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Overcoming business process reengineering obstacles using ontology-based knowledge map methodology

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Abstract

Business process reengineering (BPR) is identified as one of the most important solutions for organizational improvements in all performance measures of business processes. However, high failure rates 70% is reported about using it the most important reason that caused the failure is the focus on the process itself; regardless of the surrounding environment, and the knowledge of the organization. The other reasons are due to the lack of tools to determine the causes of the inconsistencies and inefficiencies.

This paper proposes Process Reengineering Ontology-based knowledge Map Methodology (PROM) to reduce the failure ratio, solve BPR problems, and overcome their difficulties. Using an organizational ontology to show the structure and environment surrounding to organization's processes, using knowledge maps as an inference that succeeds to identify and find out the causes that lead to contradictions and inefficiencies, and using Analytical hierarchy processing to identify and prioritize processes of the business to be re-designed. Through the proposed methodology, all organizational processes are completely analyzed. Moreover, Analytical Hierarchy Processing technique is used to show the most important processes with high priority to be reengineered first then it is easy to discover any errors occurred during reengineering process through knowledge map so BPR is done successfully. Finally, Apply the proposed methodology to inventory management shows how processes reengineering are done successfully and helping the organization to achieve its objectives.

Keywords: Business process reengineering; Knowledge map; Ontology; Analytic hierarchical processing

1. Introduction

Today, the structure and behavior of the organizations have to be considered to help adaptation and evolution in a dynamic and more rapidly changing in the environment.

Currently, the organizational changes are unexpected although they were expected in the past. New technology appeared the globalization of business processes and the changing of customer requirements are the most factors that affect the organization position among the market. The aims of most organizations are to grow with high performance, achieve excellent work, minimizing the cost of services and products, and add value to the customer through good understanding about their requirements. Consequently, they need to be efficiently and continually redesigned in a world of new technology, changes, and strong competitors and redesigned to actualize strategic and operational success. The causes of strategic failures of the organizations are the inefficiency of the business processes, the lack of innovation, entailing serious consequence for companies and its competitiveness [51].

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BPR is defined as "a fundamental rethinking and radical redesign of business processes to achieve substantial improvements in all performance metrics such as cost, speed, quality, and service." Each of private and public organizations are either subject to use BPR or looking for an alternative methods which achieve the same results. Although a lot of organizations embraced the concept of BPR programs, only a few of them success, while the other fail with a high failure rate (e.g. 70%) [43,51].

Many factors affect the success of the BPR that will be explained in details below and these factors including the understanding of the environment in which the business process exists. As a result, organizations need techniques and integration of knowledge management models to understand the environment which includes processes, people, workers, customer, and tools.

The ontology contains a range of concepts and classifications, so it is developed to improve the comprehending structure of the organization and relationship between the organization goals it also used in the knowledge domain.

Knowledge map "is a representation of knowledge which reveals relationships of the sources of knowledge by using the metaphor of maps to display a certain place." It is a knowledge management technique that is used for different purposes, such as finding sources of knowledge or opportunities for knowledge creation, increases their participation and how they interact within the organization; identify the experiences and the ability to determine the terms of references [36].

Analytic Hierarchical Processing (AHP) "is a structured technique for organizing and analyzing complex decisions, based on mathematics and psychology".

In this paper, ontology is used to improve, build data and information structure. Also, knowledge map is used to identify and find out the causes that lead to contradictions and inefficiencies in the business processes reengineering depending on the ontology structure. Moreover, AHP is used in this paper to identify and prioritize processes of the business to be redesigned use the ontology to collect all information related to the business procedures that demand to be reengineered. The organization may don't have the resources to handle all processes at once so AHP is very important in this case.

This paper aims to propose a methodology to BPR to be successfully done through using ontology, AHP, and knowledge map. Therefore, all organizational processes will be analyzed and the most important process will be reengineered first. Then if any errors occurred the map will find why this error occurred, who are caused it, and where these errors are founded to make everything clear during BPR and tackle any obstacles.

The paper is organized into the following sections; the BPR, organizational ontology, and knowledge map are described in Section 2. Section 3 describes the BPR's success and failure factors then BPR models and methodology are described and evaluated. After this, the PROM methodology is proposed finally the conclusion and the future suggestions are presented.

2. Theoretical background

This section presents the BPR theoretical concepts. It starts with the definition, analysis of the nature of BPR and the role of BPR in modern organization, followed by discussion of the business process reengineering environment linked to the significant of all support concepts such as knowledge map, organizational ontology and AHP. Then the environment structure is presented through BPR, selecting appropriate modeling tools both BPR and its environment and choosing the most successful methodology for BPR using ontology and knowledge map. Finally, criticism and contradictions are presented that are related to BPR.

2.1. Business process Re-engineering

BPR Used since 1990 works on a large scale and had achieved many benefits, such as lower costs and increases production, improves products and increases customer satisfaction. There are many definitions for re-engineering processes and these definitions vary in focus.

BPR is defined as "A radical redesign of processes to gain significant improvements in cost, quality, and service" [15]. That means neglect all existing structures around the procedures, inventing new ways to end, accomplish work and get the job done in record time. Re-engineering is the re-renewal of the business process starts with assumptions and does not take anything for granted.

BPR is "an approach used to create a computer-based system for the management of the supply chain traceability information flows" [25]. It has emerged from key management traditional like systems thinking and scientific management. "The development of the Information system can be regarded as business process reengineering practice, either because it automates some human-based processes or because it replaces an existing legacy system" [57]. Also, BPR is defined as "Methodologies to change the internal business of the organization in response to environmental and requirements changes" [14]. Business process "is a group of logically related tasks using the firm's resources to provide customer-oriented results to support the organization's objectives" [60].

Another definition is "the radical redesign fundamentally of a business process to gain dramatic improvements in performance measures such as quality, cost, speed, and service" [3]. This definition contains keywords: fundamental, radical, dramatic and process, which implied that before reengineering it is necessary to understand the process and the fundamental business operation, while it ignores the underlying rules and assumptions of the traditional/old business processes and to radically redesign the business process for dramatic performance can be measured in terms of time, speed, cost, and quality.

Reengineering is achieving significant improvements in the performance of the organization and not just the work of amendments, for example, there are three companies used reengineering. The first one found itself in big problems and there is no an alternative solution. The second company found

itself in trouble as a result of environmental changes around it. The third company found itself subject to many pressures and conditions and there is no solution. These three companies found re-engineering the chance to solve their problems and meet their rivals. Business activities must be seen as a group of people or even a total of tasks that must be partitioned into processes which can be designed with more effective in both the manufacturing and service environment [47].

Business process management (BPM) is aiming to improve organizational performance, while BPM focuses on improving or reusing the processes of the organization. So, it differs from BPR in time, cost, and processes change.

BPR is known by many names, such as "core process redesign", "new industrial engineering" or "working smarter". BPR is commonly viewed as a top-down solution from a management perspective.

BPR can be done successfully if it considers all the success factors, use the organization processes and its environment knowledge around these processes.

2.2. Knowledge map

A knowledge map has been defined as "a visual display of captured information and relationships" [41] and it "is a tool for presenting what knowledge resides where e.g. Media, People, organizational units or sources of knowledge outside the organization" and for indicating the models of knowledge flow (distribution, access, learning). A map "Is a drawing expressing physical relationships of the things that are important places or through human history, People were inventing physical maps such as Atlas and cave drawings and his recent survey satellite scans and computer visualization in three dimensions [45,26].

For example, a map includes Mind Map for improving memorization and Concept Map [3] for learning objects. A knowledge map "is a representation of knowledge which reveals relationships of the sources of knowledge by using the metaphor of maps, to display a certain place". For instance, knowledge maps for new magazines, which launches new light on the subjects and their relationship by using the package to represent the concepts of the keys is possible to use lines to represent the relationships. The first step in knowledge mapping is to build an inventory of knowledge (i.e. the knowledge base) and develop the processes of knowledge sharing but this knowledge based on a tool to be ready for using this technique such as ontology [36].

2.3. Organizational ontology

Ontology is a "specification of a conceptualization" [23]. This definition is one of the best and most reliable for ontology. It can be explained and interpreted well. Illustration meaning of the word conceptualization is a simplified view of the world.

In the sense that each range of knowledge must be based on the conceptualization and for each conceptualization is based on the objects and concepts and other entities which are supposed to have the same importance and relations existing among them.

It can also interpret the word world as referring to some of the topics or region-specific phenomena. The word specification which is the first part of the above definition means "a formal and declarative representation". The ontology using formal language containing concepts and limitations in the data structure representation, and this means that the ontological representation must be a readable language However it is not considered a program that it represents knowledge, which is used by the program.

Ontology "is a group of knowledge terminology, including the semantic interconnections and the vocabulary, and some simple rules of inference and logic for some particular topic." [11,9]. The ontology is also known as the relationship between the concepts used in a certain domain of range. For instance, the ontology of "musician" may include instruments and how to play them, as well as albums and how to record them. Through different abstract levels, ontologies can be known as, the top level enterprise ontology, or specific domain of ontology. Higher level ontologies including a lot of concepts that can be reused by a much lower level ontology [38].

For the process of mining and analysis, the main objective of this work is the use of domain ontology and corporation level ontology which give analysis for the results that are closer to the actual operation of the corporation. Based on generic information which may be included in process execution data, data elements can be described by domain ontologies which are needed for multi-perspective analysis task, originator, event, time and data attributes. "specification of a conceptualization" definition is the most significant one for the ontology.

The ontology is very important to improve, build data and information structure for this it is developed appropriately because it contained a range of concepts, classifications and used in the programs and also in the knowledge domain. So ontology is created to improve the comprehending structure of the organization and relationship between the organization goals. The knowledge of the domain experts is created from the ontology and entrepreneurs, to know all the relation and the details of the organization data and the organization goals conformance [56]. The ontology is produced for representing "who does what" and "who knows what" in the organization. It provides a knowledge perspective of an organization, just as it assists in the representation of knowledge that, is included in the main practices (i.e. the cases) of an organization [41].

