innovation) dimension ranked last among the statements of this variable with mean of (4.03). This result indicates that extractive companies in Jordan have an interest

in employing modern technology in their production processes, in terms of keeping pace with technological developments to continuously develop their production processes. This result also indicates the companies 'awareness of the importance of the financial financing needed to develop production processes, by supporting the financial budget needed for modernization and development processes, and providing the necessary resources to transform creative ideas into innovative products.

2. Results related to the second study question: What is the relative importance of applying flexible production in the extractive companies in Jordan:

The results of the descriptive analysis of the dependent variable (flexible production) from the point of view of the study sample indicated that the relative importance of the flexible production variable came in a high degree with an arithmetic mean (4.38), and the (cellular manufacturing) dimension ranked first with an arithmetic mean of (4.58) and a high relative importance whereas, the (productive maintenance) dimension came last among the items of this variable, with an arithmetic mean of (4.00), and of high relative importance. After organizing the work site, it came with a high relative importance, with a mean of (4.48), and this result indicates the awareness of managers working in extractive companies in Jordan.

After the comprehensive productive maintenance came with a high relative importance and an arithmetic mean of (4.00), and this result indicates the awareness of managers working in the extractive companies in Jordan the importance of comprehensive maintenance of production equipment to maintain its durability, maintain quality, and continuous follow-up of equipment maintenance through the maintenance department, With attention to the feedback received from the operating team on the condition of equipment and machinery, handling these observations, and solving production problems.

After the value flow map came with a high relative importance and an arithmetic mean of (4.32), and this result indicates the awareness of the sample members of the importance of adopting the concept of the value flow map in extractive companies in Jordan in terms of interest in analyzing the flow of raw materials to the final product within the specified work procedures, with Focusing on the internal arrangement of equipment and production lines to maintain timely delivery of orders to customers without delay.

The production map came after the specified time, with a high relative importance, with a mean of (4.54). This result indicates the awareness of managers working in the extractive companies in Jordan of the importance of adopting the production approach on time, in terms of concern for the time factor in production, which is related to the delivery of parts manufactured in the various stages of production within the specified time without delay, and to maintain the flexibility required to reduce the time required for the production process.

3. Results related to the third study question: What is the relative importance of continuous improvement in the extractive companies in Jordan?

The results of the descriptive analysis of the intermediate variable (continuous improvement) from the viewpoint of the study sample showed that the relative importance of the level of the paragraph scale was all high, with an overall arithmetic mean of (4.10). This result indicates the awareness of managers working in extractive companies in Jordan of the importance of adopting a continuous improvement approach in production processes based on eliminating waste of resources needed for production, constantly diagnosing production problems and providing appropriate solutions to solve them, in order to reach high-quality products that meet the needs of their customers.

The results of the hypothesis testing

The first main hypothesis:

Ho1: There is no statistically significant effect at a significant level ($\alpha \leq 0.05$), of innovation in its dimensions (technological innovation, management innovation) on flexible production in its combined dimensions (work site organization, productivity maintenance, value flow map, timely production, and cellular manufacturing) . In extractive companies in Jordan.

The results of the first main hypothesis test showed that there is a statistically significant impact of innovation in its combined dimensions (technological innovation, management innovation), on flexible production in its combined dimensions (work site organization, production maintenance, value flow map, production on time, and cellular manufacturing), in Jordanian companies. It follows from this that the more interest there is in innovation, the more it is promoted in achieving flexible production dimensions in the extractive companies in Jordan.

The first sub hypothesis:

Ho1-1: There is no statistically significant effect at the level of significance ($\alpha \leq 0.05$) for

innovation in its dimensions (technological innovation, management innovation) combined, in organizing the work site in the extractive companies in Jordan.

The results of the first sub-hypothesis test showed a significant effect of innovation in organizing the workplace as one of the dimensions of flexible production. So the path coefficient reached (0.680) at a level of statistical significance (0.000), which is smaller than the level of significance assumed by the study (0.05), and the results indicated in Table (5-17) that the value of (t) reached (4.392), which is Statistically significant at the level of significance ($\alpha \leq 0.05$); The results of the analysis also indicated that the innovation variable explained (46.3%) of the variance in the organization of the work site, according to the coefficient of determination ($R^2 = 0.463$).

