

Relationship between Technology Management and Operational Performance in Manufacturing Companies

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Abstract

Nowadays, with the presence of technology in the human life, organizational levels have received a lot of changes which affected the operational aspects and the organizational structures from traditional to modern. Therefore, this study investigated the role of technology management to predict operational performance as the most important sources for gaining competitive advantages. It aimed to identify the indicators and investigate the relationship between technology management and operational performance. Two researcher-made questionnaires were used in order to assess operational performance and technology management. These questionnaires have been allocated to the experts of the company which produces utility gas meters. Data analysis was performed using Pearson correlation and One Sample T-Test with the Amos software. The research findings showed that technology management has the power to predict the operating performance of the company. It means the improvement in technology management leads to better and higher operational performance.

Keywords

Technology Management, Operational Performance, Manufacturing, Utility Gas Meters.

1. Introduction

Technology has become a leading factor in competition between companies and their origin countries. Technology management is the ability to create a mutual understanding between business and technology, identify the constraints of the strategic planning process and the use of technology as a part of the strategic planning process of the company [1]. Therefore, technology management can be considered as part of strategic management [2]. Technology management is, in fact, the management of a system that enables the creation, acquisition, and use of technology and includes the responsibility that sets these activities in the lines to serve for the human being and meets the needs of the customer. Research, invention and development are the most basic components of technology creation and the advent of technological advancement, but there is also a more important component in the path of wealth generation which is just use or commercialization of technology. In other words, the benefits of technology are realized when customer reaches its results. A customer can be a person, a company or a government entity, such as defense organizations. An invention laid down on the shelf does not generate wealth, and the idea that appears and does not be used has no financial returns even if it is registered as an invention. A technology generates wealth when it can either be traded or used to achieve the strategic or operational goals of an organization. Technology management integrates engineering, science and

management principles into the planning, development, and implementation of technological capabilities in order to achieve the strategic and operational goals of the organization [3]. Technology management affects many of the functional components of the organization such as research and development, design, production, marketing, finance, personnel, and information. Its scope includes both strategic and operational issues of the organization [4]. Operational dimensions deal with everyday activities of the organization. Today, companies try to measure their performance and compare it with their competitors in order to take appropriate action to achieve a level of performance that can keep them in the market [5]. Basically, the evaluation has a direct relationship with the target performance. An evaluation of the organization's performance means measuring the extent to which the organizational unit has achieved its predetermined goals in its program. The results of the evaluation of their performance are not intended, but rather they are tools that are used to predict future plans, as well as to improve the strengths and resolve the weaknesses of that unit. The performance appraisal system of an organization is considered as the main mechanism for clarifying the set of tools and organizational communications in line with the implementation of strategies. In the current management theories, targeting and evaluating organizational performance play a key role which is expressed in the form of phrases such as "whatever has been done will be measured" [6]. One of the problems of companies in developing countries is the lack of effective technology and operational planning that the most important of which is the lack of technology management or the desired use of operational performance in the organization. Once the technology management and operational performance tailored to the industry are directed, they can contribute to improve competitive position of the company and lead the organization in line with its capabilities and capabilities, and enhance the abilities of the company and optimal use of resources. The purpose of this study was to investigate the relationship between technology management of the company and the operational performance improvement. Given that researches indicate the importance of using technology in organizational performance, however the issue of how technology can overshadow the operational performance is not investigated. On the other hand, managers are interested in measuring the position of technology management in the field of human resource management. Considering the importance of the issue, various methods for assessing the performance of organizations have been presented which can be referred to in the Pyramid of Performance Evaluation [7]. Managers use a variety of criteria such as innovation, efficiency, productivity and quality in order to evaluate the performance of their organizations, and technology is a key factor for economic growth, and competition between organizations is based on technology, as well as technology management and its linkage with operational performance such as necessities that organizations need in the world of competition and ultimately lead to effectiveness, efficiency, productivity, and responsiveness to the needs of the organization. Some researchers have been carried out in this field including Farsijani and Samiei Neiestani [8] that examines the role of integration between total quality management and technology management in determining the performance of quality and innovation. Total innovation management has positive and significant effects on all three functional variables; that are quality performance, process innovation, and innovation performance. Ghanbarinejad Esphaghan Sari and Mohammadi Almani [9] who examined the impact of technology management and research and development (R&D) on the organization performance in terms of innovation and quality showed

