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## Solutions to Business Process Reengineering in Order to Improve Organizational Performance in Biotechnology Incubator

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### Abstract:

This study aims to provide a platform to improve organizational performance and develop an appropriate model for other similar and colleague organizations via evaluating and presenting solutions to business process reengineering in the biotechnology incubator. To do so, based on the conceptual model, the status of organizational performance in the bio incubator was evaluated primarily in the form of a questionnaire with 46 questions and consequently the business processes in the bio incubator were reengineered through Hammer-Champy methodology. Finally, the organizational performance in the bio incubator was reevaluated using the exact same questionnaire after presenting the recommended and implemented solutions and performing the business process reengineering. The results demonstrated that the presented solutions to business process and criteria reengineering in the bio incubator have positively and significantly affected the four parameters of reengineering, including speed, quality, cost, and service improvements, and led to the advancement of organizational performance.

### Introduction

The world is in a permanent transformation to an extent which makes its destiny unpredictable. The organizations, nowadays, are also required to go with the flow of these transformations having no choice rather than following or even outstripping this changes.

In order to achieve an excellent and top position, leaving the former traditional structures, a vicissitudes way must be wended by current organizations. A variety of management approaches and theories have been suggested and created to prevent the organizations wane, each with their distinctive and different effects amongst which the business process reengineering (BPR) has occupied a special place among professional organizations and managers and become more comprehensive than other management theories.

On the other hand the growth and development of technology through supporting the knowledge based companies and in turn all-round development of the country are accounted as current important issues

which are mentioned everywhere in upstream and macro documents of the country especially the second chapter of the fifth development plan. The present study will at first review the definitions and history of reengineering briefly and based on the results of two questionnaires before and after the reengineering, statistically analyse the recommended solutions for BPR next via presenting hypothesis and conceptual model of research. Finally, the results will be discussed and the recommendations and solutions will be overviewed.

### Problem Statement and research questions

Considering the importance and necessity of improving the business conditions and comprehensive development of the organization, it seems inevitable that every corporation or organization desires to surpass the competitors in their challenging environment passing the obstacles ahead. This requires perpetual modernization, optimization, development, and improvement of the processes.

All branches of science including management have faced significant evolutions nowadays making the former methodologies and approaches start vanishing or lose their functionality which has led to the inexorable exigency of new principles and paradigms more than ever.

The dynamic transformation of the word economics in recent years has required the public and private organizations to alter their demarches fundamentally. Therefore, innovative management techniques and polys have been emerged to oil the wheels of these changes amongst which reengineering is accounted as one of the most prominent systems for adapting to this newly transpired complex modus operandi.

That is why the concepts of reengineering have been attracting accumulating aficionados in both public and private sections. The tools and knowledge of reengineering has been considered and accepted in the protocols of reorganization of public sections in both developing and developed countries at local and national levels. [10]

On the other hand the growth and development of technology through supporting the knowledge based companies and in turn all-round development of the

country are accounted as current necessities which are mentioned everywhere in upstream and macro documents of the country in a way that sometimes it is highly emphasized by authorities.

With a glance to the fifth development plan the special emphasis on science and technology can be observed to an extent that the second chapter of the plan, with the title of “science and technology”, addresses the explaining of macroeconomic policies and strategies regarding the development and promotion of these two factors in the articles 15 to 23.

Since the lack of appropriate structures and implementing inefficient, old, and obsolete processes prevents all the facilitating and supportive legislations as well as macro strategies, objectives, and plans from being effective wasting the social scientific and human resources, and considering the other above mentioned points, reengineering and altering the structure of working procedures in scientific and educational centers, especially bio incubators and science and technology parks seems inevitable.

Despite multitude of articles, dissertations, and books which have recently published to address the definition and what being of BPR, the details and how being of this context has been neglected significantly. Therefore, in the present study, a platform will be provided for improving organizational performance and an appropriate model will be developed for other similar and colleague organizations via evaluating and presenting solutions to business process reengineering in the bio incubator.

