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The Role of Management and Human Resource in implementing e-Factory by AHP method
(Case study of Guilan province Industries)

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ABSTRACT: This article is based on a research project to investigate the Barriers to implementation of an electronic factory with AHP method has been developed.The purpose of this research is identifying and ranking all factors to implementing e-factory in the Islamic Republic of IRAN industries, that has been done by collecting data through library studies and distribution of specialized and limited questionnaire, accompanied by interview with experts of Guilan industries (as case study). Methodology of this research can be divided into three major sections. At the first step factors facing the industry were identified for establishing e-factory based on the questionnaire. Cronbach's alpha coefficient was used for determining indicators validity. At the second step identified factors were prioritized by using questionnaire "B" and constitution of the model of analytic hierarchy process (AHP) by EC (expert choice) software. At the third step regarding prioritizing barriers, appropriate procedures of situation of the country's internal and external environment was presented. The method of statistical analysis of data is based on nonparametric inferential statistic methods by SPSS software .Therefore, identified factors in order of priorities are: management, organizational culture, Human Resource, production strategy, quality management, on-time production and technology. In this paper two key factors, "management" and "Human Resource" was emphasized**.**

Key words: e- commerce, e-factory, analytic hierarchy process (AHP)

I. INTRODUCTION

Creating the e-factory brings with it opportunities and risks. The opportunities include realizing the benefits of transformation of business processes and entire enterprises. The risks include the chances of choosing technology and designing processes that, when put together, do not achieve the performance levels needed. The roadmap methodology outlined herein is an organized approach to analyzing the technology and process needs of a manufacturing organization and identifying the technology solutions necessary to respond to those needs. The roadmap approach also makes it possible to deal with the rapid changes and evolution of the third wave of Internet-inspired technology for the e-factory (Beavers, 2001). Although the debate about whether evolution is a valid theory for the creation of mankind has been going on for two centuries, the concept of evolution is gaining ground as a philosophical approach to the design and development of new products and technologies. The evolutionary approach is based loosely on the theory of natural selection: that only those random changes in a current design will survive if those changes create a better or more survivable design. Taken to its extreme, the evolutionary approach to product design is more like a brute force acceleration of evolution: create an exhaustive number of random perturbations to a design concept, challenge all of the designs with a do or die test, and keep only those that perform the best. Nowadays the atmosphere of business for industrial unit has severely become competitive and its sophistication is becoming much more every day. Sooner or later all manufacturing units are forced to accept this competitive and sophisticated atmosphere; such that it is necessary to achieve essential capabilities for accelerating adaptation of its situation with changes that happens in their business. It is obvious that each company which can adapt itself much more and faster with the condition of change is more successful and it is in this way that the concepts of e-supply chain and e-factory will get significance as the basis of e-commerce. E-factory and e-supply chain will realize e-commerce network in two vertical and horizontal dimensions. Changes that have been made at the process of manufacturing by e-commerce are very impressive; from this view that it completely changes our mind about a factory. In other words it creates new engineering in our

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managerial worldview. This research is going to supply new insight of the nature of the fallowing manufacturing environment to managers and practitioners of country's industry by consideration of critical factors of establishing e-factory in country besides methodology in order to be able to think well about its location at the fallowing situation and its challenges by using its guidance [1].

II. THEORETICAL FRAMEWORK

There has been much said and written over the last ten years about how business will be or is being conducted in cyberspace. While this "hyping" of the business utilization of the Internet has been aimed at promoting the cutting-edge aspects of companies offering products that are necessary for the Internet to continue growing, it has been a harbinger of great change in how business to-consumer (B-to-C), business-to-business (B-to-B), and business-to-employee (B-to-E) will be conducted in the future. Although the nature and use of this hype has been changing yearly, there is a fundamental change in the structure of how business is being transacted due to the advent of the technologies related to the Internet. There are several concepts and structural models that are key to describing what is happening in business cyberspace. The concepts of e-business and the e-factory and models that describe the key elements of each are introduced in this paper. These models and concepts are used throughout the remainder of this paper.

a. e-Business

One of the terms that was long ago overworked but which is still useful is "e-business." The definition of e-business includes everything from the electronic facilitation of business transactions using the Internet to a whole new form of commerce based on "outside the box" strategic thinking about where companies add value in their global supply chains [2]. As a minimum, e-business is characterized by three adjectives: on-line, real-time, and interactive. On-line means that individuals and companies have computers that are actively connected to a network for a considerable portion of their decisions and transactions. Real-time means those individuals and companies are expecting answers to their inquiries or their communications within seconds. Interactive means that individuals and companies are conducting extended conversations, negotiations, or transactions while they are on-line [3].