The second sub hypothesis:

Ho1-2: There is no statistically significant effect at the level of significance ($\alpha \leq 0.05$) for innovation in its dimensions (technological innovation, management innovation) combined, on productive maintenance in the extractive companies in Jordan.

The results of the second sub-hypothesis test showed a significant impact of innovation in productive maintenance as one of the dimensions of flexible production, as the path parameter reached (0.871), at a level of statistical significance (0.000), which is smaller than the level of significance assumed by the study (0.05), as well as The results in Table (5-17) indicated that the value of (t) reached (6.601), which is statistically significant at the level of significance ($\alpha \leq 0.05$). The results of the analysis also indicated that the innovation variable explained an amount (75.9%) of the variance in productive maintenance, according to the parameter of determination ($R^2 = 0.759$).

Third sub-hypothesis:

Ho1-3: There is no statistically significant effect at the level of significance ($\alpha \leq 0.05$) of innovation in its dimensions (technological innovation, management innovation) taken together, on the map of value flow in extractive companies in Jordan.

The results of the third sub-hypothesis test showed that innovation had a significant impact on the value chain as one of the dimensions of flexible production. The path parameter (0.859); At the level of statistical significance (0.000), which is smaller than the level of significance assumed by the study (0.05), and the results in the same table indicated that the value of (t) reached (6.366), which is statistically significant at the level of significance ($\alpha \leq 0.05$). The results of the analysis also indicated that the innovation variable explained (73.8%) of the variance in the value chain, according to the coefficient of determination ($R^2 = 0.738$).

Fourth sub-hypothesis:

Ho1-4: There is no statistically significant effect at the level of significance ($\alpha \leq 0.05$) of innovation in its dimensions (technological innovation, management innovation) combined, on the on-time production in the extractive companies in Jordan.

The results of the fourth sub-hypothesis test showed a significant effect of innovation in production on time, as the path parameter (0.695) At the level of statistical significance (0.000), which is smaller than the level of significance assumed by the study (0.05), and the results in Table (5-17) indicated that the value of (t) reached (4.967), which is statistically significant at the level of significance ($\alpha \leq 0.05$); The results of the analysis also indicated that the innovation variable explained (48.5%) of the variance in production at the specified time according to the coefficient of determination ($R^2 = 0.485$).

Fifth sub-hypothesis:

Ho1-5: There is no statistically significant effect at the level of significance ($\alpha \leq 0.05$) for innovation in its dimensions (technological innovation, management innovation) combined, on cellular manufacturing in the extractive companies in Jordan.

The results of the fifth sub-hypothesis test showed a significant effect of innovation in mobile manufacturing. So the path coefficient reached (0.699) at the level of statistical significance (0.000), which is smaller than the level of significance assumed by the study (0.05), and the results indicated in Table (5-17) that the value of (t) reached (4.859), which is Statistically significant at the level of significance ($\alpha \leq 0.05$); The results of the analysis also indicated that the innovation variable explained (47.6%) of the variance in cellular manufacturing according to the coefficient of determination ($R^2 = 0.476$).

The second main hypothesis:

Ho2: There is no statistically significant impact, at a significant level ($\alpha \leq 0.05$), of innovation in continuous improvement in the extractive companies in southern Jordan.

The results of the second main hypothesis test showed the existence of a statistically significant impact of innovation in its combined dimensions

(technological innovation and management innovation) on continuous improvement in the Jordanian extractive companies. It follows from this that the more interest there is in innovation, the greater the achievement of continuous improvement in the extractive companies in Jordan.

The third main hypothesis:

Ho3: There was no statistically significant effect at a significant level ($\alpha \leq 0.05$) for continuous improvement in flexible production in the extractive companies in southern Jordan.

The results of the main hypothesis test showed that there is a statistically significant effect of continuous improvement in flexible production in the Jordanian extractive companies, and it is concluded from this that the greater the interest in continuous improvement, the stronger this is in achieving flexible production in the extractive companies in Jordan.