Accordingly, the questions of the present research are as follows:

1. Why is the business process reengineering of the bio incubator (BPR) necessary?
2. What are the main obstacles of BPR?
3. What and how is the extent of BPR effectiveness in improving the organizational performance?

#### **Definition of concepts and background**

In this section, the common terms of the present study such as reengineering, process, biotechnology, bio incubator, and technology unit will be defined first and a history of related research will be reviewed next.

#### **Reengineering:**

Reengineering is defined as fundamental rethinking and designing new processes in order to achieve the significant improvement and progress in current critical criteria such as cost, quality, service, and speed. [1]

Reengineering of organizations is referred to a set of efforts of an organization in order to alter its internal processes and controls in order to change from traditional vertical hierarchical structure into a horizontal interactive group-based flat structure in which all processes are aimed to satisfy the

customer. [2]

Process:

Process is described as a group of functions which together provide the customer’s values. The keywords are “group”, “together”, “result”, and “customer” in this definition. The process-centric perspective does not consider the duties individually valorizing their collection which fulfill the customer’s demands. In process-centricity it is the result which is appreciated, not its constituents. [4] Process is referred to as integrated steps to present an output or a desired service and consists of process goals, process owner, start /stop activity in process, outputs, and process indices. [5]

#### **Biotechnology:**

This word is defined as “practical implementation of living organisms (microorganisms) or their components for production or development of technology (Sanati, Mohamad hossein, Esmail zadeh, Nasrin sadat 2001). [12]

#### **Incubator:**

Incubator centers are institutes managed by professionals which are created to support the development of innovating business by entrepreneurs founded as active newly formed units with sci-tech-based goals in various fields leading to technology via providing supportive services including:

- 1) Providing the workplace (rental); 2) laboratory, workshop, and information services; 3) management, legal, financial, credential, project, and marketing services; 4) special professional training and consultation; 5) other services related to development, growth, and promotion of the technology units.[14]

#### **Technology unit:**

Technology units are the units with independent legal entities from the incubator which are, according to the statute and other legal documents, active in application and developmental fields of research, engineering design, reverse engineering, technology transfer, providing professional services, and commercialization of the research outputs. These units include private companies, industrial research and development units (R&D), and/or those research centres affiliated to universities or executive agencies. [14]

The augmented levels of competition is considered as an important feature of current marketing environment. Those institutions willing to enlarge their share of marketplace and profit the business must adapt to this atmosphere. Thus, significant alterations are being formed in business methods one of which is the business process reengineering defined as fundamental rethinking and redesigning the business processes in order to remarkably improve the today’s performance criteria. [11]

Smith's proposed model in eighteenth century was based on division of labor and grouping the specialized staff. At the beginning of the twentieth century, to complement Adam Smith's model, Taylor discussed a controlling system based on organizational hierarchy. Both were considered as appropriate models according to their time and place.

Two concurrent articles by Thomas Davenport and James Short in *Scan Management Review (SMR)* and Michael Hammer in *Harvard Business Review (HBR)* were published in 1990 emphasizing the rethinking of organizational processes and the effects of information technology on organizational development. The authors of the first article called this notion "new industrial reengineering" and process innovation and Hammer's message in his article was to "erase the old processes, throw away the existing rules, start with a new clean slate, then use the information technology to alter the operational processes".

Michael Hammer was the first theoretician who brought up the concept of reengineering. He had novel opinions in his article "Re-engineering Work: Don't Automate Obliterate" and asked if it is possible to do works in another way. He had a new viewpoint into companies' customers which was entirely different from Adam Smith's theories and led to the introduction of reengineering to the world of management. He then published "Reengineering the corporation: Manifesto for Business Revolution" with James Champy's co-authorship and explained reengineering in the framework of a theory. [4]

Reengineering of organizations is somehow the historical and practical proceedings of management approaches such as total quality management, competition based on time, focus on customers, etc. Reengineering is a holistic approach which relates the competition strategies of an organization to the internal procedures and staff over a process. Furthermore, fundamental transformation and basic improvement are the major differences of this with other management approaches and its establishment is far more difficult. [2]