that technology management and R&D (Total Innovation Management) have the power of prediction for qualitative performances of organization but their prediction power for innovation performances of organization is higher. The most important conclusion of this research is that the use of technology management and R&D leads to the promotion of quality functions and, more importantly, the strengthening of innovation functions in organizations. Shojaafarian and Mahmoodpour [4] who investigated the impact of technology management and human capital on organization performance stated that the role of technology management in R&D is proposed on the performance of the organization and in order to convert human resources to human capital and in the fields of quality and innovation as the most important resources for gaining competitive advantage for organizations. Tabatabaiyan[10] also showed that technology management has the predictive power for qualitative functions of the organization in examining the impact of technology management on the performance of the organization in terms of innovation and quality, but its predictive power is higher for innovation performance of the organization. Most importantly, the use of technology management causes to improve the quality performance and, more importantly, enhance the innovation performance in organizations. Another research by Prajogo and Sohal [11] entitled the integration of TQM and technology/R&D management in determining quality and innovation performance revealed that technology management and R&D management have a significant relationship with quality performance, but the intensity of the relationships that have with innovation performance is greater. It can be pointed out to other results from the Prajogo and Sohal's research that there is a positive correlation between total quality management and technology management/R&D. In addition, their research showed that total quality management has the power of predicting quality performance, but no significant relationship was found with innovation performance. Also, Prajogo et al [12] in their research entitled impact of value chain activities on quality and innovation concluded that R&D management has a positive impact on product innovation. Considering the importance of the fact that technology management is one of the most important sources for achieving a higher level of organizational performance, this question is proposed whether technology management will affect the operational performance of industrial manufacturing companies.

2. Theoretical Foundations

There has been an intensive competition in the field of production and supply of services by the increasing trend of industrial, economic and technological development and the elimination of geographical boundaries, and technology growth has become one of the strategic goals of managers in organizations [13]. On the other hand, the operational performance brings with itself the growth and continuation of the activity of companies and it is effective in advancing the goals and activities of the organization to achieve the desired descriptions.

2.1 The Concept of Technology Management and Operational Performance

There is no definite definition of technology management since the mid-eighteenth century, given that much writing was written about the interdisciplinary expertise of technology management in this century. The definition that is used so much is that management technology is a process that involves planning, guiding, controlling, and coordinating the creation and implementation of

technological capabilities in order to shape and perform the strategic and operational goals of an organization. Operational (executive-tactical) operations are also functional that provide details of how to implement strategic functions, in other words, executive functions are short-term decisions that are taken to best utilize existing resources with respect to environmental changes [5].

2.2 Identification of Technology Management and Operational Performance Indicators

2.2.1 Technology Management Indicators

1. Identification: It includes the development and progression of awareness of all technologies that are important or will be important for business. Identification can be performed by searching for information, needs assessment of applicant units, evaluating the environment for new technologies, receiving research topics through universities and knowledge-based companies, information from foreign technology, and referral suggestions from the participation system of the company.

2. Evaluation and selection: Selection is a decision-making process and considers relevant issues that need to be evaluated effectively or have capacity of assessment. The selection of technology involves a set of activities in which the identified technologies within or outside the organization are examined and analyzed for the present and future according to different indicators and the choice of appropriate technologies is done.

3. Acquisition /Absorption: The process of acquisition and absorption of technology embraces all areas of technology from the production of knowledge and design to construction, operation and even repair and maintenance. Acquisition means how a company gets valuable technologies for business. Absorption is decision-making about buying, co-operating and manufacturing technology [14].

