

# Innovation Management in Low-Tech Industries: An Innovation Audit of Confectionery Industry

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**Abstract**—Despite an increasing importance and interest of innovation and innovation management, there are still some special points which need more and detailed studies. This study will closely examine one of these topics: innovation management in lower technological industries with the example of confectionery industry. Innovation and its management may especially be seen as vital for the companies of developing countries and hence we are aim to specify this matter for them to be able to contribute their innovativeness. This examination will be conducted by a questionnaire to all companies (approximately a hundred companies) in the industry in Turkey. The findings will be mainly examined by Tidd and Bessant's scale and its cobweb model to identify the average score of the industry and compare it with ideal score and other industries. Also, some SPSS analysis such as frequency distribution and ANOVA will be used to specify some noteworthy points. The results will show us the level of innovation management in low-tech industries and it may be helpful to compare it with the literature and other industries.

**Keywords**—Innovation, Innovation Management, Innovation Audit, Low-Tech Industries

## I. INTRODUCTION

INNOVATION has become an issue cannot be ignored for both business and academic worlds. In parallel, innovation management has received more significant role in the process and become an apparent field of interest among companies in various industries and scientific researchers because of being a necessary factor for the success and survival of companies [1]. Although the importance of innovation and innovation management is an incontestable issue, the issues of how to be managed in the most effective way are still controversial. As Werner and Souder stated, there are many studies on these issues and most of them have tried to find the most effective tool or system to apply in all organizations [2]. However, it seems that it becomes more ambiguous and confusing for companies because of complex and comprehensive tools and systems [3] and a basic measurement system will be more useful as a start point, especially in lower innovative and small businesses.

Another issue is the discussion of whether innovation is just the matter for high technological industries (high-tech) or any kind of industries. As reference [4] stated, innovation is mostly assumed the matter of high-tech and high value added industries. Conversely, reference [5] specified that innovation is accepted one of the most important way to obtain competitive advance in micro level, get and sustain economical growth and employment in macro level. There is no need to specify how innovation is crucial in high-tech and high value added industries. However, the importance of lower technological industries are underestimated (e.g. [5], [6]) because they account for over 60 percent of employment in the whole manufacturing sector and continue to evince remarkable stability ([7] as cited in [5]). If innovation has one of the most significant roles for economical growth and employment then it is an issue of any kind of industries instead just high-techs.

These discussions lead us to think on innovation management in low technological industries (low-tech): How well do low-tech companies manage innovation? Thus the aim of this study is to determine the situation of innovation management in low-tech companies and for this aim, to introduce a basic but useful and assessable tool of innovation audit in order to conduct in any kind of organization regardless of size, industry, type, level and so on. The study will focus on a low-tech industry which is confectionery to make its innovation audit and specify an industrial understanding. To be able to distinguish industries in terms of their technological levels, OECD's classification which classifies the levels according to R&D intensities will be used [8].

The study will continue with the discussion of innovation, innovation management and why they are matter for different companies and industries, then the used methodology will be explained in depth and lastly paper will be concluded with the conclusion section.

## II. INNOVATION MANAGEMENT IN LOW-TECH INDUSTRIES

### A. Innovation and Innovation Management

Innovation is a whole process, which starts with new ideas/novelties or inventions and finishes with the last customers through marketing and commercialization activities [9]. According to reference [10], innovation is

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related to the description of how to add value in a systematic way to consumers and it is new ideas and different thinking for success [11]. Nevertheless, reference [12] defines innovation in more basic and helpful as “the process of creating value from ideas” (p. 3). Although the definitions of innovation are clear, it is still complex and ambiguous issue because it is a difficult and challenging process (e.g. [3], [9], [12] and [13]). Most companies claim themselves as an innovative company and innovation is an easy and embedded process for them but as [14] states, only one of eleven ideas or concepts is successfully commercialised (please see Appendix 1). It is clear that innovation and managing it are not easy as claimed and the main problem or challenge here is not coming up with novel or creative ideas; it is to introduce them into practical use [12] because the variations in understanding and implementations of innovation can be confusing and ambiguous [3]. Thus, innovation management seems more critical than innovation itself in order to create and sustain success [13].