Fourth main hypothesis:

Ho4: There is no statistically significant effect at a significant level ($\alpha \leq 0.05$) of innovation in its dimensions (technological innovation and management innovation) on flexible production through continuous improvement in the extractive companies in Jordan.

The results of the fourth main hypothesis test showed the existence of a statistically significant effect of innovation in flexible production in the presence of continuous improvement as an intermediate variable, in the Jordanian extractive companies. It follows from this that whenever there is interest in innovation, it strengthened it in achieving flexible production, in the presence of continuous improvement as an intermediate variable, and in the same context, the greater the interest in innovation and continuous improvement, this strengthened the flexible production in the extractive companies in Jordan.

In view of the scarcity of previous studies that dealt with the indirect impact of continuous improvement on the relationship between innovation and flexible production, or linked these variables, to the best of the researcher's knowledge in the Arab environment and elsewhere, and for the purpose of simulating the results of this study. The current study decided to make comparisons with previous studies, which are at the core of the topic of achieving the objectives of the current study represented by addressing continuous improvement as a mediating variable and its relationship with other management variables and concepts.

Conclusions

The study reached a number of conclusions after conducting this study on the mining extractive industry sector in Jordan, and among these conclusions are the following:

1. The high relative importance of all the paragraphs of the study indicates that the extractive companies in Jordan pay great attention to innovation and its importance in production processes, and in flexible production, and linking it to continuous improvement.

2. The industrial sector in Jordan is one of the most important sectors in the development of the national economy, and in order to preserve this sector and its position in the local and global markets and in light of intense competition, so it is necessary to keep pace with developments in the surrounding environment.

3. The extractive companies in Jordan have the ability to reduce waste and waste as much as possible and in all production stages, whether this loss results from (overproduction, transportation costs, retention, and delivery) and any losses resulting from activities that do not add value.

4. The extractive companies in Jordan are constantly keen to maintain the quality of products, through continuous improvement, comprehensive production maintenance, and innovation.

5. Adherence to the deadlines set for delivery to final clients is an important matter for extractive companies in Jordan.

6. The extractive companies in Jordan have the capabilities to establish research and development centers whose mission is to research, innovate and create, whether in products or in marketing or operations.

7. The extractive companies in Jordan can build a network of local and international relations, because they produce internationally demanded products and compete with the local and international markets, and the demand for them increases annually.

8. The extractive companies in Jordan have an effective communication system with their external environment that enables them to seize opportunities in the external and even the international environment, enabling them to seize opportunities in the external environment, but also internationally.

9. Through the study, it was found that the extractive companies in Jordan are interested in implementing flexible production dimensions, such as site organization, comprehensive production maintenance, on-time production, value-flow map, and cellular manufacturing.

10. The interest of higher managements in educating their employees about the concept of innovation and its dimensions and flexible production and its remoteness, by holding training courses that enhance their ability to do so.

Recommendations

The need to continue to maintain the level of adoption of innovation in its technological and administrative dimensions in the extractive companies in Jordan, to pay attention to the employment of modern technology, to follow up on technological developments that contribute to improving the quality of products, and to develop production lines by developing them continuously, while continuing to allocate a financial budget to finance the development of technologies and follow up on modernization continuous production equipment. Also, they should to pay attention to adopting creative ideas and converting them into innovative products that achieve product excellence and outperform competitors.

2. The need to continue to maintain the level of adoption of administrative innovation in the extractive companies in Jordan, through the interest in updating organizational structures to keep pace with modern changes, as well as the use of modern administrative applications that help in developing work methods and improving the quality of production as well continuing to maintain interest in the human resource for its important role.

3. The need to continue to maintain the flexible level of production in the extractive companies in Jordan, in terms of concern for organizing the work site based on keeping the tools necessary for work, and providing the tools necessary for work, with the need to maintain the comprehensive productive maintenance of equipment and production lines, with an emphasis on the existence of a system for periodic maintenance continuously. Also maintaining the level of adoption of the value chain through careful analysis of the flow of raw materials required for production, with a focus on reducing the time required to deliver customer orders without delay. The results of the study also indicated that the level of production at the specified time was high.

