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A Spring Model: A new Information Technology system development methodology to combine software engineering stages and project management factors

Navid Hashemi.Taba
Department of Information Technology
Preston University
P.O.Box: 20488 Ajman
United Arab Emirates

M. Nawaz Brohi
Department of Information Technology
Preston University
P.O.Box: 20488 Ajman
United Arab Emirates

ABSTRACT
This paper develops the spring model as a new information technology (IT) system development methodology to combine software engineering stages and project management factors. Spring model conducted time line control mechanism, progress measuring as well as the conventional IT system development tasks. The new integrated approach enables the developers to control time, budget, and other vital assets during engineering process. Spring methodology improves the existing IT system development methodologies using the results of a comprehensive literature review about the lack of project management tools in current IT system development methodologies.
The new proposed methodology supports requirements of project control process (PCP) and project life cycle (PLC). Besides new methods, spring model utilizes some of the current useful features of popular lifecycle methodologies. Therefore, the new methodology is easy to use and has the capability to apply to any type of IT systems including IT business application, system software, and even embedded systems.

In the suggested spring methodology, the Percent Complete Rules axis with IT governance criteria, technical aspect, and managerial aspects are three pillars that provide a powerful approach for system development process. Finally, the Spring Methodology enables engineers and managers to work together in an integrated professional environment with different perspectives to control the development progress from their particular criteria.

Keywords
Agile, Gantt chart, Prototype, Spring Model, Project Control Process, Project Life Cycle, Rapid Application Development.

1. INTRODUCTION
By now, most organizations use the information system developed in many disciplines. The IT system development like the software term is not old. The history of information system deployment is related to history of the computer. Four decades ago, code-and-fix was the first method in software development process, which was not reliable. After that, the structured system development was used for 40 years. Although rapid application development (RAD), Prototyping, and Agile Methods are used to develop a large range of information systems, most of the software development models are based on the life cycle scheme **[1].** Currently, object-oriented (OO) Methodologies are most popular; however, some as aforementioned models such as OO do not cover all stages of system life cycle.

Besides the Information system development models, the project management models have had a significant rise. The project management processes have grown greatly, from the Gantt chart in early years and critical path method in middle era to advanced artificial intelligence based models **[2].**

1.1 Failures of current approaches
The latest professional reports have shown that about 24% of IT projects failed and more than 44% face challenges. Based on various researcher by Mitchell (2006), Standish Group (2001), Forrester Research Inc. (2002), Johnson Hackett Group (2003), Perks (2003), Varon and Ware (2005), and Jack (2007), 24% to 100% of IT projects exceeded time and cost estimates. According to Standish Group's 2009 software CHOAS report (Standishgroup, 2010), from 2006 to 2009, there has been a 3% decline in project success rates (from 35% to 32%) and five percent increase in failed rate (from 19% to 24%). Figure 1 depicts the software development crisis studies from 1994 to 2006 **[3].**

