

# **Measurement of Innovation Performance in Selected industries in Sultanate of Oman**

**Ahm Shamsuzzoha, Mahmood Al-Kindi and Emad Summad**  
Department of Mechanical and Industrial Engineering  
Sultan Qaboos University  
Muscat, Sultanate of Oman  
ahsh@squ.edu.om, kindim@squ.edu.om, esummad@squ.edu.om

## **Abstract**

The aims of this research are to benchmark individual innovation excellence and performance of innovation indicators in selected industries in Oman. It also identifies the emerging trends of innovation across various types and sizes of industrial sectors (both manufacturing and service) in Oman. The methodology adopted to conduct this research was mainly case study along with quantitative analysis. This article presents the initial results from an ongoing research project and future research will be carried out to get the actual results.

## **Keywords**

Innovation, indicators, performance, case study, Sultanate of Oman

## **1. Introduction**

Innovation is a multidimensional approach but the basic definition of innovation is that process which translates the new idea or solution into service to meet the requirements and add value to their people's needs (Bossink, and Vrijhoef, 2009). Innovation is one important domain which appeared recently and could be a sustainable success for a long period. Innovation is the main driver of the nation's economy in developed countries (Visnjic et al., 2016). Innovation could be the reason behind the sustainability of the long-run businesses. Nowadays the needs of innovation activities are becoming more important than before since they provide the requirements, needs, and added value to people's life. In addition, the innovation activities extend the employment base by creating new jobs. It is enhancing the quality of life to make the world better for the next generations (Cui and Wu, 2016).

In general, the innovation activity is based on many pillars, which are products, process, service, and technology. These pillars are used as the baselines to measure the innovation level in any specific industry or organization (Balca et al., 2014). The purpose behind this research paper is to offer an overview of innovation, measuring the main important dimensions on it and to find out the relationship between the levels of innovation and how they are affecting the sales of the firm focusing on selected industries in Oman.

Along with the measurement of innovation, this research also made an effort to identify the drivers and barriers of innovation, which lead to the conduct of an innovation index. The objectives of this research therefore can be outlined as follows:

- To conduct an index to measure the level of innovation practice and link it with the industry's sales.
- To create an innovation index based on collecting relevant information in innovation activities within Omani industries.
- To find out limitations and bottlenecks on innovation to identify prospective drivers and barriers of innovation in Omani industries.
- To provide recommendations to improve generic innovation practices in Omani industries.

## **2. Literature review**

Innovation is a critical component for both small and large industries. Most of the global industries are looking forward to score high in the level of innovation, but innovation cannot be realized easily. Many studies shows that 90% of industries put the first priority of innovativeness in their perspective. In order to be innovative, there are two definite ways namely; “pull” and “push” systems. Pull system is based on knowledge, information and ideas that the industries have and they convert it to an innovative product to convince customers that they are really need it. In push system, industries need to conduct the market survey, from where they might get new ideas based on customers’ requirements. The push system is considered as the most successful in most of the cases. From literature reviews, it is noticed that customer plays a critical role in innovation-based activities.

Innovation is a very huge world. It is related to many things in our life. There are different definitions of innovation. Some definitions depend on specific aspects different from other definitions. For instance, Janszen, F. (2000) quoted that “Austrian economist, Schumpeter said: "Innovations are the composite of two worlds, namely, the technical, and the business; so when only a change in technology is involved, this is just an invention; but as soon as the business world is involved, it becomes an innovation". Moreover, according to Ramadani and Gerguri (2011), Joseph Schumpeter clearly defined innovation as an activity, which results in four elements, they are: introducing new source of raw materials, new products, new processes in production, establishing new organizational forms in industry and opening new markets or enhancing existing ones. Also Baregheh et al. (2009) quoted similar definition, which defines the innovation as efficient applications of new processes and products to benefit the organizations and stakeholders.

### **2.1 Importance of innovation**

The importance of innovations can be explained by presenting the benefit of innovation in different sectors. For example from customers point of view innovation is very important to have high quality and better products and services which mean better way of life. Where In business, innovation is the way to have sustainable growth, development and great profit. Moreover, employees point need innovation to have new and interesting jobs also high salaries. Productivity and prosperity for all are the main goals of innovation in whole economy world (Ramadani and Gerguri, 2011).

Innovation plays a basic role in the development of industries. There are many researches, which clarify that innovation is significant to gain the benefit of competition in many international markets. Nowadays customers look for the newest, higher quality and the lower cost, in other words they look for the more innovative products and services. Innovation helps companies to increase their returns and to achieve a stabilize profit (Hitt et al., 1997).