4. Operation: The exploitation process refers to the making profits or to the achievement of the interests of technology; operation can be defined by the use of new technology or scientific development in order to improve the performance of products, services or manufacturing processes.

5. Protection: Technology management is obligated to protect the knowledge and experiences (skill) inherent in products and production and manufacturing systems in order to maintain its competitive advantage and its technological capability. Protection of technology involves identification and protection of the commercial business benefits of the organization that lies in the technology. It may be that the knowledge which the product provides will be protected because of the heavy capital used to make that product. The protection of technology is tied to other technological management tasks and is somewhat noticeable throughout activities of identification, selection, acquisition, and operation of technology.

6. Learning: Learning is a dynamic concept and individual, organizational or national process that helps individuals and organizations perform tasks faster and better and identifies new opportunities. The learning process occurs at all levels of the national economy from the individual level to the level of companies, industries, sectors or government [14].

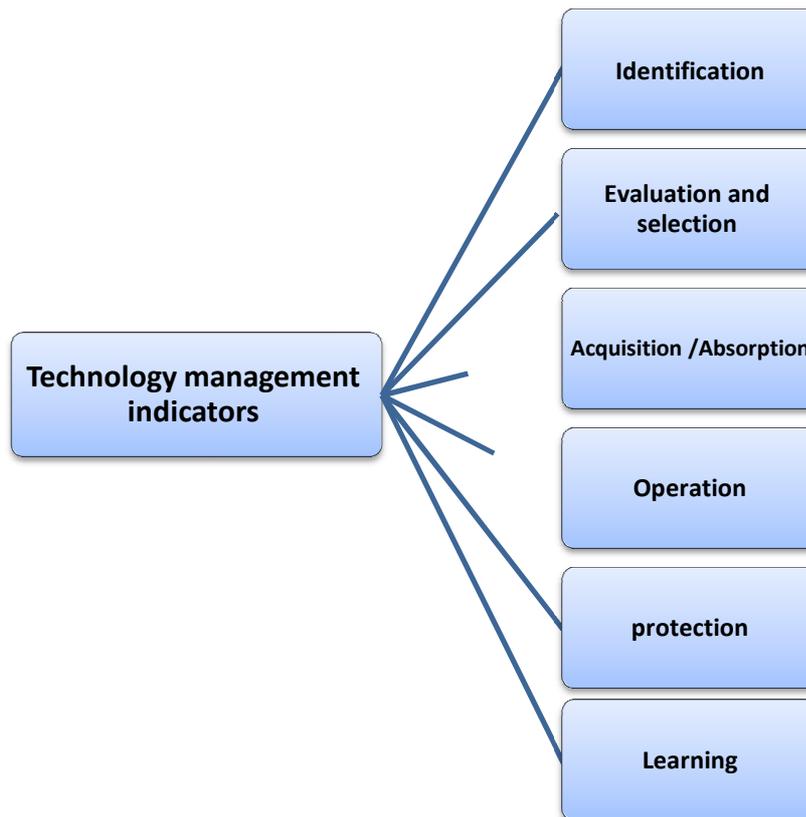


Figure1. The chart of technology management indicators

2.2.2 Operational Performance Indicators

1. Innovation: Innovation is the transformation of the idea into an applied program, product, new service, process or improvement of a presentation and new operation [15]. Innovation consists of three components of innovation in product and service, innovation in the process, and innovation in the organization.

- **Innovation in product and service:** Innovation is the implementation of a new product and service and completely improved in business practices, organization or external relations [16].

- **Innovation in Process:** Innovation is the concept of introducing a new process into the market through making new applications in the creation or commercialization of the product [16].

- **Innovation in the organization:** Innovation which is considered as the idea, behavior, approach, strategy, policy, and new programs that are accepted in the organization is referred the organizational innovation [17].