4. The necessity to focus on the comprehensiveness of the process of continuous improvement of the elements of the production process in the company.

5. The need for the extractive companies in Jordan to continue to deliver orders on time, and to establish a specific program to avoid delays in orders, while strengthening activities by monitoring production quality to ensure delivery on time within the company's production programs.

6. The study recommends the necessity of continuing to maintain the cellular manufacturing activities to ensure a smooth flow of materials without obstacles, as well as reducing the percentage of unfinished materials manufacturing, continuing to enhance the skills of workers with multiple experiences to improve their job performance, and adhering to the requirements of total quality management.

.

References

Abdullah, Fawaz (2003). **Lean manufacturing tools and technique in the process industry with fo- cus on steel**, Ph.D. dissertation, School of Engi- neering, University of Pittsburgh.

Agus, Arawati, & Iteng, Rosman (2013).Lean Production and Business Performance: The moderating effect of length of lean adoption, **Journal of Economics and Management,**1(4), 324-328.

Aichouni, M., & Al-gonamy, A. (2010).**Quality in University Education in the Islamic World**, Third conference Naïf Arab University For Securi- ty Science(20-22 December).

Alves, A. C., Dinis, Carvalho, J., & Sousa, R.M.(2012).Lean production as Promoter of think- ers to achieve companies agility, **The Learning, Organization,**19(3), 219-237**.**

Andreeva, Natalia (2008). **Lean production and agile manufacturing-new systems of doing business in the 21st century,** AJII, 75-81.

- Anvari, Alireza, Ismail, yusof, Mohammad, seyed & Hojjati, H. (2011). A study on Total Quality Man- agement and Lean Manufacturing: Through Lean Thinking Approach. **World Applied Sciences Journal,** 12(9), 1585-1596.
- Anderson, M., Lindgren, R., & Henfridsson, O.(2008). Architectural Knowledge in inter Organizational IT innovation. Journal of Strategic.
- Aguado, S., Alvarez, R., & Domingo, R.)2012). Model of efficient and sustainable improvements in a lean production system through processes of environ- mental innovation, **Journal of Cleaner Produc- tion,** 47, 141-148.
- Bhat , Shishir . B .(2008). Cellular Manufacturing – The Heart of Lean Manufacturing, http://maja.uni-mb.si/files/APEM/APEM3-4_171-80.pdf. 7-Bates
- Seth, 2006 , Cellular Manufacturing, http://www.engr.sjsu.edu /sbates/images/mfg/Manufacturing_Cells.pdf .Bellingham, R., & OBren, W.(2005). **The Leadership Lexicon**, HRD Press, Inc, Amherst. ISBN: 0−87425−855−3.
- Butler, Michael, Szwejczewski, Marek, & Sweeny, Michael. (2018). A Model of Continuous Im-provement Programme Management, **Journal Production Planning & Control,** 29(5), 386-402.