Innovation management is not only a significantly necessary but also very complex issue and hence such an innovation management framework is needed in order to not only capturing all dimensions - which are strategy, organization (structure and culture), processes (ideas generation, selection, projects, indicators), linkages and learning - but also easy to understand and conduct [3]. Thus, Tidd and Bessant's [9], [12] scale seems more beneficial.

### *B. Innovation in Low-tech industries*

Industries can be classified into different subfields in terms of the level of innovation, geography, size and so on. One of these classifications attempt is [8]'s technology level classification of industries. Reference [8] divided the industrial sectors into four different classes which are: a) High-technology industries (high-tech), b) Medium-high-technology industries, c) Medium-low-technology industries and d) Low-technology industries (low-tech) according to the R&D intensity of industries. On the one hand, while high-tech industries (e.g. aircraft and spacecraft or pharmaceutical industries) have more than 5 percent R&D intensity, on the other hand low-tech industries (e.g. food and textile industries) have less than 1 percent R&D intensity (please see Appendix 2).

Although innovation and its management are mainly accepted an important issue for high-tech industries or just larger companies, it should also be matter of lower technological industries and relatively smaller companies because they have respectable growth in productivity, attract high technological industries, create significant innovation and are a regionally and internationally important element in the innovativeness and effectiveness [5]. Moreover, SMEs, especially the small-sized ones, are responsible for most of the innovative and creative products or services [15]. While it is assumed that innovation has a fundamental role in economies, how can stay lower technological industries which have the largest share in any kind of economies out from the issues of innovativeness? Reference [16] highlighted that

although high-tech industries seem to have natural skills for innovation, it may be much more important necessity for low or medium technological industries. They claim that there is a strong societal and governmental pressure on some industries such as food and energy generation to produce safer and more environmentally friendly products and these pressures make innovation more important for them than all other sectors. In the past, innovation could be accepted a matter of just high tech or large organizations but the reason of this was not being unnecessary for lower technological industries or smaller businesses; it was due to being expensive and not easy to access for them [17]. However, the technological improvements and high level accumulated knowledge on innovation has made it easy and cheaper for any kind of organization or industries. Moreover, innovation has become a mandatory requirement to all sectors, but especially for sensitive sectors such as food and textile, because of social, legal and health expectations [16].

As a member of food industry, confectionery industry is seen different from other food industry representatives because contrary to other member of food industries confectionery is the most luxurious one in all food sectors, it is not a staple food and it probably seems the unhealthiest one [18]. Therefore, it needs more innovation activities than others in terms of health, packaging, preservation and so on [18], [19].

Before finishing this part, highlighting some of the hypotheses which may be arise from the study may be beneficial:

H1: There is an association between R&D intensity and industry as it claimed in the literature.

H1: There is an association between innovation management capabilities and the size of company in terms of the number of employees.

H1: There is an association between innovation management capabilities and the age of companies.

H1: There is an association between innovation management capabilities and company's shareholding structure.

H1: There is an association between innovation management capabilities and the number of patent, registrations, utility models, industrial designs and so on.

H1: There is an association between innovation management capabilities and the perception of innovation.

As mentioned, these hypotheses are just some assumptions and changeable, the actual hypotheses can be determined after collecting data.

## III. METHODOLOGY

### *A. Sample*

As mentioned above in detail, even though innovation is mainly assumed the matter of high value-added and technology-intensive industries, it is a necessity for any kind of products or organizations or industries (e.g. [5], [16] and [20]). Also, a sensitive industry like confectionery can be more important and very useful to add some novel information or point of view to the literature. Reference [16]

specified that food industry is one of the most sensitive industries due to social, legal and health concerns and one of the sectors where innovation activities are most commonly used. Thus the data of this study will be collected from confectionery (chocolate, wafer, biscuits, etc.) manufacturers in Turkey as a representative of the food and low-tech industries. Reference [21] stated that this kind of sampling is very useful when there is a need of in-depth explanation and deeper understanding and accessing deeper understanding of innovation management is the aim of study and hence it seems the most suitable sampling for the study.

