

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):

$$IL_i = f(I_{ij}) \dots\dots\dots (1)$$

$$IL = \left\{ \begin{matrix} I_{i1} \\ \dots \\ \dots \\ J_{in} \end{matrix} \right\} \dots\dots\dots (2)$$

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.

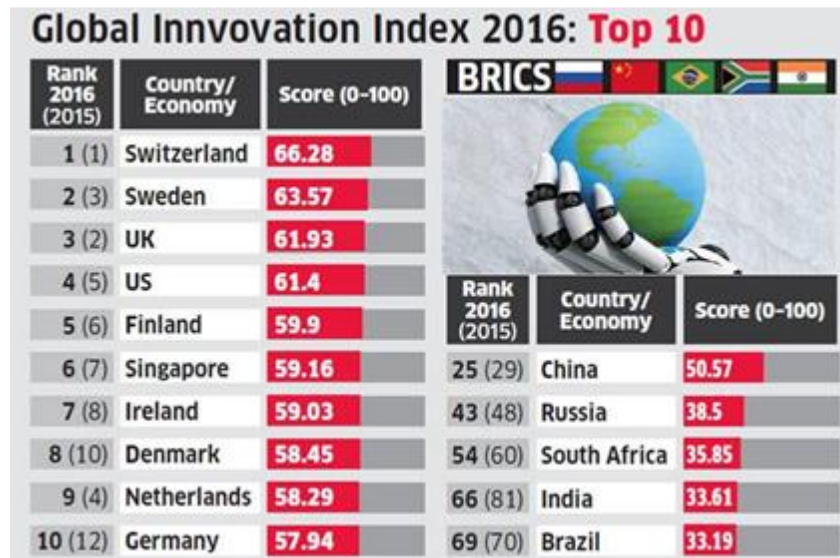


Figure 1. The top 10 global innovative countries in 2016.

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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