- Castro, Maria, Rociom Quesada & Posada, Juan,G.(2019). Implementation of lean manufac-turing techniques in the bakery industry in Medel-lin. **Journal of Gestao,** 26(2), 10-17.
- Chase, Richard, B. and Alquilano, Nicholas, J.(1995).**Production and Operation Manage-ment, Irwin**. Mc Grow- hill, Boston, USA.
- Chikhalika, Pratik, & Sharma, Suman. (2015). Imple- mentation of Lean Manufacturing in An Engine Manufacturing unit-A Review, **International Journal and Mechanical Eng & Rob Res,** 4(1), 404-419.
- Carrión, G. C., Henseler, J., Ringle, C. M., & Roldán, J.
- L. (2016)**.** Prediction-oriented modeling in busi-ness research by means of PLS path modeling: Introduction to a JBR special section**. Journal of business research,** 69 (10), 4545 - 4551.
- Cooper, John, J. (2011)**. The integral role of organizational characteristics and their impact on lean implementation success.** Southern Illinois University Carbondale, Availabel at: http://www.opensiue.lip.siu.edu/dissertat
- ions/314.
- Damanpour, fariborz, & Schneider, Marguerite.(2009). Characteristics Adoption in Public Organization: Assessing The Role of Managers, **Journal of Pub- lic Administration Research Theory** DOI: 10.1093/jopart/Mun021 ,19: 495-522.
- Darooch, J . and McNaughton, R. (2002). "Examining the link between the management Practices and types of innovation " **Journal of Intellectual Cap- ita**, 3(3), 210-222.
- Dewi, Sandra, Kasali, rhenald, Balqia, Ezin, & Widjaja, Wachidin. (2017). The Role of Entrepreneurial Orientation in Achieving Organization Perfor- mance Through Business model Innovation and Strategic Collaboration, **international Conference on Business and Management Research** DOI:10.2991/icbmr-17,2017,23.
- Dey, prasant, Malsios, Chrisovalantis, De, Debashree, Chowdhury, Soumyadeb & Abdelaziz, Foud (2020). The impact of lean practices and sustaina- bility-oriented innovation on sustainability per- formance of small and medium-sized enterprises: empirical from UK, **British Journal Manage- ment,** 31(1), 141-161.
- Dighe, Santosh, B., & Kakirde, Abhay.(2012). Lean Manufacturing Implementation Using Value Stream Mapping : A Case Study of pumps Manu-facturing Company, **International Journal of Science and Research,** 3(6), 2492-2498.
- Goehuera, Lara, Luiz., & Bandera, Renata (2016). Lean manufacturing implementation for multination companies with production subsidiary in Brazil: Development of a road map, **International Jour- nal of Lean Thinking,** 7(1), 11-23.
- Drucker, Peter (1985). **Innovations and Entrepreneur ship**, pan. Harper, Eow Publishers.
- Dukeov, I., Bergman, J., Heilmann, P., & Nasledov, A. (2020). Impact of firm's commitment to learning and open-mindedness on its organizational Innova- tion among Russian manufacturing firms, **Baltic Journal of Management,** 15 (4) , 551-569, Emer- ald Publishing Limited 1746-5265 DOI 10.1108/BJM-04-2019-0128.
- Dutta, Soumitra, Lanvin, Bruno., & Wunsch-Vincent, Sacha (2020) **Global Innovation Index**