There are approximately 100 mass-producers and their affiliations in 15 different cities, mostly in Istanbul (31), Gaziantep (14), Karaman (17) and Konya (5) (the list of all companies can be seen at appendix 3). All of the firms in the industry are chosen due to the availability of access to all firms and the investigation of entire sector may help us to obtain more reliable data.

To obtain data, in-person (groups of subjects from each company) questionnaire will be used and to do this, cooperation with the managers of the companies will be done: Firstly, they will be called to set an appointment and arrange at least one person from each department of their companies. Then the company will be visited to conduct questionnaire face-to-face and a technical report will be supplied for all participating companies in return for their cooperation. One of the most important issues in a research is the response rate; the higher response rate a research has, the more reliable the study is and hence in-person questionnaire is one of the best ways to get highest response rate [21], [22].

The quantity and quality of data is a significant issue due to reliability and validity concerns [21]. The number of companies in the industry is not too high and all are available and hence the quantity is not an issue for the study. However, the quality of data is still an important issue. In-person questionnaire is very useful to get the highest response rate and quality data but when it is conducted individually, for some reason like confidentiality, the quality of data will be decreased (e.g. [22], [23]) on the other hand when it is conducted in groups, this make participant more confident and with the supervision effect the quality of the data will be highest [21] – [23]. Thus, face-to-face questionnaires in groups will be chosen for this study.

Pilot testing is important to understand the process of the study and it also help to increase validity of the research [21] and hence a pilot test will be conducted in the study. For this aim, five companies in food industry and three experts of innovation were arranged to conduct the pilot test.

**B. Measurement**

In the literature there are various scales for the measurement of innovation (e.g. [25] – [28]) but as [3] specified, most of them focus on some parts of innovation and this is not enough for a successful measure. There are five significant dimensions of innovation which are strategy, processes, organization, linkages and learning, and all of them should be evaluated during the measurement process.

Thus, Tidd and Bessant’s scale ([9], [12]) is chosen to evaluate all these dimensions at the same time. Also this scale is easy to understand and conduct, and it seems very beneficial to get more reliable and valid data. To be able to use this scale, Tidd and Bessant’s permission was also a need and hence their permission was received before conducting.

The scale consists of 40 questions and each sub-dimensions are measured with 8 questions; 1st, 6th, 11th, 16th,... 36th questions for strategy; 2nd, 7th, ..., 37th questions for processes; 3rd, 8th,..., 13th questions for organization (structure); 4th, 9th,..., 39th questions for linkages and 5th, 10th, ..., 40th questions for learning dimensions. All scales used a 7-point Likert-type response with anchors ranging from (1) not true at all to (7) completely true. As it can be seen at Figure 1, after calculating participants’ total scores, the total will be divided by 8 and an average score will be obtained to show each participant score on Figure 2 to compare with ideal score and the industry’s average score. Also, there are two different supportive sections which are companies’ information and participant information. Companies’ information consists of 11 questions (e.g. R&D share, innovation level, the number of patent, registrations, utility models, industrial designs and so on) to get some background information for company about their innovation capabilities and participant information consists of seven questions to get some demographic information of participants.

