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Evaluation of the use of business process reengineering (BPR) for improving business-IT alignment by utilizing the intelligent decision support system (IDSS)

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Abstract

The present study aimed to evaluate the use of business process reengineering (BPR) to improve the business-IT alignment in knowledge-based businesses in Tehran by MATLAB programming software. The research issues included the ambiguity and fatigue of decision-makers and managers of knowledge-based businesses in Tehran due to the combination of different methods of evaluating the use of BPR to improve the business-IT alignment. Using the intelligent system, the status of "improving the alignment of IT with knowledge-based businesses of Tehran" can be examined numerically and more accurately: From the perspective of ideal importance, if the state of "IT service business strategy process reengineering ($X1$)" is good, i.e. 0.813, and "IT service business design process reengineering ($X2$)" is good, i.e. 0.824, and "IT service business transfer process reengineering ($X3$)" is good, i.e. 0.819, and "IT service business operation process reengineering ($X4$)", i.e. 0.812, and "IT service business continuous improvement process reengineering ($X5$)" is good, i.e. 0.815, then the state of "improving the alignment of IT with Tehran knowledge-based businesses" is at the "excellent (fifth level)" level, i.e. 0.952. According to the membership functions of linguistic variables by experts, the value of 4.76 within a 5-value range in the range defined for the "excellent" linguistic variable, i.e. the state of improving the alignment of IT with knowledge-based businesses in Tehran was obtained equal to 0.952 with a programming code $[0.813; 0.824; 0.819; 0.812; 0.815]$.

Keywords: Business Process Reengineering (BPR), business-IT alignment, knowledge-based businesses of tehran, Intelligent Decision Support System (IDSS), Artificial Neural Networks (ANN)
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1 Introduction

Due to limited resources in today's complex world of business, having knowledge, even basic but fundamental, about industrial management for everyone is felt [15]. Given that production planning is still performing in obsolete ways in many businesses and it is incompatible with the growth of technology and management science, managers are seeking to utilize the methods invented and implemented by researchers to improve production in their enterprises [5]. The production process improvement has been a factor that can help the survival of enterprises and it has occupied the thoughts of leading business managers [8], [15].

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Each goal-oriented business, which has an active and coordinated system and is connected to the external environment, is a social institution. Most businesses relied on gradual changes to take advantage of opportunities in the past, but over time, it became clear that gradual changes alone would not solve the current problems of businesses, and sometimes it was necessary to make fundamental changes for businesses to survive [18]. The IT Infrastructure Library (ITIL) developed with the realization that businesses were increasingly dependent on information technology to achieve their goals. This increase in dependency has increased the need for information technology services as an intermediary to achieve business goals. These goals meet the customer needs and expectations [5] and [34]. In recent years, the emphasis has shifted from the development of "IT applications" to the "ITIL Framework". An applied information technology software (sometimes refers to as an information system) [16] only participates in the realization of major business goals when the system is available to users, and it is supported by maintenance and operations management in the case of an error or needs to repair. Throughout the life of IT products, the operational phase accounts for 70 to 80 percent of the total time and cost, and only the rest is spent on product development (or product development) [12]. Therefore, the efficiency of ITIL framework processes is essential in Business-IT alignment for IT success. This is true for any type of business, large or small, public or private, centralized or decentralized, in IT services, outsourcing or providing domestic IT services [26] and [8]. In all cases, the service must be reliable, consistent, high-quality, and reasonably priced. The ITIL framework guides the provision and support of IT services to fulfill business needs [17].

According to studies in Scopus, ScienceDirect, Springer, Irandoc, Islamic World Science Citation Database (ISC), as well as research at Tehran and Tarbiat Modares universities, there was not any similar study on designing a neuro-fuzzy decision support system for evaluating the application of business process reengineering to improve Business-IT alignment in knowledge-based businesses in the MATLAB programming software. In the present study, the novelty and innovation aspects were as follows:

- Designing the neuro-fuzzy decision support system for the application of business process reengineering to improve Business-IT alignment in knowledge-based businesses
- Modeling the decision-making space and case study of BPR documents and research in the form of a system to investigate the components affecting the application of business process reengineering to improve Business-IT alignment in knowledge-based businesses in MATLAB software
- Developing the localization of BPR components (a tool for transfer from the current state of the business (As-Is) to the optimal state of the business (To-Be)) to improve Business-IT alignment in knowledge-based businesses.

