Original Research

A Novel Hybrid Approach to Enhance Intelligence Integration in Small-Medium Enterprises

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Abstract
This research aims to enhance intelligence integration in small-medium enterprises. The approach is included an integrated structural model and an optimal human resource allocation (HRA) using a novel intelligence method. To optimize the current organizational structure used enterprise engineering (EE) in IT and Business parts (Using ITIL and COBIT standards, BSC and KAP model, respectively), and statistics method like as regression test is used. Also, continuous HRA is simulated using HRA mathematical program, Gray Wolf Optimization Algorithm (GWO), and Sugeno Fuzzy Inference (SFI) model to add a self-regulating attribute to the GWO algorithm. Results showed that the EE was issued a new optimal and integrated structure in IT and business parts and the examination of the PMBOK approved it, too. Also, results of the novel self-regulating algorithm using data from previous researches and by the top five proposed methods in the researches (Includes: SGA, PRS, SRS, MIP, HM) based on three methods of evaluating the quality of solutions (GA-FSGS, MP-FSGS, GA-SGS) showed that increase of Ω from 15,000 to 25,000. Also, it showed that HM and SGA performed better than other previous cases even in the larger B100 and B200 datasets.

Keywords: Intelligence Integration, Enterprise Engineering, Human Resource Allocation, Sugeno Fuzzy Inference, Gray Wolf Optimization Algorithm.

1. Introduction

The development of business conduction has increased the involvement of multiple actors, all with multiple access channels and interfaces. These collaborative processes have created massive interdependencies. The diffusion of boundaries between products and services, technology-based intelligence, and events created by social actors necessitates the integration of technology functionalities into business processes. Large-scale transactions between customers and producers via technology-based platforms and the internet can be a threat that leads enterprises to enterprise mechanizations. To avoid these sorts of problems, there is a need for specific designs for an enterprise (Yu et al. 2018).

In this part of the research, the focus is on the enterprise design process. Earlier in this thesis, the two main and essential competencies of an enterprise were introduced, one is focused on enterprise operation (enterprise governance) and the other one is enterprise change (enterprise adaption). Operational activities are coping with maintenance of the current relationships with the environment taking into account the internal priorities and the supportive activities. Governance competence is concerned with adequately accomplishing enterprise changes. The manifestation of activities to realize governance competence is known as governance behavior (Hoogervorst, 2018).

No need to argue that the successful arrangement of the purposeful activities does not happen incidentally. The harmonious ordering and arrangement of activities and resources following the mission and vision of the enterprise are called organizing which is the opposite of doing nothing. Organizing leads to an organization. However, organizing is not the same as interpose design but heavily it depends on it.

Organizing must be understood in a dynamic sense, the enterprise should have a basic level of presumed order to reliably deliver products or services. Recalling the fundamental maxim of (Deetz, 1996) "all theories of organization are based on a philosophy of science and a theory of society", the foundation of enterprise design in the employee-center theory of organization (Dietz and Hoogervorst, 2007).

Enterprise engineering is based on three important scientific theories: system thinking, an organization is a social system, and languages the thread of the organization, enterprise, the processes, and systems (Op't Land and Dietz, 2012). Moreover, it is proved that translating the abstract ideas of systems theory into tools for better understanding of economic and organizational change (Brown and Watts, 1992). They articulate a cornerstone position of human values in the workplace; namely, that vision, purpose, reflectiveness, and systems thinking are essential if organizations are to realize their potentials. He has worked with leaders in business, education, health care, and government, and has authored many articles in both academic journals and the business press on systems thinking in management.

Enterprise engineering is a developing discipline of system engineering that studies organizations from the perspective of engineering. The ontology of enterprise attempts to provide the models reducing the complexity (Suga and Iijima, 2017). Modern enterprises are complex and living organisms, they perform by comprising people, technologies, and human interactions in a complex pattern. (Aveiro et al., 2015) states that researchers face two challenges to analyze these patterns, ontology, and design. In the previous chapter, the focus of the study was on the ontology of these patterns. Ontology and design need to work together in an enterprise engineering discipline. Enterprise engineering is rooted in both organizational science and information system science (Aveiro et al., 2015). The challenge of integrating these two areas of science has been investigated after the recognition of communication as a form of action. Therefore, involving enterprise engineering for integrating and organizing an organization needs three types of organizational structure, strategic organizational, companion organizational, and innovative organizational structures, respectively. Thus, this paper is the first part presents a novel integrated structure that can cover the gap, and tries to do HRA using a self-regulated algorithm in the second phase. How these phases do, and why these gaps have to cover, will answer as follows.

2. Literature Review

More than twenty years ago, the science of enterprise architecture came to be known. The main two problems stated and discussed in enterprise architecture are system complexity and poor business alignment. The consequence of poor business alignment for companies is "more cost, less value". The cost of having an advanced IT system in organizations has increased and is increasing dramatically while due to their complexity, the added value of these systems is under question (Sessions, 2007).

2.1. Enterprise engineering

Enterprise engineering is aimed to engineer the structure of an enterprise, business processes and activities, resources, products and services, and supporting facilities. It includes activities of strategy development, architecture and design, and implementation (Sarkis et al., 1995).

Organizations often have to deal with the different facts that diversified disciplines, knowledge, tools, and techniques, therefore organizations face significant obstacles to the consensual model representing the business. (Parker, 2016) have started a new term "Platform revolution" and they define it as the new business model that uses technology to connect people, organizations, and resources in an interactive ecosystem in such an amazing amount of value can be created and exchanged.

There are different criteria to define SMEs, according to the literature, number of employees, turnover, and annual balance sheet are among the most important elements to refer, defining SMEs. The most common criterion is the number of employees. As mentioned earlier, based on the EU commission definition, micro-enterprises are those with 1 to 9 employees, small enterprises with 10 – 49 employees, and medium enterprises with 50- 249 employees. The annual turnover should be taken also into account, the turnover of less than 40 million euro and the total balance sheet less than 37 million euro and they should be financial independence.

Here in this part, we are exploring the most common SMEs challenges, the focus is mainly on SMEs in Iran. These enterprises are mainly suffering from mismanagement or weak management. SMEs are more focused on technical and operational issues. Therefore their focus on management skills is less (Abor and Quartey, 2010). It is when the success of enterprises is heavily dependent on management skills, training and education.

The other challenge for SMEs is finance. To have access to financial resources causes problems for SMEs. These enterprises are not able to get loans at the beginning of their career. The lack of financial support has consequences for SMEs. Among them are difficult to have effective economic growth, maintenance, and purchasing of new machines, purchasing of the raw materials and services. Therefore the main goal of SMEs has become to survive in the markets (Kosanke et al., 1999).

Technology brings another challenge to SMEs, the lack of infrastructures and technologies leads the SMEs to traditional ways of management (Stephen and Elvis, 2011), though to remain in the market, SMEs need to invest in the technology and IT (Aspelund and Moen, 2004), and in SMEs is one of the areas which receives the small attention. However, SMEs need to invest in RandD to adapt to the big changes of today's world of economy and technology. They need to have strong marketing RandD to achieve a competitive advantage, to know customer requirements, and to fulfill their customers' needs, to achieve economic growth (Mu and Kwong, 2018).

Due to the nature of these enterprises, there is a lack of trust among them and usually, they have no corporation with each other in the sector. This leads to more isolation of these enterprises. The empirical part of this research focused on studying SMEs in Iran. Since the main attention of this thesis is on integration and alignment within SMEs, to choose our sample we tried to take those SMEs with the highest focus on IT. The strategic context of these SMEs is evaluated. We explore both business and IT strategies. The core activities are questioned and the areas of concerns are discussed more in the empirical part of this thesis.