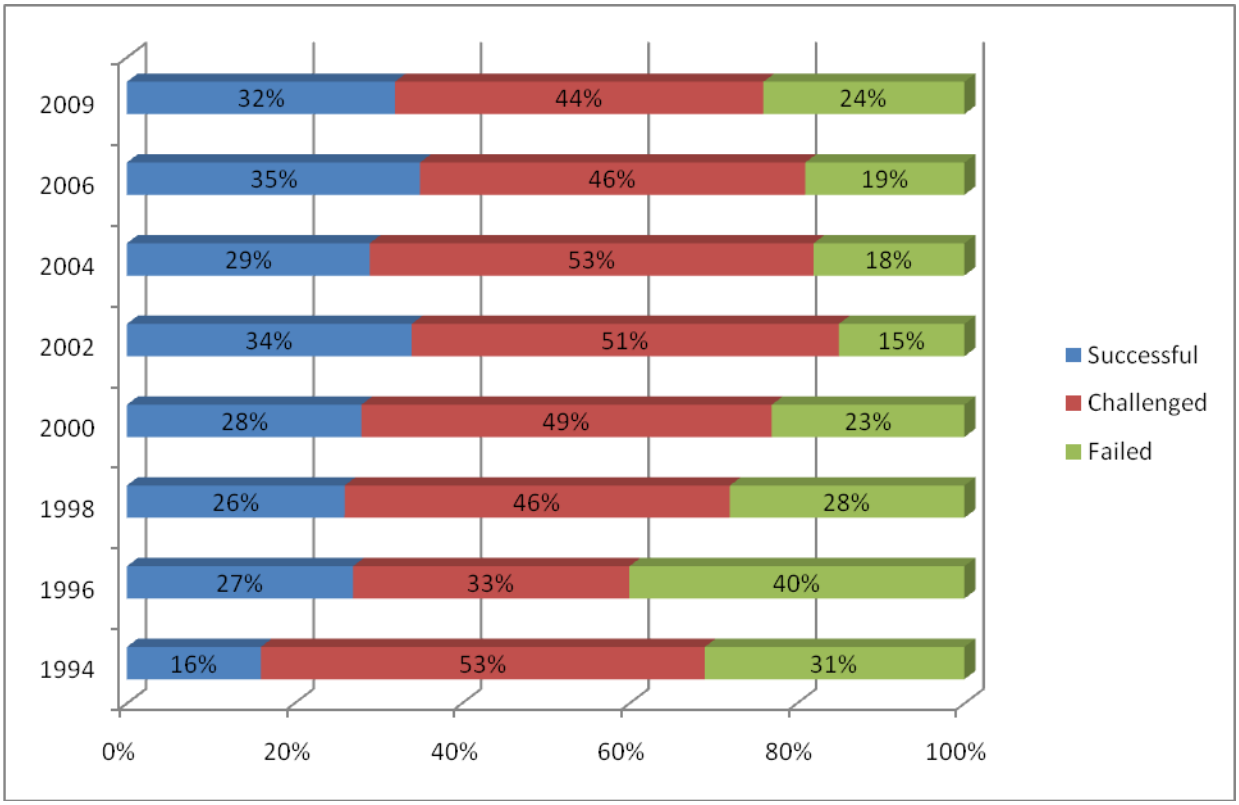

Figure 1: Software development crisis studies from 1994 to 2006 extract form

There are cases in which Information Technology projects overlap with project management and control issues. The current development models neglect this important aspect. As the result the projects have difficulties in implementation. The deep study on IT system development models and project management as well as control methodologies and available tools indicate that the combination of these two wings will enable the developers to plan the information, which are systems more implementable.

2. DEVELOPMENT PROCESS vs. PROJECT MANAGEMENT

According to Knahl, a set of adequate definition of concepts and policies are mandatory for IT infrastructure, development and operations as well as IT project management [5]. Producing a system as a final product requires using an appropriate methodology corresponded to the nature and characteristics of the software **[3]** stated:" Information technology projects are organizational investments." In other words, development process is the frame work to produce reliable software and IT solutions aims to assigning time, professional man power, and other important resources to the a project with an expectation value-return **[3].**

2.1 System Development Life Cycle and Project Life Cycle methodologies

The Information system development dates back to 70 years ago; however, at that time there was no specific method for it. Major activities to make information system development systematic occurred in the year 1970. Exclusively structured programmings followed by Object-Oriented and Grammar-Oriented in logic programming were the conventional approaches. There are several types of IT development methodologies. A few such as waterfall could be placed in a historical traditional system development life cycle (SDLC) category**.** Rapid application development is another meta-class for software development processes with quick development iteration tasks.

Besides aforementioned methodology classifications, project life cycle methodologies are suitable for projects with solid deadlines and exact time-lines. According to Marchewka, the project life cycle consists of logical phases to make a map covering the major stages of development of an information system from requirement definition to end product delivery [3].