2 Theoretical research bases

"Business process reengineering (BPR)" is defined as a radical redesign of processes to significantly improve cost, quality, and service. Businesses have performed various business activities over the years [15] and [26], from providing strategic sourcing to order fulfilment, and customer relationship management (CRM). Business process reengineering projects lead to major changes in business processes [22], [24]. It is reasonable to expect that business process reengineering and modeling projects have a significant and measurable impact on business performance [21], [33]. Business Process Reengineering (BPR) includes identifying the root causes of problems and providing solutions, setting objective and quantitative indices for measuring performance, preventing problems, measuring market information for prioritization, experts' awareness of production issues and problems, and holding the consultation and survey session to evaluate the process, review tasks of the production department, and improve it, and identify important and key processes and improvement [38]. BPR is a way to completely improve performance by utilizing sources as the maximum value added is obtained in business activities. Costly activities of processes or the whole business are minimized in reengineering [23], (Khoon Siavash and Mohammadi 2009). Many businesses in the implementation of business process reengineering pay less attention to activities and capabilities that their businesses gain from other improvement projects, and this will sometimes lead to re-costs for those efforts and activities [5], [34]. Furthermore, all previous activities and improvement efforts in businesses create capabilities in businesses, and awareness and conscious use of them lead to the success of businesses in other ongoing projects in the business, including BPR [32]. In a competitive space, businesses need an efficient and integrated system of business sources to achieve higher quality and speed in providing goods and services. The use of ERP software is an appropriate tool to achieve this goal. The inconsistency of ERP with BPR is the main problem for implementing ERP. Proper implementation of BPR, inspired by strategic planning and senior management support, will lead to successful ERP implementation, followed by a strong correlation with the results of performance appraisal in business [19].

Despite the importance of using information technology, we see problems in many businesses due to the lack of meeting business needs because of the high volume of investment in information technology and low alignment. Increased competitive pressure in businesses requires a higher level of efficiency [5], [15]. Strategic alignment has traditionally been considered a means to achieve optimal productivity in information technology, but recent research has raised knowledge about the role of IT alignment and business in this field. However, there is little empirical evidence for the relationship between information technology and business with business performance [1]. Businesses all over the world have come to realize that information technology is an important supporter of economic success and a strategic partner. Businesses, which recognize the benefits of IT and understand and manage risks and critical dependencies of many business processes on IT, are more successful. Such businesses also use IT alignment with the business to create more value. However, since the business intervention and participation are also vital in creating value from IT investments [10], [30], the need for a shift from IT alignment with business to IT business governance became apparent. IT business governance goes beyond IT-related responsibilities and extends to IT-related business processes that are essential to creating business value. Therefore, businesses need to establish IT business governance by using frameworks that can correctly identify both IT and business responsibilities [10], [30]. In this regard, Val IT and COBIT frameworks can pave the way for businesses. Businesses need to understand the relationship between these two frameworks and use them simultaneously to achieve more success in this regard [9]. In today's turbulent business environment, the success of businesses depends on the orientation of all sectors of the business in line with its strategic path [30]. In such an environment, where most businesses invest in information technology and information systems, businesses have no choice but to use information technology as a strategic resource to achieve their strategic goals [26], [34] and this is where the concept of alignment of IT and business strategies (strategic alignment) finds meaning [10], [30].

The following table shows a brief description of the foreign research background

To summarize the chapter and present a theoretical framework of the research, an appropriate theoretical framework should identify important variables in a situation that is related to the research problem and provide a link between these variables in a logical way. The following variables will be used to evaluate the use of business process reengineering to improve Business-IT alignment. The following tables present the theoretical framework of the research based on the theoretical bases in the field of BPR and Business-IT alignment.

3 Research methodology

The research method was applied modeling in terms of purpose because, on the one hand, it accurately described concepts and rules of BPR application evaluation to improve the Business-IT alignment technology, and on the other hand, the relationships between these concepts and rules are evaluated and determined by experts. Decision support system: The concept of a decision support system did not experience the initial failures of the management information system probably due to the more limited scope of the decision support system. A gentler approach to the decision support system maximizes the chance of success. These systems combine human resources (personal knowledge) with computer capabilities to improve the quality of decision-making, especially on semi-structured issues. Decision support systems use the intellectual resources of people with computer capabilities to improve the quality of decisions. These systems are usually used to solve semi-structured problems. Decision support systems are computer-based interactive systems that help decision-makers solve semi-structured problems using data and models [2].