Based on the information obtained by the empirical part of this thesis the model is suggested and launched using the framework inspiring by the COBIT framework. In particular, SAM suggests firms need to integrate business and IT components at three levels: strategies (i.e., external integration or intellectual alignment), infrastructures (i.e., internal integration or operational alignment), and strategies and infrastructures (i.e., cross-domain integration).

2.1. Human Resource Allocation

Resource allocation is aimed to resource the optimal resources into different work levels. The relevant literature about resource allocation and the concept of assigning the most suitable state of resources to different activity levels are reviewed to conduct us for applying the resource allocation model with the optimal integrated enterprise structure (Tukel and Wasti, 2001). Vicente et al., (2013) presented a decision-making model for the human resource allocation problem in an information systems project. In their paper, a novel approach based on dynamic programming is developed to allocate the human resources in an IT project. The proposed approach investigated different complexities, human resources' capabilities, and required skills in each project. Then, a simulation method was used to depict a decision-making model and showed the model's efficiency.

Aviso et al., (2018) proposed a resource allocation model in operational organizations under disruption using a fuzzy framework. They used an optimization approach to assign scarce resources to a business structure. Also, it should be stated that most of the other researches including (Rohaninejad et al., 2015), (Elango et al., 2011), (Arrau and Medina, 2014), (Bacon and Hoque, 2005), (Wu et al., 2014), (Pérez Arrau and Muñoz Medina, 2014), (Dabirian et al., 2019; Ballesteros-Pérez et al., 2019; Yousefi and Yousefi, 2019), and (Xiao, 2020) studied the resource allocation problem by defining an optimization model in different projects.

Finally, it should be noticed that after investigating the current literature on human resource allocation, different types of modeling and approaches were discussed. The most common topic among these researches were multiple states of structures, developed time intervals, and net profit-based objective functions (Kolisch and Hartmann, 2006). Moreover, different issues on industrial engineering and recent concerns resulted in emerging new models solving the current gaps. Researches on resource allocation models for production and manufacturing (Tavares, 2002) and (Nübel, 2001), for vehicle staffs (Elmaghraby, 1977) and (Rom et al., 2002), for Iron industries (Chiu and Tsai, 2002), (Nudtasomboon and Randhawa, 1997) and (Franck and Neumann, 1997), for medicine(Cesta et al., 2002), biotechnologies (Heilmann, 2001), medical science, air transportation, Navy (Vanhoucke, 2006), IT projects (Davis et al., 1992). Considering previous papers highlights the current gaps. There exist not great attention on continuous resource allocation problems. Focusing on the current literature of resource allocation and enterprise engineering, attempting to cover gaps discriminates the current paper from the literature as follows:

- proposing an integrated model for resource allocation and simulation of organizational units process
- presenting an integrated model considering the optimal structures of business and IT applying BSC and Archimate, respectively.
- approving the integrated model efficiency using managers attitudes with KAP
- solving the integrated model to find the optimal resource allocation using Sugeno Fuzzy Inference (SFI) and applying the GWO algorithm.

The next section involves the problem description and the solution approach, precisely.

2.2. Problem Statement

The proposed method in the current paper is especially collective. The collection tool is the questionnaires prepared to use the experts' ideas and implementing enterprise engineering in the society's objective. Besides, for representing a conceptual framework to be used in different organizational levels, the existing frameworks and each category's features were completely reviewed. To deal with the current gaps and the existing disorders the ultimate model is verified by a qualitative approach. Here, the qualitative data sets delineate critical trends and concepts and also concentrates on the data description.

Moreover, to cover and integrate the organization's business structure with the IT framework as two main bases of an organization, a novel integrated model is described. Thus, an integrated harmonious model is defined for the IT framework using ITIIL and COBIT standards. Afterward, a uniform business model is described applying Business Score Card (BSC) method. Then, the two optimal distinct structures are integrated via Agilian software to deal with the stakeholders' concerns. The organization integration influenced by the following points:

Finding a trade-off among the beneficiaries and organizations' stakeholders.

Integrating the business structure with the IT department is the main concern of the current paper.

The whole integration of the model considering IT structure and business framework coordination was done through the Product Owner and SCRUM Master in the agile projects.

Also, the manager's viewpoints toward the model application are investigated using the KAP method. To this aim, the collected data is analyzed in EXCEL and SPSS and the model depiction was carried using UML and BPMN. Afterward, having the main structure of the optimal model, resource allocation is the next aim to touch. For finding each category's optimal resources the verbal variables are used by Fuzzy Theory to derive reasonable rule bases. Then, the optimal values of each node resource are obtained by applying the novel self-regulating algorithm which will be described in the following section, precisely.

The contribution of this research is in conceptual and methodological views. First, this research has tried to optimize the structure of SMEs using EE and meet their permitted structural integration and optimization. Secondly, the research has tried to solve the HRA problem under critical (absence or leaving employees due to forced or unforeseen events or pervasive events such as COVID-19, etc.), and in a normal situation using a comprehensive and intelligent approach. In the methodology, after issuing the structure, it evaluates by PMBOK categories and using regression analysis. Also, the research has used a combination of the GWO algorithm and SFI method to design a new self-regulating algorithm that can be the first local searching algorithm that can set parameters and the goal, automatically. While previous researches were only able to provide the necessary control of HRA before and after the crisis, and it was hoped that an intelligent solution can provide to solve the problem in critical and non-critical situations with minimal human intervention (due to computational error).

2.3. Methodology

This research tries to issue an integrated and smart structure using EE, and do a meticulous HR allocation using the novel self-regulating algorithm. The flowchart is illustrated in figure 1. According to figure 1, the proposed method is a novel approach in conceptual and methodological views.

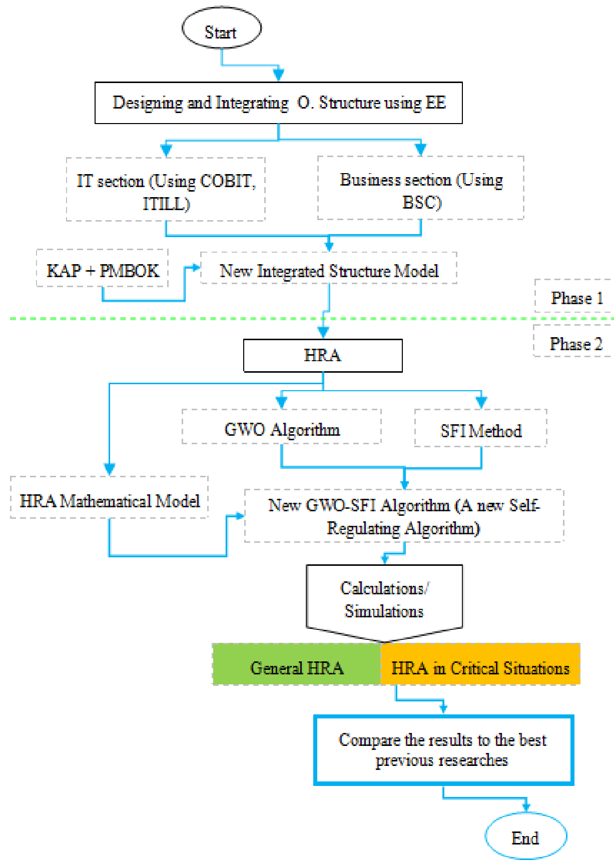

Figure 1
Flowchart of the research (Authors)

2.4. Resource Allocation Model

After obtaining the optimal enterprise structure from the previous section, the resource allocation model can be developed to find the appropriate human resource assignment in this structure tolerating the risk of disruptions and other uncertainties. For developing the resource allocation model, divider nodes were assumed to assign the activities to the human resources. To this aim, each divider node has at least one connection with a human resource node. Each divider node has specific traffic of activities to emit among resources. On one hand, a human resource can 'not bear more than its associated capacity. On the other hand, a divider node with zero traffic will be inactive to have cost savings.