3. SPIRAL MODEL

Spiral model is the innovation of Boehm, an eminent scientist in software engineering field **[9].** Boehm improved software development lifecycle with approaches based on risks and illustrated software development within spiral iterations of different phases. Figure 3 depicts this process. Each curve in Spiral model starts with planning, risk calculation, and finished it with user evaluation. In this model, there are two perpendicular axes, which form four areas or quadrants. Boehm emphasized that the most important advantages of this model is risk analysis at the earliest stages, which decrease the risk consequences and assist developers to produce the software with efficiency in cost and time **[9].** The downside of the spiral model is that it is complicated (See figure 2), requiring conscientious, attentive, and knowledgeable management **[9].**

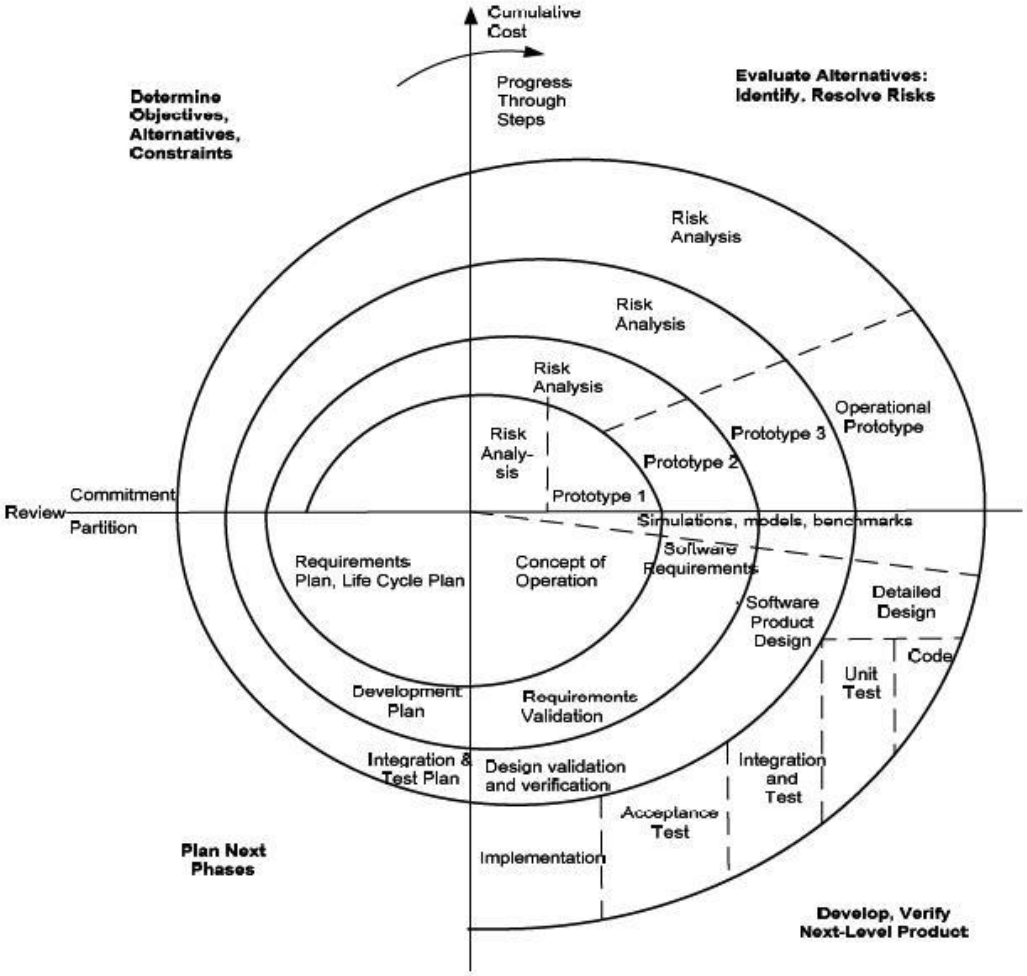

Figure 2: Spiral Model [9]

3.1 Spiral model disadvantages

The main disadvantage of the spiral model is the poor combination of planning tasks and implementation phases that limit the progress control; in other words, the evaluation is placed at the end of each rotation and deviation correction can only be done in the next iteration. According to Kerzner, authority is the most important issue in the project management process. Spiral does not make any autonomous authority position for project manager professionals and disarms software project managers in their professional duties [10].