(13th ed), SC, Johnson, College of Business.

- Eaidgah, yoness, Maki Alireza, kurczewski, & Ab- dekhodaee. (2016). Visual Management, Perfor- mance Management and Continuous Improve- ment: A lean Manufacturing Approach, **Interna- tional Journal of Lean Six Sigma,** 7(2), 187-210.
- El kelety, Ibrahim Abd El Mageed (2006) Towards a Conceptual Framework For Strategic Cost Man- agement-the concept, objectives, &instrument **www. Archive. Tu-chemnitz.**
- Ferdousi, Farhana, & Ahmed, Amir (2010). A manufac- turing strategy: An overview of related concepts, principles antechiques. **Asian Journal of Business Management,** 2(2), 35-40.
- Frenza, M., & Letto-Gillies.(2009). The impact on innovation performance of different source of knowledge: Evidence from the Uk Community Innovation survey, **Research Policy,** 38(7), 1125-1135.
- Fryer, Karen, J., Antony, Jiju, & Douglas, Alex.(2007). Critical Success Factor of Continuous Improve- ment in the Public Sector, **The total Quality Magazine (Emerald),** 19(5), 497-513.
- Galende, J., & Fuente, J. (2003). Internal factors Determination a Firms Innovation, **Research Poli- cy,** 32(5), 715-736.
- Ganter, A., & Hecker, A. (2014) "Configurational paths to organizational innovation: qualitative compara- tive analyses of antecedents and contingencies, **Journal of Business Research,** 67(6), 1285-1292.
- Garvey, B., & Williamson, B. (2002).**Beyond Knowledge Management**, Financial Times, Pren- tice Hall, Harlow.
- Greshame, G., Hafer, J., & Markowski, E.(2006). Inter Functional Market Orientation between Marketing Department and Technical Department in the Management of New Product, **Journal of Behav- ioral and Applied Management**, 8(1), 43-65.
- Griffin, Ricky, W.(2006). **Fundamentals of Manage- ment, Houghton Mifflin Co**, Boston, USA.
- Groissi, Giovanni. (1990). Promoting Innovation in a Big Business, **Long Range Planning,** 23, (1)**,** 41-51.
- Guan**,** L., Hanson, D., & Mohryn, M. (2009). **Cost Management**, SWIY, South-Western, India.
- Gujarati D, Porter, D, and Sangeetha, G. (2012). **Basic Econometrics, (5th ed)**, USA, New York: The Mc Graw- Hill Gunasekar.
- Hachicha ,W. & Masmoudi ,F. & Haddar , M.(2007). **An Improvement of A Cellular Manufacturing System Design Using Simulation Analysis ,** http://www.ijsimm.com/Full_Papers/Fulltext2007/text6-4_193-205.pdf
- Hart, Greg. (2010). **Total Productive maintenance**, Person Education Inc., NJ.
- Hair Jr, J. F., Matthews, L. M., Matthews, R. L., & Sarstedt, M. (2017). PLS- SEM or CB-SEM: updated guidelines on which method to use. **Internation Journal of Multivariate Data Analysis,** 1 (2), 107 - 123.
- Hair, J. F., Ringle, C. M., Gudergan, S. P., Fischer, A., Nitzl, C., & Menictas, C. (2019). Partial least squares structural equation modeling-based discrete choice modeling: an illustration in modeling retailer
- choice. **Business Research,** 12 (1), 115 - 142.
- Heizer, Jay, Render, Barry, & Munson, Chuck. (2017). **Operation Management: Sustain Ability and Supply Chain Management (12thed)**, INC, U.S.A.
- Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in var- iance-based structural equation modeling**. Journal of the academy of marketing science**, 43(1), 115- 135.
- Herrmann, A., Gassmann, O., & Eisert, U. (2007). An empirical study of the antecedents for radical product innovation and capabilities for transfor- mation, **Journal of Engineering and technology Management,** 24(1-2), (92-120).
- Hilton, Ronaldw (2005).**Managerial Accounting, (6thed)**, McGraw-Hill Co, Inc.
- Housere, C. J.(1996).Small-Scale Study Using the PDCA Cycle, Todays Management Methods, 209-222.
- http://web.b.ebscohost.com/ehoste/pdfviewer.
- Houts, Lisa, M. (2016). Minimizing the seven wastes at betts spring manufacturing, International **Journal of Business and Applied Social Science,** 2(4), 23- 28.