The main goal is to minimize the active human resource nodes in the allocation layer and achieve a balance of inactive human nodes. Therefore, increasing the node traffic may devastate the company's qualities in fulfilling jobs. In such cases, if each human node increases the divider nodes can transfer the activities to human resources.

The following table 1 below represents the sets, parameters, and decision variables using to formulate the mathematical modeling.

Table 1
The sets, parameters and decision variables

parameters	
$\boldsymbol{\alpha}$	A threshold showing the ration of real human traffic to the total capacity and should not be greater than the capacity in the $0 < \alpha \leq 1$
$\boldsymbol{\beta}$	A threshold showing the ration of real human traffic to the total capacity and should not be greater than the capacity in the $0 < \backslash betta \leq 1$
$\boldsymbol{C}$	Set of human resource nodes $\lvert C \rvert = n$
$\boldsymbol{S}$	Human resource divider $\lvert S \rvert = m$
$\boldsymbol{B_i}$	A binary variable, 1 if divider is active, 0 otherwise
$\boldsymbol{R_{i,j}}$	Relation between divider node j and human resource node i
$\boldsymbol{F_j}$	Activity divider's j traffic demand
$\boldsymbol{T_i}$	Capacity of server i
$\boldsymbol{N_i}$	Maximum number of activities can be done a human resource
$\boldsymbol{B}$	Batch $R_{i,j}$
$\boldsymbol{R}$	Batch T_i
$\boldsymbol{T}$	Batch F_j
$\boldsymbol{\delta i,j}$	Human resource node i and divider node j interaction with F_j

Assume C as the set of human resources and $|C| = n$. Each human resource capacity is T_i and can bare traffic amount of c_i and α is fixed lower than the ration of real activity traffic toT_i . Consider N_i the maximum number of activities a server C_i can tolerate. Moreover, B_i is a binary variable shows the active or inactive states of human resource nodes. In addition, S represent the batch of divider nodes and$|S| = m$. For each divider node, $R_{i,j}$ is an integer showing the relation among nodes s_j and c_i.

If a relation can be defined between these two aforementioned nodes, then $R_{i,j} = 1$ and also f there exist not any relation, $R_{i,j} = -1$ and 0 otherwise. Moreover, F_j is the divider node s_j traffic demand and $\delta_{i,j}$ is the traffic demand F_j ratio that can be made with relation among $c_i$ands_i (Fündeling and Trautmann, 2010). The resource allocation model is formulated as follows:

$$\min \sum_{i=1}^{n} \boldsymbol{B_i} \quad (1)$$

s.t.

$$\boldsymbol{B_i} \in \{\boldsymbol{0}, \boldsymbol{1}\} \quad (2)$$

$$\sum_{i=1}^{n} \boldsymbol{\delta_{i,j} B_i = 1} \quad (3)$$

$$\boldsymbol{\delta_{i,j}} \in [\boldsymbol{0}, \boldsymbol{1}] \quad (4)$$

$$\sum_{i=1}^{n} \boldsymbol{\delta_i, j} \, |\boldsymbol{R_{i,j}}| = \boldsymbol{1} \quad (5)$$

$$\sum_{j=1}^{m} \boldsymbol{\delta_i, j} \, |\boldsymbol{R_{i,j}}| \times \boldsymbol{F_j} \leq \boldsymbol{\alpha T_i} \quad (6)$$

$$\sum_{j=1}^{m} \boldsymbol{\delta_i, j} \, |\boldsymbol{R_{i,j}}| \leq \boldsymbol{N_i} \quad (7)$$

Relation (1) shows the objective function for minimizing the number of active human resource nodes. Constraints (2) represent the active or inactive states of each human resource node. Constraints (3) assure that each divider node should support an active human resource node, thoroughly. Constraints (4) show the complete form of each divider node's traffic demand. Constraints (5) state that each node demand should be satisfied just via connections. Constraints (6) show that the total amount of human resource node traffic should be lower than the predefined capacity of a server. Constraints (7) ascertain the number of divider nodes connecting to a human resource node should not violate the threshold. The model inputs are α, F_j, $R_{i,j}$, n, m and T_i . Moreover, decision variables are B_i and $\delta_{i,j}$ (Tritschler et al., 2017)

2.5. GWO Algorithm

As stated in the previous section, the GWO algorithm is the most appropriate method for solving the proposed resource allocation model. Investigating the social behavior of wolves and the hunting procedure conducts us to generate a set of random solutions. The random solution set is categorized in three groups: Alfa, Beta, and delta, respectively. Other solutions are also categorized in omega. The solutions: α, β, and δ are using for directing the hunt procedure and ω solutions are just subordinates.

For implementing the three phases mentioned before, it is necessary to determine points around the hunt and afterward, the attack process can be defined, precisely.

The following relations for determining the points around the hunt:

$$\vec{D} = \left|\vec{C}.\overrightarrow{X_p}(t) - \vec{X}(t)\right| \quad (7)$$

$$\vec{X}(t+1) = \overrightarrow{X_p}(t) - \vec{A}.\vec{D} \quad (8)$$

Term t shows the current iteration. $\vec{D}$, and $\vec{A}$ the coefficient factors and $\overrightarrow{X_p}$ is the hunt location and $\vec{X}$ is the status location of a gray wolf. $\vec{D}$, and $\vec{A}$ as the coefficient factors are driven as follows:

$$\vec{A} = 2\vec{a}.\vec{r_1} - \vec{a} \quad (9)$$

$$\vec{C} = 2\vec{r_2} \quad (10)$$

Factors $\vec{a}$ are decreasing from 1 to zero during the iteration and $\vec{r_2}$ and $\vec{r_1}$ are stochastic in interval [0, 1]. The following constraints now can be formulated to mathematical model of hunt.

$$\vec{D_j} = |\vec{C_i}.\vec{X_j} - \vec{X}| \quad (10)$$

$$\vec{X_i} = \vec{X_j} - \vec{A_i}.(\vec{D_j}) \quad (11)$$

$$(i,j) \in \{(1,\alpha),(2,\beta),(3,6)\} \quad (12)$$

Finally the point X can be obtained by calculating different values of X_i

$$\vec{X}(t+1) = \frac{\overline{x_1} + \overline{x_2} + \overline{x_3}}{3} \quad (13)$$

Now the complete form of optimal solution can be derived. But, to apply the optimal solutions in the model, the uncertainty and lack of knowledge in modeling different systems highlight the need for using a fuzzy system delivering a trustworthy rule-base.

2.6. Fuzzy Inference System

After finding the optimal solutions of the resource allocation model, the uncertainty of the system should be modeled via a fuzzy inference system capable of proposing the best strategies for each condition (Marimuthu et al., 2019). To apply the fuzzy inference system the following structure is used to (i) fuzzify the crisp inputs, (ii) setting rules in the inference, (iii) obtain the fuzzy outputs, and (vi) defuzing the fuzzy outputs (Aslinezhad et al., 2020). Figure 2 showed a fuzzy inference system. The Sugeno fuzzy Inference is one of these systems.

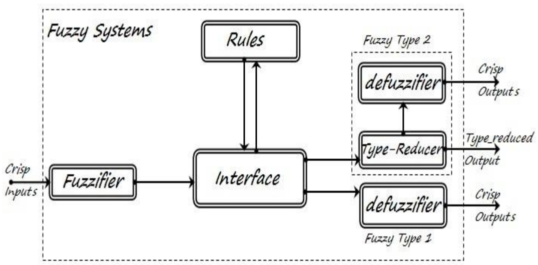

Figure 2
The fuzzy inference system

The Sugeno method is used here to have rules as the system outputs. In this approach, the following rules are defined (Yan, 2020):

If x_1 is A_1 and y_1 is B_1, then z will be $f_1(x,y)$.
If x_n is A_n and y_n is B_n, then z will be $f_n(x,y)$.

Therefore, each solution now can results in a specific output as depicted in the figure 3.