2. Quality: Quality literally means "of what kind" and it has different meanings in the absolute and relative sense; quality in the absolute sense is things that are complete and without additional expense, and its two aspects are scarce and expensive, quality is admired by many people, but few have it [18]. Quality involves eight components including management and leadership contribution in quality improvement, customer focus, identification and training of employees in making quality, empowerment of staff and teamwork to improve quality, measurement and analysis of quality, the process management, and relationship with the supplier, and continuous improvement.

- **Contribution management and leadership in quality improvement:** Management and leadership play a role in enhancing, improving and promoting quality, and their support and participation cause to improve quality.
 - **Customer focus:** It refers that quality is important for the customer and it must be used to meet the needs of both domestic and foreign customers [18], also, it must be used to identify employees for participation and quality improvement. Intended purpose of customer is not just buyers, but it includes all internal staff too. The degree of conformity of the manufactured goods or the provided services with the customer need indicates quality and it has a significant role in increase of the customers in view of the complaint of customers.
 - **Identification and training of employees in making quality:** Holding training courses is essential for the identification and training of employees and the promotion of organizational quality.
 - **Empowerment of staff and teamwork to improve quality.** Use of encouragement of group performance and teamwork presentation is very effective in order to empower employees.
 - **Measurement and analysis of quality:** The analyzed information is available to the departments in order to measure the quality [19], as well as information is obtained from domestic and foreign customers and manufacturers, and then analyzed and the size of quality is measured.
 - **Process management:** Process management can be controlled using control of the placement of charts and quality control tools.
 - **Relationship with the supplier:** Maintaining relationships and cooperation with suppliers leads to good communication and quality improvement [19].
 - **Continuous improvement:** The attention of organization personals to the proper conduct of activities and continuous monitoring of processes lead to continuous improvement [19].
- 3. Productivity:** A mental attitude - an approach that seeks to continuously improve what is being called productivity. Productivity involves four components including improvement and increase of sales revenue (output), increase of output per unit of production cost (output), the optimal use of workforce (input), and the optimal use of capital.
- **Improvement and increase of sales revenue (output):** The measurement of customer satisfaction, the customer appreciation ratio and the level of customer loyalty show the improvement and increase in sales revenue (output).
 - **Increase of output per unit of production cost (output):** Inventory turnover rate, internal defect rate, return or customer rejection, rework level or wastes, and timely delivery commitment indicate an increase in output per production cost unit.
 - **Optimal use of workforce (input):** With regard to workforce productivity, employee participation rates in group activities and in the system of recommendations, hours of education and training costs are considered on the total income of the optimal use of workforce.
 - **Optimal use of capital:** The optimal use of capital is measured by considering the share of research and development costs and the optimal use of space, equipment and machinery.
- 4. Performance:** This represents the concept of how well an organization uses its resources to produce its best performance at some point in time. Performance includes a component of inputs/enter data.

- **Inputs/enter data:** The cost of raw materials, the cost of waste reworking, the cost of transportation, the cost of maintenance and storage, and the cost of consumed energy indicate the amount of inputs or enter data [18].

