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An empirical study for integrating XP with VTSP to improve business process

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Abstract

Actual problems that threaten organizations are the excessive unnecessary organizational processes. The Business Process Reengineering (BPR) methodology is developed to improve the return of investment rates within organization. BPR guides to rearranging processes and removing unnecessary ones and consolidating the remaining processes into linear open system. Unfortunately, usage of modern Information Technology doesn't solve such problems in the Middle East countries and especially Egypt and doesn't realize the expected results. The limitations and drawbacks of IT projects refer mainly to the dependency on plan-driven team software process methodology that could not achieve frequently requirement changes of customers and usually exceeds estimated budget of the project. This research adopted the eXtreme Programming methodology using virtual team software process work providers in order to avoid these drawbacks and applied the proposed hybrid methodology to three main departments within Suez Canal Authority in Egypt.

1. Introduction

Business Process Reengineering (BPR) project aims to rearrange managerial processes and to remove unnecessary processes in order to improve the overall quality management system of any organization [3,10]. In literatures BPR projects have detected many troubles and problems that are: inability of plan driven team software process methodologies to implement projects and to respond to frequent changes of customer requirements and to avoid risk factors. The strategic agility is preferred to accelerate BPR projects using the following concepts [12,14]:

1- Active Stakeholder Participation
2- Model Storming
3- Requirement envisioning
4- Prioritized Requirements
5- Architecture Envisioning

Agile methodologies introduced best practices to execute software projects. These methodologies including eXtreme Programming (XP) depend mainly on twelve basic processes [4,7]:

1- Coding standard
2- Onsite customer
3- Continuous integration
4- Small releases
5- Collective ownership
6- Frequent refactoring
7- Planning game
8- Test-first
9- Simple design

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10- 40 h week
11- System metaphor, and
12- Pair programming.

The next section describes the initiatives of this paper. It refers to noticed problems that have been induced during the software development of business process reengineering projects. Unfortunately, organizations could not fulfill the recommendations of quality management system. The recorded reasons are the failure of plan-driven team software process methodology to execute project at a time and to response to frequent requirement changes especially in Middle East countries [9].

The literature studies have introduced solutions depending on eXtreme Programming and unique adaptation method. They have also monitored effect of virtual team work on the success of project and minimization of collocation meeting costs [9].

2. Background

The twelve baseline practices approved their ability to respond to frequent requirement changes and to avoid frequent risk factors. The dependency on virtual team meeting such distributed pair programming and online representative customer or end user are proposed to get better results as minimizing transportation costs and allow system high availability. The proposed Virtual Team Software Process Methodology adopts eXtreme Programming and virtual team methodology to avoid restrictions of plan driven team software methodology and realize flexibility, scalability and continuous upgrade of systems [11].

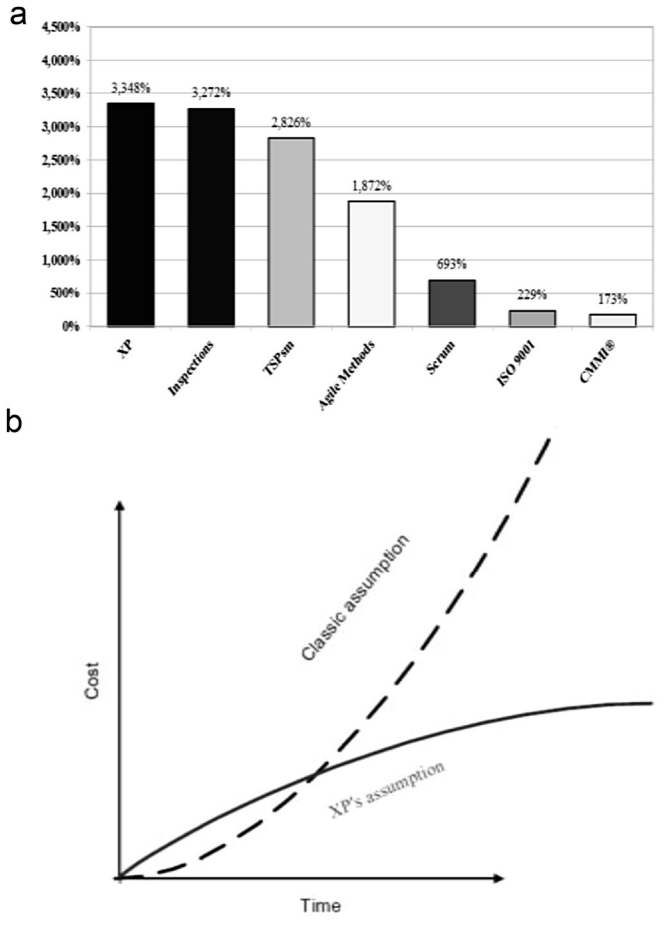

Fig. 1. a): XP versus agile methodology per estimate return of investment, b): runtime flatten cost of change per time or successive iterations of eXtreme Programming methodology.