The main component of the framework that needed for creating knowledge maps is dependent on the developing of the ontology of the domain knowledge. From that, it can be known "as a group of concepts and relationships. The refinement process was iterative and involved identifying further relationships and constraints" [44]. Resulting ontologies should be used in all stages of business with given information of domain problem and the running of the knowledge-based system to generate new data and exploiting of the existing data before the emergence of the knowledge-based system. Continuing through displaying information in ontological

contexts in various user interfaces and ending with decision support tasks built on data mining processes [10].

3. BPR success and failure factors

The critical success factors (CSF) of BPR described by many authors, to improve the implementation of BPR generally in all sectors. These factors include for example, "top management," "commitment and support," "education of manpower," and all of these factors play a significant role in the success of BPR.

The common and the most important factors collected from previous studies [24,6] are categorized into four main and 17 subcategories (factors) while only one failure factor" (category) of resistance to change "is taken for this study. Fig. 1 shows BPR success factors including "egalitarian leadership," "working environment," "top management commitment," "use of information technology", and "managerial support".

3.1. Egalitarian leadership

The main key in managements consists of employee involvement, leadership nature, and communication. Top managers should provide vision (share vision) to drive the changes. All employees should be more responsive to changes. All members of the BPR team should know and have more information about the process.

Top management must raise awareness among employees through a communication channel, it is open and continuous to develop their abilities and to empower employee and cooperate in a new system within organizational decision making, should establish inter- and intra-organizational confidence and trust.

Through the use of groupware technology, the time needed to analyze the stages can be decreased and enable "top management" to actualize optimal process operation through the effective use of their ideas [4].

3.2. Collaborative working environment

It is related to the equitable Culture, cooperation (cooperative environment) and it is an important factor in the success of BPR projects. Employees should work together in the same department within the organization and "interact in a friendly way" at the same time with each other. Employees should work in a cooperative environment through trust each other, and interact with each other in a friendly way, and make sure that the top management knew their roles "recognition among employees.

3.3. Top management commitment

Explicitly define strategic mission so it is necessary for redesigned. The strategic management is the most important departments in any existing organization as it contain senior officials and administrators who define the strategic directions of the organization.

Senior management must be with the full knowledge of all the terms of the organization; it is intransitive to have a "sufficient knowledge about the BPR projects" and "factual forecasts of BPR results" [24].

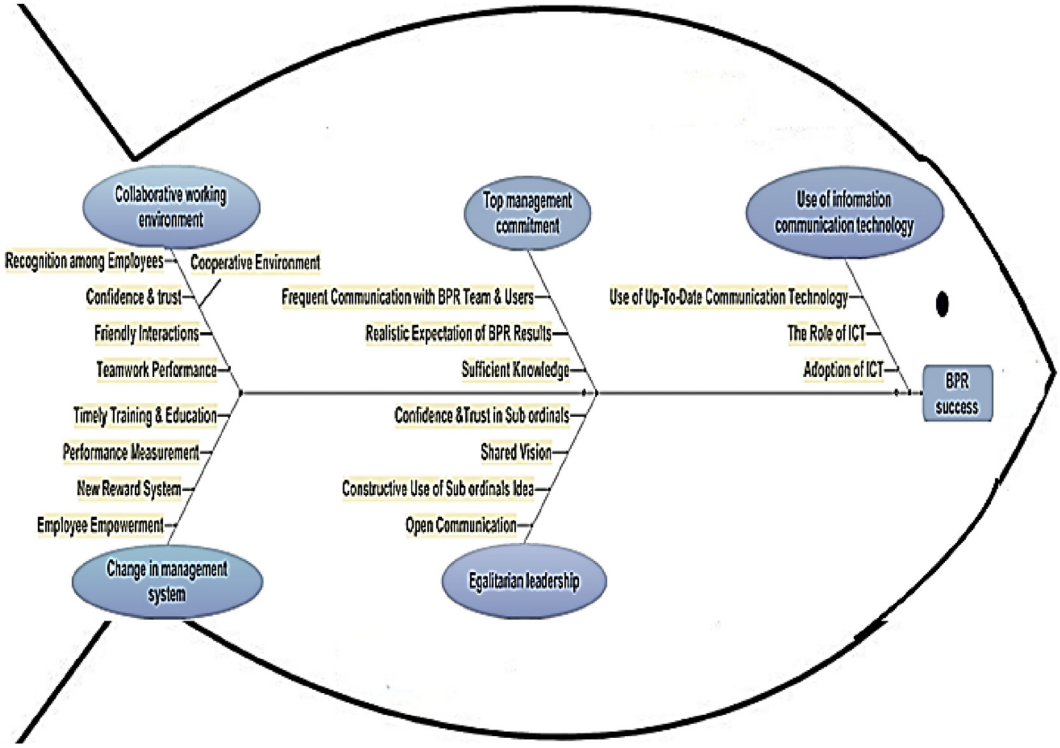

Fig. 1. BPR critical success factor.

3.4. Changes in management system

It shows how the system change, improve the work and improve the performance of the organization through improving organizational processes and also, show how people and teams are affected by an organizational transition. The aim of change management is to ensure that the new system is used and can handle all procedures effectively.

3.5. Use of information and communication technology (ICT)

ICT is presented as a natural factor of BPR and a critical component, which has a significant and continuous role in BPR projects. ICT includes "the areas of the information system, and communication technology, which provides members with the needed information. These bring effectiveness in realizing the CSF mentioned above by pulling human, business, and organization together". Through ICT,

- Share database making information available at any places
- Use Telecommunication networks, allowing organization to be centralized and decentralized at the same time
- Automatic identification and tracking, allowing things to be easily founded [7].

3.5.1. BPR failure factor: resistance to change

Naturally, the change is a basic in BPR but usually human resists this change. This resistance is considered the most common problem of the BPR success. Employees resist changes due to what they will be in the future, the change which is made by BPR including authority loss, job loss, and getting anxious [24]. Fig. 2 shows the BPR Failure Factors.

4. Related work

This section explains several BPR models and methodologies containing many phases and steps that have advantages and disadvantages. It is important to recognize the strengths and weaknesses captured from each previous study related to the re-engineering processes, find out the advantages and disadvantages of these methodologies and make newly developed methodology for process re-engineering. Through this section BPR models are discussed to determine the limitations and useful sides of each model such as conceptual model, network model, simulation model, object oriented model and knowledge based model. All of these models try to solve BPR problems and achieve improvements for the business. All the features of previous methodologies can be integrated with the strengths points to create a new methodology with high success ratio.

Although different models are proposed for implementing business process redesign and there is no standard methodology for it. Some of the famous methodologies for BPR are [12,13,16], Rao, et al., 2012 [51], Valiris & Glykas 1999 [59], Ozcelik 2010, Davenport 1993 [16], Eftekhari and Akhavan 2013 [19], Hussein 2008 [29], Vakola and Rezgui 2000 [58], and [30,31,39,40]. The main goal of BPR methodology is to redesign new processes and satisfy the organization's needs but during the implementation of BPR many problems occurred so, still need strong methodology to overcome BPR problems, achieve continuous improvements and identify the causes and effect of these problems these will be discussed with the proposed methodology ontology reengineering knowledge map in section 5.

4.1. Conceptual model

Conceptual model is a representation of a system, made of the composition of concepts which are used to help people know, understand, or simulate a subject the model represents". "Conceptual modeling is the activity of formally describing some aspects of the physical and social world around us for the purposes of understanding and communication." Conceptual model have many techniques and methods such as Data Flow Modeling, Entity Relationship Modeling, Event Driven Process Chain, Unified Modeling Language And State Transition Modeling.

A Conceptual model is used extensively in the development of process re-engineering models [34]. developed a framework and used conceptual models for explaining the role of information technology and how it was able to develop the re-engineering processes significantly on a large scale. An appropriate framework must be ready for the use of information technology to improve the re-engineering processes in different areas of the organizations on large-scale; for example, there is a need for an appropriate framework to add value for customers and then clarify the role of information technology to process re-engineering. A conceptual model for BPR are proposed and applied in a case study with a cargo company in Malaysia [20].

The advantages of using conceptual model

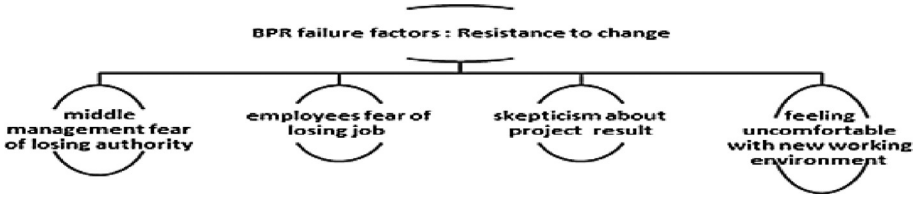

Fig. 2. BPR failure factors.

- Enhance an individual's understanding of the represented system
- Introduce a domain of reference for system designers to extract system specifications
- Simplify conveyance of system details between stakeholders
- Document the system for future reference and give a means for collaboration.

4.2. Simulation model

Simulation modeling "is the process of creating and analyzing a digital prototype of a physical model to predict its performance in the real world. Simulation modeling is used to help designers and engineers understand whether, under what conditions, and in which ways a part could fail and what loads it can withstand". Simulation modeling can also help to predict fluid flow and heat transfer patterns. It analyses the approximate working conditions by applying the simulation software" [52].

Many organization use Simulation model because it is,

- created faster than real time
- Safer and cheaper than conducting real-world experiments.
- more realistic than traditional experiments

4.3. Object-oriented model

This model appeared since the 1990s, object-oriented modeling "is an approach to modeling an application that is used at the beginning of the software life cycle when using an object-oriented approach to software development. "The object-oriented modeling approach creates the union of the application and database development and transforms it into a unified data model and language environment. Object-oriented modeling allows for object identification and communication while supporting data abstraction, inheritance and encapsulation. It consists of progressively developing object representation through three phases: analysis, design, and implementation. During the initial stages of development, the model developed is abstract because the external details of the system are the central focus. The model becomes more and more detailed as it evolves, while the central focus shifts toward understanding how the system will be constructed and how it should function. It is used by many programmers because it has many advantages including:

- Flexibility and re-use of modeling
- Can support any number of alternatives structures for the same set of data
- Facilitate Complex structures that are represented by composite objects, each object may contain other objects
- Provide communication between objects through methods

Object-oriented model hard to be understood by users and does not consider the strategic choices or implications in the re-engineering processes it can only represent part of the total system [1].