- Huiban, J. & , Bouhsina, Z.(1998).Innovation and the quality of labour factor, **Small Business Econom- ics,** 10(1), 394-406.
- Inkinen,H , T., Kianto, A,& Vanhala, M.(2015). Knowledge management practices and innovation performance in Finland, **Baltic Journal of Management,** 10(4), 432-455.
- Iranmanesh, Mohammad, Sailani, Suhaiza, Hyun, Sunhyup, Sean Ali, Mohd Helmi Ali & Kwangyong, Kim.(2019).Impact of lean Manufacturing practices on firm sustainable performance: Lean Culture as a moderator. **MDPI Journal,** 11(4), 1-20.
- Ivasciuc, I., & Epuran, G. (2015). Marketing approach on how continuous processes improvement can con- tribute to hotel business Organic Growth Bulletin of The Transilvania University of Brasov, **Series V: Economic Sciences,** 8(2), 185-200.
- Jiao, J., Ma, Q., & Tseng, M.M. (2003). Towards high value-added products and services: mass customi- zation and beyond. **Technovation,** 23(10), 809-
- 821.
- Kaplan, Robert S., &Atkinson, Antony A. (1999). **Advanced Management Accounting (3rd ed.)**, Prentice Hall, Inc.
- Kasher, M., Mani, N., Sharma, R., & Zhang L. (2018). **Application of Lean Manufacturing Principles in Optimizing Factory Production,** New Jersey's Governors.
- Kholker, Mayer (2013). **Implementing Total Product Maintenance Learning From Tow Companies, MBA, GOA**, Institute of Management, India.
- Kilpatrick, Jerry. (2003). **Lean Principles**, MEP Utah (www, mep, org http://www.geocities.ws/jdkilp/lean_principles_ver2b.pdf)
- Kim, D.Y., Kumar, V., & Kumar, U.(2012). Relationship between quality management practices and innova- tion, **Journal of Operation Management,** 30(1)295-315.
- Kim, M., & Tagkopoulos, I. (2018). Data integration and predictive modeling methods for multi-omics da- tasets. **Molecular omics**, 14 (1), 8 -25.
- Kurosawa, K.(1990).**Roles of the leaders Moral Code and Japanized Confucianism, Productivity Im- provement in Japan, in Proceeding of the Seven Productivity Congress, Malaysia.**
- Laforet, Sylvie (2008). Size, Strategic, and market orientation affect on innovation, **Journal of Business Research,** 61, 753-764.
- DOI:10.1016/j.jbusres.2007.08.002.
- Lawless, William, D.(2006). Introduction to Kaizen Budgeting, http://roadwarrior7.net/Documents/Introduction%20to%20Kaizen.pdf.
- Linn, Robert, L, & Gronlund, Norman, E, (2012). **Measurement and Assessment in Teaching, (11th ed)**, Prentice Hall, USA.
- Lopes, Rui, B., Freitas, Filipa., & Sousa, Ines. (2015). Application of lean Manufacturing Tools in the Food and Beverage Industries, **Journal of Technology Management and Innovation,** 10(3), 120-
- 130.
- Manea, Delia. (2013). Lean Production-Concept and Benefits, **General Management,** 17(1), 164-171.
- Marodin, Giuliano, A., Frank, Alejandro, G, Tortorella, Guilherme, L., & Fetterman, Diego, C. (2017). Lean production and operational performance in the Brazilian automotive supply chain, **Total Quality Management & Business Excellence,** DOI: 10.1080/14783363.2017.1308221.
- Marten-Costa, M., Marten-Lorente, R. & Chio, T.(2008). Simultaneous consideration of TQM and ISO 9000 on performance and motivation: An empirical study of Spanish companies, **International Jour- nal of Production Economics,** 113(1), 23-39.
- McBride, David. (2003). **The seven manufacturing wastes**, EMS Consulting Group, Online at: http://www.emsstrategies.com.
- Sadeghi, M. A. (2017). Meta-Analytic of the Relation- ship between Human Resource Management and Customer Satisfaction in Lean Production Adop- tion and Implementation Processes. **International Journal of Management, Accounting and Eco- nomics,** 4(8), 880-887.
- Otsuka, Keijiro Jin, Kimiaki, & Sonobe, Tetsushi. (2018). **Applying the Kaizen in Africa: A new avenue for industrial development**, ISBN 978-3-319-91400-8, Palgrave Macmillan, Cham, http://dx.doi.org/10.1007/978-3-319-91400-8.
- Phan, Thi Thus Anh. (2019). Dose organizational innovation always leads to better performance? A

study of firms in Vietnam. **Journal of Economics and Development,** 21(1), 71-82.