Hitt et al. (1997) noted as “Economists argued that firms producing innovation had the motivation to geographically diversify to achieve more and higher returns on their investments in producing the innovation.”

### **2.2 Relationship between technology growth and innovation performance:**

Zeng et al. (2010) discussed that in the last two decades, there was a big change in systematic and fundamental concepts of innovation inside the firms. Hagedoorn (2002) found that both SMEs and large industries are growing with technology as well and it may be affected by it very quickly. Technology can help innovation performance positively by increasing the flow of information and resources, which is one of innovation barriers. In addition, technology is kind of a trust, which protect and publish innovation. However, the SMEs are more facing this problem since they have more uncertainties in innovation and having less resources and R&D Diez, (2002). Many literatures show the same point that SMEs have to put more effort to develop and reduce all uncertainties in innovation.

Information technology can affect the three main pillars of innovation that are product, process and service (Bartel et al, 2007). Discussed that advanced IT improves product innovation as firms can easily increase their production with less cost. The advanced IT also introducing the idea of customization which considering a driver indicator for innovation. In addition, technology introducing a new CNC machines controllers, which improve manufacturing and production of variety products with less cost. In process and service, innovative IT is a factor of improving quality

of systems, which results qualified output products by developing new CNC machines. The quality could be improved by reducing the setup and run time.

### **3. Methodology**

With the objective to measure innovation practices within Omani industries, several techniques were adopted. Firstly, extensive literature survey was conducted in order to know the overall concept of innovation and how to measure it. Secondly, a set of questionnaires were prepared and distributed among the industries personnel physically, especially who are involved in innovation activities and posting them online too. The questionnaires were constituted the queries about the new product or process innovation whatever it is radical or incremental. The aims of the questionnaires were to collect relevant information on innovation practices and performances within selected Omani industries. Thirdly, several face-to-face interviews with innovation experts in selected industries in Oman and with personnel in Ministry of Commerce and Industry in Oman were conducted to experience the innovation performance level within the country. Some more interviews are in the pipelines. Finally, the data, which are already collected, are stored and the future data will be collected.

After completing the data collection, the data will be analyzed and evaluated quantitatively to measure the innovation performance level in selected Omani industries in both selected Omani industries both in manufacturing and service industries. This performance measurement technique, which is based on the case studies research, is a proved scientific way to validate any research findings. As mentioned earlier, the relevant data as collected and will be collected are from industries operating in various sectors such as manufacturing and services with different sizes (small, medium and large enterprises).

### **4. Innovation measurements**

Measuring innovation is not a direct process, due to the different factors that affect the practice of innovation in industries. Lack of supporting measures in industries results the limitation in adopting innovation in organizations (Robertson, 1996). Studies shows that development of innovation measures are product oriented (Freel, 2000).

Lack of supporting innovation measurement infrastructure like collection systems, as scarce recourses are used in stuffs that insure exact outcomes rather than the uncertain result of innovation process (Vossen, 1999). There is necessary to understand the motivation of the firm or the industry in order to improve and develop innovation measures approach (Culkin, 2000). Innovation is a 'process', and there is increasing in that awareness, but innovation is a 'fluid' process because it has no fixed sequence of stages (King, 1992). Neely et al., 2000 research provided set of simplified guidelines for measuring innovation process, as follow:

- Performance measures should be derived from the company's strategy.
- The purpose of each performance measure should be made explicit.
- There should be clear data-collection methods.
- All stakeholders should be involved in the selection of the measures.
- The measures should be changeable based on organizational and environmental dynamics.

There is a need of clear understanding for the purpose of innovation and this understanding comes with considerable time and the purpose of measurement depend on the manager and employees awareness of the market competition and the growing number of competitors in the industry, as well as knowing the link between them (Vossen, 1999). Measurements of company's innovation performance is linked to the company strategy and the market .It is important to keep in mind that innovation measurements must be dynamic and changeable, to satisfy different organizations strategies and goals (Rodney, 2004).

#### **4.1 Indicators to measure innovation performance**

In general, innovation performance is measured through several indicators. Some of the indicators can me stated such as budget for research and development (R&D), patent count, patent citations, innovation philosophy, new product announcement, etc., (Hagedoorn and Cloudt, 2003). The allocated budget for R&D is considered significantly affecting future output, as it is a part of companies' generation of new ideas and new models process,

which eventually will lead to new product and new patent (Griliches, 1998). Number of patent or patents count is appeared as an indicator but with an argue ‘it is appropriate indicator or not’ due to the differences of patents between large and small companies. However, it accepted as a good indicator that enable comparing innovative performance of companies in term of new technologies, new process and new products (Bresman et al., 1999).