When using a nodal network model for the supply chain, it is clearly seen that factories can be viewed as just a node in the e-supply chain. Inside this factory node are the business processes that must interact with the e-business facilitated external processes. As a result, each process in a factory must be e-business oriented to satisfy the cycle time requirements, to operate within the network of supply chain nodes, and to provide the flexibility and speed required [4].

In summary, e-business is radically transforming business processes. Industries are dis intermediating because of e-business. Enterprises are rethinking where they add value and thinking about their industry as a network or assembly of component processes. As a result, there are significant transformations of entire industries and, more importantly, entire supply chains where there is a regrouping who owns the components and where they fit in the supply chain [5]. E-Business is changing supply chains by changing the structure, the dynamics and the economics of how large groups of companies work together [6].

b. An Enterprise Process Model

One of the results of the emergence of e-business is that companies have to rethink where they add value in a supply chain, how they do that profitably, and how they should transform themselves. To describe how these issues can be addressed, a few simple models of business "enterprises" are presented in the following.

The full impact of e-business on the manufacturing enterprise is best understood when a business process model is used. In reality, an enterprise consists of only a few key business processes. The diagram in figure (1) illustrates a few of the key processes that exist in most manufacturing companies:

The product realization process (PRP) consists of all activities associated with converting market need into a deliverable product or service. The order fulfillment process (OFP) consists of all the activities necessary to convert an order for a product or service into a delivered product or service. The order capture process (OCP) consists of all the activities necessary to grow, improve, and nurture customer relationships, as well as to convert a customer's need into a purchase order. Support processes can include a variety of processes and activities, such as field service, administrative support, human resource management, financial management, and legal[7].

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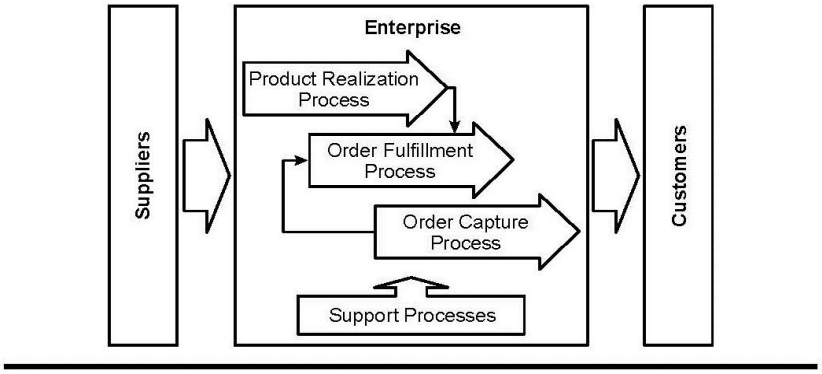

Figure (1): Typical Enterprise Process Model (Beavers, 2001)

c. Extending the Enterprise Model into Supply Chains

Most final products are the result of many companies working together through a progression of facilities and conversion steps to produce a final product. This cooperation of companies working through a progression of facilities is called a supply chain. Illustrated in figure (2) is the business process model that encompasses the supply chain[8].