In fact reengineering requires thematic changes to provide an improved performance. Hammer's opinion about reengineering is: "First, despite many management models which are only specious on paper and do not have real effects on organizations, reengineering is effective. Reengineering is not the miracle drug, however it works if implemented correctly. Second, time will place reengineering on in its real place. Lots of people are struggling with

harsh conditions. Many industries, even public sections, are facing a variety of pressures and need to be altered, something that would really aid them. This need will help reengineering be esteemed for its importance and effectiveness. Third, being a simple achievable tool the concept of reengineering is not burdensome, scary, or impractical." [10]

#### **Hypotheses and conceptual model:**

The hypotheses of the study:

##### **First hypothesis:**

The proposed solutions for the bio incubator processes reengineering have direct remarkable effects on organizational performance.

##### **Second hypothesis:**

The proposed solutions for the bio incubator processes reengineering will lead to the increased quality of activities.

##### **Third hypothesis:**

The proposed solutions for the bio incubator processes reengineering will speed up the activities.

##### **Fourth hypothesis:**

The proposed solutions for the bio incubator processes reengineering will reduce the costs.

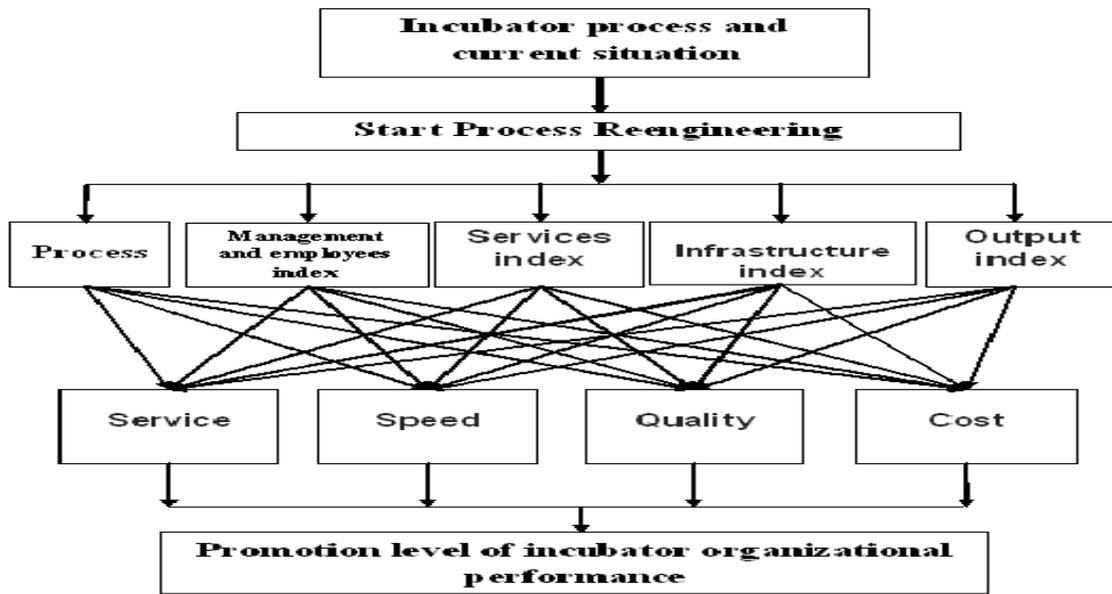
##### **Fifth hypothesis:**

The proposed solutions for the bio incubator processes reengineering will improve the services.

#### **Methodology:**

This study is practical with regard to the goal and descriptive with regard to the method of data collection and has reengineered the bio incubator processes using Hammer-Champy method based on the conceptual model. The statistical population of this research was selected from the members of the technology units located in the biotechnology incubator and the center's staff. The data collected using questionnaires. The number of installed companies in the biotechnology incubator was 20 and the board of directors, fulltime technicians, and staff were approximately 80 persons. Using Morgan's table, the suitable sample volume was calculated to be 66 according to the number of staff. The questionnaire consisted of two sections. The first included demographic data such as gender, age, education, familiarity with incubator and its processes, and their relation with the biotechnology incubator. The second section addressed the study parameters.