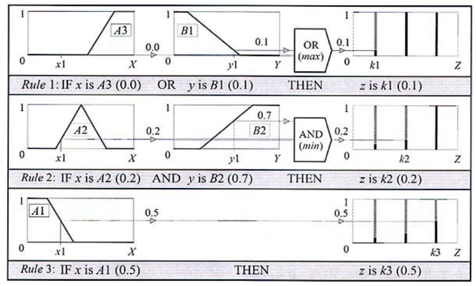

Figure 3
Output evaluation in the Sugeno controller

4. Case Problem Analyses

4.1. Case Study (Research Sample)

The study is based on the data collected through a survey conducted in 30 SMEs, in Iran. In total 90 staff members participated in the survey. They were asked to fill out a questionnaire. The questionnaire was designed to assess how employees experience their job environment. The questionnaire is not specified to be used in a specific area and it is applicable for other countries, the English versions are available. It was designed to collect the data related to organizational culture preference and the degree to it, the company reflects different organizational cultures. Also the attitude of employees toward alignment.

4.2. Data Analyses

The different distribution for organizational culture preferences and organizational culture perception is measured and presented in figure 1. The organizational culture preference and organizational culture perception are compared with each other using the descriptive statistics analysis. The figure shows the importance of different organizational cultures in the eyes of the employees. The possible alignment strategy practice in these organizations in Iran is measured and presented in figures 5 and 6. The correlation between the organizational cultures and alignment strategy is the most meaningful one.

4.3. Organizational Culture Preference Measures

To measure the organizational culture preference, six images of internal culture orientation are presented in the questionnaire. Image 1 stands for innovation-oriented, image 2 stands for the traditional-oriented organization which is in contrast with innovation and it reflects reluctance toward changes. Image 3 is a people-oriented organization which is in contrast with image 4 of a system-oriented organization. The former stands for confidence in people and the latter describe standardization and formalization. Image 5 and 6 present the collectively oriented and the specialization oriented organization. In a collectively oriented image (image 5), the social solving problem and teamwork are at the center. And in image 6 which is a specialization-oriented organization, specialized professionals are the center of attention.

Therefore, 8 images of organizational culture are described in the questionnaire, and two questions are asked, one is "would you like to work in organization X?" and the second question is "to what extent does your organization resemble X?" The answers are offered in the Likert- Type items in the scope of 1 to 5 were designed in ascending order "absolutely not" to absolutely yes".

In this approach not only the organizational culture preference is measured but also the organizational culture perception. In this research, the focus is on organizational culture preference. In table 2 the definitions of IT-Business alignment used in this research have been shown.

Table 2
Definitions of IT-Business alignment

Business alignment	Business alignment refers to the degree in which the extremely focuses business strategies are aligned with internally focused business infrastructure and process.
Cross domain alignment of business strategy to IT infrastructure and processes	This alignment refers to all aspects of bridging the high level of IT strategies to the internally focused of IT infrastructure and processes.
Cross domain alignment of IT strategy to business infrastructure and processes	This alignment refers to all aspects of bridging the high level of focused IT strategy to lower level of business. This comprises how the IT strategy aligns with the business infrastructure and processes
Intellectual alignment	This alignment focuses on the strategic level of alignment and deals with how business strategy and IT strategy are supporting each other.
IT alignment	This alignment is focused on alignment in IT and the degree it is aligned with lower level of IT infrastructure and processes.
Operational alignment	This kind of alignment is focused on internally focused operational level of alignment and deals with how business and IT processes and infrastructures support each other.

To develop measures of discrete forms of alignment, we used the SAM framework. We undertook two different types of surveys, quantitative and qualitative surveys. Looking at the figure below, we can conclude that there are a big potential and driver in practicing the alignment strategy in the SMEs in Iran. At the same time, it is crucial to take into account the barriers that have been mentioned by SMEs. There is a positive attitude toward implementing the alignment in these SMEs.

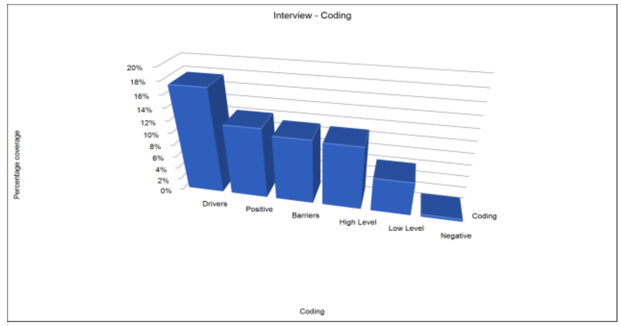

Figure 4
Interview coding results

The chart below (Figure 5) has been constructed using the "word-frequency" query of NVIVO. The 'word-cloud depicts the terms weighted per frequency identified in the KAP nodes of the business stakeholders. As it can be seen, the boldest words are "Service", "Market", "effective" and "working". Words like "investment" "innovation" and "competitive" are less used. The word cloud is complementary to the matrix findings and illustrates the importance given to profitability and survival in the market, looking at the primary data of businesses, we can conclude that the main strategy in SMEs in Iran is to be survived in the market. They are in this sense more risk-averse.

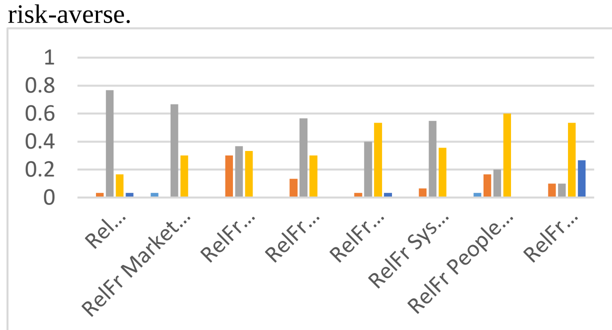

Figure 5
Relative frequency of organization culture preference comparison

The different distribution for organizational culture preference is measured and it is presented in figure 5. As it is shown in this figure, the perception of sustainability culture on the score 3 is very high which indicates the neutral position of participants about this aspect, neutral positions are not interested in our research and the conclusion on them is either the participants don't have enough knowledge toward it or they don't feel any difference between this culture and the current culture of their company. Therefore, we are interested in the score higher or lower than three in our research. As we can see in the figure the majority of participants with a score 4 are interested in the organizational culture of people and after that innovation is the most preferred culture in SMEs.

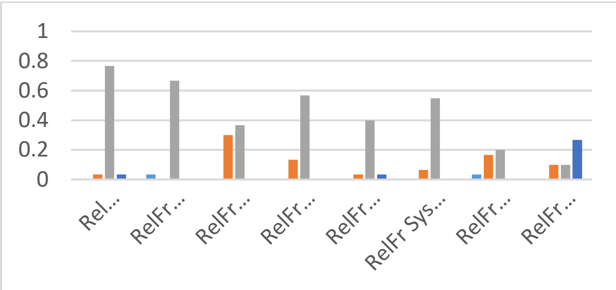

Figure 6
Relative frequency of organization culture preference comparison

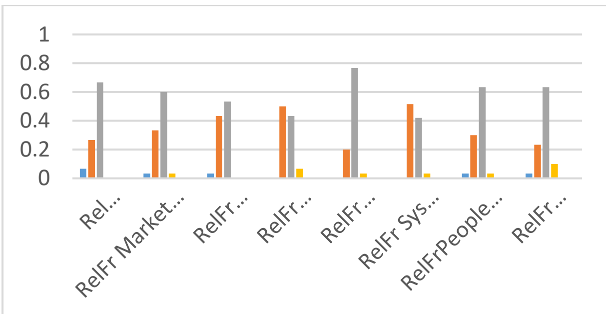

Figure 7
Relative frequency of Organization culture perception

The different distribution for Organizational culture is measured and it is presented in figure 7. As it is shown in this figure, in these SMEs the organizational culture of Tradition and System are perceived the least and they perceive their organizational culture in most cases of innovation type. In the following tables, the attempt is to explore the impact of applied organizational culture and the importance of these organizational cultures on the alignment strategies presented to the participants. The regression analysis was performed to analyze the impact of different organizational culture importance and applied to the alignment strategies. In most cases, the relationship was not statistically significant. But the following tables indicate the statistically meaningful relationships between the organizational culture importance and applied, and the alignment strategy from the point of view of the participants.