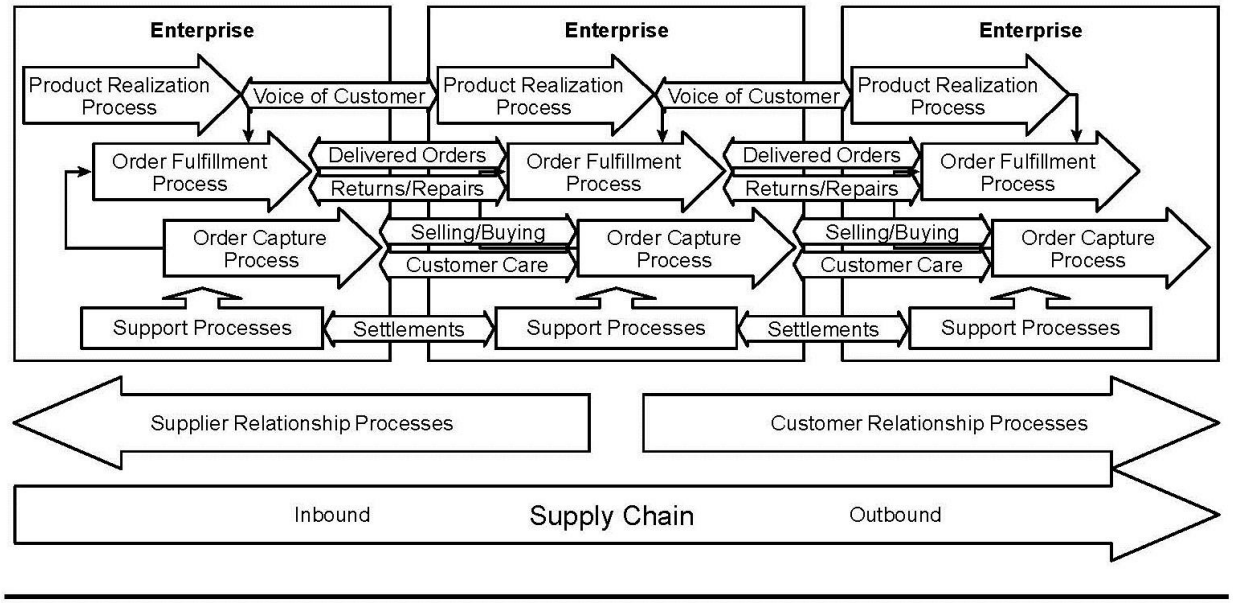

Figure (2): Supply Chain Enterprise Process Model (Köksala & Tekinb, 2012)

d. e-Supply Chain

This model of the supply chain needs to be converted to a two-dimensional model to fully encompass all the dynamics of a real-world environment. For example in figure(3), two dimensions of a supply chain are identified. The horizontal dimension is called the e-supply chain.

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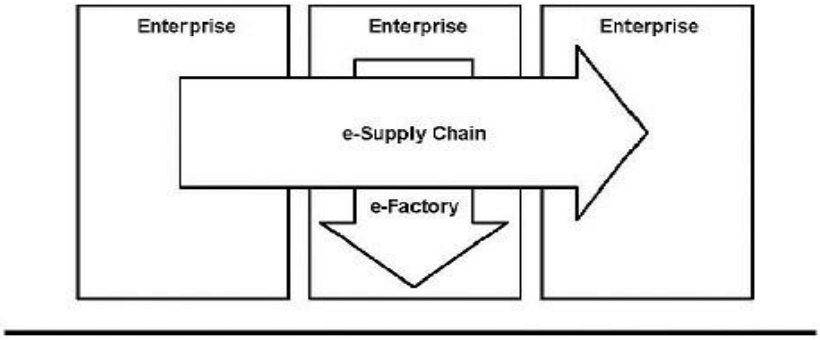
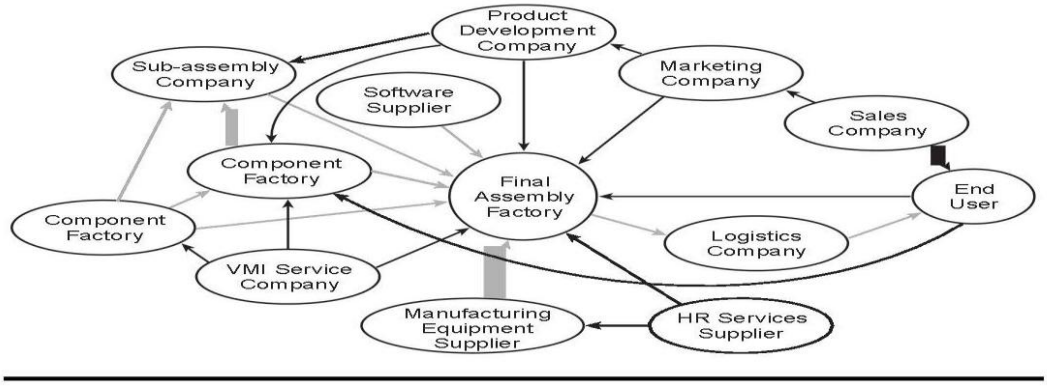


Figure (3): Two-Dimensional View of e-Business (Beavers, 2001)

The e-business driven supply chain is more like a network or Web of nodes where each node is performing some type of value-adding activity. Figure (4) illustrates a supply chain that typifies the semiconductor industry today. Each node in this supply chain network is a company, and in particular, a facility of a company. Information in the supply chain consists of all the interactions between all the nodes in the network. For this supply chain, or in reality a supply web, to operate successfully, all of the transactions, communications, and deliveries between all of the nodes must happen at the proper time and with the proper results[9].