4. SPRING IT SYSTEM DEVELOPMENT MODEL SCHEME

Spring is a multi-layer lifecycle based IT system development methodology that satisfies both of process perspective and project landscape in any software development scheme. Spring methodology facilitates IT system development process in a reliable manner and could be assumed as a soft technology **[11].** In other words, the Spring Methodology synchronizes the development process with project management tasks as two important aspects of successful development **[12].**

Software development project methodology (SDPM) is a strategic approach to integrate major solution for the reliable software development approaches such as PMLC and SDLC **[13].** The lack of clear declaration of each aspect in SDPM as well as the lack of continuous project management tasks in Spiral Model is resolved in Spring Methodology. Figure 3 shows the spring system development model (SSDM) scheme. SSDM composed of two major dimensions (components). The first dimension is the project control process; which is adapted to project life cycle protocols.

Figure 3 represents the schema of Spring Methodology. As the project aspect of model, there are two major component assist mangers and project control specialists to evaluate and control the project progresses:

1 **Setting baseline plan**. The baseline plan will be designed at the first stage of every process, based on the specification of end product and IT governance details

2 **Periodical processes**. During the development process and in each cycle (iteration) of Spring Model, the periodical processes, the following should be done:

a. Measuring progress and performance
b. Comparing plan against actual progress
c. Taking appropriate action (including deviation correction or success report)

The type and tasks of the aforementioned processes may vary from one specific project to the next.