Fig1: The conceptual model is accordingly presented



The questionnaire contained 46 questions which generally evaluated the four parameters increased quality, increased speed, reduced costs, and improved services. The same questionnaires were filled by the statistical population in two time sections before and after the reengineering. In addition, the questions were ranked from 1 to 5 according to Likert Scale. The questionnaires were distributed randomly in the target population and 60 questionnaires were collected eventually for statistical evaluations.

In order to validate the questionnaires, the questions, their quantity, and their extent were analyzed by 6 directors from the target population and experts in addition to the reengineering team. The questionnaires were appropriately corrected after collective the opinions of the referees. Since 95 percent of the corrective opinions were considered in the final version, it can be concluded that the questionnaires are formally valid.

Cronbach's alpha method was used to evaluate the reliability of the questionnaire in SPSS software. It was calculated to be 0.93 which is acceptable.

**First hypothesis: The proposed solutions for the bio incubator processes reengineering have direct remarkable effects on organizational performance.**

**Data analysis**

The data were analyzed in SPSS statistical software. The demographic data were studied first using descriptive statistics and to test the hypotheses, Pearson correlation analysis and compare means test was used. The significance threshold was set to  $P < 0.05$ .

The results of the T-test demonstrated that the mean evaluated performance in the two groups (before and after the reengineering) were different (with higher than 99% confidence) suggesting the significant effectiveness of the proposed reengineering-driven solutions in improving the organizational performance of the biotechnology incubator ( $P=0.000$ ). Inferential statistics showed that the average assessment of the organizational performance was 163.60 before presenting the solutions and 191.63 after subjecting them in order to improve the organizational performance of the biotechnology incubator. Broadly speaking, the performance evaluation index increased 18% after reengineering.

Second hypothesis: The proposed solutions for the bio incubator processes reengineering will lead to the increased quality of activities.

Inferential statistics demonstrated that mean organizational performance assessment was 47.18 with a standard deviation (SD) of 8.63868 and a standard error of the mean difference (SEM) of 1.11525 before applying reengineering procedures while it increased to 72.35 (SD=9.65476, SEM=1.24642) after. This suggests that the proposed solutions for reengineering the biotechnology incubator processes would significantly increase the quality of activities ( $P=0.000$ ). This shows the occurrence of 53% improvement in the quality parameter after exerting reengineering.

Third hypothesis: The proposed solutions for the bio incubator processes reengineering will speed up the activities.

According to results it can be concluded that the mean performance assessment was significantly different between the two groups (with higher than 99% confidence) indicating the significant effectiveness of reengineering solutions on speeding up the processes parameters (P=0.000). In addition, inferential statistics showed that the mean performance assessment raised from 31.61 before the applying solutions to speed up the processes to 47.66 after that and indices indicating a 50% increase in the speed parameter.

Fourth hypothesis: The proposed solutions for the bio incubator processes reengineering will reduce the costs.

Analyzing the accuracy of the fourth hypothesis led to this understanding that the mean performance assessment was significantly different in the two target groups (with higher than 99% confidence) suggesting that the solutions of reengineering have been significantly effective in reducing the costs of processes and indices (P=0.000).

According to inferential statistics, the mean performance assessment was 32.66 and 44.08 before

and after applying the solutions for cost reduction. Thus, the cost reduction index raised in an extent of 33 percent.

Fifth hypothesis: The proposed solutions for the bio incubator processes reengineering will improve the services.

The statistical tests demonstrated a significant increase in the mean performance assessment in the two groups after reengineering (with higher than 99% confidence, P=0.000). Inferential statistics indicated that the mean performance assessment was, respectively, 52.13 and 73.88 before and after presenting the solutions to service improvement. Therefore, it can be concluded that the service improvement index has been increased 42 percent.

In addition, the relation of reengineering parameters (cost, quality, speed, and service) with each process and evaluation index of the incubator was analyzed using Pearson correlation coefficient and the results of which demonstrated in table 1.