Table 3
Statistical evaluations traditional culture and IT alignment

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.714
R Square	0.510
Adjusted R Square	0.474
Standard Error	0.340
Observations	30

ANOVA

	df	*SS*	*MS*	*F*	*Sign. F*
Regression	2	3.251	1.625	14.061	6.54E-05
Residual	27	3.121	0.116		
Total	29	6.371			

Table 4
Statistical evaluations on business alignment

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.664
R Square	0.441
Adjusted R Square	0.340
Standard Error	0.371
Observations	30

ANOVA

	df	*SS*	*MS*	*F*	*Sign. F*
Regression	2	2.925	1.462	10.642	0.000391
Residual	27	3.710	0.137		
Total	29	6.635			

The cross alignment business is determined for 44% by the mean of traditional cultural importance and applied. The importance of traditional culture is perceived as a negative factor in practicing the cross-alignment business strategy. It can be explained by the fact that the cross-domain alignment implies a new adaption in the structure and strategy of the organization.

Table 5
Statistical evaluations on IT alignment

SUMMARY OUTPUT					
Regression Statistics					
Multiple R	0.893				
R Square	0.798				
Adjusted R Square	0.783				
Standard Error	0.192				
Observations	30				
ANOVA					
	df	*SS*	*MS*	*F*	*Sign. F*
Regression	2	3.922	1.961	53.288	4.23E-10
Residual	27	0.994	0.037		
Total	29	4.916			

The above table is the regression analysis of the impact of Traditional culture "mean importance and mean of applied of this culture" on cross-domain alignment. From the results, we see that we explain 79% of the variation. Also in the coefficient table, we see the mean importance has a positive influence and the mean applied has a negative influence. It means that the application of traditional culture has a negative influence on cross-domain alignment. It makes sense because the organizational culture of the traditional type is not friendly with the changes and new adaption and for these SMEs, the cross-domain alignment is determined only by applying the change in the whole strategy and structure of their companies.

Human Resource Allocation Findings

4.4. Validation of the solving methods

In this research, we have used two sets of data as A and B from (Kolisch and Sprecher, 1997; Fündeling and Trautmann, 2010). The test set A includes samples with a maximum of 4 sources taken from the samples of these two studies. Because MIP results are not available for larger samples. This study only includes a test set of specimens with a maximum of 55 activities. So, we have 509 samples set of the A and these samples are labeled as a sample set of A≤55 whose indices show the number of activities. Test set B includes samples of sets: B_{10}, B_{20}, B_{40}, B_{100} and B_{200} with 10, 20, 40, 100 and 200 activities, respectively, and maximum of 4 sources. Fündeling and Trautmann (2010) generated up to 480 samples in each test set using order strength factorial design of problem parameters, source factor, and source power. However, if the order strength is higher it means that the priority relationships in the project network will be higher. So, this study has used values of 0.25, 0.5, and 0.75 as order strengths.

The resource factor indicates the number of resources required per activity. Its values are 0.25, 0.5, 0.75 and 1. For example, a value of 0.5 indicates that each activity requires 2 of 4 sources. Resource Strength (RS) also measures resource scarcity by comparing resource demand with resource availability levels. In this study, RS values will be zero, 0.25, 0.5, and 0.75. Also, lower RS leads to more lakeness. For RS = 0 there is at least one activity for each resource that may specifically occupy the resource due to the high usage limit of the q_{ir} resource, and for RS = 1 access to the resource does not limit the schedule. The minimum time interval is also set between 2 and 4 blocks, randomly (Kolisch and Sprecher, 1999; Fündeling and Trautmann, 2010; Naber and Kolisch, 2014).

In each sample of the problem, all activities require the main source named as $\hat{r}$. In addition, for the independent source r, the components of the source function include: $\alpha_{ir} = (\bar{q}_{ir} - \underline{q}_{ir})/(\bar{q}_{i\hat{r}} - \underline{q}_{i\hat{r}})$ and $\beta_{ir} = \underline{q}_{ir} - \underline{q}_{i\hat{r}}\alpha_{ir}$ are used in algorithmic problem solving according to Naber and Kolisch (2014).

4.4.1. Comparing the results of proposed method with best methods in previous research

In this research, the proposed method will be compared with the following methods from previous research:

- **Self-Adapted Genetic Algorithm (SGA)** (Naber and Kolisch, 2014).
- **Parallel Random Heuristic Modeling (PRS):** Creates an activity list by random pattern modeling and generates scheduling with standard parallel SGS (Kolisch et al., 2003).
- **Heuristic Serial Random Modeling (SRS):** This is the same as PRS but uses standard serial SGS.
- **MIP:** Known as the reference for commercial solvents using the FP-DT3 of the PIM model. The best solution obtained after 2 hours is considered as the answer (Naber and Kolisch, 2014).
- **HM:** This method was proposed by Tritschler et al. (2017) which is a metaheuristic method to solve a research problem. Also, to analyze the effect of HM components on the quality of the solution, three HM variables were compared, and the results were compared with the proposed method, too.
- **GA-FSGS:** FSGS without VNS is embedded in GA. This combination has been used to evaluate the effect of VNS (Kolisch and Hartman, 2006).

- **MP-FSGS:** To evaluate the effect of GA, FSGS is used in a multi-pass method. Using FSGS, this method generates a large amount of scheduling and selects the best value for the objective function. We produce three λ with the LPF, MTS, and MWR priority rules and ρ and σ are zero. We select the remaining λ using random activity selection and ρ and σ randomly within the given boundary range (Fündeling and Trautmann, 2010).
- **GA-SGS:** GA only works in λ and is combined with standard parallel SGS. This combination has been used to evaluate FSGS.

The methods mentioned above are compared based on the maximum number of produced scheduling (Ω) per sample number. In addition, if the project execution time beT_{min}, then the optimal scheduling is obtained, the calculations are completed and the computation time required for each method is expressed as a single CPU time (Kolisch and Hartmann, 2006; Van Peteghem and Vanhoucke, 2014). However, the proposed method of present study has been run in MATLAB software using a computer with a 4.3 GHz Intel Core i7-7700k CPU with 16 GB of RAM. In addition, Naber and Kolisch (2014) have solved their MIP model using CLPEX on a PC with 3.4 GHz Intel Core i7-3770 CPU and 16 GB of RAM.

4.4.2. Setting the Parameters

One of the features of the proposed method is that there is no need to set the parameters, manually for each type of HRA problem. This future does automatically in the algorithm, because of the dynamic capability of the GWO algorithm and added the Sugeno fuzzy interference context to the algorithm, which is superior to other meta-heuristic algorithms based on local search due to structural optimization, the parameters of the proposed method are self-adjusting. In this study, to adapt GA to the problems with different sizes, the group size is set according to the min (10·n, 400) function, and used the number of activities n, and the transformation rate for the activity list pλ = 5% and also p_σ = 0.5% and p_ρ = 5%.

Besides, the interaction between GA and VNS is simplified by adjusting the number of schedules as a termination criterion based on the size of the problem. Also, for the VNS schedule limit is set the value of $\Omega_{VNS} = \lfloor \Omega . \max(n/200, 0.25) \rfloor$ and for the GA schedule limit is set value of$\Omega_{GA} = \Omega - \Omega_{VNS}$. Also, in the VNS it has used 1000 unimproved schedules for the proposed solution, 200 generated schedules for the neighborhood, the maximum 5 neighborhood, and 5 longest routes in the activity selection (Hartmann, 1998).