Figure(4): Supply Chain as a Network of Nodes (Meyer, 2009)

As technology and process trends accelerate the introduction of new technologies into the e-factory, decision-making about which software and hardware suppliers to use becomes more complex[10]. Over the last half of the last decade there was a raging debate associated with information technology strategies as to whether a company should use a single software provider for all its business application and control needs, or whether there should be a "best of breed" approach. The rapidly growing enterprise resource planning (ERP) companies such as SAP and Oracle were of course advocating the single supplier enterprise approach. However, the reality was that the enterprise systems were hardly up to performing all the functions in a company, especially not for the e-Factory. As a result, using a best-of-breed solution set is often the best approach to the e-factory. Thus, the "solution set" for an e-factory will likely consist of multiple suppliers. The horizontal e-chain is illustrated in Figure (5).

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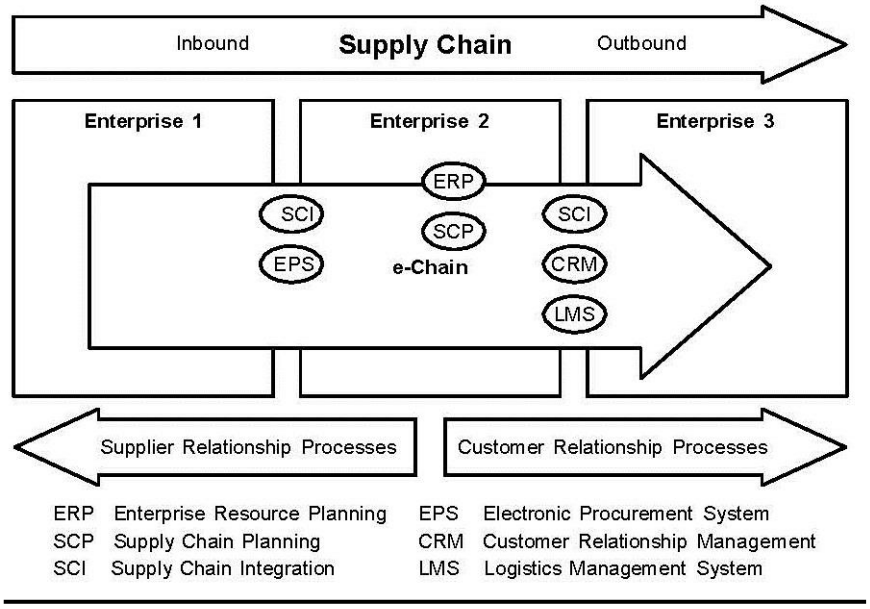

Figure (5): Horizontal Solution Set Components (Beavers, 2001)

e. e-Factory

The e-factory is the vertical dimension in the two-dimensional e-Business. In simple terms, the e-factory is a new, all - encompassing term for all of the electronic control, automation, and intelligent machines that occupy today's factory environment. Electronic control of the factory has been growing in breadth and sophistication for the last two decades. With each new increase in performance and reduction in cost in computer technology, the factory environment comes under greater computer control.The vertical components of an e-factory solution set address the requirements that are created by the need to support the internal process requirements and the interfaces to the e-chain solutions that different customers and suppliers might have. The enterprise and supply chain model extended to illustrate vertical solution set components is illustrated in figure (6).

d. summary of Theoretical Framework

E-business is radically transforming business processes. Industries are dis intermediating because of e-business Enterprises are rethinking where they add value and thinking about their industry as a network or assembly of component processes. As a result, there are significant transformations of entire industries and, more importantly, entire supply chains where there is a regrouping who owns the components and where they fit in the supply chain. E-Business is changing supply chains by changing the structure, the dynamics, and the economics of how large groups of companies work together[11].