- Pine II, B, J. Victor, B., & Boynton, A, C. (1993). Making Mass Customization Work, **Harvard Business Review,** 71(5), 24-25.
- Porter, Michael, E.(1990). The Competitive advantage of Nations, **HBR,** 68(2), 73-93.
- Prabhuswamy, M, S., Ravikumar, K, P., & Nagesh, P**.** (2013)**.** Implementation of kaizen Techniques in TPM, **IUP Journal of Mechanical Engineering,** 6(3), 38-54.
- Queiroze, G., Cobra, R., Guardia, M., Oliveira, J., Ometto, A., & Esposto, K. (2015). **The use of Lean Manufacturing Practices in Cleaner Production: A Systematic Review**, Conference Paper Sao Paulo-Brazil-May (20-22).
- Raymond, L. & Pierre, J. (2010). Determination of Innovation in manufacturing SME: An attempt at empirical clarification**, Technovation,** 30(1), 48-56.
- Ringle, C. M., Da Silva, D., & Bido, D. D. S. (2014). Modelagem de equações estruturais com utilização do SmartPLS**. Revista Brasileira de Market- ing,** 13 (2), 56 - 73.
- Romijn, H, A., & Albaladejo, M. (2002). Determination of innovation capability in small electronics and software firm in south east England. **Research Policy,** 31(7), 1052-1072.
- Russell, R, S., & Taylor lll, Bernard, W. (1998). **Operation Management (2nded),** Prentice Hall, INC, U.S.A.
- Sarstedt, M., Hair Jr, J. F., Cheah, J. H., Becker, J. M., & Ringle, C. M. (2019). How to specify, estimate, and validate higher-order constructs in PLS- SEM. **Australasian Marketing Journal (AMJ),** 27 (3), 197 - 211.
- Shan, H., Li, Y., & Shi, J. (2020). Influence of supply chain collaborative Innovation on Sustainable De- velopment of Supply Chain: A Study on Chinese Enterprise, **Sustainability 2020**, 12, 2978; doi: 10.3390 /su 12072978.
- Sekaran, U., & Bougie, R. (2016). **Research methods for business: A skill building approach**. John Wiley & Sons.
- Shingeo, Shigo. (2017). **Fundamental Principles of Lean, manufacturing, Cambridge**: Productivity Press.
- Simons, D., & Zokaei, K. (2006). Performance Improvements through Implementation of Lean Practices: A study of the U.K. Red Meat Industry, **International Food and Agribusiness Management Review,** 9(2), 30-53.
- Singh, J., & Singh, H. (2011). Assessment of the Importance Level of continuous improvement strategies in Manufacturing industry of Northern India, **International Journal of Management and business Studies,** 1(1), 8-13.
- Schermerhorn, J., & John, R et al.(1997).**Organizational Behavior**. John Wiley & Sons, Inc. New York.
- Schniederjanes, D, G. (2018). Business process innovation on quality and supply chains. **Business process Management Journal,** 24(3), 635-651.
- Slack, N, J., Brandon, A., & Johnston, R. (2013). Operation Management **(7th ed.)**, published Under the Pitman Publishing imprint, United Kingdom.
- Solomon, M, R., & Stuart, E, W. (1997): **Marketing**, Prentice Hall International, Inc-New Jersey.
- Stevenson, W. J. (2007). **Operation management (8th ed.**), Von Hoffman Press.
- Stevenson, Willian, J., & Chuong, Sum, C. (2010). **Operation management: an Asian prospective (9th ed**.). New Yourk, NY: McGraw Hill Education.
- Stimec, A., & grima, F.(2019).The impact of implement- ing continuous improvement upon stress within a lean production framework, International **Journal of Production Research,** 57(5), 1590- 1605.
- Sun, S.(2011).The strategic role of lean production in SOEs development, **International Journal of Business and Management,** 6(2), 160-168.
- Swink, M., Melnk, S., Cooper, B., & Hartley, J. (2014). **Managing Operations Across the Supply Chain (2nd)**. McGraw-Hill Education, Irwin Series in Op- erations and Decision Sciences.
- Teece, D, J. (2000). **Managing Intellectual Capital, Oxford University Press,** Oxford.
- Toomanian, Ara., & Mansourian, Ali (2009). **An integrated framework for implementation continuous improvement of spatial data infrastructures.** SDI Convergence Research, Emerging Trends and Critical assessment, 48, Iran.
- Tortorella, Guilheme, L., Fateman, D., Miguel, P, A., & Sawheny, R.(2019),Learning Organization and Lean production: an empirical researchon their relationship, **International Journal of Production Research**, 14(3), 45-76.

- Vega-Jurado, et al. (2008). The effect of external and internal factors on firms product innovation**,** **Re- search Policy,** 37(4), 616-632.
- Venkatesh, J. (2007) An Introduction to Total Productive Maintenance(TPM),Online at http://www.plant-maintenance.com/articles/tpm_intro.pdf.
- Upadhye, Nitin, & Suresh, Garg. (2010). Lean manufac- turing for sustainable development, **Global Busi- ness and Management Research: An Interna- tional Journal,** 2(1), 125-137.
- Urbaniak, Maciej.(2015). The rol of continuous improvement tools of processes in bulding rela-tionships in supply chain**, Scientific Journal of Logistics,** 11(1), 41-50.