**Table 1. Correlation matrix of four parameters of reengineering and the evaluation indices of the incubator**

Invoice issuance	management	Financial supports	ordering	services	Educational services	Performance evaluation	Infrastructure	Reception and establishment	commercialization		Performance assessment
PC=1	PC=0.89	PC=0.60	-	PC=1	-	PC=0.81	PC=0.76	PC=0.69	PC=0.29	cost	
P=0.00	P=0.00	P=0.00	-	P=0.00	-	P=0.00	P=0.00	P=0.00	P=0.00		
PC=1	PC=0.93	PC=0.97	PC=0.96	PC=1	PC=0.87	PC=0.68	PC=0.8	PC=0.73	PC=0.78	quality	
P=0.00	P=0.00	P=0.00	P=0.00	P=0.00	P=0.00	P=0.00	P=0.00	P=0.00	P=0.00		
-	PC=0.97	PC=0.76	PC=0.9	PC=1	-	PC=0.84	-	PC=0.94	PC=0.81	speed	
-	P=0.00	P=0.00	P=0.00	P=0.00	-	P=0.00	-	P=0.00	P=0.00		
-	PC=0.92	PC=0.98	-	PC=1	PC=0.64	PC=0.76	PC=0.81	PC=0.87	PC=0.76	service	
-	P=0.00	P=0.00	-	P=0.00	P=0.00	P=0.00	P=0.00	P=0.00	P=0.00		

**Conclusion**

According to the definition, especially based on Hammer and Champy’s opinion, reengineering is explained as the fundamental rethinking and redesigning the processes in order to achieve remarkable improvements in important parameters such as costs, quality, speed, and services. Thus, the effect of reengineering on these four factors as well as evaluation parameters of the incubator was analyzed in this study and the effectiveness of reengineering on the improvement of the mentioned factors and, in turn, organizational performance promotion of the biotechnology incubator was confirmed through statistical tests.

According to the analysis and coefficients, the four factors of reengineering and incubator’s performance evaluation parameters improved in response to BPR and the proposed solutions.

Data demonstrated that the organizational performance improved to an extent of 18%, processes and performance parameters quality to 53%, processing speed to 50%, costs reduction to 42%, and service improvement to 33% as the result of the applied solutions in the biotechnology incubator.

Considering the positive effects of the presented solutions and the enthusiasm of the technology units to the majority of the proposed or executed plans of the present study, it seems that these approaches can be helpful to the activities of incubator centers and science and technology parks as a primary model. Incubators and science and technology parks would try the reengineering methods choosing the appropriate models and operative approaches according to their own conditions and status in order to step toward the improvement of their performance and progression of their goals and promotion of the technology units in achieving the technological ideas and commercialization. Some of the proposed solutions of this research are comprehensive which can be applied to nearly all incubator centers and science and technology parks. A selection of these solutions are presented in the following.

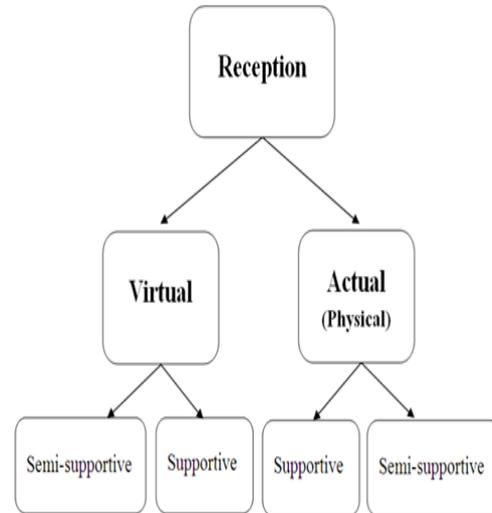
**1- The new model of reception**

As a basic process, reception is considered as a highly important step according to the goals and missions of the incubator. Due to the limitations of resources and equipment of the incubator in recruiting all innovative ideas and supporting them, altering the reception process in order to better and more efficient recruitment of ideas can be a forth going step towards the performance improvement in incubator centers.