4.4. Integration Definition (IDEF) model

Integration Definition (IDEF) model is a group of modeling languages used to implement systems and engineer software these languages are used in data functional modeling, simulation, object-oriented analysis, and knowledge acquisition". The developing of IDEF models for the analysis of business processes it has been motivated to improve the structure of manufacturing systems and the communication and increase productivity. Constructing an Integration Definition model is only one component of a full-scale processes modeling effort. Integration Definition 0 is an approach designed to model the actions, decisions, and organization activities or system. IDEF1 is a technique designed for both communication and analysis in the building of the requirements. The IDEF3 (Process Description Capture Method) is a method or a mechanism for a process to be collected and documented [52].

The components of the IDEF family are IDEF0, IDEF1, IDEF2, and … Fig. 3 explains the different methods of the IDEF.

4.5. Network model

"Is a database model conceived as a flexible way of representing objects and their relationships". This model is often used as it puts obligations to the workflow of the organization these obligations very important in business processes and represents these obligations in maps. So, it can be utilized from these maps in the design of business processes to support the use of information technology in the management of commitments quality standards to increase customer satisfaction and productivity [1]."A study of a complex scheduling process at George Mason University shows how the mapping notion and the method work" [17].

Network model differ from other models in its schema, which is viewed as a graph where relationship types are arcs and object types are nodes. Unlike other database models, the network model's schema is not confined to be a lattice or hierarchy; the hierarchical tree is replaced by a graph, which allows for more basic connections with the nodes.

The benefits of the network model include [49]:

- Simple Concept: Similar to the hierarchical model, this model is simple and the implementation is effortless.
- Ability to handle more relationship types: The network model has the ability to handle one-to-one (1:1) as well as many-to-many (N: N) relationships.
- Accessing the data is simpler than hierarchical model.
- Data Integrity there's always a connection between the parent and the child segments
- Data Independence: is better in network models than the hierarchical models.

The drawbacks of the network model include:

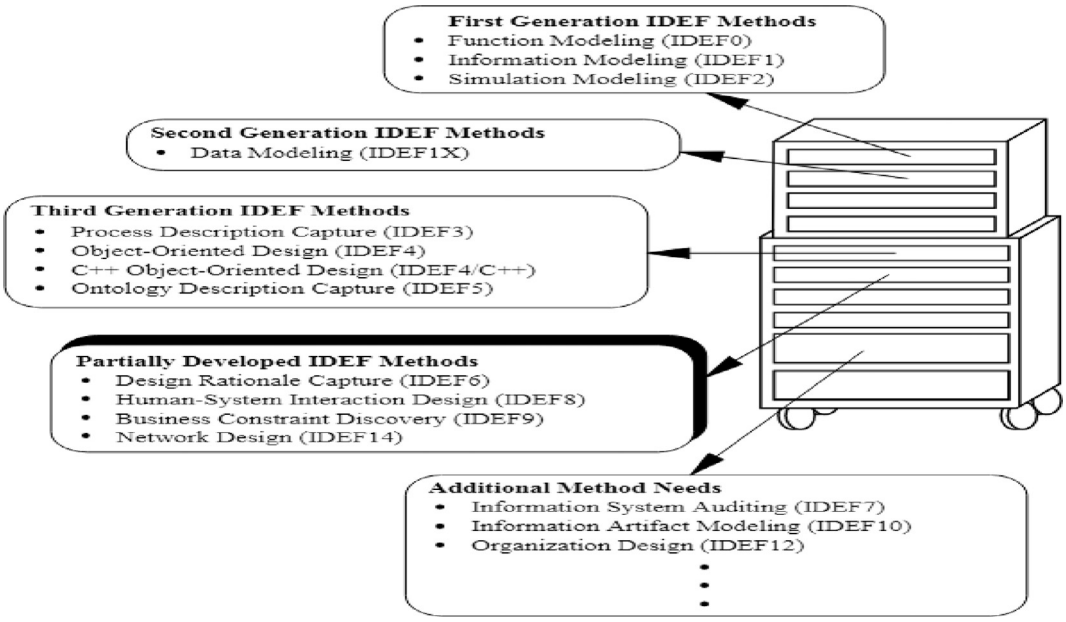

Fig. 3. IDEF methods [46].

- System Complexity
- Functional Flaws: Because a great number of pointers is essential, insertion, updates, and deletion become more complex.
- Lack of Structural Independence

4.6. Knowledge-based model

Knowledge-based model is a process of computer-aided usage of such knowledge models for the design of products, facilities or processes". Knowledge based is used to represent knowledge explicitly via tools such as ontologies and rules. Knowledge-based models include Expert Systems (ES) Artificial Intelligence (AI) and Database Management (DM). Decreasing the complexity of the analysis and modeling of BPR to facilitate the processes of re-engineering and finite knowledge-based models has been developed. However, this model needs further development to help processes reengineering within organizations [1].

Knowledge base has many advantages:

- Acquisition and maintenance. Through using rules experts can often define and maintain the rules themselves rather than via a programmer.
- Explanation. Representing knowledge explicitly allowed systems to reason about how they came to a conclusion and use this information to explain results to users.
- Reasoning. Extracting knowledge of the organization work so it consider inference engines

Knowledge base is considered inference engine representing logical assertions and conditions about the world, usually represented via IF-THEN rules. The proposed methodology in this paper uses this type of model and the main focus of this research.

Table 1 shows the weakness and strength points of the previous BPR methodology.

It can be found that not one methodology addresses all the Problems and obstacles related to re-engineering As a result, it is the best to collect all the features and strengths of each re-engineering methodologies, and build strong experience from all methodologies that are presented. This did not happen yet, perhaps any methodology may be not applicable in every situation.

To overcome the obstacles of the previous methodologies, using methodology that considers the success and failure factors of BPR, make preparing stage before applying BPR, using technique that will make management analysis for the organization and its surrounding environment like ontology, using inference mechanism technique that know the causes of the failure like knowledge map, and using technique that give priority for every organizational process to know which of them are important to be reengineered and save time that consumed in reengineering all processes. All of these steps will be explained through the proposed methodology in the next section.

5. Research design and methodology

The success of business process reengineering needs to strong technology. This success includes not only implement the BPR, but also provides the holistic understanding of the environment surrounding the business processes, provides the accessibility of the organization's knowledge, and these will be found in the proposed methodology, as it uses some powerful techniques such as (ontology, knowledge map, analytical hierarchy processing). Through this section the proposed method

Table 1
BPR analysis and limitations of last models & methodologies.

Author name	Date	Proposed methodology	Advantages	Disadvantages
Valiris&Glykas [59]	1999	"establish a disciplined model for BPR and using a sound approach are Prerequisites to BPR success"	• "Provide a consistent set of techniques and guidelines which enable the business process redesigned to reorganize business activities and processes in an organization".	• Neglecting the role and responsibility of the employee who is basically executing activities that combine such processes.
Kee-Young Kwahk & Young-Gul Kim [37]	1999	"Propose a cognitive map based method for BPR, through developing a prototype modeling tool called two-phase cognitive modeling facility TCMF. Working procedures of the TCM method and TCMF features".	• Help organization's members to identify potential organizational conflicts, • Capture core business activities, • And suggest ways to support the necessary organizational change.	• The method does not consider the cause−effect relationships with time delay among causal concepts. • It is hard to obtain causal values which are agreeable to everyone • The method begins with the assumption so it is not easy to produce a theoretically robust and valid causal model.
Vakola&Rezgui [58]	2000	Present a critique of the BPR methodologies. To reach successful and sophisticated methodology focusing on the need for an integrated approach more suitable for changes in the organization and its workforce.	• Present a critique of the previous BPR methodologies and identify the weaknesses which served as a basis for the development of a new eight-stage BPR methodology.	• Stop at the implementation phase and as a result, it seems to be completely fixed. The exclusion of evaluation • There is no inconsistency between the continuous improvements and changes and developments around the world and from a highly competitive environment • Despite the importance of developing models but difficult to apply in practice due to cost or time limits or lack of sufficient information.
Joshua Liem [33]	2005	"Propose methodology called NIMSAD (Normative Information Model-based Systems Analysis and Design) to evaluate methodologies related to systems development".	• "Compare three different methodologies that was introduced in the nineties, then he combined all strength points of all methodologies in one new framework called (The true road to successful BPR)".	• Ignores organization structure and human aspect.
Yoo.K&Suh.E&Kim.K [36]	2007	"provide a methodology for knowledge flow-based business process redesign and gave ten guidelines for knowledge flow optimization".	• "Provide practical methodology and guidelines that can be directly applicable to performing business process reengineering by introducing a real case".	• Need evaluation method that is b • Require statistical analysis to assert the proposed guidelines for knowledge flow optimization.
Ahmad. H& Francis.A &Zairi. M [6]	2007	"Making case studies on three private higher education institutions and found Seven factors critical to BPR implementation success. The factors are teamwork and quality culture, quality management system and satisfactory rewards, effective change management, less bureaucratic and participative, information technology/information system, effective project management and adequate financial resources".	• "Provide a framework for future research to explore organizational development in making BPR happen successfully".	• Fixed Nature and was not dynamic reality that there are some organizations give priority to the application of information technology and the other to the cost.
Chen Lei & Liu Bin [13]	2007	"introduce A workflow model supporting dynamic BPR which maintains flexible and dynamic BPR implementation with enabling the possibility of changing the process at any stage".	• "Came up with new framework called dynamic BPR instead of the consumed statics BPR concept".	• Ignores human aspect
Hussein [29]	2008	Collect a large group of successful business reengineering factors from the various research, these are "organization-wide commitment, BPR team composition, business needs analysis, effective changing management, suit able it infrastructure, and ongoing continuous improvement".	• Examine the critical success factors of business process • Reengineering (BPR).	• Only describe processes operationally • Fixed nature and was not dynamic reality that there are some organizations give priority to the application of information technology and the other to the cost. • Twice the attention analyzed forbusiness organization's environment.