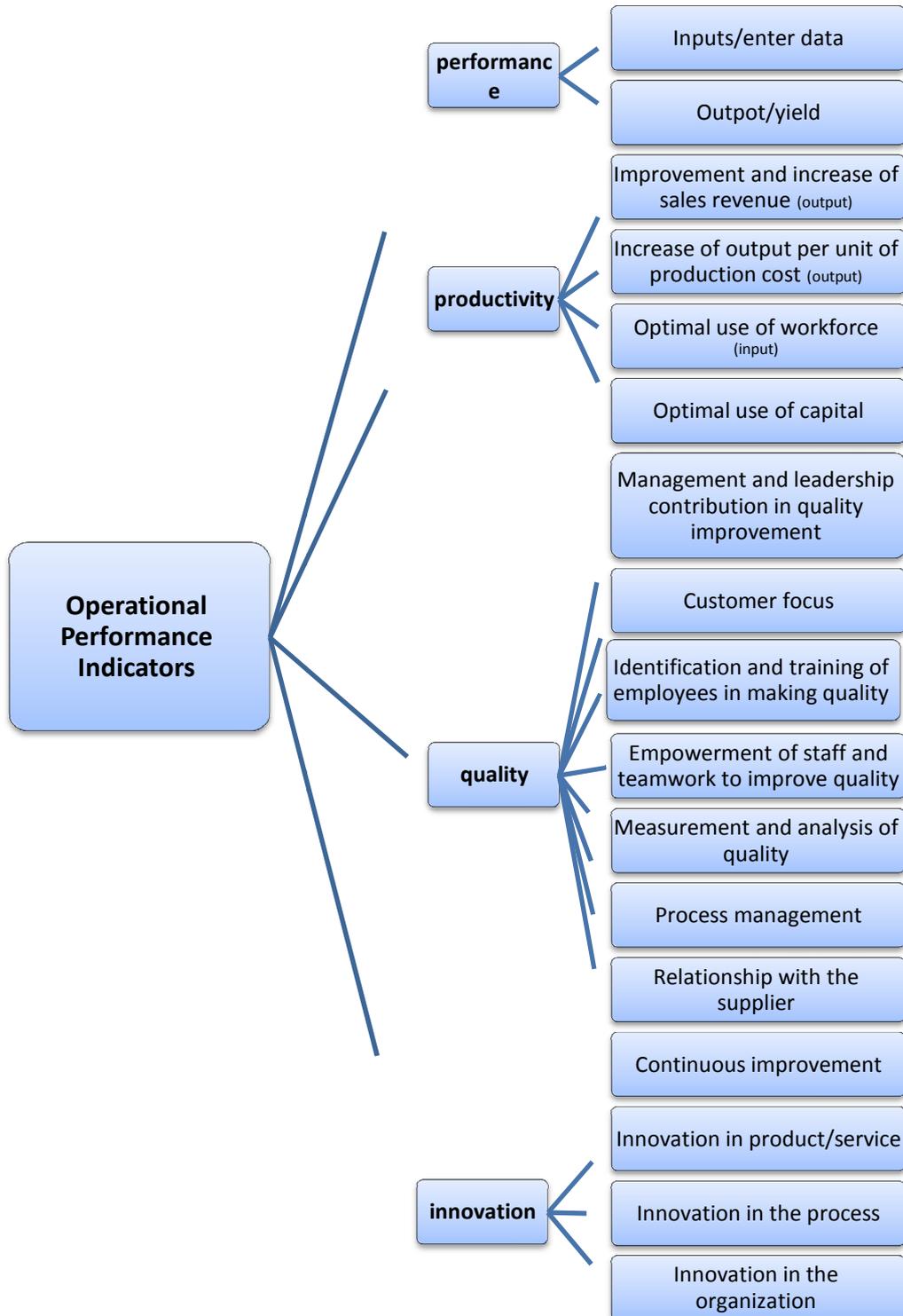


Figure2. The chart of operational performance indicators

3. Research Method

The present research is a survey and applied study. Also it is considered as a field study according to the content of the subject. The study population consisted of 30 experts and managers in different departments including administrative, human resources, engineering and finance of the manufacturing company which produces utility gas meters. Then, they were evaluated by interviews and questionnaires. In this research, interview and use of three researcher-made questionnaires including technology management, strategic management and operational performances were used. The related questionnaires were distributed and accumulated in the manufacturer company of utility gas meters and then a discussion of assessment of variable impacts was conducted. In this research, the coefficient Cornbrash's alpha for questionnaires is 0.853, which is a high and acceptable coefficient; therefore, its reliability is confirmed. Content validity was used to determine the validity of the questionnaires. In this regard, a questionnaire was evaluated by professors and researcher and related supervisor professor and its validity was confirmed.