2.1. Baseline eXtreme Programming methodology

The most light weight documentation agile methodology for small firms is the eXtreme programing (XP). The advantages of XP is the flatten cost of change (COC) and relative high return of investment (ROI) (see Fig. 1). The baseline eXtreme Programming (XP) practices are nuclear of progress in this paper [12]. The simplicity and rapid feedback and flexibility of XP allow dynamic adaptation and modularity into successive iterations and releases to develop final product [7] (see Fig. 2).

The baseline eXtreme Programming methodology approve the ability to compensate and to handle system errors among successive iterations and release and so minimizing rate of investments gradually according to global software development life cycle time. (t0) time is not supposed to be unit of execution time but (i0) is the unit of iteration achievement.

2.2. Virtual teams concept

The immediate issue that organizations discover when approaching the topic of virtual teams is defining what virtual teaming actually encompasses. The social scientists developed the following virtual team definition: A virtual team is a group of people with complementary competencies executing simultaneous, collaborative work processes through electronic

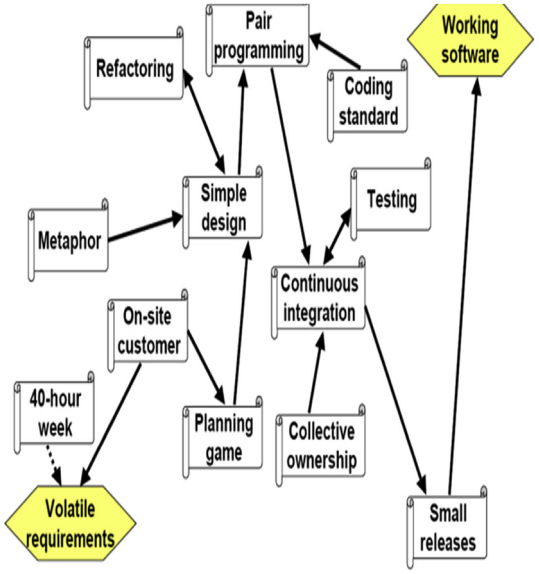

Fig. 2. Detailed eXtreme Programming methodology co-located team structure.

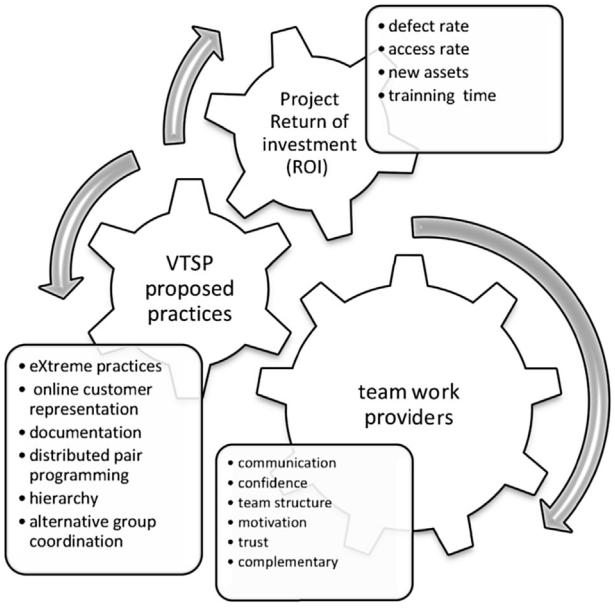

Fig. 3. Theoretical framework.

media without regard to geographic location. The important concept is that virtual teams allow individuals or groups to collaborate on a project in real-time through electronic media. In this manner, the virtual team operates as an integrated team whose members may happen to be located in different parts of the country or world. The potential advantages of this type of collaboration are numerous including [5,23]:

- Efficiency of project execution
- Removal of physical boundaries
- The integration and optimization of competencies, and
- The ability to form new partnerships.