L. Maruster and Nick Beest [39]	2009	"Propose a methodology that relays on process mining and simulation. They tested the methodology on three unique case studies (Gas company, government institute and web based DSS)."	• It allows organizations to predict the redesigned process performance before implementing it using the simulation.	• Ignores human aspect.
Ozcelik [47]	2010	"Examine whether implementation of Business Process Reengineering (BPR) projects improve the firm performance or not through analyzing a huge data set on a large organization in the United States."	• Determine the impact that a more holistic approach would have on the success of BPR implementation.	• Ignore the team that carrying out the BPR initiative in the organization.
Abdi.N &Zarei. B &Vaisy. J [3] &Parvin. B	2011	"Review the previous BPR methodologies and innovation concepts and models and introduced BPR framework based on the innovation models using dubin's methodology".	• "Help the organization to use all the employees in the redesign processes based on the innovation concepts and cultivates the organization's culture for agility and effectiveness".	• Only some preliminary conditions are mentioned • No evaluation • Having no attention to consistency.
Rao et al.' [51].	2012	"Propose an ontology-driven methodology for business process re-engineering that includes the development and analysis of knowledge maps and ontology".	• Analyze the organizational processes well, • the environment surrounding these processes, • And use all the knowledge of the organization through using knowledge map.	• Little evaluation of existing practices and the implementation.
Jamaiah H. Yahaya, Aziz [20] Deraman&Fithri. S	2012	Provide BPR methodology using a conceptual model that suitable for small and medium enterprises (SME) and apply it in a case study collaborated with a Malaysia company.	• Cover the process improvement effort from the identification of a need for change to the final implementation and maintenance of the improved workflow.	• High risk when use this methodology with a large enterprise • Ignoring knowledge base aspects, The used system are only input, retrieve, operation and result.
Eftekhari&Akhavan [19]	2013	"present a comprehensive it tools based methodology (CITM) for BPR by using both approaches -clean slate and -dirty slate approach (the analysis of existing processes on details)".	• "Evaluate the BPR failure factors and came up with new framework, develop an inclusive methodology that utilize information technology tools and maintain failure analysis along the implementation".	• Fail to recognize the importance of the diagnosis • Uncovers bottlenecks • Very difficult to produce a standard BPR recipe of success for every business sector and under all circumstances • Having no attention to consistency.
Hussein [28]	2014	Provide conceptual model exploring factors that created readiness for changes in organizations for process re-engineering such as sufficient background information "leadership style," "information technology," (it) "top management commitment" and "collaborative working environment".	• Minimize risk of implementing business process reengineering (BPR) initiatives by identifying certain factors crucial towards creating readiness for BPR.	• No substantial scientific basis • This model not empirically tested • No guiding and managing implementation.
Hussein. B &Hammoud.M &Bazzi. H [31] & Amin Haj-Ali	2014	Propose Process reengineering Integrated Spiral Model (PRISM) which is a systematic agile model that would carry out BPR.	• Improve the chances for organizations to successfully carry out BPR initiatives and projects according to their goals and objectives in a dynamic fashion.	• It is not suitable for small projects • Model is too expensive to use • The risk analysis requires a lot of experiences. • Success is highly relying on the risk analysis phase.
MUSA. M [45] & THMAN. M & AL-RAHIMI.W	2014	"Propose a methodology rely on the use of ontology and knowledge maps to identify needless transactions that must be reengineered to enhance the healthcare management."	• "Help to enhance business process redesign in health care sector, collects non value-added transactions, and redesign them to improve the healthcare management".	• Having no attention to consistency • Need costing model to audit • The impact and feasibility of the proposed improvements during the demonstration.
Hossain [27] A. Alghamdi& A. Alfarhan. M& AL-Ghamdi.A	2014	"Evaluation of Existing BPR Methodologies and Limitations considering BPR success and failure factors".	• Discuss the design of recent BPR methodologies and presents the success and failure factors that affect BPR projects.	• No criteria on which approach to select • Limited comparison only,3 methodologies

(*continued on next page*)

Table 1 (*continued*)

Author name	Date	Proposed methodology	Advantages	Disadvantages
Bahramnejad.P& Sharafi. S [48]& Nabiollahi. A	2015	"Provide a methodology using enterprise ontology improving the analysis of current system by model current system and its goals applied this methodology on a company using ARIS tools to compare and simulate processes".	• Redesign the processes with most connections with the chosen processes to reengineer, causes improving the performance of BPR system.	• Complexity for analyzing current system • No guiding and managing implementation • No use of external consultants considered.
Musa. M & Othman. M [8]	2016	"Provide A Literature Review on the Methodologies and Approaches of Business Process Reengineering in Healthcare".	• "Review a series of literature published between 2004 and 2013" • "Analyze BPR in healthcare which having only 8 article representing 8.8% of the total article published within the period of 2004–2014".	• Only focus on BPR in healthcare literature • Limited in scope like changes in physical structure and medical record systems.
Mekonnen.Nn [18]	2017	"Implementing Business Process Reengineering (BPR) in Government Organization".	• "Collect The factors impended to successfully implement BPR in the region categorized as top management support factors, change management factors, organizational factors, BPR project management factors, information technology factors (IT) and country related factors".	• There is no new techniques used through his methodology • Only Focus on the implementation phase.

will be explained for processes reengineering which are provided to overcome the failure rates 70% that have been reported about BPR, this method consists of seven steps and its aim to present a successful approach for BPR depend on ontology map. Fig. 4 shows the steps of implementing BPR ontology map methodology, starting with the first steps, preparation and readiness for the organization. If the organization is not ready for change, it needs training on administrative change to be ready or has the ability to change. If the organization is ready, it can move to the second step. building the ontology based on information that are collected from the first step to provide the relationship between organizational goals, sub goals, tasks, sub tasks, business processes, actors, roles and decision makers. Ontology shows how decision maker can access knowledge and prevent mis-match between knowledge needed for specific tasks and the knowledge allocated for these tasks. The third step is to know the priority for each process the organization may contain many processes that need to be re-engineered so need technique like AHP for identifying and prioritizing the processes because the organization may have not the resources required to address all processes at once. Then fourth steps begins, which is the construction of knowledge structure and source maps based on the ontology, knowledge source map determines the knowledge requires for the actors, but knowledge structure map determines the relation between subtasks and the decision maker roles. Then the analysis of these maps begins to identify the mistakes or knowing the causes of the errors or inefficiency. Therefore, the modification of the processes that cause the errors is done and evaluate the results. Finally, the ontology must be updated to reflect changes.

5.1. Step 5.1: preparing for BPR

One of the biggest problems facing BPR is the resistance of workers to change and their fear of the future, their fear of the current status and occupation so need organizational change management strategy for preparing employees before change. Readiness is very important before starting with BPR implementation and its aim is to find out whether the organization needs a redesign or not, as one of the BPR failure factor is the resistance of the workers to change, so they must first qualify for change. Through this step, the strategy of the organization, all the employees, all sections, collective works, and all documents of the work are identified. Preparing step is done according to Prosci's Organizational Change Management Process model [5], this model shows and explains the preparing for any organizational change management through many steps i.e.,

5.1.1. Define your change management strategy

The strategy of the organization work must be cleared to know the nature of the organization work all departments and employees impact with change. Change management means the use of any technique that helps individuals, teams, and organizations using system to change the use of resources, business process, and budget allocations.

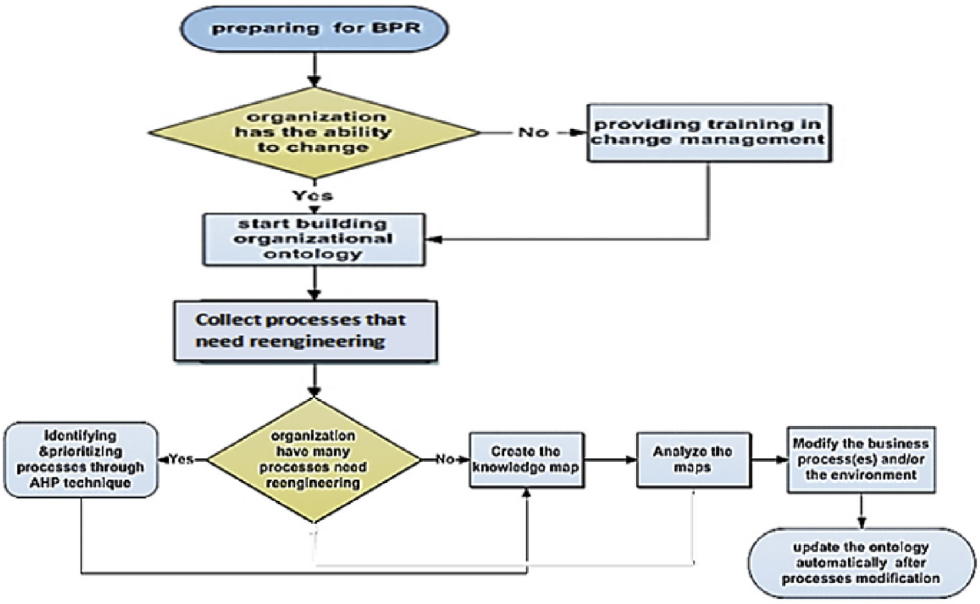

Fig. 4. Proposed PROM (Process Reengineering Ontology Map) methodology.

- Identify the Change Characteristics Scope
- Identify the departments, workgroups, divisions impacted
- Determine the number of individuals impacted by the Change
- Define the areas of the organization which is changing i.e. process system or technology, job roles, staffing levels other.

5.1.2. Preparing your change management

After identifying all the departments and all employees affected by the change, it is necessary to choose a group of staff with a high level of communication skills and can provide information about the organization.