	Qu. no.	Score	Qu. no.	Score	Qu. no.	Score	Qu. no.	Score	Qu. no.	Score
	1		2		3		4		5	
	6		7		8		9		10	
	11		12		13		14		15	
	16		17		18		19		20	
	21		22		23		24		25	
	26		27		28		29		30	
	31		32		33		34		35	
	36		37		38		39		40	
Total										
÷ by 8										
Your score for...	<b>Strategy</b>		<b>Processes</b>		Organization		<b>Linkages</b>		<b>Learning</b>	

Fig. 1. The Scoreboard of Tidd And Bessant’s Scale

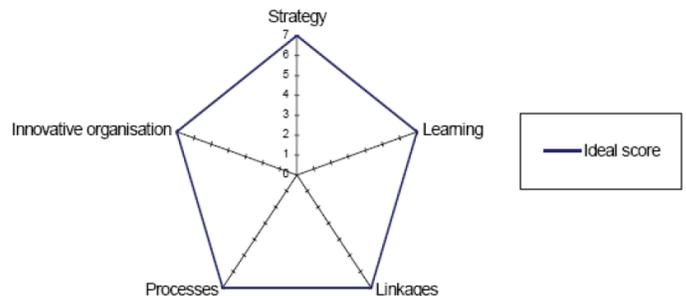


Fig. 2. The cobweb model of Tidd and Bessant’s scale

The scale is originally in English and hence the translation of the scales was a need to apply in Turkey. For the translation, three bilingual academics work together: the first one translated the questionnaire into Turkish and the Turkish version was subsequently back-translated to English by another bilingual academic. The third academic compare both translation and then three translators met to finalize the

Turkish version of the instrument (please see appendix 4 and 5 to see the English and Turkish version of the whole questionnaire). In addition to these, face and content validity analysis are conducted by two expert professors in the field. After collecting data, Cronbach's Alpha will be used to assess internal consistency. Although an alpha coefficient value which is equal or bigger than .70 is accepted reliable, the literature shows that if the alpha score is bigger than .80, it is reliable and if equal or bigger than .90, it is highly reliable [29]. Therefore the aim of the study is to get a highly reliable score.

### C. Analysis

To analyse obtained data, three methods will be used. Tidd and Bessant's scale and its measure. This measure will be used to see average industry level of innovation management and it will help to understand the level of each participant companies' level and to compare them between them and between industry averages. It will also help to specify interesting point in data and if there are any noteworthy differences in data, we can go to depth to understand the reasons of the differences.

This analysis will also give the answer of the research question: How well low-tech industries manage innovation? When the average of the industry is determined, it can be compared with the ideal score and the score of other industries which will be obtained from the literature.

*The frequency distribution analysis.* This analysis will show the big picture of the industry and like Tidd and Bessant's scale, it will help to identify notable points and help us create some hypotheses.

*Chi-square analyses.* These analyses will firstly be used to test the interesting points which rise from the first two analyses. Also, it will be used two compare the literature and the obtained results from data. Design

The design of studies is another crucial issue of the research and the research question usually shapes the design of the study ([21], [22] and [30]). It is better to remember the research question here because it is the main element in shaping the research design: The research question of this study is "How Well Do Low-Tech Companies Manage Innovation?". Although some causal and relational relationship of the sub-issues will be investigated during the process such as the relationship between the number of patent or employees and innovation capabilities, the shareholding structure and innovation capabilities and the age of company and innovation capabilities, the aim of the study will just be examined the situation of innovation management of participant companies. Neither the reasons beyond it nor the causality between them will not be investigated and hence this study will be a descriptive one (non-experimental) and our design will be shaped according to this.

## IV. CONCLUSION

There are different point of views and arguments on innovation and innovation management, and there is a large group which has claimed that innovation and as its corollary

innovation management is mainly the matter of high-tech industries. However, if we accept that innovation is one of the most important elements of any economy, this cannot be acceptable because lower technological industries are one of the main arteries in any economic system. Therefore, it is clear that lower technological industries have the need of qualified innovation management at least as much as high technological ones. For this reason, this study will investigate a low-tech industry which is confectionery industry to understand their level of innovation management and to compare with other industries and the value is regarded as ideal.

It is not possible to discuss any results here but it is obvious that the confectionery industry will be interesting to investigate in terms of innovation and innovation management. Also, some possible hypotheses that may be derived from the data might make new achievements to the literature.

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