For GSA, the size of the min group (5·n, 200) was used and the list of activities in the initial group was created as HM. The SGS flag is randomly set with the same probability for serial or parallel, and the conversion rates are set to 5% for both the activity list and the SGS flag (Hartmann, 2002).

4.4.3. Computational Results

In this research when we talk about statistical significance, it refers to the significance level of α = 0.05 confirmed in the Kruskal – Wallis, and single-sided analysis of variable or Mann – Whitney U test.

4.4.3.1. Quality of Solution

Table 6 shows the mean relative deviation of the mean Δ_{mip} obtained from the best MIP solution and comparative mean deviation of Δ_{lb} from the lower bound of the T_{min} project execution time. Optimal MIP solutions for all samples are obtained from the B10 set, while for sets: B_{20}, B_{40}, and A≤55 all solutions are not optimal. For each sample set, average results for schedule limits (Ω) are given four schedules amount includes 1000, 5000, 15000, and 25000, and the average result is highlighted throughout all scheduling limits. The last row of the table shows the overall results for all sample sets and scheduling limits. The differences between the methods are statistically significant in all rows. Based on the results presented in Tables 6, the proposed method leads to better results than other statistically significant methods. The advantage of Tritschler et al. (2017) is the maximum value in the B10, while all MIPs are solved to optimize and are equal to the optimization distance. In Tritschler et al. (2017) for 25,000 scheduling, with the optimization distance of 14%, it is about 9 times less than the same value in other methods. Research by Tritschler et al. (2017) improves with an increase of Ω from 15000 to 25000 while other methods remain the same. For the average A≤55, and B40 datasets, HM finds some of the best new solutions. For larger B100 and B200 datasets, HM and SGA perform better heuristic random modeling. Also, the proposed method provides better results than the research of Tritschler et al. (2017) for all cases.

Table 6
Mean deviation as a percentage of the best MIP (Δmip) and T_{min} (Δlb) solution

Set / Ω	Proposed Method		Tritschler et al. (2017)		SGA		PRS		SRS	
	Δ_{mip}	Δ_{lb}	Δ_{mip}	Δ_{lb}	Δ_{mip}	Δ_{lb}	Δ_{mip}	Δ_{lb}	Δ_{mip}	Δ_{lb}
A≤55	-0.73	5.52	0.03	5.60	2.12	7.82	2.64	8.41	3.89	9.83
1000	0.11	4.73	0.64	6.27	2.52	8.30	3.26	9.09	4.66	10.68
5000	-0.54	3.76	0.01	5.58	2.13	7.83	2.67	8.45	3.95	9.86
15000	-0.56	4.68	-0.24	5.30	1.95	7.63	2.37	8.10	3.57	9.47
25000	-1.07	3.96	-0.27	5.25	1.88	7.53	2.26	7.98	3.40	9.28
B10	0.16	3.73	0.24	5.40	1.31	6.57	1.55	6.81	1.59	6.88
1000	-0.51	4.12	0.44	5.62	1.34	6.61	1.56	6.83	1.62	6.91
5000	-0.10	3.94	0.22	5.38	1.30	6.56	1.55	6.82	1.58	6.87
15000	-0.24	3.63	0.15	5.31	1.30	6.56	1.55	6.81	1.58	6.87
25000	-0.85	4.60	0.14	5.28	1.30	6.56	1.55	6.81	1.58	6.87
B20	-0.64	3.81	0.28	4.24	0.75	4.77	1.28	5.34	1.31	5.40
1000	-0.21	3.31	0.60	4.60	0.86	4.90	1.63	5.73	1.70	5.84
5000	-0.41	3.48	0.27	4.23	0.75	4.78	1.31	5.37	1.30	5.39
15000	-0.05	2.79	0.15	4.10	0.70	4.71	1.12	5.16	1.15	5.23
25000	-0.53	3.07	0.10	4.04	0.69	4.70	1.07	5.10	1.09	5.16
B40	-2.86	3.05	-1.88	4.08	-1.73	4.29	-0.05	6.21	0.32	6.74
1000	-2.53	3.02	-1.66	4.35	-1.53	4.55	0.49	6.84	0.93	7.44
5000	-2.69	3.74	-1.88	4.09	-1.72	4.31	-0.01	6.26	0.42	6.85
15000	-2.54	3.39	-1.98	3.96	-1.82	4.18	-0.29	5.94	0.04	6.41
25000	-2.56	3.70	-2.10	3.93	-1.85	4.13	- 0.4	5.81	-0.09	6.26
B100		2.10		3.94		4.05		7.15		8.09
1000		3.65		4.07		4.21		7.68		8.86
5000		3.52		3.98		4.08		7.21		8.14
15000		3.72		3.89		3.97		6.92		7.84
25000		2.21		3.87		3.93		6.80		7.71
B200		1.72		3.41		3.55		7.12		8.20
1000		1.60		3.46		3.65		7.53		8.67
5000		2.04		3.40		3.57		7.16		8.27
15000		2.30		3.39		3.51		6.95		7.98
25000		1.82		3.39		3.48		6.83		7.88
Sum	-0.97	3.41	-0.33	4.46	0.63	5.20	1.37	6.86	1.81	7.55

4.4.3.2. Computational Time

Computing the average time in seconds requires generating 1000 scheduling for each problem (based on the average of the 25000 scheduling generated) that is listed in Table 7. Although this is not completely linear, it still works well. The computational time of Tritschler et al. (2017) increases as a fixed factor equal to 2.5 through doubling the number of activities, when considering the range of 10 up to 100 activities. For 200 activities, the factor slowly increases to 2.86. Because of repetitive production and analysis of source trends in selected activity, the VNS of Tritschler et al. (2017) requires more time than the GA method of the Tritschler et al. (2017). As VNS does not run in all solutions, its effect on HM computation time is small. The key factor for computation time is the used SGS, as the FSGS runs more complex operations to determine the source value compare to other SGSs. The computational time of the proposed method is almost 100 times better compared to any case study that has been issued in the literature review of Tritschler et al. (2017).

Table 7
Average time to generate 1000 schedules per second

Set	Propposed Method	Tritschler et al. (2017)	GA	VNS	SGA	PRS	SRS
A≤55	0.0006	0.14	0.11	0.24	0.05	0.06	0.02
B10	0.0002	0.08	0.08	0.17	0.04	0.04	0.02
B20	0.0010	0.2	0.18	0.28	0.09	0.09	0.05
B40	0.0084	0.5	0.38	0.65	0.21	0.21	0.1
B100	0.0146	1.55	1.19	2.72	0.84	0.69	0.31
B200	0.019	4.44	3.58	9.08	2.61	1.85	0.7
Sum	0.01	1.15	0.92	2.19	0.64	0.49	0.2

4.4.3.3. The Sample Parameters

The effect of sample parameters on the quality of the solution is evaluated. Table 8 and Figures 8 show the T_{min} distance for different amounts of ordinary strength (OS), resource factor (RF), resource strength (RS), and minimum block length. In table 8, the averages for each of the 4 scheduling limits Ω are plotted for the B10 to B200. According to the results of Fündeling and Trautmann (2010) ordinarily, strength has an irreversible effect on the quality of the solution. The effect of the minimum block length is small, too. Resource strength and resource factors have a significant effect on the quality of the solution. Also, the observations are similar to the RCPSP observations (Kolisch et al., 1995). For samples whose resources are so constrained like those with RS = 0, the benefit of HM and SGA over random sampling is very clear.