Team Acquires team resources by interviewing candidates and looking for those with (excellent communication skills, commitment to change, business influence, team players, change management experience, and knowledge of the business).

5.1.3. Develop your sponsorship model

In order to start the actual change, it is necessary to identify the officials who have the right to make the decision because they are aware of the goal of change and the actual problems of all employees and the disruption of work, besides that their decision is certain.

Identify sponsors needed for the project. Sponsors are managers/leaders who are in a position to authorize the Change.

All the preparing steps are collected from structured interview to collect all data and information from the organization.

The interview was analyzed through many steps according to Ref. [35] i.e.

- **Open Coding**

Read the interview carefully and collect the answers for some question like What themes, ideas, and concepts appear, and the relation between them? Collect data and information then categorize them.

- **Focused Coding**

Read the interview again and collect the information that are related to each other.

- **Data Compilation**

Correct the data and cut the information from place and put it in the correct categorize.

- **Theory building**

See if you can find patterns, themes, and commonalities from your respondent's quotes in each of the conceptual categories.

5.2. Step 5.2: building ontology

Need to know the relationships between the business processes within the organization and the environment surrounding these processes to facilitate the extraction of knowledge and sharing knowledge easily. Adopt high-quality ontology for the organization this ontology represents the knowledge of the organization that gives the meaning to comprehend the relationships between organization goals, businesses processes, organization sub-goals, decision makers, organization tasks, organization subtasks, and organization resources (groups,

actors). Ontology has vital role in the proposed methodology because it helps to collect all data and structure of the organization including surrounding environment data. Fig. 5 shows the general architecture of the organizational ontology, which describes the structure and behavior of the organization to facilitate the sharing of knowledge. The figure determines:

- Organization has goals and sub-goals which achieved by actor,
- Actor responsible for business process that composed of tasks and sub tasks,
- Decision makers require knowledge to perform task and composed of group and roles, and
- Decision maker consumes resources that stored in different locations

These resources include data, information, tools and knowledge. Ontology Help in determining the necessary actions and tasks for each business processes and is also used in identifying who is performs a specific task and the sources provided for consumption during the execution of subtasks. The interest of using ontology in this methodology, because it provides a good understanding for the information inside and outside the organization so the structure of the organization is cleared. As result, the reengineering for the processes done with all information about all processes. Ontology is considered as a reference of information that is used to create knowledge.

5.3. Step 5.3: identifying and prioritizing processes

The processes that need to be re-engineered may be more than 10 processes. So, it is required a priority technique like AHP to be used to identify the priority of the processes. From the ontology, it can be easily know the business procedures that demand to be re-engineered, and then find the priority for each process. Table 2 shows the priority for each process depending on the weight of organization's goals and organization's sub goals. Prioritization and resource allocation is very important as the organization may have not the resources to handle all processes at once. If the goals of the organization are cleared and the business processes are known then it is easy to know the priority of the processes. The information is available from the ontology, so the business process priority are identified depend on the organization's goals priorities. Prioritization is "a subjective decision" and therefore "Analytic Hierarchical Processing (AHP)" is used [55].

AHP technique has three phases to solve problems: decomposition, relative judgments, and priorities composition. In the first phase, the hierarchical is constructed to put the problem that need the decision at the top level to represent all objectives and the lower levels represent criteria, sub criteria, and alternatives. Then start pairwise comparisons at second phase includes the decision elements. Estimate the weights of the decision elements, then the third phase aggregate these weights to provide a set of ratings for the decision alternatives [21,2].

There are many techniques for priority such as decision-making paradox, pairwise comparisons and multi-criteria decision making analysis, but AHP has many advantages that make it suitable with the proposed methodology:

- It is Well-proven.
- It is a broad set of applications.
- It is intuitive and easy to use.
- It is designed for multi-criteria.
- It builds alignment around criteria priorities.
- It validates consistency

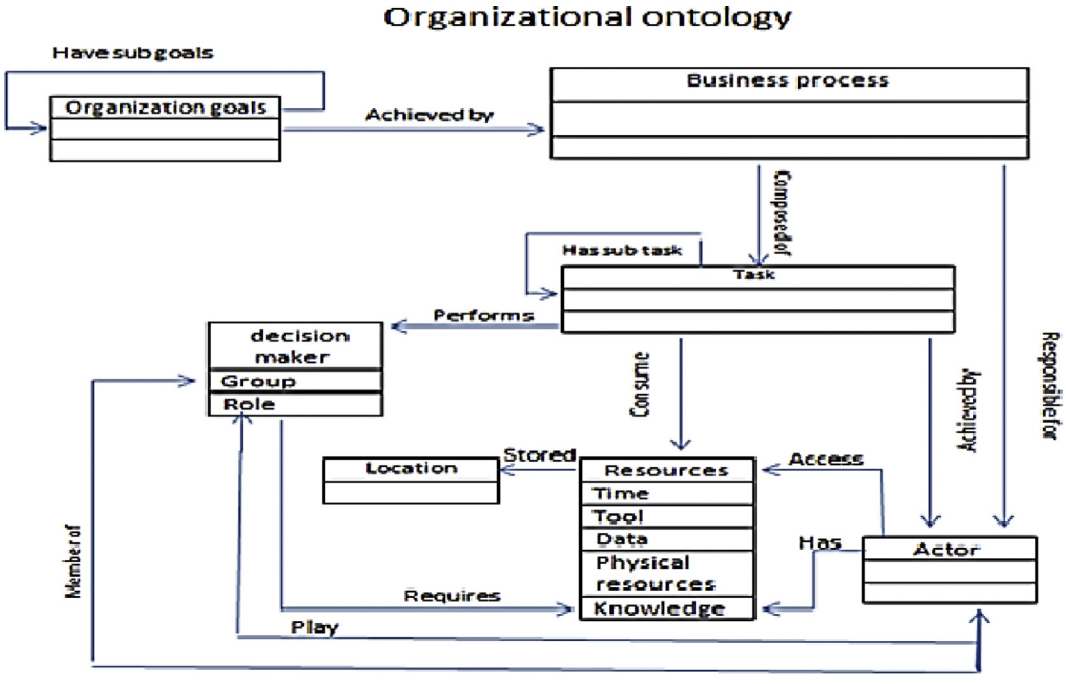

Fig. 5. Building the organizational ontology.

Table 2
AHP for inventory processes.

Goals	Weight	Sub goals	Weight	Process	Priority
G1	0.2	Sg1	0.3	P1	0.3*0.2=0.06
		Sg2	0.2	P2	0.2*0.2=0.04
		Sg3	0.4	P3	0.2*0.4=0.08
		Sg4	0.1	P4	0.2*0.1=0.02
G2	0.5	Sg5	0.3	P5	0.5*0.3=0.15
		Sg6	0.4	**P6**	0.5*0.4=0.2
		Sg7	0.2	P7	0.5*0.2=0.1
		Sg8	0.1	P8	0.5*0.1=0.05
G3	0.3	Sg9	0.2	P9	0.3*0.2=0.06
		Sg10	0.3	P10	0.3*0.3=0.09
		Sg11	0.3	P11	0.3*0.3=0.09
		Sg12	0.2	P12	0.2*0.3=0.06

From Table 2, It showed that business process with high priority P6, P5, and P7.

- Each process has a specific weight that depends on the importance of this process and is distinguished from the rest of the processes and is useful in the resource allocation.
- Selection of processes needed re-engineering depends on the weights and priorities of these processes and not on the order of operation in the organization.

5.4. Step 5.4: Create the knowledge map

Creating source and structure map from the organizational ontology, this step involves creating and developing these maps. The knowledge structure map was created by extracting the knowledge from the ontology to collect information and knowledge about the tasks, business processes, subtasks and resources that related to the structure of the organization. Use the ontology to build knowledge structure map by extracting know-what, know-how and know-where. The knowledge source map was created by extracting the knowledge from the ontology about group, roles, tasks and decision makers to identify who responsible for specific task and who is causing the errors and what knowledge needed for him to complete tasks. Create Knowledge source map by extracting from the ontology know-who and know-what.

Fig. 6 shows how to create knowledge from ontology, the knowledge source Map held by the actors and their roles and the structure map shows the basic tasks and sub-tasks and their sequence, the resources produced in performing a subtask, the decision makers (roles/groups) containing, and their interactions with each other. These maps determine the knowledge of the organization and its environment, so during the re-engineering processes the environment must be considered. Knowledge map is considered inference mechanism to discover the causes of any errors occurred and who are responsible for it and the reason that lead to this error.

5.5. Step5.5: Analyze the maps

It's easier for knowledge maps to be analyzed to find the reasons of the insufficiency using business processes modeling language [53]. Knowledge has a great importance in knowing the errors that affect the performance of the organizational operations and also helps to know the causes of these errors or the reason of the inefficiency processes. Fig. 7 shows knowledge structure map that are extracted from ontology and used to determine the mistakes and the causes of it through know-what (the roles and resources), know-where (the location of the various resources) and know-how (subtasks and tasks). But knowledge source map determine the mistakes related to know-who (the actors and the roles they play) and know-what (the knowledge that the decision makers possess and the knowledge that they require).

5.6. Step 5.6: modify the business processes and evaluate the results

Once identify the causes of inefficiency start modify in the business processes and its environment then evaluate the results. The business process reengineering team is responsible for assembling all problematic or inefficient processes and starting to find solutions to solve these problems. Once the appropriate solutions have been found, they begin to modify the process and evaluate the proposed solution and its benefit to the organization then the ontological model must be updated so that they are always reflective to the changes in the organization as it exists. The evaluation of the proposed methodology based on the BPR success and failure factors through five dimensions:

- Change in management system.
- Collaborative working environment.
- Top management commitment.
- Egalitarian leadership.
- Use of information communication technology.

The proposed methodology consider all these factors during the implementation of BPR, it begins with preparing step that achieve the collaborative working environment, egalitarian leadership, top management commitment the use ontology, knowledge map and analytical hierarchy processing these achieve the factor of change in management system and the shring of knowledge which achieve the use of Information communication technology.