An important reason for using artificial neural networks and fuzzy systems in this study is that real-world problems usually have complex structures, indicating ambiguity and uncertainty in their definition and understanding. Since humans could think, they have always faced ambiguity in various social, technical, and economic issues. The human brain defines and evaluates sentences according to a variety of factors based on inferential thinking, and their modeling in mathematical language and formulas will be very complicated if not impossible. Linguistic variables are expressed based on linguistic (verbal) values, which are in the set of phrases (words/terms), and linguistic terms are attributes for linguistic variables. Here, linguistic variables are variables that have acceptable values in the forms of human and machine language words and sentences instead of numbers. A fuzzy number is a special fuzzy set in which x accepts real values of the member of the set R and is a function of its membership function [7] and (Keshavarzmehr 2012) and [13].

Equation (3.1):

$$A' = \{(x, \mu_{\tilde{A}}(x))jx \in X\} \tag{3.1}$$

The following classification indicates the relationship between fuzzy logic and neural networks according to this view. [25], [28], (Keshavarzmehr 2012), and [29]

Concurrent Neuro-Fuzzy Models: Neural networks and fuzzy systems work together on a single task but have no effect on each other. None are used to determine another parameter. In this model, neural networks are usually used to preprocess the input or output of the fuzzy system.

Table 1: A brief description of the foreign research background

Row	Research title	Source	Research summary
1	A quantitative and qualitative study of the link between business process management and digital innovation	Looy [27]	Levy et al. (2021) presented a model for investigating the relationship between business process management and digital innovation.
2	Strategic IT alignment Projects. Towards Good Governance	Pérez et al., [27]	Pérez et al. [27] identified and analyzed the relationship between strategic IT alignment projects toward good governance.
3	A framework to evaluate the interoperability of information systems – Measuring the maturity of the business process alignment	Liu et al. [26]	Liu et al. [26] provided a framework for evaluating the interoperability of information systems with the aim of measuring the maturity of the business process alignment.
4	Proposal model of change for Business-IT Alignment	Kawtar et al., [20]	Kawtar et al. [20] designed a proposal model of change for Business-IT Alignment.
5	Factors Hindering Business-IT Alignment in Small and Medium Enterprises in China	Wang & Rusu, [42]	Wang & Rusu [42] evaluated factors hindering business-IT alignment in small and medium enterprises in China.
6	Modeling and automatic code generation for Wireless Sensor Network Applications using Model-Driven or Business Process approaches: A systematic mapping study	Teixeira et al. [40]	Modeling and automatic code generation for Wireless Sensor Network Applications using Business Process Management Systems (BPMS): A systematic mapping study
7	A systematic literature review on the architecture of business process management systems	Pourmirza et al. [36]	A systematic literature review on the architecture of business process management systems in continuous Business-IT alignment with an emphasis on the Business Process Management Systems (BPMS)
8	A new paradigm for the continuous alignment of business and IT: Combining enterprise architecture modeling and enterprise ontology	Hinkelmann et al. [17]	Improvement of business intelligence application using a new paradigm for modeling business-IT architecture, and enterprise ontology; Emphasis on the continuous alignment of business and IT
9	Literature review of the situation research faces in the application of ITIL in Small and Medium Enterprises	Cruz & Mesa [12]	Review of the management of IT services and IT infrastructure library (ITIL) in small and medium-sized enterprises (SMEs) to improve the use of business intelligence
10	An evaluation framework for comparing business-IT alignment models: A tool for supporting collaborative learning in organizations	El-Mekawy et al. [14]	The study on infrastructures and requirements of implementing the IT service and ITIL with a systematic approach to continuous business-IT alignment
11	KM-oriented business process reengineering for construction firms	Cheng et al., (2012)	Providing a comprehensive framework for data mining of business process reengineering (BPR) to improve IT service management and business knowledge management
12	Integrating SDLC & ITSM to 'Servitize' Systems Development	Pollard et al., [35]	Investigating the infrastructures and requirements of designing and integrating the service system development by information technology service management (ITSM) and methodology of system development with an emphasis on using business intelligence
13	Transforming IT service management-the ITIL impact	Cater-Steel et al. [11]	A comprehensive study on promotion to IT management in continuous Business-IT alignment with an emphasis on vital effects of IT infrastructure library (ITIL)

