

AUDITING AND COMPARING INNOVATION MANAGEMENT IN ORGANIZATIONS

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ABSTRACT

The objective of this paper is to audit innovation management in one of the largest Saudi petrochemical companies (SABIC) and compare the results with those of companies in Brazil and China in order to identify the company's strengths and weaknesses from an innovation perspective. First, an audit survey was carried out in the Saudi company. The results revealed that there is top management commitment and support for innovation, learning is well managed, the company is committed to the development of its employees worldwide and the innovation system is flexible enough to allow small projects to be fast-tracked. Second, the audit results were compared with those of four companies in Brazil and China. SABIC was doing better than some companies in the linkages, learning and process dimensions. Some of the gaps between SABIC and the average of the Chinese and Brazilian firms are very low and could easily be closed. SABIC has strengths and weaknesses similar to the Chinese firms. They both showed strength in learning and weakness in strategy, while the Brazilian firms showed strength in the strategy and weakness in linkages. On the other hand, SABIC's innovative organization and strategy dimensions ranked lowest and special attention is needed in these aspects

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INTRODUCTION

A World Bank Institute report described the innovation climates in developing countries as problematic, characterized by poor business and governance conditions, low educational levels, bureaucratic climate and mediocre infrastructure (Aubert, 2004). The World Bank (2010) recommended that governments need to pay attention to innovation, particularly in the developing world, because innovation is the key driver of economic development and it is the main tool to cope with major global challenges. A report made by UNESCO (2010) stated that even oil-rich-Arab states like Saudi Arabia need innovation. Despite the need for innovation, literature shows that Saudi Arabia lags far behind developed countries in terms of Science and Technology (Sanyal & Varghese, 2006; UNESCO, 2010) and there are few published works that evaluate technological innovation in Saudi Arabia. The objective of this paper is to audit innovation in one of the largest petrochemical company in Saudi Arabia in order to analyze and evaluate how well the company manages innovation. This paper consists of five parts. The first part examines the literature on innovation auditing. The second discusses the case company's background. The third part describes the data and used methodology. The fourth part explains the results. And finally, the last part presents the conclusions from the case study analyses. This is followed by the references and authors' biography.

LITERATURE REVIEW

Innovation: From the date of the first printing press to the current explosion of the Web, the great moments in the history of innovation has been catching the attention of economists, scientist, researchers, engineers, and people in the management field. The reason for this interest according to Pasher and Ronen (2011) is the realization that constant innovation is a must for the survival of organizations. Many definitions were made about innovation. Tidd and Bessant (2009) state that the origin of the word 'innovate' comes from the Latin 'innovare' meaning 'to make something new'. Another definition of innovation was given by Ramalingam, et al. (2009) as "dynamic processes which focus on the creation and implementation of new

or improved products and services, processes, positions and paradigms. Successful innovations are those that result in improvements in efficiency, effectiveness, quality or social outcomes/impacts". The definition emphasizes that novelty itself is not enough but successful innovations must result in efficiency, effectiveness, quality or society improvements.

Innovation Measurement and Evaluation: In the modern business world, innovation is considered an engine of growth, but surprisingly many companies still don't measure their innovation performance and look at the innovation process as something that is mysterious and difficult to master (Skarzynski & Gibson, 2008). Wetter (2010) categorized the main measurable characteristics of innovation into hard and soft. Hard measures refer to the ones that are linked directly to the innovation process such as the number of patents. Soft measures, like productivity improvements, may be direct but are less clear due to their influence by other factors such as managerial factors. Abdel-Razek and Alsanad (2013b) developed and implemented an innovation mapping model capable of *mapping and evaluating the innovation space available to organizations*. They also suggested and implemented an evaluation approach by simultaneous innovation mapping and auditing. They stated that linking mapping and auditing results provides a wider, finely-tuned overview of innovation status and should make it possible for progressive innovation improvement in the company (Abdel-Razek and Alsanad, 2013a). Innovation could be categorized according to the scope and place to be measured. It could be measured at the company level, sector level and even country level. Each has its own characteristics and calls for different types of metrics. Another categorization of innovation measurement is by using quantitative measures such as the input output model or qualitative measures by using an innovation audit.