5.7. Step 5.7: Update the ontology

In this methodology the ontology can be updated automatically using OUL (Ontology Update Language) Algorithm, once the processes are changed then the ontology will be updated automatically instead of consuming more time and effort to find a process and update it in the ontology [32].

6. Applying this methodology to the inventory management at helwan university this case study will determine the progress and improvement caused by the proposed BPR ontology map methodology

Helwan University is an educational institution that contains different faculties and many departments. In this

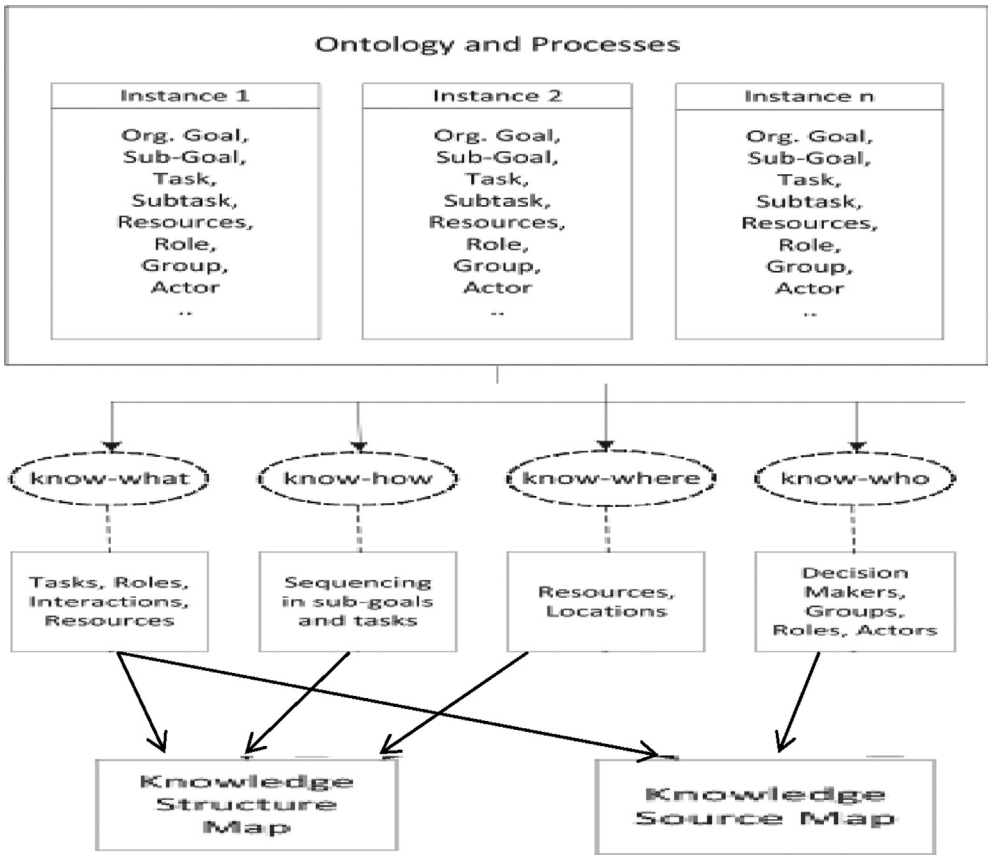

Fig. 6. Create Knowledge Map [51].

research, the focus is on the inventory department where there are many problems affecting the university budget and reduce the performance or efficiency of the university. The inventory management includes a large number of employees specialized in the receipt of items from outside companies, store them in the inventory, the exchange of certain items for the need, an annual reviewing of the contents of the store, the installation of some elements, and many operations. All the inventory management transactions are manually.

6.1. Step5.1:Preparing for BPR

Preparing for BPR using Prosci's Organizational Change Management Process model [5]. This model shows and explains the preparation for any organizational change management through some steps that are discussed before. These steps are done through a structured interview with the general manager of the inventory and interview with many employees and experts and collect all document, data, and information

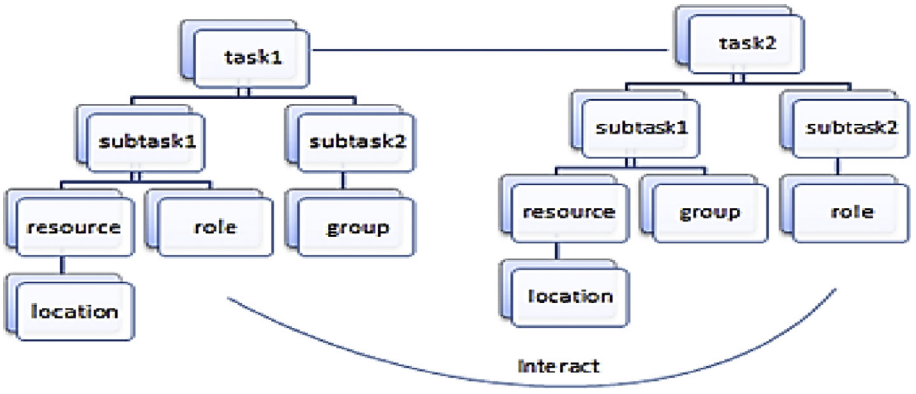

Fig. 7. Knowledge structure map [51].

about the inventory. The data and information about the inventory goals, sub goals, inventory tasks, sub tasks and business processes are collected from the director and cooperative employees. Table 3 contains some of this information like inventory's goals, sub goals and inventory's processes.

6.2. Step 5.2: Building ontology

Construct high-quality ontology for the organization this ontology represents the knowledge of the organization that gives the meaning to comprehend the relationships between organization goals, businesses processes, organization subgoals, decision makers, organization tasks, organization subtasks, and organization resources (groups, actors). Fig. 8 shows the implementation of ontology in protégé owl.

Table 3, collects the inventory goals, sub goals, and process related to these goals. Other information is collected and discussed below like Inventory management tasks, Inventory management subtasks and so on.

Inventory management tasks include: checking items, receiving items and disbursement items include:

- Disburse items based on the exchange signed by authorized one to do so, then the exchange must determine the levels of the exchange rate
- Examination done by the storekeeper in the case of regular varieties and done by technician in the case of technical items and maintenance tools by check management in the case of qualities specific companies
- Exchange upon request by hand exchange the league exchange for custody exchange for the replacement for exchange metaphor
- In the absence of demanded items can identify alternatives to the requesting parties if that it is not possible to identify needs and sent to the purchasing department to provide it
- Recording incoming items
- Refuse the items this is by the examiner after making a report
- Report on the damaged and in case of its existence and supplier are notified as soon as possible
- Review the quantities received in order to ascertain matching quantity of what was issued by the by the purchase order specifications consistent in weight and double the number, shape and measurement with the request time that the order is received on time
- Sustainable items endless use and consumables items it ends completely use such as raw materials, fuel, stationery and unusable items it considered damaged and can be repaired
- Work permit receiving and recording data on the variety, quantity, supplier name, the carriers name, the damaged quantity and packaging form

Decision maker consists of group and role.

Group include check committee, inventory management and inventory management commodity.

Role include committee members, employee, head of department, head of committee and worker.

Resource consists of actor, knowledge and data/information.

Knowledge include.

- How much to order
- When to reorder
- How much at each location
- How to balance service and cost
- Amount of every items in the store
- Items exist or not
- Items needed for inventory.
- Received items quality

Table 3
Inventory goals, sub goals and processes.

	Goals	Sub goals	Processes
G1	Ensure no loss or damage or theft of inventory items through a precise system for the receipt, retention, drainage materials stored	Ease of Seeking required items	Detecting items damaged/missing
		Providing an appropriate degree of secrecy	Registration in the general budget
		Ease of communication between all the stores	Custody of the store
		Store the largest amount of data storage	Asked reflux items
G2	Working to reduce the cost of storage and reduce the amount of capital invested in inventory assets to a lesser extent possible, taking into account the lack of low stocks for the right limit of the needs established	Perform calculations accurately	Delisting the notebook
		Determine elevations inventory	Request and permission disbursement
		Ease and speed of data entry	Permission add
			Daily stores
		Saving time and effort for each storage procedures	Detecting the increase and deficit
G3	Help in decision support	Processing and preparation of the inventory estimate for the financial year to the needs of Organization and the various departments accurately	Annual requirements for commodity supplies
		Provide the necessary data: coordination between programs and procurement, marketing plans and capabilities and storage systems available.	Record inventory items
		Facilitate the extraction of reports and input and output operations	Statement employers Covenant and fees outstanding to calculate the insurance fund for government guarantees employers Covenant
		And the existence of archive Email	
		Ensure the existing items	Compare the two folders of delisting and the store folder every three months

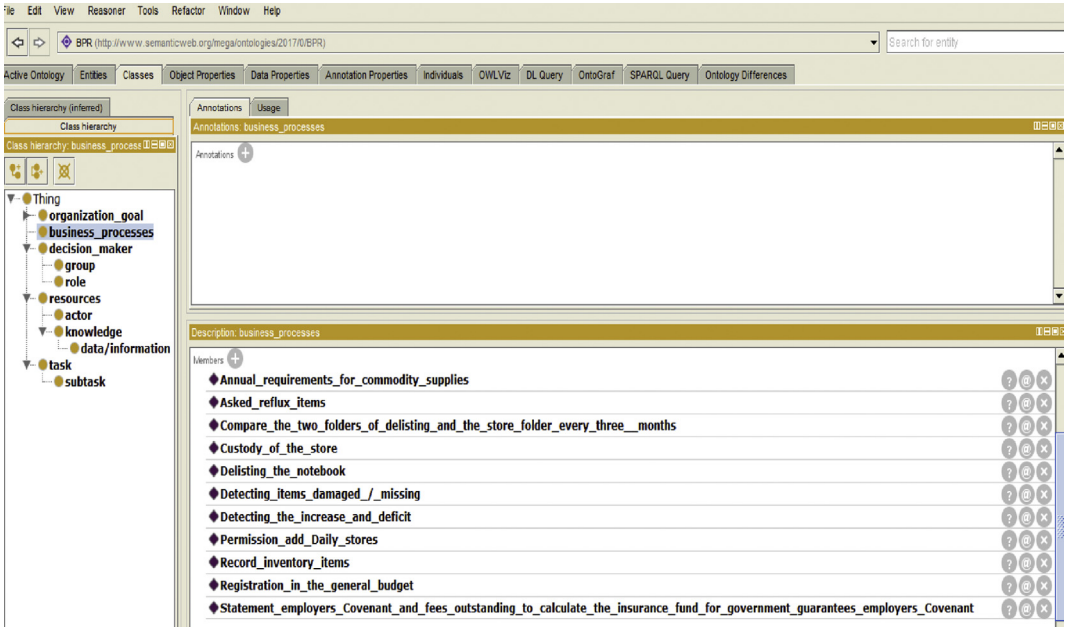

Fig. 8. Ontology fot inventory management in protege OWL.