4. Research Results

4.1 Determining this Assumption that Data is Normal by the Kolmogorov–Smirnov Test (*ks*)

Parametric statistics requires presumptions about the population from which sampling has been sampled. As the most important presumption in the parametric statistics, it is assumed that the distribution of the population is normal, but nonparametric statistics do not require any assumptions about distribution. The parametric statistics techniques are strongly influenced by the measurement scale of variables and the statistical distribution of population. If the variables are nominal and sequential, nonparametric methods should be used. If the variables are of a distant and relative type and the statistical distribution of the population is normal, parametric methods are used; otherwise, nonparametric methods are used. To investigate the normality of components of pattern dimensions, Kolmogorov-Smirnov test was used. In all tests, the statistical hypotheses are as follows:

The data of related variable have a normal distribution: H0

The data of related variable don't have a normal distribution: H1

The final result of this test shows that there is a normal distribution for variables. If the significance level is greater than 0.05, the zero assumption is confirmed and the data has normal distribution, otherwise the zero assumption is rejected and the distribution of the data is abnormal.

Table1. The result of normality test of variables

Variable	Significant level	Error value	Confirmation of assumption	Conclusion
Operational performance	0.966	0.05	H0	Normal
Innovation	0.569	0.05	H0	Normal
Quality	0.730	0.05	H0	Normal
Operation	0.576	0.05	H0	Normal
Performance	0.234	0.05	H0	Normal
Technology management	0.940	0.05	H0	Normal

According to the results of Table (4-5), the significant level for all variables is greater than the error value of 0.05; As a result, the data have normal distribution and parametric tests can be used.

4.2. Examining Demographic Variables

Frequency distribution of respondents' gender was that the most frequency percentage of gender is related to men who were 19 persons (63%) and women were 11 persons (37%). Frequency distribution regarding the level of education of respondents was 17 respondents (57%) had university degree and 9 persons (30%) of them had master's degree and 4 persons (13%) had vocational school. Regarding the work experience of respondents, 13 respondents (43%) had work experience of 11 to 15 years old, 10 persons (33%) had 6 to 10 years old, 4 respondents (13%) had less than 5 years old and 3 persons (10%) had 16 to 20 years old. According to the findings of the research, 9 respondents (30%) aged 36 to 40 years old and 8 persons (27%) were between 31 to 35 years old and 6 respondents (20%) were between 25 and 30 years old and 5 persons (17 %) aged between 41 to 45 years old and 3 respondents (10%) were more than 45 years old.

4.3 Explaining and Interpreting the Research Hypothesis

Research hypothesis: The relationship between technology management of the company on improvement of operational performance is significant.

Table2. Pearson Test between Technology Management and Operational Performance

Dependent variable	Independent variable	Pearson Coefficient	Significance level	Number
Technology management	Improvement of operational performance	0.373	0.042	30

As shown in the above table, Pearson correlation coefficient is equal to 0.373 and the significance level is 0.042 which is higher than its standard rate, 0.05. That is, this relationship is significant. Therefore, the second hypothesis which is based on the effect of the technology management of the company on the improvement of operational performance is confirmed. Due to the fact that the correlation coefficient is equal to 0.337, there is a direct and intermediate relationship between the variables. Therefore the operational performance is improved in the presence of technology; therefore, technology management plays an important role in improving the operational performance of the company. It means that the better and higher the management of the technology, the better and higher the operational performance becomes.

5. Conclusion and Recommendations

Today, the use of technology management among organizations has its own facilities and, on the other hand, it is related to the performance of human resource management at the operational level. Also, technology management has facilitated the transfer of human resource management performance, in other words, it has an effective and significant role in choosing correctly and using consciously of tools and desired techniques of performance, and the company examined its role on the assessment of operational performance using technology management in its organization. This study investigates the relationship between technology management on operational performance of

industrial manufacturing companies. According to research findings, technology management has the power to predict the operational performance of companies, and the most important result of this study is that the use of technology management can enhance operational performance and, more importantly, enhance performance in companies.

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