Table 2: Theoretical framework of the research

Business process reengineering for Business-IT alignment [?], [27], [26], [12], [17],[3], [35], [4], [6], [20],[39], and [42]	
Service strategy process reengineering	Service design process reengineering
Financial management process	Service Catalog Management Process
Service portfolio management process	Service level management process
Service Demand Management Process	Service Capacity Management Process
Business Relationship Management Process	Service Availability Management process
Service operation process reengineering	IT Service Continuity Management process
Service Event Management Process	Service Information Security Management Process
Service Incident Management Process	Service Provider Management process
Service Request process	Service transfer process reengineering
Service Issue Management Process	Service Transfer Planning and Support Process
Service Access Management Process	Service change management process
Service desk process	Service asset and configuration management process
"Continuous service improvement process" reengineering	Service Dissemination and Deployment Management process
Service Improvement Process	Service test and validation process
Service Reporting Process	Service evaluation process
Service monitoring and control process	Service Knowledge Management Process
Benefits of using BPR in business [34], [27], [26], [17], [3], [40], [31], [36] and [20], [39] and [42]	
1. Reducing costs	4. Faster customer service
Reducing business costs in the field of hardware	Rapid development of services and products to customers
Reducing business costs in the field of software	Providing fast services and products for customers
Reducing business costs in the field of manpower	Providing services independently or in groups
Reducing business costs in the field of infrastructure upgrades	Eliminating delays due to hardware and software purchases
2. Improving flexibility and scalability	Increasing the computing power
Quick business response to market changes	Providing the latest solutions
Meeting customer needs on various scales	Utilization of the Internet to provide business services at any time and place
Meeting needs within the business on various scales	5. Establishing customer relationships
3. Increasing productivity	Better insight from customers
Easier use of new technologies	Provide custom services
Integration of applications in the future	Facilitating payments between buyers and sellers
Eliminating the complexity of technology and business	Sharing business plans

Cooperative Neuro-Fuzzy Models: Neural networks are used to determine the parameters of a fuzzy system. These parameters include fuzzy rules, the weight of rules, and fuzzy sets.

Neural network-driven fuzzy reasoning systems: Some researchers consider these systems to be cooperative models. These models are used to extend fuzzy laws.

Hybrid Neuro-Fuzzy Models: Neural networks and fuzzy systems are combined in a coordinated structure. This model can be considered as neural networks with fuzzy parameters or a fuzzy system with distributed learning. ANFIS, ANNBFIS, NEFClass, and FLEXNFIS are examples of this model.

Given the use of the intelligent system designed in the present research, five steps were considered to design an intelligent BPR use evaluation system to improve Business-IT alignment, inspired by the studies [25], [13], Keshavarzmehr 2012, [28], [29] as follows.

1- Modeling the concepts of BPR use evaluation to improve the Business-IT alignment to identify input and output variables and draw their relationships.
2- Defining qualitative variables using linguistic constraints and assigning fuzzy numbers and sets, and membership functions to them
3- Designing an intelligent system based on definitions and designs according to MATLAB software: This stage includes extracting expert rules and evaluating them by experts and creating a fuzzy rules database, as well as designing an inference engine with access to fuzzy rules.
4- Designing the user interface and the way of displaying the options and using the designed intelligent system
5- Selecting a method for defuzzification to convert fuzzy numbers and sets to a definite value to actually evaluate the system performance

The following table presents the intelligent system validation tool to evaluate the use of BPR to improve Business-IT alignment (IT.ALIGN.BPR+ANFDSS) to evaluate the research system's responses:

Table 3: Intelligent system validation tool

Analysis	Intelligent system output component	Intelligent system input components					Rule number
	Status of improving Business IT alignment	Continuous business-IT service improvement process reengineering	Business-IT service operation process reengineering	Business-IT service transfer process reengineering	Business-IT service design process reengineering	Business-IT service strategy process reengineering	

4 Result

In the present study, an intelligent system is a system in which input information can be inaccurate, i.e. the input information of a fuzzy system is in the form of fuzzy sets or fuzzy numbers. Furthermore, the processing of a fuzzy system can be done inaccurately. The use of a fuzzy rule database is a well-known and most inaccurate process in fuzzy systems. In a fuzzy law database, any law is defined by an "if-then" structure. Given the use of neuro-fuzzy decision support systems designed in the present study, five steps were considered to design an intelligent BPR use evaluation system to improve the Business-IT alignment as follows:

Step 1: Identifying the input and output variables of the system: The input and output variables of the neuro-fuzzy decision support system were defined after finalizing the proposed model of the intelligent research system. The intelligent system input variables for evaluating the use of BPR to improve Business-IT alignment included: Business-IT service strategy process reengineering in the governance of the Business-IT; Business-IT service design process reengineering in the governance of the Business-IT; Business-IT service transfer process reengineering in the governance of the Business-IT; Business-IT service operation process reengineering in the governance of the Business-IT; and Continuous business-IT service improvement process reengineering in the governance of the Business-IT. "Evaluating the use of BPR to improve the Business-IT alignment" was the output variable of the intelligent system. According to the proposed research model and \applying the experts' opinions to evaluate that model, the input and output variables of the intelligent system can be entered into the system.