Innovation Audit: Innovation audit is defined as a tool that can be used to reflect on how the innovation is managed in a firm and is a significant breakthrough in the area of technological innovation management (Liao et al. 2011). There are several tools and frameworks to audit innovation management. One framework was suggested to audit innovation against a core process model which consisted of concept generation, product development, process innovation and technology acquisition (Chiesa et al., 1996). Another framework, "inventory for organization innovativeness", was proposed by Tang (1999) and intended to measure organizational effectiveness in innovation. Mentz (1999) developed what he called a "competence audit for technological innovation", the aim was to check the organization's abilities relative to best practices in innovation. Radnor and Noke (2002) presented a self-diagnostic tool referred to as the "innovation compass" to pinpoint gaps between current and desired performance of organizations regarding innovation. Another innovation audit framework was suggested by Goffin and Mitchell (2005) for identifying strengths and weaknesses using the "Pentathlon Framework". A recent audit tool was presented by Tidd and Bessant (2009) who have identified the factors that influence the success and failure of innovation and used these factors to develop an audit tool for assessing innovation performance in organizations.

Auditing Innovation in Sabic: Petrochemicals are making their impact worldwide as they are an essential part of our everyday lives. There's a broad scope of petrochemicals products ranging from cables, book covers, rubber, plastic and a lot of everyday items. A couple of decades ago, Saudi Arabia didn't seem as a location for major industrialization drive (Ramady, 2010). Oxford Business Group (2007) stated that Saudi Arabia is one of the largest petrochemical-producing countries in the world that in recent years, it has managed an output almost equal to China's.

DATA AND METHODOLOGY

This study is implemented in a large public petrochemical company based in Riyadh, Saudi Arabia. Its main manufacturing facilities are located in two industrial cities: Al Jubail on the east coast and Yanbu on the red sea coast of Saudi Arabia. It operates in more than forty countries with more than thirty three thousand employees across the world and is composed of six business units: Chemicals, Polymers, Performance Chemicals, Fertilizers, Metals and Innovative Plastics. It has seven technology centers distributed around the globe. The company has ownership rights or licenses to about 3,760 active patents and 3,394 pending patent applications around the world and received many awards for its innovativeness.

One of these awards was from the European Polycarbonate Sheet Extruders (EPSE). As petrochemicals play a vital role in economics and also in our everyday lives, the demand on it grows day after day making it one of the most competitive and innovative industries.

The Audit Tool: The selected tool to audit innovation was developed by Tidd and Bessant (2009). It was used in different studies such as Duin (2006), Ye and Zhou (2009), Pang and Qu (2010), Lima (2011) and Karlsson et al. (2011). The questionnaire composed of five audit dimensions: strategy, learning, linkages, processes and innovative organization. It consists of forty statements and for each statement, a score between 1 to 7 is determined. The scores determine the respondents' degree of agreement or disagreement that the statements are true.

The Participants: The data was obtained using a combination of online and email questionnaire sent to the participants of this study between September 2011 and April 2012. All fifty employees from one of SABIC's technology centers, the Technical Service Lab, were surveyed using the audit questionnaire (Alsanad 2012). This particular centre was chosen for the study since it is the closest to innovation activities. Two thousand audit statements were answered. The participants were categorized according to their job title as shown in Table 1. The highest percentage of participants was engineers (36%), followed by scientists (20%), and followed by both administrators and technicians with (22%) each. Employees were also categorized into four levels according to their educational qualifications. Table 2 shows that four of the respondents (8%) were Ph.D. holders, eight (16%) were Master degrees holders, eleven (22%) were Post Graduate Diploma holders and twenty seven (54%) were Bachelor degree holders.