Creating the e-factory brings with it opportunities and risks. The opportunities include realizing the benefits of transformation of business processes and entire enterprises. The risks include the chances of choosing technology and designing processes that, when put together, do not achieve the performance levels needed.

This evolution impossible without an "Change Management Vision"**.** Change management is the process of managing an organization's ability to deal with and implement change. Implementing an e-factory usually involves significant change for the workforce. Changes typically come in the form of training to perform new jobs, training to use new technology, working in a different supervisory environment, all being measured by different types of performance parameters and being compensated by different types of reward systems.

The key elements to a change management vision should include:[12]

- Feedback and improvement methodology
- Frequency and nature of communication
- Training and recycling skill sets

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This requires an organized approach to analyzing the technology and process needs of a manufacturing organization and identifying the technology solutions necessary to respond to those needs. Change management also makes it possible to deal with the rapid changes and evolution of the third wave of Internet-inspired technology for the e-factory.

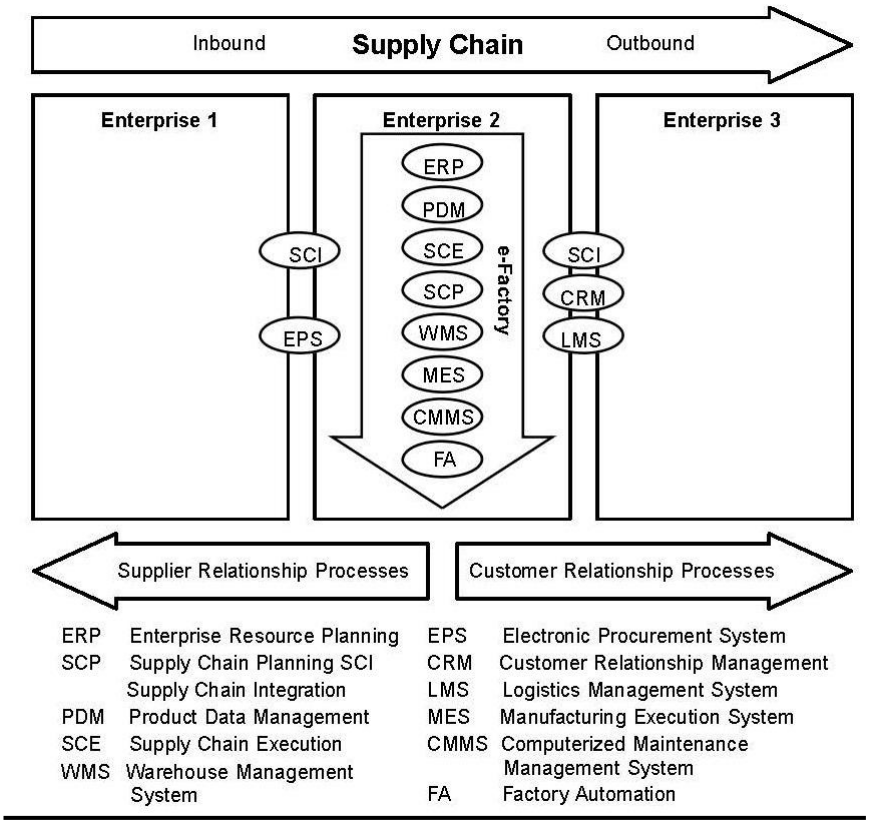

Figure (6): Horizontal Solution Set Components (Beavers, 2001)

III. RESEARCH METHODOLOGY

Research methodology can be divided into 3 major parts that has been done in the framework of fallowing design.
First step; includes identifying management and human elements facing industries for establishing e-factory that is done based on the questionnaire (A). The result of this step is identifying indicators and effective factors. In order to determine validity of indicators Cronbach's Alpha has been used.
Second step; identified indicators will be ranked in previous phase that its data are obtained by using questionnaire (B).
Third step; ranked factors of previous step are prioritized.

a. First step

Regarding studies related to identification route of e-factory in theoretical studies, dimension and indicators of establishing e-factory has been identified. Then through questionnaire that was designed for various industries experts (Questionnaire A) indicators and effective factors of establishing e-factory system was questioned in order to be prioritized based on their viewpoint (Table 2).For testing reliability of the questionnaire questions of the interview, Cronbach's Alpha coefficient was used:

$$\alpha = \frac{n}{n-1}\left(1 - \frac{\sum S_i^2}{si}\right)$$

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Table (1): Result of Cronbach's alpha