Step 2: Defining qualitative variables by linguistic constraints and assigning fuzzy numbers and sets and membership functions to them. The table and figure show the linguistic variables, fuzzy values, and the membership functions of triangular and trapezoidal numbers relating to the input and output variables of the intelligent research system in the ternary and quintet spectra:

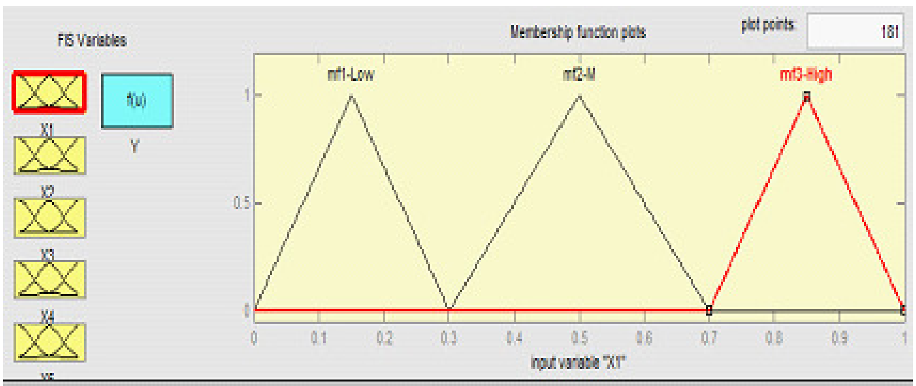


Figure 1: Separation of the input variable of the neuro-fuzzy system- fuzzy values related to linguistic variables (membership functions of triangular numbers)

Step 3: Designing the knowledge base of the neuro-fuzzy system: This stage includes the extraction of the rules of expertise and their evaluation by experts, and the creation of a database of fuzzy rules. The fuzzy rule database is a set of "if-then" rules that are the heart of the intelligent system because other components of the fuzzy system are used to implement these rules effectively and efficiently. The probability of occurrence of different steps

Table 4: Linguistic variables relating to the input variables of the module of "evaluating the BPR use to improve Business-IT alignment"

Linguistic variable	Triangle number membership functions
Low	$(0 \quad 0.15 \quad 0.3)$
Medium	$(0.3 \quad 0.15 \quad 0.7)$
High	$(0.7 \quad 0.85 \quad 1)$
Training Data of the ANFIS system	
0,0,0,0,0,0	
0-0.05,0-0.05,0-0.05,0-0.05,0-0.05,0.1	
0.05-0.15,0.05-0.15,0.05-0.15,0.05-0.15,0.05-0.15,0.2	
0.15-0.30,0.15-0.30,0.15-0.30,0.15-0.30,0.15-0.30,0.3	
0.3-0.4,0.3-0.4,0.3-0.4,0.3-0.4,0.3-0.4,0.4	
0.4-0.5,0.4-0.5,0.4-0.5,0.4-0.5,0.4-0.5,0.5	
0.5-0.6,0.5-0.6,0.5-0.6,0.5-0.6,0.5-0.6,0.6	
0.6-0.7,0.6-0.7,0.6-0.7,0.6-0.7,0.6-0.7,0.7	
0.7-0.8,0.7-0.8,0.7-0.8,0.7-0.8,0.7-0.8,0.8	
0.8-0.9,0.8-0.9,0.8-0.9,0.8-0.9,0.8-0.9,0.9	
0.9-0.95,0.9-0.95,0.9-0.95,0.9-0.95,0.9-0.95,0.95	
0.95-1,0.95-1,0.95-1,0.95-1,0.95-1,0.99	
1,1,1,1,1,1	

between the main variables of the same neuro-fuzzy system is considered here. The starting point for building a knowledge base in a fuzzy system is to obtain a set of rules. If fuzzy is the knowledge of experts or the knowledge of the study field, then the next step is to combine these rules into a single system. Due to the nature of the input variables of the neuro-fuzzy system to evaluate the use of BPR to improve the Business-IT alignment, the probability of occurrence of different steps between the main variables of the neuro-fuzzy system is considered the same. Using fuzzy logic calculations and artificial neural networks, all the rules of the knowledge base of this neuro-fuzzy system were automatically generated by the ANFIS toolbox of MATLAB. Finally, the number of fuzzy rules of the "evaluation of the BPR use to improve Business-IT alignment" module of the intelligent system is equal to 243 due to the existence of 5 main variables each of which with 3 states. The figure for the fuzzy rule bases of the intelligent system module is as follows:

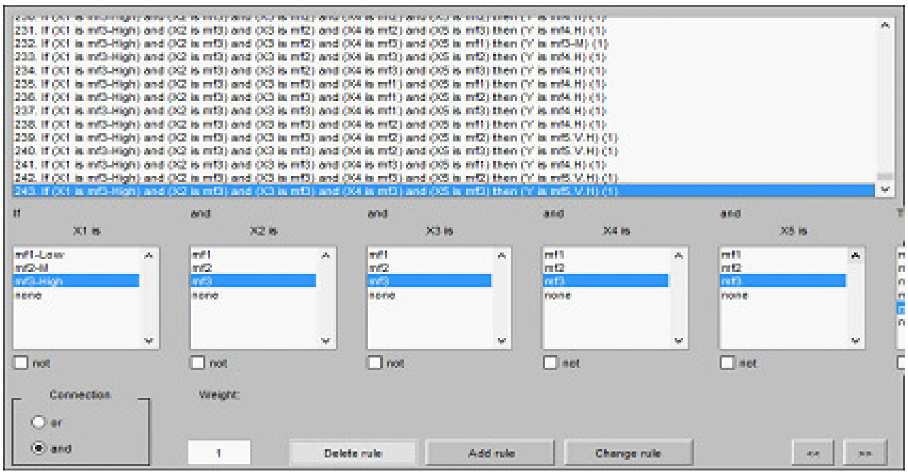


Figure 2: Fuzzy rules within the system module knowledge base

Step 4: Designing the Intelligent System Inference Engine: In this step, the Wtavar method is selected for defuzzification to convert fuzzy numbers and sets to a definite value to evaluate the system performance. The following figure shows the intelligent system inference engine.

Step 5: Description of the way of using the designed neuro-fuzzy decision support system, and analysis of its outputs

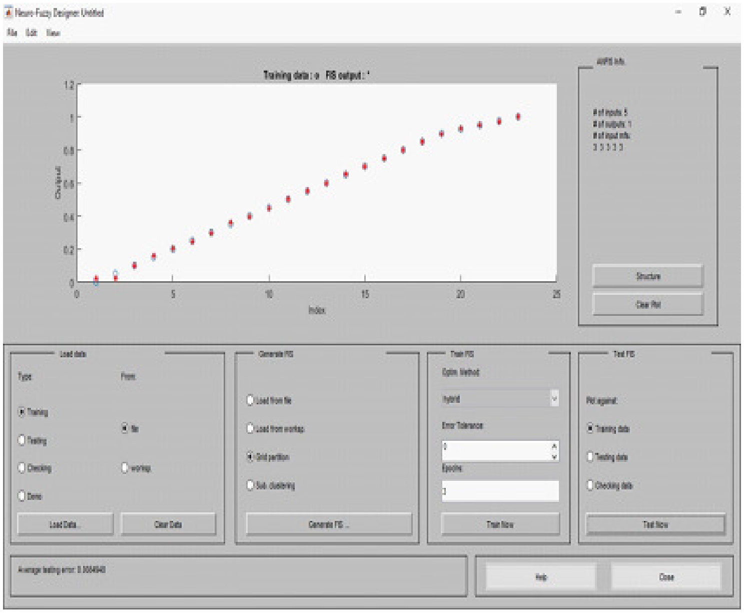


Figure 3: Intelligent system inference engine

to analyze the behavior of the output system variable, “the evaluation of BPR use to improve the Business-IT alignment” of the intelligent system can analyze the intelligent system output numerically (accurately) and linguistically. To determine the weight of the system input values, information about the ideal and functional weight of each main variable of the research is provided:

Table 5: Information about the ideal weight of each main variable of the research