Table 1: Participants' Job Titles

Job Role	No of Employees	No of Participants	Percentage	Response Rate
Scientists	10	10	20%	100%
Engineers	18	18	36%	100%
Administrators	11	11	22%	100%
Technicians	11	11	22%	100%
Total	50	50	100%	100%

This table shows the categories of the participants according to their job titles.

Table 2: Respondents' Educational Qualifications

Degree	No of Respondents	Percentage
Ph.D.	4	8%
Master's	8	16%
Bachelor	27	54%
Diploma	11	22%
Total	50	100%

This table classifies the participants according to their qualifications.

RESULTS

Overall Auditing Results

The data were analyzed (Alsanad & Abdel-Razek, 2013). The average scores given by the respondents to each of the auditing statement of the five audit dimensions are summarized in Table 3. The results showed that the average score of the learning dimension is the highest, 5.04, which indicates that the employees are satisfied and agree that the company is managing the learning aspect very well. The linkages and process dimensions ranked in the middle while the innovative organization and strategy aspects received the lowest scores.

Table 3: The Company's Audit Results by All Employees

Strategy		Process		Innovative Organization		Linkages		Learning	
Statement No.	Mean	No.	Mean	No.	Mean	No.	Mean	No.	Mean
1	4.46	2	4.54	3	4.58	4	5.68	5	4.84
6	4.30	7	4.30	8	4.64	9	4.82	10	5.38
11	4.42	12	4.58	13	4.48	14	3.86	15	5.86
16	4.48	17	4.36	18	3.98	19	4.78	20	5.22
21	4.34	22	4.94	23	4.38	24	4.22	25	4.92
26	5.10	27	4.32	28	4.96	29	4.84	30	4.62
31	4.22	32	4.40	33	4.16	34	4.46	35	4.82
36	4.82	37	5.12	38	5.04	39	5.04	40	4.62
Total	36.14	Total	36.56	Total	36.22	Total	37.70	Total	40.28
Score	4.52	Score	4.57	Score	4.53	Score	4.71	Score	5.04
Rank	5	Rank	3	Rank	4	Rank	2	Rank	1

This table summarizes the respondents' scores to the audit statements.

Learning: This dimension stands out as the highest ranking among the five dimensions of the audit. The results showed that the company has established itself as a learning organization. An in-house teaching structure has been established which focuses on learning the real, day-to-day challenges that managers and teams face in order to develop new skills which allow them to reach their full potentials. The average score of 5.04 out of 7 signifies that the employees agree that the company is managing the learning aspects well. Among all of the 40 audit statements, statement number 15: "We learn from our mistakes" received the highest score. The results also showed that the company works closely with its customers and end-users. Statement number 10: "We are good at understanding the needs of our customers/end-users" received a relatively high score of 5.38.

Linkages: This dimension ranked second among the five audit dimensions. It implies that this dimension is managed relatively well. The highest score in this dimension was 4.7 and was given to statement number 4: "There is a strong commitment to training and development of people". This score and other statements scores showed that the company is committed to training its employees. The organization invests in its employees worldwide in terms of training and education, both in-house and in partnership with academic institutions in order to achieve its vision. However, the lowest score was 3.86 and was given to statement number 14: "We work well with universities and other research centers to help us develop our knowledge". This problem is more emphasized by knowing that this statement was given the lowest score among all forty statements in the 5 dimensions. This is most probably due to the fear of leaking their projects to others.

Process: The process ranked third out of the five dimensions with an average score of 4.57. Statement 37 of the survey: "There is sufficient flexibility in our system for product development to allow small 'fast-track' projects to happen", received the highest score of 5.12 among the eight statements that are concerned with the process dimension. Therefore, the positive element in this aspect is that the company has flexibility in their innovation system. However, statement number 7: "Our innovation projects are usually completed on time and within budget", received the lowest score of 4.3 which implies that there are some flaws in the process.