The promise of these advantages has resulted in the majority of Suez Canal Authority members believing that virtual teams will be a primary mode of immediate project execution and continual quality improvement. Project focuses on deploying a set of guidelines and recommendations for virtual team implementation. The conclusions from this research can be summarized in the following statement: "*Technology is not the barrier to successfully implementing virtual teams. Although technology can lead to virtual teaming failures, sufficient technology is available to successfully implement*

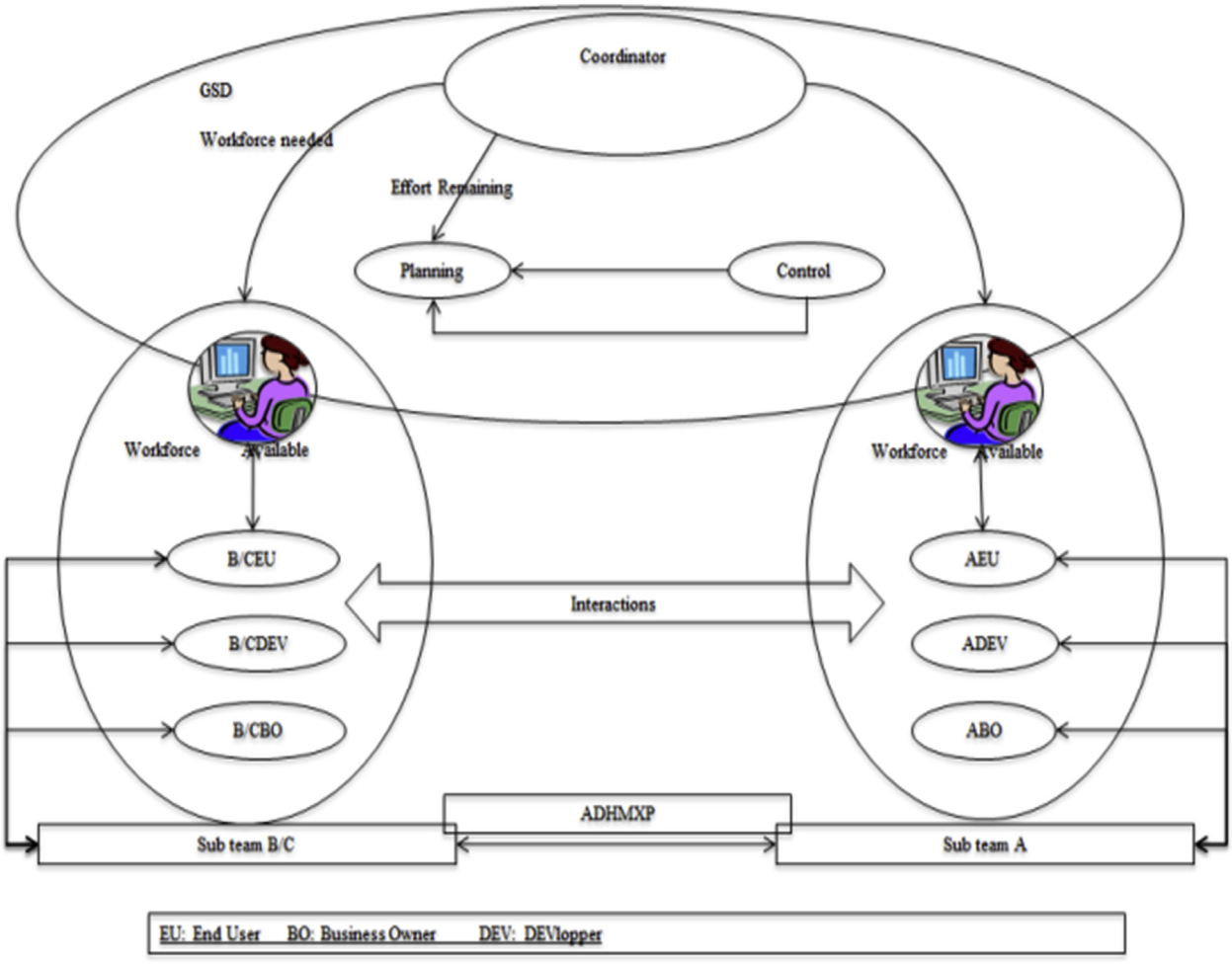

Fig. 4. Adoption and mix of virtual team work guidelines and eXtreme Programming methodology.