Validity of patents citations as an indicator measures the quality of innovation performance (Albert et al., 1991). According to Devinney (1993), there is a positive relation between number of patents and announcement of new products at level of industries but not in individual companies, as the statistics show that less than 3% of the variance in individual firm new product announcements is explained by patent intensity.

#### 4.2 Innovation performance measurement level: an approach

Indicators simplify the measuring process, and give the ability of visualize the current state in order to identify the variation of sub-indicators level, then direct the prober decision to make changes and improve the performance. Indicators helps in understand the status of something and the changes toward improvement and challenges (Rosen and Kishawy, 2012).

The challenge is to come up with innovation indicators. Generating applicable indicators for innovation types is difficult task, because innovation is still a new definition in industry. Innovation performance indicators are uncertain parameters because of the differences of innovation practice from industry to another, even if they work in the same sector (service, production).

One indicators is not enough in order to measure innovation performance in a company, because as mentioned before innovation is represented by different dimensions. Providing effective indicators is by considering different metrics for innovation dimensions in order to facilitate decision-making process. The metrics also will help to measure the progress toward the challenges face innovation practice in industries.

Innovation level (IL) is calculated using Equation (1). Equation (1) can be modified as Equation (2) (adapted from Garbie, 2016):

$$\begin{aligned}
 IL_i &= f(I_{ij}) \dots\dots\dots (1) \\
 IL &= \left\{ \begin{array}{l} I_{i1} \\ \dots \\ \dots \\ J_{in} \end{array} \right\} \dots\dots\dots (2)
 \end{aligned}$$

Innovation level of major aspect  $i$  can be represents the aspects in each major aspect of product innovation model.  $j = 1, 2, \dots, n_{ij}$ ,  $n_{ij}$  = number of indicators (performance metrics) in each major aspect  $i$ . The model of evaluating innovation level regarding each major aspect is represented clearly as a function of them in Equation (3). Equation (3) can be represented as an exponential power sizing mathematical model after modification to be suitable to estimate the innovation index. Equation (3) modified for including all aspects.

$$\prod_{j=1}^{n_{ij}} (I_{ij})^{X_{ij}} = \left( \frac{G_{i1}}{C_{i1}} \right)^{X_{i1}} \cdot \left( \frac{G_{i2}}{C_{i2}} \right)^{X_{i2}} \dots \dots \left( \frac{G_{in}}{C_{in}} \right)^{X_{in}} \dots\dots\dots (3)$$

Where  $I_{ij}$  represent the performance metric of aspect  $j$  in major aspect  $i$ , which represent the ratio between the goal(G) and the current value (C).  $X_{ij}$  represents the logarithm of the absolute difference between the goal (G) and the current value (C) as shown in Equation (4)

$$X_{ij} = \log |G - C| \dots\dots\dots (4)$$

For more declaration, the variables are defined below:

- $i$  Represent the major aspect
- $j$  Represent the aspect of  $i$  major aspect
- $I_{ij}$  Represent the ratio between the goal of aspect  $j$  in major aspect  $i$  and the current value of it

$G_{it}$  Represent the goal of aspect  $j$  in major aspect  $i$

$C_{it}$  Represent the current value of aspect  $j$  in issue  $i$

$X_{in}$  Represent the change toward innovation, represented by the log of the absolute difference between the goal and the current

An example of using the equation is provided in later sections. The equation developed based on Decision making analysis course.

### 4.3 Measurement of innovation performance level: an example

Measurement of product innovation indicators were discussed previously in section 4.1. The indicators as identified for product innovation are outlined in Table 1, which are adopted from Garbie (2016). An example is given below with the objective to apply the technique to measure product innovation level in an industry by using Equation (3).

Table 1. Indicators of product innovation with measurement data

<i>Indicator</i>	<i>Unit</i>	<i>Existing</i>	<i>Target</i>	<i>difference</i>	$X_{ij}$
Customer need	%	62	70	12	1.079
Market opportunity	%	80	90	10	1
Product development cost	% of annual budget for R&D	55	35	20	1.301
Product development time	Day	12	7	5	0.699
Development capability	% of flexibility inside a plant	70	85	15	1.176
Regionalize product	Number of new regions related to total number of regions	6	9	3	0.477
Personalize product	Number of new product related to total number of product	3020	3700	680	2.833

Applying Equation (3):

$$IL = \left(\frac{70}{62}\right)^{1.079} \cdot \left(\frac{90}{80}\right)^1 \cdot \left(\frac{35}{55}\right)^{1.301} \left(\frac{7}{12}\right)^{0.699} \left(\frac{85}{70}\right)^{1.176} \left(\frac{9}{6}\right)^{0.477} \left(\frac{3700}{3020}\right)^{2.833} = 1.372$$

Based on the result of the previous equation, it shows that the 137.2% more of effort needed toward innovation level compared with the existing effort.