Innovative Organization: This dimension ranked fourth out of the five innovation audit dimensions, with a 4.53 score. Table 3 shows that the highest score in the eight statements of the organization dimension was 5.04 and was given to statement number 38: "We work well in teams" (5.04). The lowest score was 3.98 and was given to the statements number 18: "Our structure helps us to take decisions rapidly". This statement is linked to deficiency in the innovation organizational structure which doesn't allow taking decision rapidly. The second lowest score was 4.16 and was given to statement number 33: "We have a supportive climate for new ideas".

Strategy: Strategy received the lowest average score of 4.52 among the five dimensions of innovation audit and was ranked the fifth. This indicated that strategy could be considered one of the company's relative weaknesses from an innovation audit view. Statement 31 of the strategy dimension: "We have processes in place to review new technological or market developments and what they mean for our firm's strategy", received the lowest score of 4.22 among all the eight strategy statements. However, the results also showed

that the participants mostly agree that there is top management commitment and support for innovation, as statement number 26: “There is top management commitment and support for innovation” received the highest score of 5.1 among the eight strategy statements.

Innovation Audit by Job Titles

The participants were classified according to their job titles: scientists, engineers, administrators and technicians. The results showed that scientists are the most satisfied group with how well the company manages innovation. They gave the highest scores in matters related to strategy, process and learning, with average scores of 5.03, 4.93 and 5.48 out of 7 respectively. Engineers are the second most pleased group about how well the company manages innovation. They gave the highest score to the innovative organization dimension among the four employee groups with a score of 4.78. Administrators gave the highest score of 4.86 for linkages dimension, their view to the strategy dimension is better than engineers and technicians. Technicians on the other hand, are the least satisfied group with the way the organization manages innovation. They gave the lowest score among the four groups in strategy, innovative organization and learning.

Comparing the Company's Innovation Management with Chinese and Brazilian Companies

Ye and Zhou (2009) and Pang and Qu (2010) carried out the questionnaire in Chinese firms. Lima (2011) also used it for auditing some Brazilian firms. The scores given by SABIC were compared to the scores of these companies. The comparison was made in order to examine how well the Saudi company manages innovation relative to other companies. Studies from China and Brazil were selected simply because of the lack of published work in this area and because Saudi Arabia, China and Brazil are considered developing economies. The comparisons neither represent all Saudi, Chinese or Brazilian organizations; nor do they represent the petrochemical organizations in Saudi Arabia. However, the comparisons are useful in demonstrating how they could be done and illustrating the usefulness of the auditing tool when the relevant data are available. Table 4 shows the audit scores for SABIC, the two Chinese companies (Huagong Tools Company and Guizhou YiBai Pharmaceutical Co. Ltd) and the two Brazilian companies (Poly Easy and Arinos). The comparison showed that the Brazilian company Poly Easy is doing best in strategy, linkages and learning dimensions, while the Chinese company Huagong Tools is leading in the process and innovative organization dimensions. SABIC did not score highest in any of the innovation dimensions and ranked fourth in the process, linkages and learning.

The percentage differences between SABIC's scores and those of each of the four companies were also calculated for each of the five dimensions and are also presented in Table 4. The results revealed that the largest gap was between SABIC and Huagong Tools, with a difference of 25.79% in the process dimension. The smallest gap, a difference of just 0.43%, was between SABIC and the Brazilian company Arinos in the process dimension. SABIC, however, was doing better than some companies in various aspects; it was better than Guizhou YiBai Pharmaceutical Company by 6.7% in the process dimension, and better than Arinos by 10% in linkages and by 0.57% in the learning dimension.

The average scores of the two Chinese companies and of the two Brazilian companies were calculated and compared with SABIC's scores, as shown in Table 5. The results showed that the Chinese companies had the highest scores in process, innovative organization, linkages and learning, whereas the Brazilian companies received the highest score in the strategy dimension. The percentage differences between SABIC's scores and the averages of the Chinese and the Brazilian scores were also calculated for each of the five dimensions and are also given in Table 5. The results revealed that the differences are small and range between 0.57% and 14.71%. The comparison between SABIC and the Brazilian companies showed that the greatest gap of 14.71% was in the strategy dimension, whereas the smallest gap of 0.57% occurred in the linkages dimension. Similarly, the comparison between SABIC and the Chinese companies showed that the greatest gap of 11.04% was in the strategy dimension, whereas the smallest gap, 3.87%, occurred in the linkages dimension. The results also revealed that SABIC has strengths and weaknesses similar to

the average of the Chinese firms. They both showed strength in learning and weakness in strategy, while the Brazilian firms showed strength in the strategy dimension and weakness in linkages.