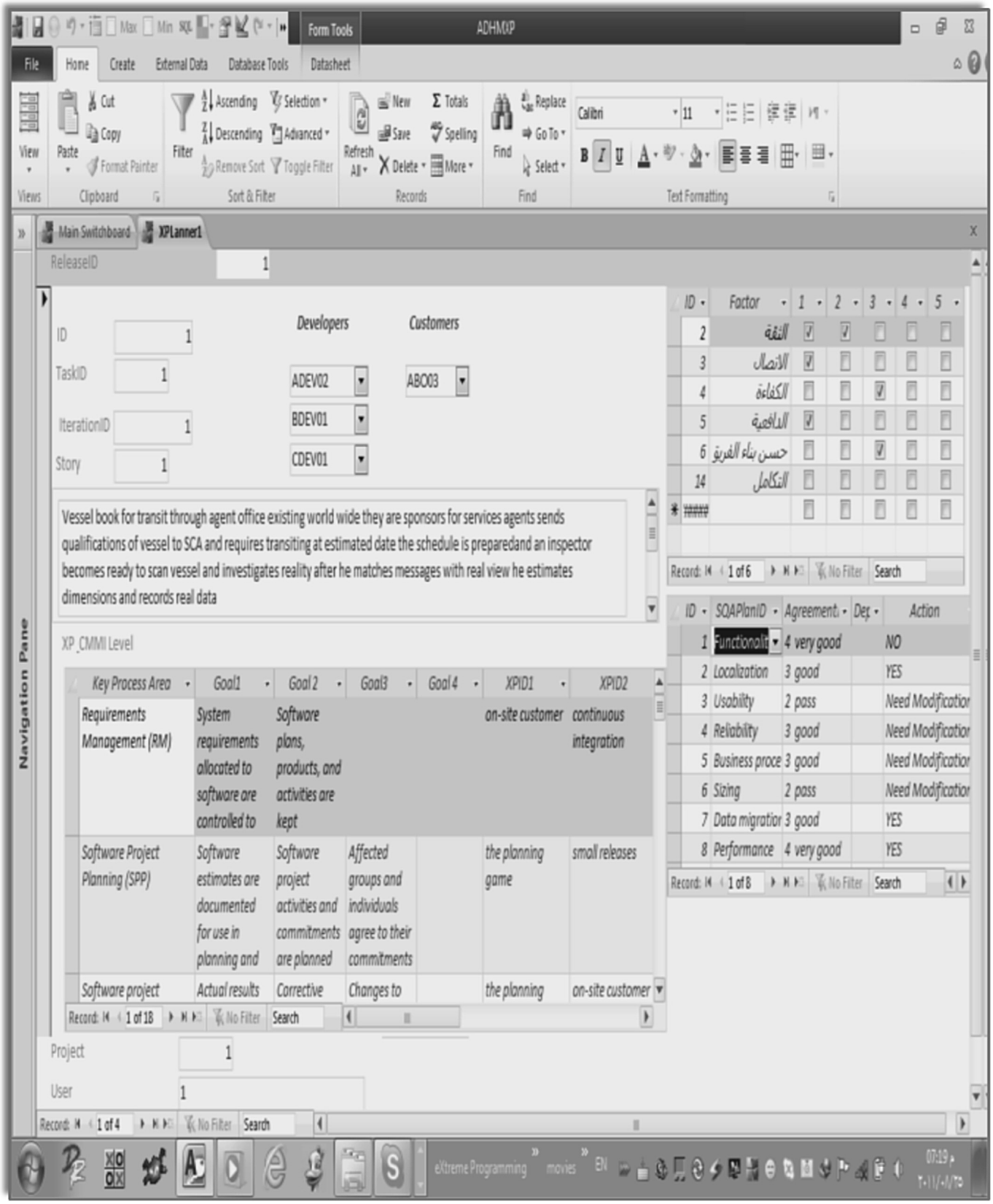

Fig. 5. The screen is collection of user story textbox allowing online representative customer or end user to detect his requirement using English and readable statement.

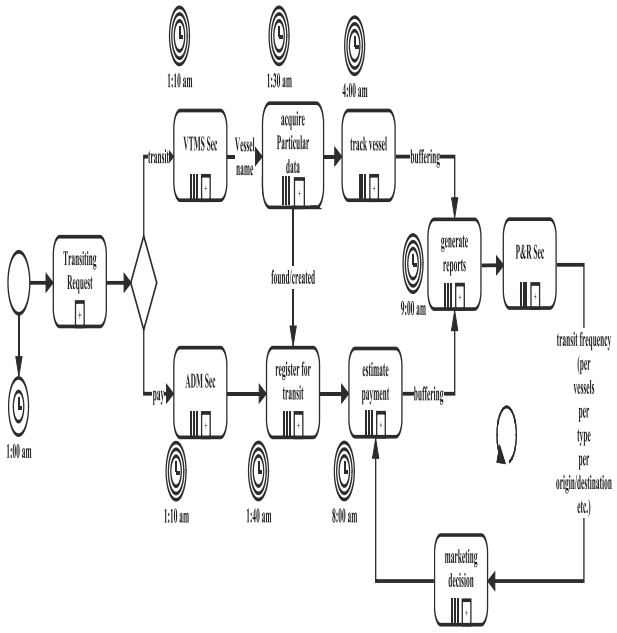

Fig. 6. The global workflow of the three main sections controlled by operating system schedules and database triggers.

virtual teams. *Rather*, *revising traditional management practices is the key to successfully initiating and implementing virtual teams*." Virtual Team guidelines depend mainly on specific social and technical parameters in order to achieve work successfully: communication, motivation, trust, well-defined structure, confidence, and complementary. Our research aims to tune these parameters using modified and adopted practices of eXtreme Programming methodology. The target is to control the output of continual improvement of overall quality management system of organization. Actually, total quality management depends on the raising of the global return of investment of significant scope of organization. In the next section the author proposes methods of implementation and evaluation of proposed methodology in order to generalize this idea or to propose other modifications for quality improvement.