As for this, the reception of applicants in incubators through two methods of actual (physical) and virtual reception with subcategories of supportive and semi-

supportive is considered as an appropriate model in order to recruit all innovative commercializable ideas on one hand and compensation of the supportive costs by the semi-supportive reception on the other hand.

**Figure 2. The proposed model for reception**



According to limit resources and spaces of incubator centers, accepting a great proportion of ideas and applicants is impossible. The evaluations have showed that the applicants of incubators include a variety of fields. Some ideas do not require permanent office and laboratory spaces and essentially can be recruited virtually. These applicants can be accepted without allocation of constant office and laboratory spaces to them. This approach of reception would provide more recruitment capacities. The virtual units can use the incubator’s equipment occasionally and cut their expenses dramatically while benefitting from the centers’ supports.

Another group of applicant are those natural and legal individuals with appropriate financial status whom can be recruited non- or semi-supportively. The applicants will be categorized in two supportive and semi-supportive groups after investigating their status. In other words, both actual and virtual reception methods contain two sub-categories of supportive and semi-supportive conditions providing the possibility of earning more income through semi-supportive reception for the incubator centers to cover the expenses and support all applicants with technological ideas while maintaining the supportive approach which includes all people with innovative ideas.

**2- acceptance of the pre-growth stage without referring to the council center**

According to the existing experience, the authority of recruitment of applicants in the pre-growth stage

is delegated to the acceptance committee and the director of incubator in order to speed up and facilitate the reception process. The prolonged delay of council meetings after registration in the system is one of the main issues for the applicants of pre-growth stage. Due to the composition of the council members who are usually occupied in other organizations during the meetings, sometimes, used to take more than a month (several months in some cases).

On one hand, experience suggests that the council's decisions are mainly based on the acceptance committee's evaluations and votes and their report is usually agreed by the council and, on the other hand, the pre-growth period is short term, being an opportunity for the cores and proprietors to register their core company and ideas during it. As for this purpose, according to the center's director's recommendation and council's approval, it was appointed to allow the applicants to start their activity as a core in case of acceptance committee and director's approval before discussing the application in the council. Obviously, qualification of the core to the growth stage requires their success in the pre-growth and their application for establishment in the growth stage will be referred to the council after submitting the focal idea and development of the core. One of the most time-consuming stages of the process and its waiting time (one to several months) is circumvented this way.

### **3- using helpful staff and teams**

Using effective staff and teams was proposed as a solution for many of incubator's processes and directly affected the speed and quality of the processes and aided avoiding the duplications and its related costs. It was observed that staff engaged in island and scattered activities in many processes when relying on automation which resulted in prolonged procedures. Considering Hammer's key sentence in his first article "automation does not work, remove the waste activities", incubators, science and technology parks, and of course all organizations can rethink their processes and entrust the effective staff and teams to perform a variety of tasks, since the important point is how a process is accomplished, not relying only on haphazard automation and instruments!

For instance, using effective staff and teams in reengineering the pre-growth reception reduced the number of process stages from 16 to 9 and decreased the 15 stages of growth period reception to 12. Durations of these processes were also reduced to 330 and 305 minutes, respectively, not accounting the waiting time savings. Using effective teams reduces the duration of the process up to a week in some cases if waiting time of staying the task in the automation system cartable is also included. This

can be extended to other processes in a way that the number of stages in the process of evaluating the technology units reduced from 9 to 7 and the stages of issuance of invoices reduced to 6 from the initial 9 stages, also shortening the duration of the processes to a significant extent (sometime up to a week).

### **4- variation and flexibility during the establishment**

The incubator centers applicants cover a wide variety of ideas with different conditions. According to the existing experience and establishment of various units, we have concluded that the required time for registering and developing the focal idea and finally production and commercialization can be different regarding the nature of the focal idea. It was recommended, as for this, to determine the establishment duration of the technology units as a function of their commercial plan and their performance evaluations during the establishment. This way, it can be flexible according to the conditions and the required operation time for commercializing the focal idea.