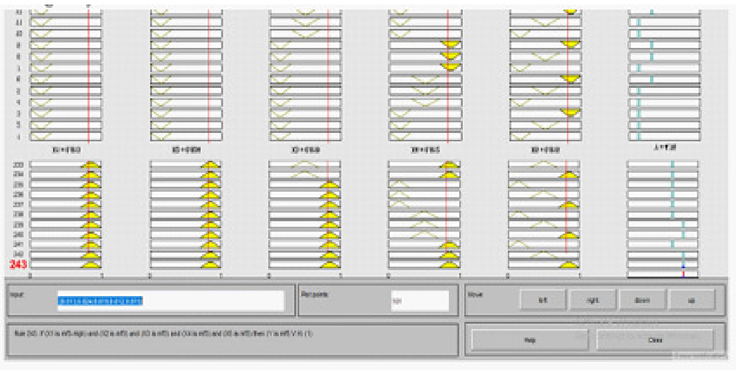
Research variables	**Mean weight**	**Fuzzy weight**
Business-IT service strategy process reengineering ($X1$)	5.690	0.813
Business-IT service design process reengineering ($X2$)	5.765	0.824
Business-IT service transfer process reengineering ($X3$)	5.730	0.819
Business-IT service operation process reengineering ($X4$)	5.682	0.812
Continuous business-IT service improvement process reengineering ($X5$)	5.703	0.815

Table 6: Information about the functional weight of each main variable of the research

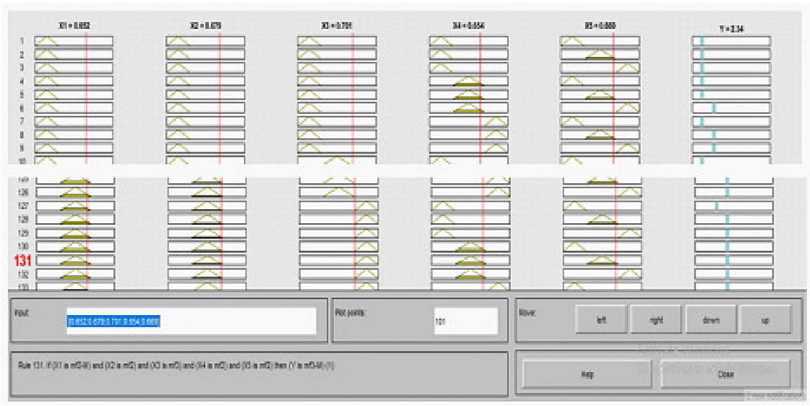
Research variables	**Mean weight**	**Fuzzy weight**
Business-IT service strategy process reengineering ($X1$)	4.562	0.652
Business-IT service design process reengineering ($X2$)	4.752	0.679
Business-IT service transfer process reengineering ($X3$)	4.903	0.701
Business-IT service operation process reengineering ($X4$)	4.577	0.654
Continuous business-IT service improvement process reengineering ($X5$)	4.683	0.669

The following figures analyze the behavior of the input and output variables of the intelligent system module:

The outputs and responses of the neuro-fuzzy system of the research were compared with the opinions of 18 experts in a separate measurement tool after designing the neuro-fuzzy system of the research. Since the experts’ opinions were expressed based on the membership functions of the output variable (with 5 MFs), the difference between the percentages of the neuro-fuzzy system outputs of the study, i.e. IT.ALIGN.BPR+ANFDSS, with the average opinions of experts, can be used to test the hypothesis of system output accuracy. The final difference between the outputs of the neuro-fuzzy system of the study, i.e. IT.ALIGN.BPR+ANFDSS and the average opinions of experts was insignificant and equal to 0.065. Since there was not enough reason to accept the null hypothesis, the alternative hypothesis was accepted, i.e. there was not any significant difference between the average opinions of experts and the outputs of the “intelligent system”.



(a) Analysis of the importance (ideal) behavior of the output variable in the intelligent system module numerically and linguistically



(b) Analysis of the situational (functional) behavior of the output variable in the intelligent system module numerically and linguistically

Figure 4

5 Conclusion

An important research result, namely "Designing a neuro-fuzzy decision support system to evaluate the use of BPR to improve the Business-IT alignment", meant that the status of "improving IT alignment with Tehran-based knowledge-based businesses" could be analyzed numerically and more accurately according to the rules of the knowledge base of the main module of the intelligent system based on calculating the weight of each main variable according to the experts' opinions and the intelligent system designed in the research.