Description	Amount of Cronbach's alpha	Type of questionnaire
Reliability of the questionnaire has been confirmed	0 . 9008	Questionnaire of industry's expert

Table (2): Effective factors of establishing e-factory system for Management & Human Resource

(criteria)	effective elements of implementing e-factory at Iran industries
Management	I. Lack of managers' mastery at economic and international strategic problems. II. Ruling of national vision instead of global vision in managers. III. Inattention to capitals' arrival and foreign capitalist to industry. IV. Lack of integrated information system of management at Iran's industries. V. Rapid replacement of top managers due to their belonging to government. VI. Lack of strategies for keeping valuable human resources.
Human Resource	I. Lack of skilled workforce. II. Lack of flexibility of personnel against changes. III. Lack of full awareness of personnel with description of their duties. IV. Lack of personnel's commitment for achieving organization's goal.

b. Second step

Collective composed matrices of paired comparisons about each group of different levels of AHP tree has been calculated separately for every element. Total composition of management elements is shown in table(3).

Table (3):) Composed matrix of Paired comparisons of Management elements

	I	**II**	**III**	**IV**	**V**	**VI**
I	1	0.38	2.55	1.93	0.71	1.85
II	0.42	1	1.61	0.84	0.65	0.90
III	0.39	0.62	1	1.05	0.54	0.74
IV	0.52	1.19	0.95	1	0.65	0.91
V	1.41	1.54	1.86	1.54	1	1.20
VI	0.54	1.11	1.36	1.11	0.83	1

Table (4): Composed matrix of Paired comparisons of human resource elements

	I	**II**	**III**	**IV**
I	1	2.33	0.65	0.79
II	0.43	1	0.47	0.613
III	1.54	2.132	1	1.184
IV	1.265	1.631	0.844	1

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Table (5): Normalized matrix of Management elements on implementing e-factory system

	I	II	III	IV	V	VI	Wi
I	0.243	0.303	0.273	0.25	0.161	0.28	**0.2502**
II	0.098	0.127	0.173	0.113	0.15	0.137	**0.133**
III	0.091	0.079	0.107	0.143	0.122	0.112	**0.119**
IV	0.121	0.153	0.102	0.135	0.15	0.14	**0.134**
V	0.33	0.196	0.119	0.21	0.23	0.18	**0.2242**
VI	0.126	0.142	0.146	0.15	0.187	0.151	**0.130**

Table (6): Normalized matrix of Human Resource elements on implementing e-factory system

	I	II	III	IV	Wi
I	0.236	0.325	0.219	0.220	**0.251**
II	0.101	0.141	0.158	0.171	**0.142**
III	0.363	0.301	0.337	0.330	**0.333**
IV	0.298	0.230	0.285	0.278	**0.273**

Rate of compatibility of composed matrices of paired comparison is calculated as below that for example calculation steps for matrix related to "management agent" is as bellow.

WSV=A.W

$$\begin{pmatrix} 1 & 2.38 & 2.55 & 1.93 & 0.71 & 1.85 \\ 0.42 & 1 & 1.61 & 0.84 & 0.65 & 0.90 \\ 0.39 & 0.62 & 1 & 1.05 & 0.54 & 0.74 \\ 0.52 & 0.19 & 0.95 & 1 & 0.65 & 0.91 \\ 1.41 & 1.54 & 1.86 & 1.54 & 1 & 1.20 \\ 0.54 & 1.11 & 1.36 & 1.11 & 0.83 & 1 \end{pmatrix} \begin{pmatrix} 0.250 \\ 0.133 \\ 0.119 \\ 0.134 \\ 1.224 \\ 0.130 \end{pmatrix} = \begin{pmatrix} 1.528 \\ 0.805 \\ 0.657 \\ 0.799 \\ 1.365 \\ 0.909 \end{pmatrix}$$

$$C.V = \frac{W.S.V}{W}$$

$$CV = \begin{pmatrix} 6.112 \\ 6.053 \\ 5.521 \\ 5.962 \\ 6.088 \\ 6.992 \end{pmatrix}$$

$$\begin{cases} C.I = \dfrac{\lambda \max - n}{n-1} \\ \lambda \max = \dfrac{\sum_{i=1}^{n} CVi}{n} = \dfrac{36.42}{6} = 6.121 \end{cases}$$