On the other hand, it has been observed that despite successful production, some technology units need extended times due to the long delays of obtaining permits from authorities, especially in the case of health related products, or the time needed to attract reliable heavy investors. It is recommended to change the establishment of the technology unit from physical to virtual in such conditions. In other words, the establishment type will change to virtual after successful production of the final product at any moment or at the end of the legal term in order to release the occupied equipment whilst protecting the technology units from failure and avoiding the waste of conducted efforts and paid costs.

### **5- preparing the motivational regulation of technology units**

Cooperation and interaction of the technology units are highly important and effective factors in correct and complete execution of incubators' tasks. Experience suggests that the technology units are not usually enthusiastic about presenting the required information and reports or filling the worksheets resulting in delay in operations and noticeable reduced quality of processes and activities in many cases of not correctly cooperating with the center's staff. Thus, a motivational regulation was prepared in this study in order to motivate the technology units for their increased interaction and cooperation in efficient progression and execution of processes. The other incubators are also recommended to prepare a motivational regulation according to their own conditions in order to encourage the top technology units and boost their

interactions with the units. This regulation has addressed the parameters of interaction of technology units with the incubator. The interaction parameters were set up in the form of specific worksheets and distributed among the staff and relevant technicians. Each technician hold a worksheet during the year scoring the technology units based on their way of interaction and responsibility and recording the quality and quantity of their interactions. The worksheets are recollected at a specific time and the technology units are ranked based on the results from scientific and technological assessment of the units by the assessment committee to determine the poor and top units. The top ones are praised according to the regulation and the poor units are penalized and required to rectify their weaknesses and improve their activities.

#### **6- correcting and strengthening the commercialization process**

One of the main processes and goals of the incubator is the commercialization of technological ideas of the established units after recruitment of new units and supporting the idea owners. In other words, it can be claimed that the incubator has achieved its ultimate goal in case of successful production of the end product and its commercialization. Manufacturing the products driven from innovative technological ideas is practically without economic justification and considered as an abortive activity if they are not commercialized and marketed. Essentially, the existence philosophy of incubators is to expend the costs, equipment, and resources in order to develop the new technological units providing the possibility of industrial or semi-industrial production and marketization of their products which is considered as producing wealth from science. To do so, according to the examinations, observations, comments and suggestions of technology units and experts, and the results of this study, the following tasks are placed on the agenda in order to achieve the center's commercialization goals and other incubators are also encouraged to study, evaluate, and execute the solutions based on their own conditions:

##### a) Founding the products marketing site

Introduction of the products to the customers, advertisement, and gaining their trust are the main obstacles of the technology units in the way of product commercialization. Basically, the majority of technology units have their own websites in which the history of the company, fields of activity, and the products are introduced to the customers. However, founding a website for integrated marketing of the products of all established technology units in the incubator can be an effective step towards the process of commercialization and

product marketing due to the scientific and commercial credits of the incubator's name and reputation.

##### b) Partnership and investment of the incubator in attractive and excellent projects

Another important issue of technology units is the lack of trust from the investors despite the presence of producible products with the ability to be commercialized and appropriately return the funds. On the other hand, aside from the supportive, research, and scientific goals, the incubator or the institute as the founder organization need for revenue and reaching the financial independence or reduced reliance on the public funds. One the effective solutions to this is the partnership and direct investment of the incubator or the institute in attractive and excellent projects. The benefits of these investments and the incomes are practically used for strengthen the other technology units and further support the innovative ideas.

##### c) Obtaining national and international standards for knowledge-based companies

As mentioned, the distrust of market and customers to the products is one the issues of technology units in commercialization. In fact the main challenge of product commercialization is gaining the trust of domestic customers, competing the similar foreign products, and proving the quality and competitiveness of their products. Aside from reducing the costs of obtaining the standards by the technology units, gaining CE (Communauté Européenne) and ISO (International Organization for Standardization) standards by the incubator would be an effective step in Accreditation of the products of the incubator's technology units. In addition, facilitating the procedures of obtaining the standard from Iranian National Standards Organization for the products of knowledge-based companies can be beneficial. To do so, several correspondences and negotiations have been taken place with the authorities in the Standards Organization.

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