## 5. Measurement of innovation indicators: special focus to the selected industries in Oman

### 5.1 Innovation in industries

The world status of economy is changed and grows due to the rapidly growth in the industrial sector more than other sectors. The growth in the industries is generally affected by many factors. One of the most important factor is the practice of innovation in the most organizations in some countries. There are many examples of companies did researches in development strategies to get benefits from the previous experience of some countries (Chenery et al., 1986). "Countries such as China, India and Brazil have experienced rapid growth in exports, while many other countries, particularly in Africa and Latin America, appear to have lost market shares, including small players such as Burkina Faso, Senegal, Tunisia, Morocco, Egypt and others." (UNESCO. 2006a).

There are very famous stories about big companies that died after many years of being at the top list of profitable companies in the world. On the other hand, there are many stories about companies became very profitable and

famous in few years. This never happens randomly or due to the luck, there are scientific and deeply efforts were put to improve the status of those companies.

Going through the revolution of Nokia Company as one of the most famous world's leading cellular phone maker company, will lead to the factors behind its success. Technical innovation was one of the top priorities for Nokia Company. Nokia worked for new products and services to gain the top of market. It achieved the goals for many years, and it became a big company (Steinbock, D., 2001). The story of Nokia is known and the end of its success was mentioned in many articles and magazines. The very slow developments in Nokia's products quicks its loss of competition in market. The story of Nokia Company clarifying the importance of developing and practicing of innovation continuously. Figure 1 below shows the global innovation index 2016.

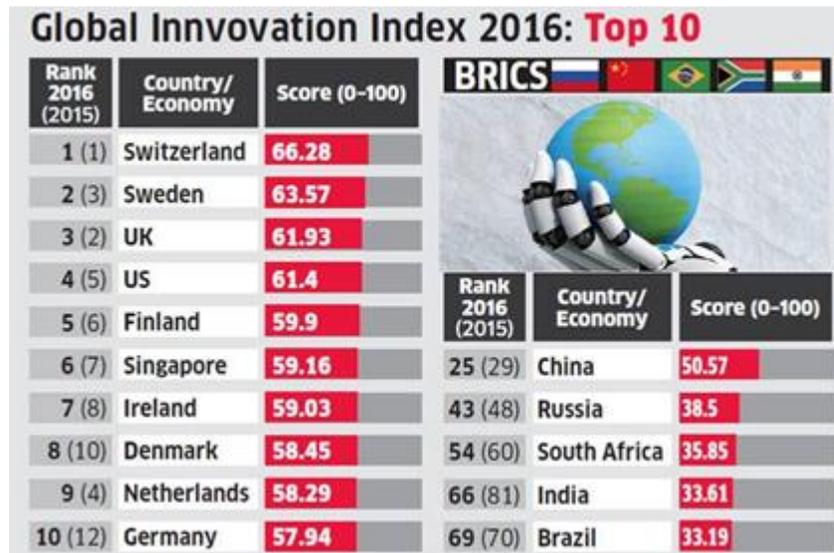


Figure 1. The top 10 global innovative countries in 2016.

## 5.2 Innovation status within the industries in the Middle East

Although Innovation provide many advantages for industries, Middle East countries still suffer of poor practice of innovation. The weakness of national systems of innovation and their absence in many developing countries is for the following reasons:

- 1- Legislative and legal factor: The lack of legislative and legal texts that guide the activity of innovation and invention
- 2- Institutional and organizational factor: Which contain many factors as the Absence of specialized structures in transfer and distribute innovation. Also the Lack of specialized scientific and technological competencies with high qualification,
- 3- Financial factor: Limited budget for R & D and technological innovation in developing countries.

Therefore, there is a need for actions to promote innovation, and improve its current situation (Bodlal Ali, 2005).

## 5.3 Measurement of innovation level within selected Omani industries

Countries with oil-based economy are currently suffering due to lower oil price. Such lower price of oil price exerts extra pressure to such countries like Oman. In order to overcome such economic crisis, the government of Oman strongly considering to diversify its economy to other sectors than oil. One of such sector is to enhance the growth of industrialization. In Oman, there already exists several industries small and medium sizes but not much larger industries. To survive from this current economic situation, the government of the country is strongly considering diversifying its economy towards other industrial sectors, not only oil, and gas industries as a whole. It is therefore, critical to look for alternatives that can lead to grow the nation economy and searching for new income alternatives.