Table 8
Average time to generate 1000 schedules per second

Set	Propposed Method	Tritschler et al. (2017)	GA	VNS	SGA	PRS	SRS
A≤55	0.0006	0.14	0.11	0.24	0.05	0.06	0.02
B10	0.0002	0.08	0.08	0.17	0.04	0.04	0.02
B20	0.0010	0.2	0.18	0.28	0.09	0.09	0.05
B40	0.0084	0.5	0.38	0.65	0.21	0.21	0.1
B100	0.0146	1.55	1.19	2.72	0.84	0.69	0.31
B200	0.019	4.44	3.58	9.08	2.61	1.85	0.7
Sum	0.01	1.15	0.92	2.19	0.64	0.49	0.2

4.4.3.4. The Sample Parameters

The effect of sample parameters on the quality of the solution is evaluated. Table 9 and Figures 8 show the T_{min} distance for different amounts of ordinary strength (OS), resource factor (RF), resource strength (RS), and minimum block length. In table 9, the averages for each of the 4 scheduling limits Ω are plotted for the B10 to B200. According to the results of Fündeling and Trautmann (2010) ordinarily, strength has an irreversible effect on the quality of the solution. The effect of the minimum block length is small, too. Resource strength and resource factors have a significant effect on the quality of the solution. Also, the observations are similar to the RCPSP observations (Kolisch et al., 1995). For samples whose resources are so constrained like those with RS = 0, the benefit of HM and SGA over random sampling is very clear.

Table 9
Average distance up to T_{min} based on percentage

Set	Propposed Method	Tritschler et al. (2017)	GA	VNS	SGA	PRS	SRS
A≤55	5.26	5.6	5.69	6.92	7.88	5.26	5.6
B10	4.43	5.4	5.41	5.6	6.85	4.43	5.4
B20	3.87	4.24	4.28	5.02	5.09	3.87	4.24
B40	3.72	4.08	4.17	5.84	4.54	3.72	4.08
B100	3.32	3.94	4.09	5.23	4.16	3.32	3.94
B200	2.78	3.41	3.58	4.24	3.69	2.78	3.41
Sum	3.89	4.46	4.55	5.49	5.39	3.89	4.46

The output of the proposed method and Tritschler et al. (2017) for T_{min} distance for different values of Ordinarily Strength is issued in figure 8.

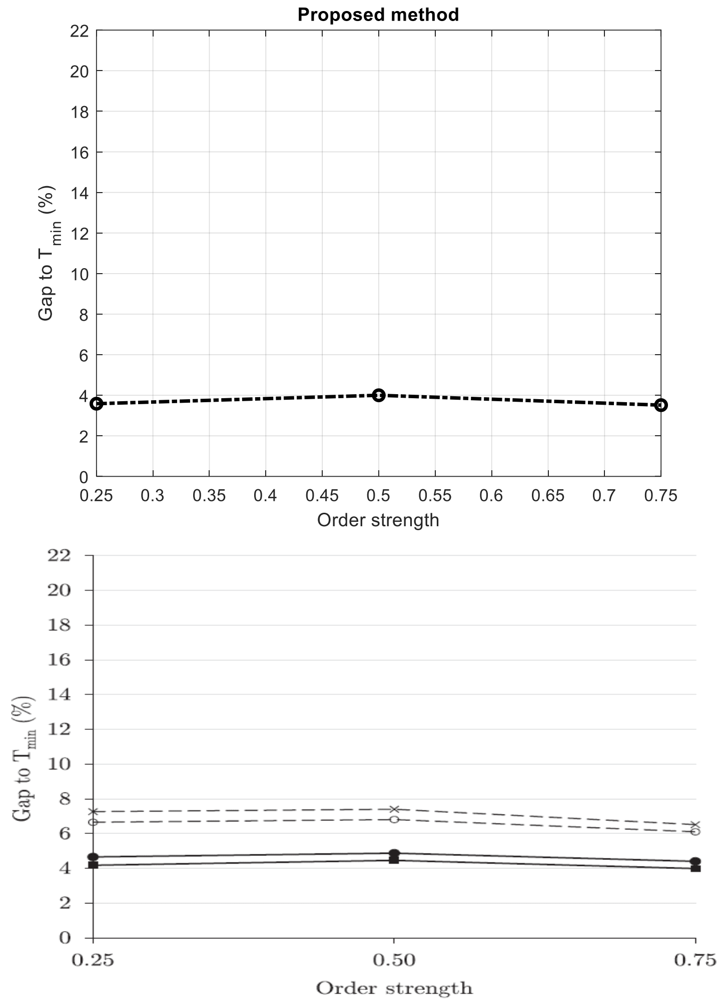

Figure 8
Output of the proposed method and Tritschler et al. (2017) for T_{min} distance for different values of Ordinarily Strength

Figure 9 shows the ratio of distance to T_{min} mean along all 4 scheduling limits of Ω. The difference in results is statistically significant in all rows of the table. By considering pairwise comparisons for overall results in the last row, GA-FSGS generates better results than MP-FSGS and GA-SGS with clear statistical signs. This identifies the positive effects of GA (between GA-FSGS and MP-FSGS) and FSGS (between GA-FSGS and GA-SGS). The advances of Trichler et al. (2017) are statistically insignificant compared to GA-FSGS when considering all samples. However, this analysis includes examples on which VNS has not been implemented. The differences are quite noticeable between the proposed method and other methods, and the proposed method shows basic improvement in the solutions, too.

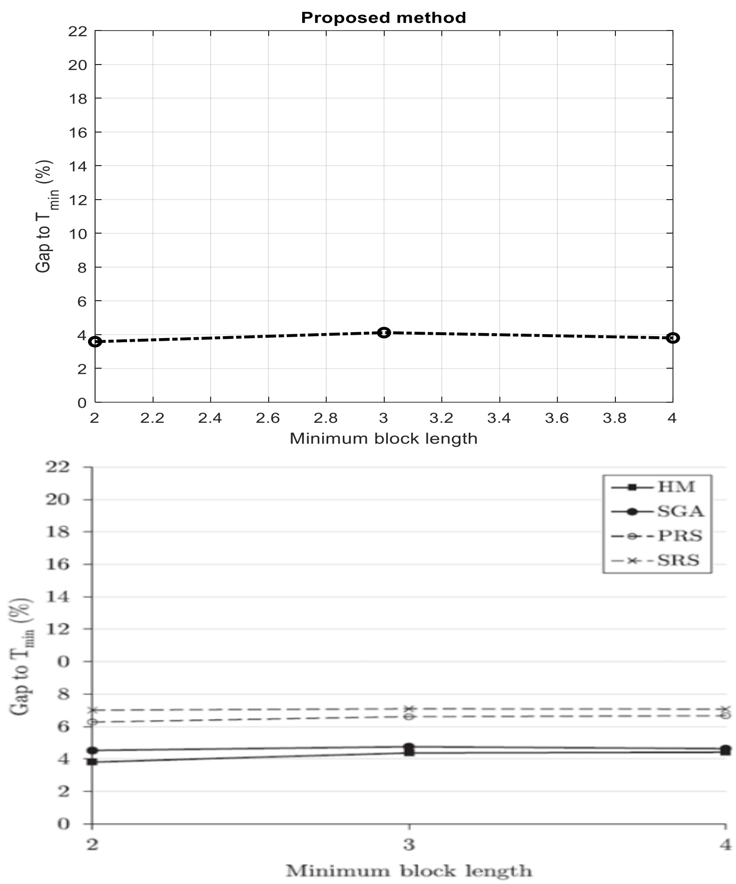

Figure 9
T_{min} Distance for different values of minimum block length through the proposed method and Tritschler et al. (2017)

4.4.3.5. Dependence on Fuzzy-RCPSP with discrete sources

Despite continuous sources that were examined in this study, there are empirical cases whose number of sources is constrained, such as those stated in Fündeling and Trautmann (2010) and Baumann et al. (2015). This section demonstrates that how the proposed method can also be used to solve discrete resource problems under the fuzzy approach. It is important to note that despite the distribution with discrete sources, the computational results of discrete sources cannot be compared with those in Fündeling and Trautmann (2010) and Baumann et al. (2015). Before these problems, they placed the exact and detailed resources in the exact amount requested by each activity, while our problem allows resources to be allocated at least the required amount for each activity and blends in with the real environment, thus gaining a fuzzy mood. In other words, more resources may be allocated to activities, while the duration of global projects can be reduced while trying to cover the minimum required block length (Fündeling and Trautmann, 2010; Baumann et al., 2015).