3. Proposed methodology

Our proposed methodology depends on the assumption of high ROI of eXtreme Programming and the flatten runtime cost of change. These hypotheses refer to the effect of utilization of existing financial and technical resources of organization. Also, they depend on the deployment of available human resources and high availability of system as it is designed for self and on-job training. The adaptation of eXtreme Programming methodology is proposed to provide ability of collective ownership and pair programming practices, which minimizes training requirements, and so any new employee can be easily involved into project with low down time [16]. The adoption of architecture eXtreme Programming to match virtual team guidelines using distributed pair programming, alternative group coordination [26], online automatic documentation, and online customer representative characterize our proposed methodology, which is called "Virtual Team Software Process Methodology". The VTSP methodology is assumed to minimize risk factors and to achieve the frequent requirement change on software development life cycle of Business Process Reengineering (BPR) project [2]. The hypothesis framework is shown (see Fig. 3). This paper refers to fuzzy logic concept to describe the input, output and processes parameters of theoretical framework. Reason to use fuzzy concept is the ambiguous level of social factors of virtual team work and the ambiguous level of practices of extreme Programming methodology. Each section is located within fuzzy region from very low to very high. We proposed decimal weight for each factor. The virtual team process methodology and ROI output of project parameters are proposed to be normalization to scales: From low levels within closed interval [0, 0.5] and high levels within closed interval [0.5, 1]. The domain of interval from [0, 1] is selected as wide spectrum to be expressible and easily evaluated [6,21].

Theoretical Framework explains effect of virtual team work parameters and adaptation of eXtreme Programming methodology within virtual team software process methodology on global return of investment ROI of organization. This shape induces feeling of trust building per iteration as example. So, for successive iteration, we may notice building return of investment of project and quality of organization may be improved continually with no pause or down time. Also, individual empowerment can be increased and training time can be diminished per iteration self-learning and individual confidence and motivation building.

This automatic system monitoring is implemented through our proposal terminal screen to sample 100 team members, who have authority to access and control screen. The rate of logging screen and number of active screen user indicate the ability of proposed methodology to improve the performance of each release and so global project [22].

The research scope is restricted for detective survey to three distributed team works. The first step is to distinguish and to initiate a well defined structure or architecture of the global or virtual team work.

The research follows the activity of the virtual team work and monitor the effect of their deployment of the modified practices of eXtreme programing [19]. This method recommends the development of virtual software application based on database server (e.g. Access or MySQL) [15]. The objective is to monitor the activity of members of team work on runtime [1,8]. The hierarchy of our methodology (see Fig. 4).

The coordinator on upper side of figure monitor and control the available workforce [25]. He produces an alternative group coordination. This practice assure high availability of system. On the left a at the right side of figure, it is noticed available distributed workforce [18,27].

The internal communication and interaction layers on our developed ADHMXP (see Fig. 5).

The distributed pair programmer or developers have authority and accessibility to screen through located combos, they are able to read and verify user requirements [1]. They