To be successful in overall industrialization growth, industries need to be as innovative as possible in order to survive in today's competitive business environment. Without innovation activities whatever the types or formats, industries cannot be able to sustain in the market with goodwill and profitability. From time to time, it is necessary for industrial organizations to measure their innovation levels. Such performance measurement helps industries to improve their existing activities on innovation activities. It also support industries to look out their limitations or bottlenecks on innovation and helps to motivate them to perform better in innovation activities.

Measuring innovation is a critical process and many countries found the process of measuring innovation is difficult. The lack of adopting innovation is due to the lack of measurement approaches. It is found that innovation can be measured in industries based on the understanding of firm's motivations to innovate and the need of innovation.

Since innovation is poorly practiced in Omani industries, this could affect the sales of large firms and may destroy the start-up ones. To ensure a high level of innovation practices and sales, Omani industries have to follow the innovation index that is based on scientific knowledge and experience. This index includes all three pillars of innovation, which are product, process and service and can be applicable for all type of industries in Oman whether it is manufacturing industry or service industry. In addition, the index is considering the three main dimensions of innovation such as economic, environment and social.

Measuring the innovation level based on the three pillars, helps industries to sustainability issue is the main core of nowadays investment. This project will focused more about how firms reach a high level of innovation and how does innovation led sustainability.

Applying an extensive survey in Omani industries to assess the potentials of innovation activities, considering the existing challenges/bottlenecks in innovation. Preliminary study found that there is no specific information/database of the industries in Oman involved in innovation activities. Keeping this research gap in mind, the aim of this research is to conduct an innovation index to study the practice of innovation in selected Omani industries and link it with the company sales.

## **6. Discussions and conclusions**

Innovation is an important factor of keeping performance of firms improving. In addition, it is one of the main reasons of getting competitive advantage in the market. In industries, cost is a critical consideration and need to be monitored along with the profit gained. Innovation practice helps increasing the profit incrementally.

Measuring innovation is a one way of rising the awareness of innovation benefits. However, Omani industries lagging behind in this field due to different reasons like the lack of specialties in this field. Also, the absence of measuring format that can evaluate the level on innovation practice then provide the appropriate action to identify the reasons and start solving them.

The aim of this research was to understand the current situation of innovation practices in Omani industries, identifying drivers and barriers in order to improve the economic situation to end with designing or improving an index of innovation practice in Oman.

As we have noticed that innovation index has to contain the three pillars of innovation, which are product innovation, process innovation and service innovation. Due to these aspects, questionnaires SMEs and large industries will prepare, and relevant data must be collected from different selected industrial sectors in Oman (e.g. product design, manufacturing, sales and service).

In future, the work will continue to identify the indicators which are drivers and barriers/bottleneck of innovation based on the result of the questionnaires. In addition, the collected data will be analyzed using descriptive statistic tools and to develop and construct the innovation index for Oman industries for measuring the level of innovation in both SMEs and large industries and compare the results. It is hoped that the future research outcomes will provide guidelines for conducting and reaching sustainable innovation.

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## **Biographies**

**Ahm Shamsuzzoha** has been working as an Assistant Professor, Department of Mechanical and Industrial Engineering, Sultan Qaboos University, Muscat, Sultanate of Oman. He received his PhD in Industrial Management (Department of Production) from the University of Vaasa, Finland and his Master of Science (Department of Mechanical Engineering) degree from the University of Strathclyde, Glasgow, UK. His major research and teaching interest lies in the area of enterprise collaborative networks, operations management, product customization, simulation modelling and supply chain management. He has published several research papers in both reputed international journals and conferences.

**Mahmood Al-Kindi** is working as an Assistant Professor at Department of Mechanical and Industrial Engineering, Sultan Qaboos University, Muscat, Sultanate of Oman. He received his PhD from Illinois at Urbana Champaign, USA in 2010. He received his Master of Science degree from the Louisiana State University, USA in 2003. His research interests lies in the area of Quality and Six Sigma, Innovation and Business Entrepreneurship, Lean Manufacturing, Production Planning and Control. He has published several research papers in both international journals and conference proceedings.

**Emad Summad** has a PhD in Industrial Engineering. He is specializing on policy issues for entrepreneurship and innovation in the knowledge-based economy. Dr. Summad currently teaches Innovation and Entrepreneurship at College of Engineering, Sultan Qaboos University. His research interest is on new perspectives on adoption and diffusion of innovations; using agent-based modelling to understand what happens when innovations are adopted by individual consumers and diffused in aggregate markets. What makes one innovation a screaming success while another just fade away! His work also includes governing innovation using social network structure and dynamics analysis. He promotes for technology-based lean startups.