- When to reorder
- Provide any data needed by the various departments, such as Statement balances stagnant Inventory prices
- Data/information include items details, type, quantity, size and price

6.3. Step 5.3: identifying and prioritizing processes

The processes that need to be reengineered may be more than 10 processes. So, it requires priority technique like AHP to be presented to identify the priority of the processes. From the ontology it can be easily know the business procedures that demand to be reengineered then find the priority for each processes. Table 3 explains all the processes of the inventory that need to be reengineered. Table 4 collects all process and the weight of them according to the assumptions of the inventory managers. Each process has a specific weight that depends on the importance of this process and is distinguished from the rest of the processes and is useful in the resource allocation in Table 4 goal2 G2 has the highest weight. Multiply the weight of the goal G with the weight of sub goals Sg to get the weight of the process then find the processes that have the highest priority like p6, p5, p7. These processes are the most important ones to the organization to start reengineered them first.

6.4. Step 5.4: Create the knowledge map

Create source and structure map from the ontology this step involves creating and developing these maps. the source Map showing the knowledge held by the actors and their roles and The structure map shows the basic tasks and sub-tasks and their sequence, the resources produced in performing a subtask, the decision makers (roles/groups) containing, and their interactions with each other. These maps determine and represent knowledge of the environment that should be considered in the re-engineering process.

Knowledge is extracted using DL-QUERY in the protégé OWL program. Fig. 9 shows example of extracting knowledge source map from the ontology in protégé owl program (what is the business processes that actor AHMED responsible for it, the result of the query detecting items damage, detecting the increase and deficit and checking items).

The knowledge structure map was developed by querying the ontology to identify the tasks and subtasks associated with the business process and also it was developed to identify, for each task, the corresponding groups, roles, actors, knowledge required for a role and the knowledge of the actor It also identified all interactions that were occurring between these tasks, the resources being consumed and are produced and their location. The knowledge source map shows the knowledge being used to perform tasks and the knowledge required to do the task.

Table 4
AHP for inventory processes.

goals	Weight	Sub goals	Weight	Process	Priority
G1	0.2	Sg1	0.3	P1	**0.3*0.2=0.06**
		Sg2	0.2	P2	**0.2*0.2=0.04**
		Sg3	0.4	P3	**0.2*0.4=0.08**
		Sg4	0.1	P4	**0.2*0.1=0.02**
G2	0.5	Sg5	0.3	P5	**0.5*0.3=0.15**
		Sg6	0.4	**P6**	**0.5*0.4=0.2**
		Sg7	0.2	P7	**0.5*0.2=0.1**
		Sg8	0.1	P8	**0.5*0.1=0.05**
G3	0.3	Sg9	0.2	P9	**0.3*0.2=0.06**
		Sg10	0.3	P10	**0.3*0.3=0.09**
		Sg11	0.3	P11	**0.3*0.3=0.09**
		Sg12	0.2	P12	**0.2*0.3=0.06**

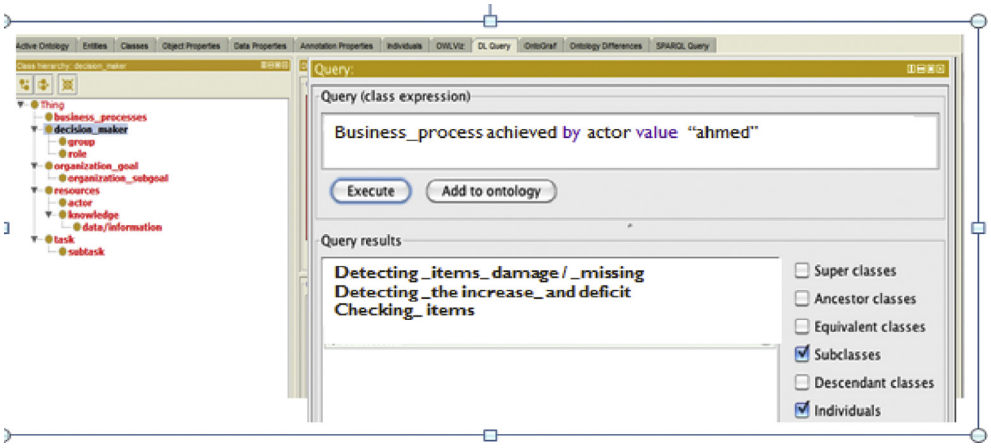

Fig. 9. Extract knowledge from ontology.

6.5. Step 5.5: Analyze the maps

It's easier for knowledge maps to be analyzed to find the reasons of the insufficiency using business process modeling language BPML [53] to determine the causes of the incompetence in the process.

The processes of the inventory department with high priority that need to be reengineered

- **Request and permission disbursement**
- **Delisting the notebook**
- **Permission add Daily stores**

The Data of items are recorded in more than one place, resulting in loss of time and effort the delisting employee records the items and sends them to another employee to register and then place them in the store. This process takes more than 3 days and primary key are not the same so, many errors are occurred.

✓ The processes are analyzed see Fig. 11 which explain the process of request items from main inventory this process take 3 days manually employee receive the list of the required items then search manually in his paper is this item exist or not if exist send it to the requester and Finish the procedures if items do not exist send order to purchase department.

✓ The Process of receiving items and store them in the main inventory of the university take more than 7 days. Fig. 12 explains the process as, administrator receive items from purchasing department with invoice then record them in manual paper and make 5 copy then check the items by a specialist if it good then starts to store them if it not good still idle process until the company change items and store in the paper of reflex items department.

✓ The process of daily stores Every day: the employee records incoming and outgoing items from the inventory

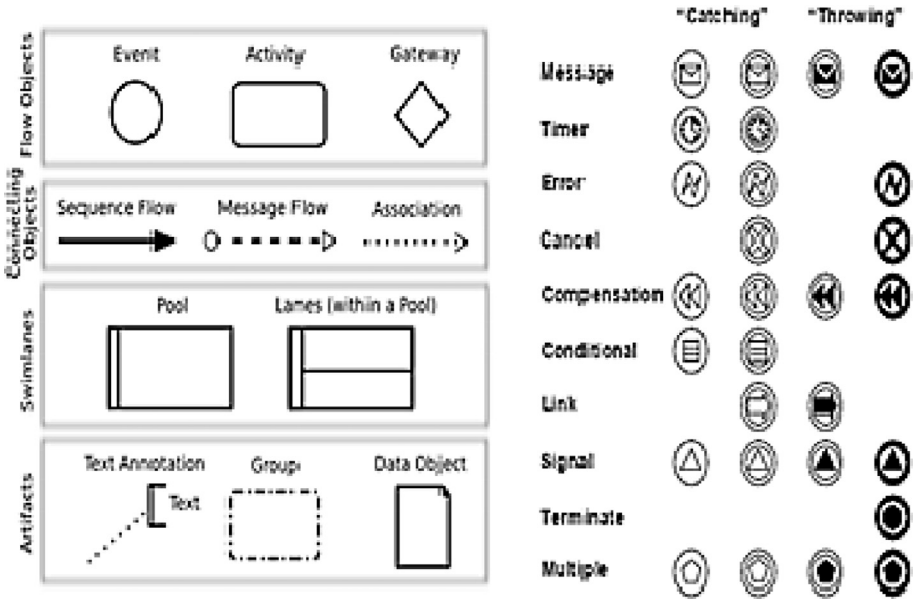

Fig. 10. Business Process Modeling Notations [42].

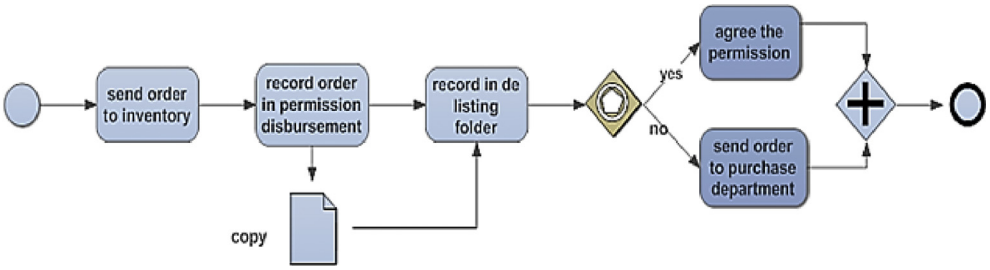

Fig. 11. The process of demand items from the main inventory.

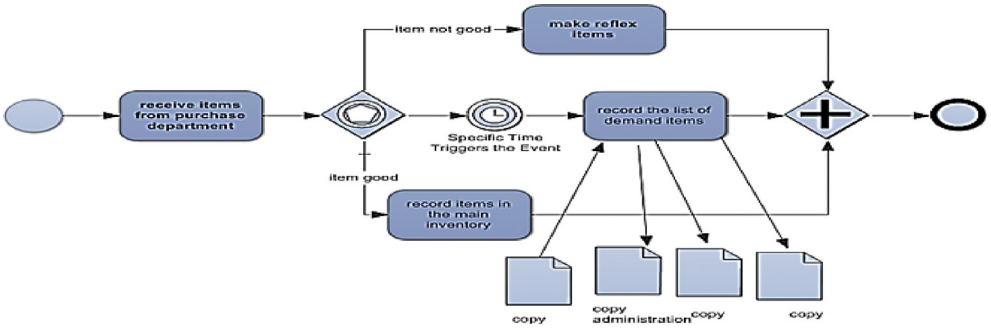

Fig. 12. The process of receiving items from the purchasing department.