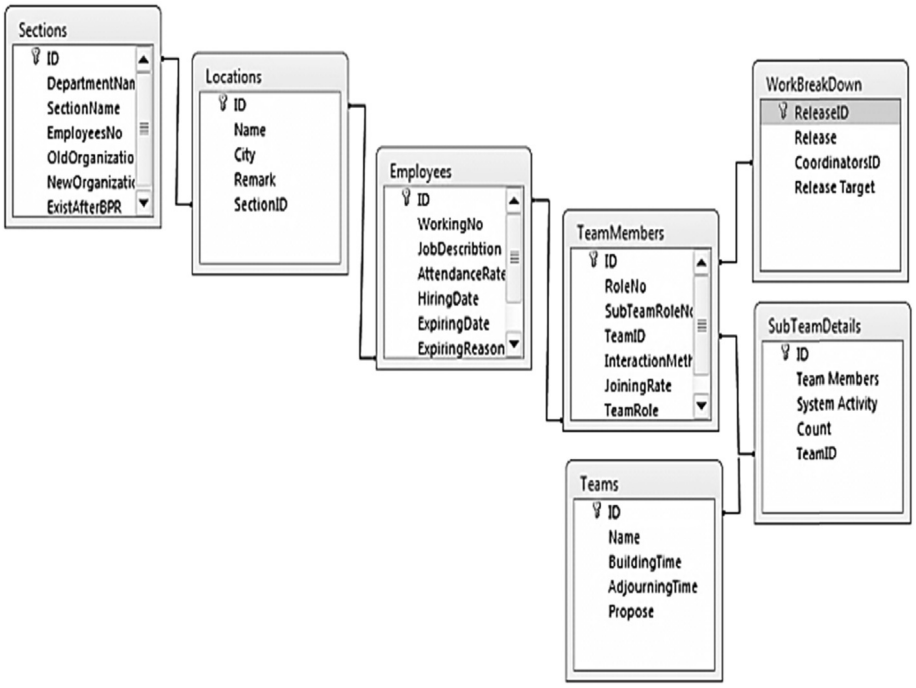

Fig. 7. Fragmentation of sections and locations and linking to team members upon defined ID and joining to definitive release and iteration.

develop codes by adding certain code lines on collective ownership code editor such as KDE developer on Linux system [20]. They compile and execute program. The programmers wait the comments of the online representative customer through acceptance sheet located on screen and available on Arabic or English language to be familiar to end user and not to restrict education level of end user. Such a method allows the deployment of the available workforce of organization [15].

The coordinator now has ability to monitor user story, the activities of distributed pair programmers. He/she can record his/her comments of social factor list plus quality assurance list of software engineering [4]. The light weight automated documentation activity defines the ability of global system to apply the frequent requirement changes and detects extra coded lines and extra assets requirements. This screen allows continuous interactions so all human, asset and financial resources are internally detected and deployed for each iteration and final release for each step of project [5]. The screen is proposed to be flexible and scalable enough to insert new features for simplifying interactions and to match requirements of online customer, and developers. Actually, our proposed methodology and screen are mix of literature trials to adopt eXtreme Programming. The literature researches have distinguished the ability of the eXtreme Programming to flexible and continual modifications in order to fulfill all agile practices with low assets and flattened cost of change [8]. They supposed that each iteration and global release can be an extension of its precedent iteration or release. So, the delta code lines and extra assets are supposed to be minimized and neglected through successive iterations.

The next section provides empirical case study of implementation of proposed methodology to improve software development into 3 departments in Suez Canal Authority in Egypt depending on in house developers and existing resources.

4. Empirical study of Suez Canal Authority

In the Suez Canal Authority (SCA), the chairman noticed the duplication of managerial works among three main departments and sub-departments: the Vessel Traffic Management, the Admeasurement sub departments of Transit Departments and the Planning and Research department. The three sections introduce different reports of the same data concerning vessels transiting canal daily or periodically. It is

Table 1
Sub-team work (ADM) break down schedule.

Release 1		Sub-team (A)	
Task/No	Task	Mem./No	Job
1	Plan New ADMSys	A001	ATL
2	Design draft RDBMS ER	A002 to A005	ADEV
3	Display to online customer	A001 + AC01	ABO
4	Investigate for legacy stories	A001 to A005 + AC01	ADEV + ABO
5	Develop small release	A002 to A05	ADEV
6	Metaphor for mockup screens	A001 to A005 + AC01	ADEV + AEU
7	Factorize Modules	A001 to A005	ADEV
8	Create BPR BPMS + WFMS	A002 to A005	ADEV
9	Design OO Class in (C++)	A002 to A005	ADEV
10	Run unit test	A002 to A005	ADEV
11	Test for First Development	A001 + AC01	ADEV + AEU

Table 2
Sub-Team work (VTMS) Break down Schedule.

Release 2		Sub-team (A + B)	
Task/No	Task	Mem./No	Job
1	Plan New VTS_ADM_Sys	A001toA005 + B01toB05	ADEV + BDEV
2	Design draft shared RDBMS	A002 to B03	ADEV + BDEV
3	Display to onsite customer	AC01 + BC01	BBO
4	Investigate for legacy stories	A001 to A005 + AC01 and B001 to B005 + BC01	ADEV + BBO
5	Develop small release	A002 to A05 + B01 to B05	ADEV + BDEV
6	Create BPR BPMS + WFMS	A002 toA005	ADEV
7	Design UNIX/Linux VTMS/ADM script	A002 to A005 + B01 to B05	ADEV + BDEV
8	Design schedule for file transfer	A002 to A005 + B01 to B05	ADEV + BDEV
9	Test for First Development	A002 to A005 + B01 to B05	ADEV + BDEV