The attribute value of q_{irt} is main variable that differentiates between discrete and continuous sources. We therefore converted the q_{irt} continuous value to the integer value by rounding to up or down values till it can examine the required resources by activity and the access limits of each resource, respectively. We performed the discrete resource-guided implementations that the results of which are calculated from solving experimental sets include: B10, B20, B40, and B100, which are issued in Table 6. It should be noted that VNS is related to these sample sets in that, and those maintain the stated integer conditions of resource and boundary requirements. A very small increase is expected in execution times in the rounding operation for discrete sources.

Table 10 shows quality of solutions in the mean deviation stages of the best MIP DR solution. Also, it reports the duration of T_{min} in project for both HM and GA-FSGS from the lower bound. While reference T_{min} values remain unaffected, the best MID DR solutions were obtained by solving best FP-DT3 model compare to Naber and Kolisch (2014), although it was imposed integrating on all the source variables.

Even though the MIP DR model is generally more difficult to solve than the CR model, it was found that all MIP solutions are optimal for the B10 test set. It is used instead of the MIP reference value for those cases that the MIPs were not optimally solved. Also, for this item modified discrete source test and error the best project execution time or the upper limit of the project execution time was obtained from Neber and Kolisch (2014). The average distance Δ_{lb} from the discrete sources is as expected is slightly greater than the continuous sources for all experimental sets, because of increasing integrity of the source variables. The mean Δ_{mip} distance of discrete sources is slightly better than the continuous sources in all expected B10 experimental sets.

This optimal output is because of the poor quality of the MIP solution at limited execution times. Despite the applicability of the proposed method, the method of Tritschler et al. (2017), and the GA-FSGS about discrete sources, it should be emphasized that these methods are designed for continuous sources. Further adaptation of these methods for future studies is suggested to improve the quality of the solution for FRCPSP with discrete sources as a combination of several types of sources. Table 10 shows the quality of the proposed solution in a fuzzy mode for different modes of the problem.

Table 10
Solution quality for FRCPSP with discrete sources

Sample	**Proposed Method**		**HM**		**GA-FSGS**	
	Δ_{mip}	Δ_{lb}	Δ_{mip}	Δ_{lb}	Δ_{mip}	Δ_{lb}
B10	0.23	5.68	0.29	5.77	0.31	5.79
1000	0.47	6.04	0.55	6.06	0.58	6.09
5000	0.21	5.65	0.26	5.47	0.28	5.76
15000	0.17	5.59	0.18	5.64	0.19	5.66
25000	0.18	5.62	0.18	5.65	0.19	5.66
B20	-0.08	4.52	- 0.04	4.56	- 0.02	4.58
1000	0.25	4.84	0.26	4.89	0.27	4.91
5000	- 0.04	4.47	- 0.03	4.57	- 0.02	4.58
15000	- 0.24	4.33	- 0.17	4.41	- 0.14	4.44
25000	- 0.31	4.34	- 0.22	4.36	- 0.19	4.39
B40	- 2.01	4.44	- 2.01	4.47	- 2.01	4.47
1000	- 1.74	4.86	- 1.67	4.86	- 1.77	4.76
5000	- 2.06	4.43	- 2.04	4.43	- 2.02	4.45
15000	- 2.15	4.26	- 2.14	4.31	- 2.10	4.36
25000	- 2.28	4.18	- 2.18	4.26	- 2.14	4.31
B100		4.14		4.21		4.34
1000		4.29		4.34		4.42
5000		4.16		4.20		4.34
15000		4.17		4.17		4.30
25000		4.13		4.15		4.29
Sum	- 0.63	4.71	- 0.58	4.75	- 0.57	4.79

According to the results, the proposed method has issued better results compare to the advanced algorithms in the case of HR allocation, comprehensively.

3. Managerial Insights

HRA problems are increasing, today. The main problem is how we can use reachable HR to complete the working process, effectively. The solution will be vital if a big problem expands its shadow on all of the organization's environment. In 2021, all of the world encounter COVID-19, and the working schedules has distributed. The variety of contexts of the issue and the presence of the employee are the most important challenges that any manager has to meet and solve. The findings are this research is a new window and a flat road to have better planning to handle the critic. If there be a solution that helps managers to manage HR efficiently, it will be a gift to reach it and use up to meet the organization's desires. This research showed that the new hybrid method can re-structure the company, and re-allocate the HR, easily. It seems that the managers have a new intelligence method (A self-regulating algorithm) that able them to have more plans for critical and commonplace conditions to control the undesirable outputs.

4. Conclusions

The current paper presented Novel Hybrid Approach to Enhance Intelligence Integration in Small-Medium Enterprises. The research was done on 30 Small-Medium enterprises in Iran applying enterprise engineering. For data collection, 4 distinct questionnaires were developed to record the managers' attitude toward the enterprise knowledge. The questionnaires were particularly designed to evaluate the organization's culture and the employee's companionships. Moreover, a semi-structured survey was considered for making an obvious AS-IS station. After passing the data collection process, all the questionnaires' data was explored via SPSS and the reliability of these surveys was proved with Cronbach's alpha. Thus, NVIVO was used to evaluate the collected data. Afterward, considering the AS-IS state, two individual IT and business structures were obtained by the ITIL and COBIT standards and BSC, respectively. Then, the models were integrated implementing Archimate for proposing an appropriate integrated structure. Hence, to assure the model application in an organization, KAP was used and an efficient agile model was obtained.

Also, the authors tried to use a new framework to continuously and comprehensively solve HRA problems (In normal and critical conditions under variability of goals and organizational conditions). For this, the novel self-regulating algorithm was used. In this study, the mathematical model of the HRA problem was first proposed, and then, the algorithm was developed using the Sugeno fuzzy inference model to solve the problem. The problem was solved with different data from previous researches, and the results were compared with those researches. In a conceptual context, the concept of separating the performing tasks page was used in this research.

For this purpose, a two-layer framework was proposed to perform HRA in two layers, continuously and under uncertain conditions. It was to avoid the congestion of tasks in the receiving nodes and load imbalance on the manpower nodes. It received tasks in a way that prevented overcrowding in the task transmission rate adjustment layer and task receiving nodes. Simultaneously, in the resource allocation layer, the available human resources were optimally allocated using the novel self-regulating algorithm was used. In this study, the mathematical model after evaluating the current situation. To improve the overall search of the standard GWO, three optimal solutions from the current population of solutions were used, which included: the best optimal population solution α', and the second and third optimal solutions were β^' and δ', respectively. Also, these three optimal solutions cause the search space to be expanded and the overall search in the algorithm, because of the change in their values each time the algorithm is run. Finally, the combination of GWO algorithm and Sugeno Fuzzy Inference Model to create a new self-regulating algorithm that occurs for risk time in developing local search algorithms.

This study was used two samples A and B test sets of Vanhoucke (2008). Also, the present study's proposed method was compared to the best methods of HRA in the previous research based on the maximum number of produced schedules per problem sample (Ω). It was also tried to make the proposed method's termination criteria in solving the HRA problem be reachable. Since The best research in solving the HRA problem was Alvarez-Valdes et al. (2008) and Tritschler et al. (2017), the finding showed that the proposed method had better results compare to all previous methods, and the quality of the solutions have been better in this research. As future research suggests, combining the newly developed algorithm with Artificial Intelligence capabilities to authorize automate the running and algorithm behavior completely. It can also be a progress advantage to compare the results of the AI algorithms with the proposed algorithm in HR-Tech categories too.

5. References

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