Table 4: Percentage Differences between Innovation in the Company and Four Other Companies

Company	Strategy	Processes	Innovative Organization	Linkages	Learning
The Saudi Company	4.52	4.57	4.53	4.71	5.04
Score as a percentage (%)	64.57	65.29	64.71	67.29	72.00
Huagong Tools Company (Chinese firm)	4.75	6.38	5.50	5.18	5.32
Score as a percentage (%)	67.86	91.07	78.57	74.00	76.02
Difference between the Saudi Company and Huagong Tools (%)	3.29	25.79	13.86	6.71	4.02
Guizhou YiBai Pharmaceutical Co. Ltd (Chinese firm)	4.90	4.10	5.10	5.40	5.30
Score as a percentage (%)	70.00	58.57	72.86	77.14	75.71
Difference between the Saudi Company and Guizhou YiBai (%)	5.43	-6.71	8.14	9.86	3.71
Poly Easy (Brazilian firm)	5.60	5.50	5.30	5.50	5.60
Score as a percentage (%)	80.00	78.57	75.71	78.57	80.00
Difference between the Saudi Company and Poly Easy (%)	15.43	13.29	11.00	11.29	8.00
Arinos (Brazilian firm)	5.50	4.60	4.90	4.00	5.00
Score as a percentage (%)	78.57	65.71	70.00	57.14	71.43
Difference between the Saudi Company and Arinos (%)	14.00	0.43	5.29	-10.14	-0.57

This table shows the percentage differences between the Saudi company's score and each of the foreign companies' for each of the five dimensions.

Table 5: Comparison Between the Company's Innovation and the Averages of the Chinese and Brazilian Companies

Company	Strategy	Processes	Innovative Organization	Linkages	Learning
Saudi Company	4.52	4.57	4.53	4.71	5.04
Score as a percentage (%)	64.57%	65.29%	64.67%	67.29%	72.00%
Average of Chinese Firms	4.83	5.24	5.30	5.29	5.31
Score as a percentage (%)	68.93%	74.82%	75.71%	75.57%	75.87%
Average of Brazilian Firms	5.55	5.05	5.10	4.75	5.30
Score as a percentage (%)	79.29%	72.14%	72.86%	67.86%	75.71%
Average difference (Saudi and Chinese firms)	4.36%	9.54%	11.04%	8.29%	3.87%
Average difference (Saudi and Brazilian firms)	14.71%	6.86%	8.19%	0.57%	3.71%

This table summarizes the percentage differences between the Saudi company score and the Chinese and Brazilian scores.

CONCLUSION

Innovation management in one of the largest petrochemical companies in the Middle East, SABIC, was audited. The results revealed that there is top management commitment and support for innovation, learning is well managed, the company is committed to the development of its employees worldwide and the innovation system is flexible enough to allow small projects to be fast-tracked. The audit results of SABIC were compared with those of two companies in Brazil and two in China. The results supported the audit results. SABIC was doing better than some companies in the linkages, learning and process dimensions. Some of the gaps between SABIC and the average of the two Chinese firms and the average of the two Brazilian firms are very low and could easily be closed. The results also revealed that SABIC has strengths and weaknesses similar to the Chinese firms. They both showed strength in learning and weakness in strategy, while the Brazilian firms showed strength in the strategy dimension and weakness in linkages. On the other hand, SABIC's innovative organization and strategy dimensions ranked lowest and special attention is needed in these aspects.

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BIOGRAPHY

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