easily to detect inconsistency and inaccuracy of data among different reports. The decision making and international publishing are inaccurate consecutively. As a first cause of existing problem, the answer is the isolation among significant sections besides the non-organized paper works, and existence of internal unnecessary processes. The limitations of creating unique team work including the sections are managerial and geographic location barriers. The Admeasurement System (ADMS) and Vessel Traffic Management System (VTMS) are distributed within three Suez Canal cities (Port Said, Port Tewfik and Ismailia). The VTMS gets instant data from Radars and Cameras distributed along the navigation path of the Suez Canal, VTMS role is to match monitored vessel to data written on Informatics database and to acquire label of essential data concerning name, dimensions, loads, cargoes and coordinate position of vessel. If vessel doesn't exist on system vessel manager should put in its name on Informatics database and reacquire vessel with created file and tracks vessel until it exits canal. The ADMS gets data daily but late when all the vessels are scheduled within VTMS list. The ADMS end user create transit file for vessel of current date if and only if vessel file exists on ADM Database, else he creates a new vessel file and reinsert the transit file. A bill calculator screen estimates the tolls that should be paid by vessel in order to pass the canal. A financial decision should be approved by chairman sometimes in order to attract some types of vessel to pass the canal. Such, study of relationships between types of vessels and rate of transiting canal besides grade of distance minimization by passing canal versus other nautical paths is developed by Research and Planning System. The final financial decision making is developed on ADMS so minimizing or increasing rules applied to each vessel transiting canal per day. An object oriented or hierarchy of virtual team work is developed and linked to virtual team database in order to get a well-defined structured team work defining the job of each sub-team work and members. Actually, each sub-team work has complete knowledge of his work but the integration and unification of data require some restrictions [24]:

1- Evaluation of compatibility between different platforms
2- Creation of shared storage area network readable by the other sub-team members
3- Estimation of latency and schedule times of accessing and handling data
4- Creation of unified scripts for the migration data between different systems.

Such procedures require global Business Process Reengineering (BPR) of three systems based on [19]:

1- Fragmentation of ADMS system the central system and
2- Integration of ADMS to Planning and Research System
3- Integration of ADMS to VTMS.

The assets required are:

1- Server and PC between ADMS and Planning and Research (P&RS)
2- Server and PC between ADMS and VTMS

The integrating scripts:

1- PHP on MySQL script to transfer data from ADMS to P&RS

Table 3
Sub-team works (ADMS + P&RS) break down schedule.

Release 3		Sub-teams (A + C)	
Task/No	Task	Mem./No	Job
1	Plan New Link system	A001 + C01	ADEV + CDEV
2	Specify fields of flat file	A002 to C01	ADEV + CDEV
3	Display mockup screen for flat file retrieve	C01 to CC01	CDEV + CEU
4	Verify Database Compatibility	C01 to C03	CDEV
5	Verify Networking connectivity	C01 + A002	CDEV + ADEV
6	Test data consistency	C01	CDEV
7	Test validity of data for marketing decisions	M01 + C01 + A01	ML + AL + CL

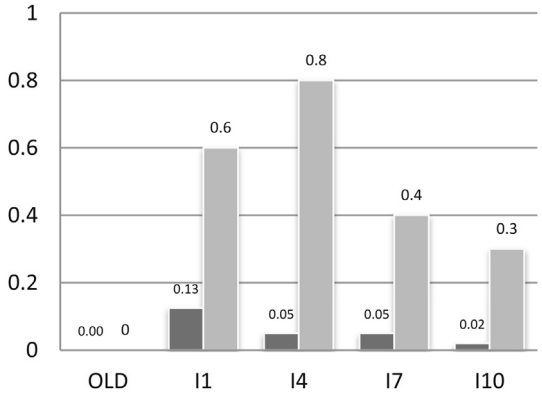

Fig. 8. Extra coding rate (black) versus distribute pair programming (grey).

2- Shared external database filled by replication and trigger from main server to external PC accessible by VTMS [26].

The workflow management system (see Fig. 6).

The hierarchy of team members is designed and stored within extension database providing this flexible and dynamic layout allowing flexible coordination and monitoring until the end and achievement of release (see Fig. 7).

This method allows independency on any member to achieve tasks lonely and so task can be achieved by another available member with low training or declaration time for existing situation. This architecture involved existing and elected customer representations for each team work regardless of his/her location. The customer is involved within software development life cycle. So, social factors such as motivation, confidence and trust are proposed to be high and resistance to new system is low. Tables 1–3 define the work break down system (WBS). The WBS doesn't depend on time but on achievement of iteration and release. The schedule is linked mainly to the identical numbers of team members as in Fig 7 not to their names. This issue also is supposed to grant alternative group coordination. These tables explain the coordination and collective ownership of shared storage and coding area. An alternative coordination of valid workforce maintains high availability and flexibility of software development. This issue minimize bad social factors such low confidence, trust and motivation. Actually, VTSP proposed methodology assure the involvement of all team members