All these processes will be explained using Smart draw program tools and Business Process Modeling Notation which are determined in Fig. 10.

6.6. Step 5.6: Modify the business processes and evaluate results

Once identify the causes of inefficiency start modify in the business environment and processes so process after reengineering are shown in Figs. 13 and 14. Table 5 shows the processes that need reengineering with its priority and determines the goals that will be achieved after reengineering these processes.

The process of request items from inventory Fig. 13 that takes more than 3 days after reengineering the employee receive the list of required items then search on the computer system if it found items send it to the requester if not exist send order to purchase department. The items have only one identification number and stored in one location so, no redundancy is founded.

The process of receiving items from the purchasing department that take more than 7 days after reengineering see Fig. 14 the employee receive the items with invoice data and wait for technical to check the quality of the items if it good record it on the computer program and send the data of the items to another employee to revise them instead of enter them again and take more times if not good write report and don't enter the items to the inventory.

The process of daily stores after reengineering is not adding value so it will be canceled.

After reengineering and modifying the processes start to evaluate the new proposed processes Figs. 13and 14 and the process of daily stores with inventory management, it found the processes is completed with minutes rather than days, process that not add value canceled and save time and effort for the inventory management, every employee know what he should do and everything are clear, the data are stored in one location and can be easily accessed by officials and The employee who is causing the disruption will be identified.

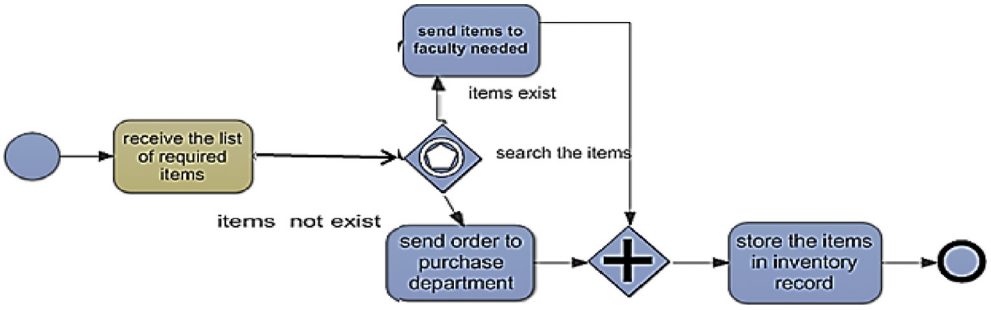

Fig. 13. The process of request after reengineering.

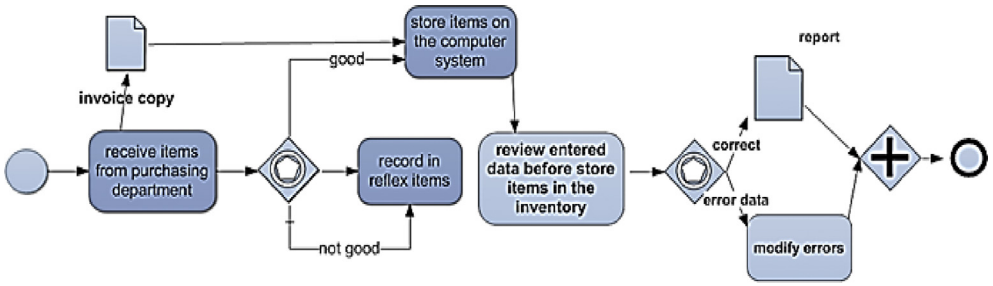

Fig. 14. The process of receiving items after reengineering.

Table 5
Inventory process priority.

Goals	Weight	Sub Goals	Weight	Processes to reengineered	Weight
reduce the cost of storage and the amount of capital invested in inventory assets to a lesser extent possible, taking into account the lack of low stocks for the right limit of the needs established	0.5	Perform calculations accurately	0.3	Delisting the notebook	0.15
		Determine elevations inventory	0.4	Request and permission disbursement	0.2
		Ease and speed of data entry	0.2	Permission add Daily stores	0.1

According to Ref [27] the evaluation of the BPR ontology based knowledge map methodology depends on the BPR success factors that are discussed in section 3 and clarifying the consideration of each factor through the implementation of the proposed BPR methodology. The evaluation factors include:

- Change in management system.
- Collaborative working environment.
- Top management commitment.
- Egalitarian leadership.
- Use of information communication technology.

The previous factors are taken into consideration during the implementation of the proposed methodology these are evident in the methodology steps. The steps begin with organizational change strategy, showing how to prepare employees and officials, how to achieve satisfaction and collaborative working environment between them then use new technology like organizational ontology and knowledge map that help the success of the methodology. Table 6 shows the evaluation factors of the proposed BPR methodology and comparing them with other methodologies.

- BPR failure factor: resistance to change

Naturally, during the implementation of the BPR methodology the change is a basic but usually human resists this change. This resistance is considered the most common problem of the BPR success so the first step of the proposed BPR ontology based knowledge map methodology is the preparing for the BPR to understand the nature work, collect the data and information of the organization, motivate employees and prepare them for change.

6.7. Step 5.7: Update the ontology

The ontology can be updated automatically after reengineering and modifying the process of the inventory department using OUL (Ontology Update Language) algorithm. Once the process is changed then the ontology will be updated automatically [32]. The following algorism is used to update the current ontology in case of many processes are changed instead of consuming more time and effort to find a process and update it in the ontology.

Algorithm 1. Deferred ontology updating (update Ontology).
Description: Update ontology with deferred execution of updates.
Input: ontology O consisting of axioms, change event op(Ax) where op ∈ {add, del} and Ax is a set of axioms.
Data: matched Handlers change handlers that match their change request and meet their precondition according to the provided change event, Update List list of update actions to be applied to the ontology.
Output: updated ontology O

```
// Find matched change handlers
matched Handlers ← match Handlers(O, op(Ax))
// Collect updates from changehandlers
update List ← collect Updates(O, op(Ax),matched Handlers)
// Apply updates to ontology in deferred way
for all update ∈ update List do
apply update to O
end for
return O
```

Findings: At the final step of BPR is the starting of the progress for the organization or for the inventory of the university. Processes are redesigned and enhanced through successful BPR ontology map model this can be shown in the processes that take minutes rather than it took days before reengineering and the causes was not be known moreover, non-value add process is canceled after reengineering so employee save their time and effort, the university will be able to predict

Table 6
BPR methodology comparison according to success factors.

Methodology Factors	(Marsuster and Besst)	(Joshua Liem)	(Eftekhari&Akhavan)	(Chen Lei &Liu Bin)	Proposed methodology
Egalitarian Leadership	–	–	√	–	√
Cooperative Working Environment	–	–	√	√	√
Top Management Commitment	√	√	–	√	√
Change In Management System	–	–	√	–	√
Use Information Communication Technology	√	√	√	√	√

what it need from the outside company and the quantity it needs also the items stored in the inventory will be cleared an well-known so no delay at any inventory process. Any errors occurred can be handled because it is cleared the causes of it by knowledge map and ontology.

7. Contribution

The proposed methodology plays a vital role in implementing successful BPR ontology map methodology through using knowledge source and structure maps that based on organizational ontology, AHP, and all of these are presented to analyze all organizational processes and choice accurately which processes that important than others to be reengineered first.

- BPR success factors and the causes of the failure is considered so BPR is staring of continuous improvement for achieving organizational objectives.
- All processes will completely analyze through ontology.
- Priority of each process is cleared through AHP
- Process to be reengineered are presented easily using business process modeling language
- Any errors occurred during reengineering can be handled where the causes is known through knowledge maps
- An organization that contains many processes needed to be reengineered and didn't have a resource to handle all of them at once it find the solution through AHP technique that shows the priority of each process
- Inference method is present through using knowledge maps which help finding and identifying the causes of the inconsistencies and inefficiencies.
- Automatic update for the organizational ontology is proposed through this paper using [32] algorithm.
- Some papers used BPR ontology based knowledge map [44,45,51]but these papers did not consider the factors of success and failure of BPR, ignore the surrounding environment for the processes and ignore the readiness step that is very important. Lack of readiness is the main factor behind high rate of BPR failures [28]. The proposed BPR ontology map methodology begin with preparing steps according to Prosci's Organizational Change Management Process model [5] that determine is the organization ready for change or need specific courses?, identify the departments, workgroups, team works, all employees and sponsorship. All of the previous papers ignore this step [44,45].did not use analytical hierarchy processing although they have many processes need reengineering and they start with only the first processes of the patients registration in their case study of the emergency unit. the proposed methodology in this paper shows the importance of using analytical hierarchy processing with case study (inventory management at helwan university) that contains many processes need to be reengineered and didn't have a resource to handle all of them at once so, it find the solution through AHP technique that shows the priority of each process and select the most important one.

8. Conclusions and future work

Finally, several models appeared to improve the work of organizations business processes through the use and develop business process re-engineering but they appear with unexpected results although most organizations using the business re-engineering to resolve all their problems and develop their work properly and gains and achieve high quality. Now they do more effort to know the causes of a failure. It is found that most of the used models suffer from many problems after the implementations of business re-engineering where it is traditionally applied without looking at the changes surrounding organization processes environment. The main goal of any model is to solve a specific problem and reach a successful way of the organization without any obstacles and problems. This paper proposes a methodology considering all success factors through using ontology and knowledge map which will overcome all the obstacles of BPR and re-engineering the processes without ignoring the environment and with this methodology it is easier to completely analyze all organizational processes and distinguish processes that important than others to be reengineered first through AHP and know the cause of the failure through knowledge maps then processes will be reengineered and the ontology updated automatically to reflect changes. There are few models which related to business process re-engineering measurements so it is necessary to find more models to measure the success rate and the failure rate of business process reengineering for each proposed methodology. BPR needs statistical analysis technique to analyze the failure ratio and reasons of any model.

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