In terms of ideal importance, if the "Business-IT service strategy process reengineering ($X1$)" is in a good status, i.e. 0.813, and "Business-IT service design process reengineering ($X2$)" is in a good status, i.e. 0.824, and "Business-IT service transfer process reengineering ($X3$)" is in a good status, i.e. 0.819, and "Business-IT service operation process reengineering ($X4$)" is in a good status, i.e. 0.812, and "Continuous business-IT service improvement process reengineering ($X5$)" is in a good status, i.e. 0.815, then the state of "improving IT alignment with Tehran knowledge-based businesses" is at an "excellent level (fifth level)", i.e. 0.952. According to the membership functions of language variables by experts in the previous tables, the value of 4.76 within a range of 5 values in the range defined for the "excellent" linguistic variable, i.e. the state of improving IT alignment with Tehran knowledge-based businesses is obtained equal to 0.952 with a programming code $[0.813; 0.824; 0.819; 0.812; 0.815]$.

In terms of functional state, if the "Business-IT service strategy process reengineering ($X1$)" has a moderate state, i.e. 0.652, and the "Business-IT service design process reengineering ($X2$)" has a moderate state, i.e. 0.679, and the "Business-IT service transfer process reengineering ($X3$)" has a good state, i.e. 0.701, and "Business-IT service operation process reengineering ($X4$)" has a moderate state, i.e. 0.654, then the status of "improving IT alignment with Tehran knowledge-based businesses" is at a "medium level (third level)", i.e. 0.468. According to the membership functions of linguistic variables by experts in the previous tables, the value of 2.34 within a range of 5 values in the range defined for the "medium" linguistic variable, i.e. the state of improving IT alignment with knowledge-based businesses in Tehran is obtained equal to 0.468 with a programming code $[0.652; 0.679; 0.701; 0.654; 0.669]$. The following table compares the most important results and findings of the present study with the results and findings of the most relevant research in the theoretical literature.

Table 7: Comparison of the findings of the most relevant studies in the theoretical literature with the present study

		Business Process Engineering	Business-IT alignment	Business process improvement	Business-IT Management	Business-IT service	Internal business analysis business	Artificial Neural environment External business environment analysis	Fuzzy logic Networks	Expert system	ANFIS toolbox	MATLAB	Research validation programming environment	Case Study:	Knowledge-Based Businesses
1	Present research research	*	*	*	*	*	*	*	*	*	*	*	*	*	*
2	Teixeira et al., 2017	*	-	-	*	*	-	-	-	-	-	-	-	-	-
3	Pourmirza et al., 2017	*	-	-	-	-	*	-	-	-	-	-	-	-	-
4	Hinkelman et al., 2016	-	*	-	*	-	*	-	-	-	-	-	-	-	-
5	Cruz & Mesa, 2016	-	-	-	*	*	-	-	-	-	-	-	-	-	-
6	El-Mekawy et al., 2015	-	*	-	-	*	-	-	-	-	-	-	-	-	-
7	Cheng et al., 2012	*	-	-	*	-	*	*	-	-	-	-	-	-	-
8	Pollard et al., 2009	-	*	-	*	-	*	-	-	-	-	-	-	-	-
9	Cater-Steel et al., 2006	-	-	*	*	-	*	-	-	-	-	-	-	-	-

The most important and key suggestion of the present study for Business-IT alignment was that using IT. ALIGN.BPR+ANFDSS inference system can help to improve Business-IT alignment because the “state of improving Business-IT alignment” component was utilized to collect and analyze data, combine the results, and come to conclusion for a specific issue. In other words, the results of the present study were enriched and completed by collecting and integrating different types of measures and criteria to improve Business-IT alignment. Using the combined approach of the present research, the broader questions can be answered more fully because the researcher is not limited to one method or a single approach and can use the strengths of a method to overcome the weaknesses of another method. Therefore, comparing the results by improving the Business-IT alignment applied for a subject can provide stronger and more evidence for the overall conclusion, and the generalizability of the results can increase. Another practical suggestion for the industry was to use the inference system (IT.ALIGN.BPR+ANFDSS) to help reduce the cost of gaining experience for business users because expert systems were permanent and stable and did not die like expert humans, and they were immortal.

Another advantage of IT.ALIGN.BPR+ANFDSS is the ease of transferring it to various geographical places. This is very important for the development of countries that cannot afford to buy expert knowledge about improving Business-IT alignment and is effective in reducing their costs. Furthermore, the use of IT.ALIGN.BPR+ANFDSS inference systems in knowledge-based businesses can lead to rapid response to risky situations because in an emergency and need, the experts may not make the right “decision” due to stress or other factors, or their slowness may have adverse consequences for the business.

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