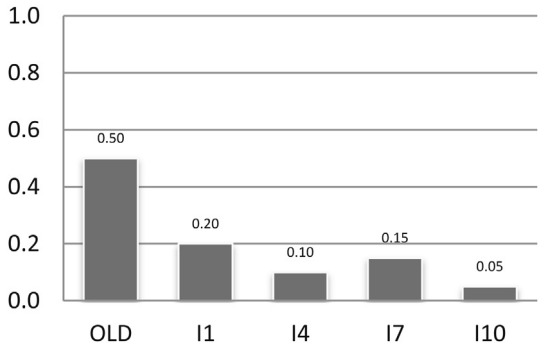

Fig. 9. New asset requirement per iteration.

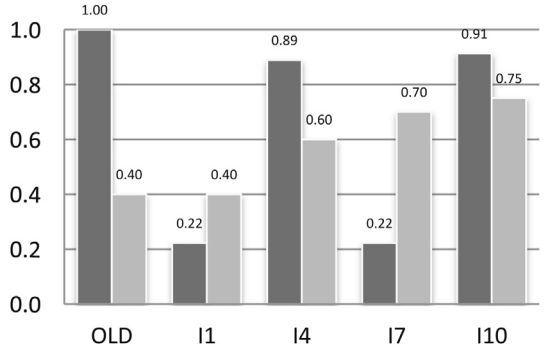

Fig. 10. Access rate (black) versus online customer presentation rate (grey).

within BPR software development life cycle from A to Z. The proposed successive iterations and releases provide the sense of starting a new project from scratch for each new feature or development. This issue leads to the on-job training and quick familiarity with system; every individual can distinguish his role friendly, with low defense or resistance.

The BPR project is assumed to be successful and realizes valuable return of investment on runtime due to successful modification of eXtreme Programming methodology based on virtual team work structure.

Our VTSP methodology has ability to be tuned and elevated upon iterations and successful releases.

The next section shows the extracted results from the implementation of new methodology. The results predict the ability of methodology to be tuned and improved in order to minimize costs and guarantee high quality.

5. Evaluation results

The system improves effort distribution and increases ability of team members for self-learning. It becomes a self-autonomous team and supports strategic and radical changes. The deployment of software, hardware and human resources are adequately valid. The rank of collected data from proposed screen is aggregated and represented into monitored chart detecting the following relationships of [6]:

1- The extra coding rate becomes lower as the implementation of distributed pair programming practice is higher (see Fig. 8).
2- The requirement of new assets or spare parts and down maintenance time per iteration become lower (see Fig. 9)
3- Screen access rate becomes higher each time the online customer representation rate is high (see Fig. 10).

The ability to generate codes becomes easier. The achievement of tasks encourages the top management to support new similar projects. Such middle driven projects motivates neighbor departments to share data and to spread activity of integration in order to initiate smooth governmental internetwork and secured EDI. Figs. 8–10 show performance improvement of organization using proposed VTSP methodologies upon observation of releases and iterations of BPR project [17].

The previous charts begin with initiative legacy system (OLD), which has already created a stable state. Legacy system has owned familiarity with end-users, despite its difficulties for daily transactions or information retrieval and maintenance or management. The isolation between different legacy systems has provided ability for security and administration control. Therefore, the inaccuracy or the integration of data has become neglected. So, the old iteration before iteration 1 (I1) has got the best grade of satisfaction, quality and asset costs. The progress of iterations and releases improve global satisfaction and initiate methods to simplify development works. Therefore the new assets or training either to developer or end-user becomes rarely required. The light documentation gathering to simple 10 or 20 pages metaphor presentation to high level managers produces global view and involve managers to BPR projects and provide some types of satisfaction about BPR system progress. Therefore, managerial support for project is introduced gradually with low risk factors and low limitations of BPR project execution.

6. Conclusion

It has been widely reported that a large number of BPR implementation fail to meet expectations, over time and over budget [14]. So this paper introduced two common implementation approaches, team software process approach and eXtreme Programming approach. Because of the disadvantages of those approaches [13] this paper also introduced a new implementation approach that combines the extended extreme programing approach and virtual team software process approach to solve disadvantages in eXtreme Programming approach and team software process approach like using a mixing interface program, deploying existing resources, data and business rules [15]. To implement this methodology, we needed to make BPR modeling dependency diagram to show the inputs for each process and the outputs from each process and based on the dependency diagram we could show the VIRTUAL TSP approach and how this approach can be worked. The proposed approach allows continual planning and launching during small releases that can refactored in turn into small iterations representing complete and usable task. This approach is assumed to refactor efforts, resistances, and challenges and redirect good experiences to the next iteration and so on until the final release and project [28].

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