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Table (7): Calculate the Weighted Sum Vector and the Consistency Vector

WSV Management	CV Management	WSV Human Resource	CV Human Resource
1.528 1.805 0.657 0.799 1.365 0.909	6.107 6.053 5.521 5.963 6.066 6.992	1.015 0.574 1.436 1.104	4.0398 4.0397 4.0395 4.0395
Sum	36.634		16.1558

$$\begin{cases} C.I = \dfrac{6.121-6}{6-1} = 0.242 \end{cases}$$

$$CR = \frac{CI}{RI}$$

$$\begin{cases} CR = \dfrac{0.0242}{1.24} = 0.0195 \end{cases}$$

Table (8): Calculate the Consistency Ratio

	λ **max**	**C1**	**RI**	**CR**
Management	6.121	0.02016	1.24	0.01635
Human Resource	4.0396	0.0099	0.9	0.011

Regarding compatibility rate that is less than 0.1 collective composed matrixes of paired comparisons about the management factor has acceptable compatibility[13]. It should be mentioned that due to using geometric mean, compatibility rate of collective matrices is less than compatibility rate of individual matrices.

4-3.third step

After being certain about accuracy of calculations and its compatibility in order to prioritize choices that are in fact barriers of implementing e-factory system at industries, total weight of choices was calculated. Team EC(Expert Choice) software after combining all matrices of the surfaces of formed tree, determining total weight based on the tree has been formed since the beginning that can arrange them based on the highest to the lowest weight. Table (9) shows prioritizing Management and Human Resource Factors on implementation of e-factory system with AHP method.

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Table (9): Prioritizing Management and Human Resource Factors on implementation of e-factory system with AHP method

Row	prioritizing barriers effective on implementation of e-factory system with AHP method	Total weight
1	Lack of managers' mastery at economic and strategic problems	0.0690
2	Rapid replacement of top managers due to their belonging to government	0.0618
3	Lack of personnel's commitment for achieving organization's goal	0.0552
4	Lack of full awareness of personnel with description of their duties	0.0453
5	Lack of flexibility of personnel against changes	0.0416
6	Lack of integrated information system of management	0.0369
7	Ruling of national vision instead of global vision	0.0367
8	Lack of strategies for keeping valuable human resources	0.0358
9	Inattention to capital's arrival and foreign capitalist to industry	0.0328
10	Lack of skilled and specialized workforce	0.0235

IV. CONCLUSION

The role of management in implementation e-factory is extremely important to the success of e-Business. Managers play a huge role that requires many responsibilities. Management must consider many factors when implementing a decision. Obtained significance coefficient in this case study shows that more than 47% of significance coefficient is devoted to the elements of management and human resources; these elements are counted as critical and key elements at implementation of e-factory.

The role and responsibility of management in decision implementation is crucial. Management must create a vision for implementation. They must also create a timeline for implementation and steps to complete this process. Management must gather resources in order to make decision implementation successful. It is also important for managers to gain trust, enthusiasm, and confidence in a plan from stakeholders. Managers must consider many factors when creating a decision implementation plan. Managers must also monitor and control the implementation process to ensure success.

Many factors affect the decision implementation. Criticism and support from employees affect decision implementation strongly. If employees are unwilling to participate or they do not want to see the plan succeed this will cause problems for the implementation plan. Stakeholders on all levels must be accommodated according to priority.

The theoretical analysis reveals the implications there are in building a management vision. The analyze implies that building a management vision would require a matching human resource strategy, which would involve the human resource management, the organizations way of working as well as the human resource policies and practices.

A successful e-factory implementing is unique, and it should motivate middle management to focus on long-term strategies rather than short-term goals. From the above study it is clear that to implement e-factory in the e-Business. It needs support from the top management and all staff members. Different enterprises can adopt different approaches to implement e-factory. By adopting certain strategies the HR manager can overcome the barriers while implementing the e-factory in an business.

As it was predicted, the element of management has the highest significance than other elements so this element has the most effect on implementation of e-factory system. The reality at interview with experts, conform to this result. Therefore regarding prioritizing identified barriers in relation with the elements of management, it should be tried for their solution that of course part of this duty is undertaken by organization and another part is undertaken by government and its macro policy-making.

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