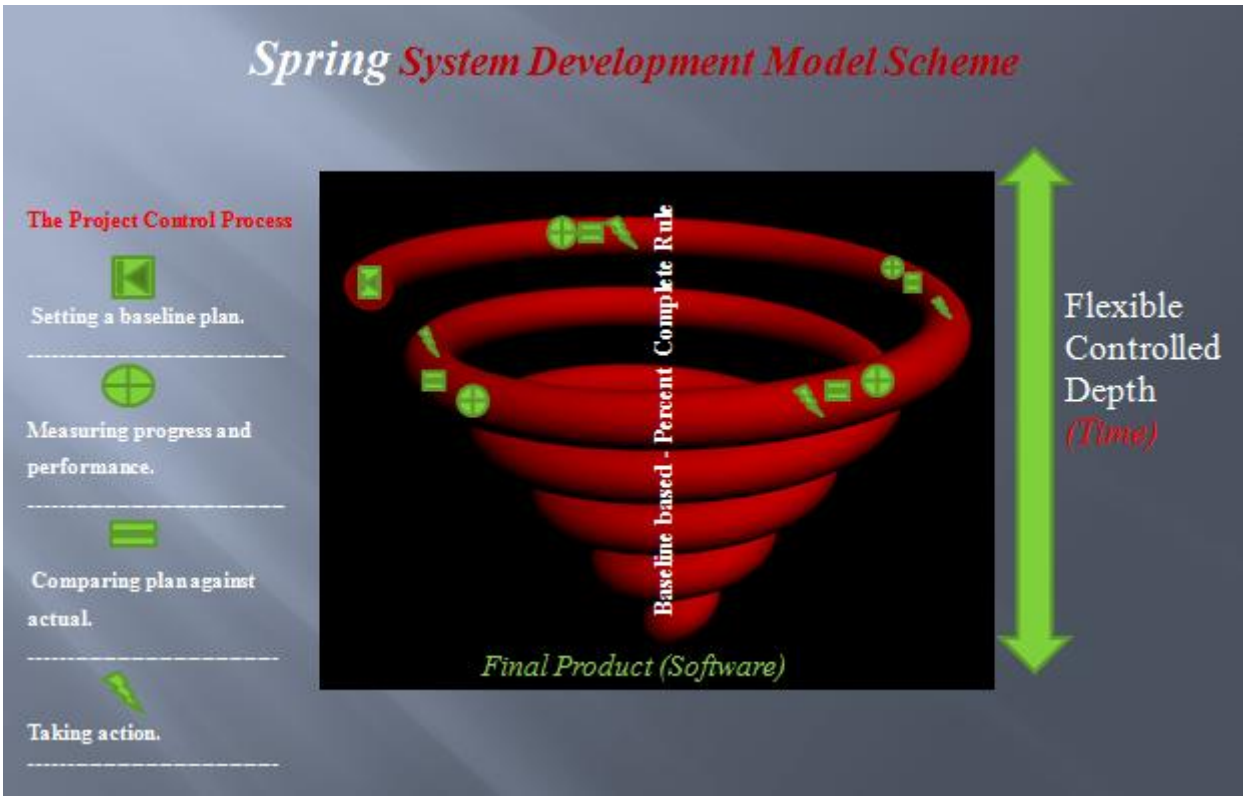

Figure 3: Spring IT system development model schema

5. PERCENT COMPLETE RULES

The Percent complete rules (PCR) as the baseline core compensate for the completion time deficit in other development methodologies. PCR is the main axis of the model and plays a central pillar role for managerial and technical processes. Therefore, the PCR under pre-defined logical and interaction mechanism and protocols will perform the entire incremental process of the model.

Glass focused on the qualitative nature of success and failure and stated that success depends on viewpoint more than criteria [14]. Spring model has solved Glass warn point with defining and setting the PCR. Developing baselines and comparison procedures is possible in a wide variety, from size-oriented metrics to Fuzzy set depending on the nature and features of the end-product [15].

5.1 Spring development methodology specifications

The spring specification and configuration is summarized in Figure 4. Although Spiral methodology inserted some project control tasks in an iterative trend, it has a significant lack in clarifying the role of each two dimensions. Therefore, spring system development methodology combines project control process and project life cycle concepts in an integrated approach and defines a clear formal relationship between the two. Spiral is a rotational incremental methodology. In each rotation, both of software development stages and project management activities could be utilized concurrently.

System development process typically consists of three sequential stages:

- Requirement analysis,
- System design and implementation,
- System support and maintenance.

Each phase contains activities and each activity has corresponded tasks.

6. SPRING AS A PROJECT MATURITY MODEL

According to Gray, and Larson, Phase Gate Methodology as a specific type of project life cycle methodology provides an in-depth review of individual projects during specific phases in the organizational project maturity model [17]. One newer model has received a great deal of publicity. In January of 2004, after eight years of development, the project management institute (PMI) rolled out its second version of the Organizational Project Maturity Model. Typically, these models are divided into a continuum of growth levels: initial, repeatable, defined, managed, and optimized. Although, PMI focuses on deliverables rather than resources and measures progress periodically and commits to developing effective plans at the beginning of each project, spring controls the trend of progress continuously. Therefore, the project management mechanism in spring model is more comprehensive than PMI.

According to Wysocki**,** there are five different project management life cycle models [18]: linear, incremental, iterative, adaptive, and extreme to manage a project. Spring conducts include iterative processes in an incremental manner. Project activities in spring model consist of:

- Work Breakdown structure
- Process Breakdown Structure
- Responsibility Matrices
- Project Communication Plan

The managerial component of spring leads to accomplishing specific goals and milestones to satisfy the important criteria of PML **[19].**Therefore, the Spring Methodology has the potential to cover level four (resource capacity and contribution to strategic goals) and level five (continuous improvement) of organizational project maturity model (See Figure 4).

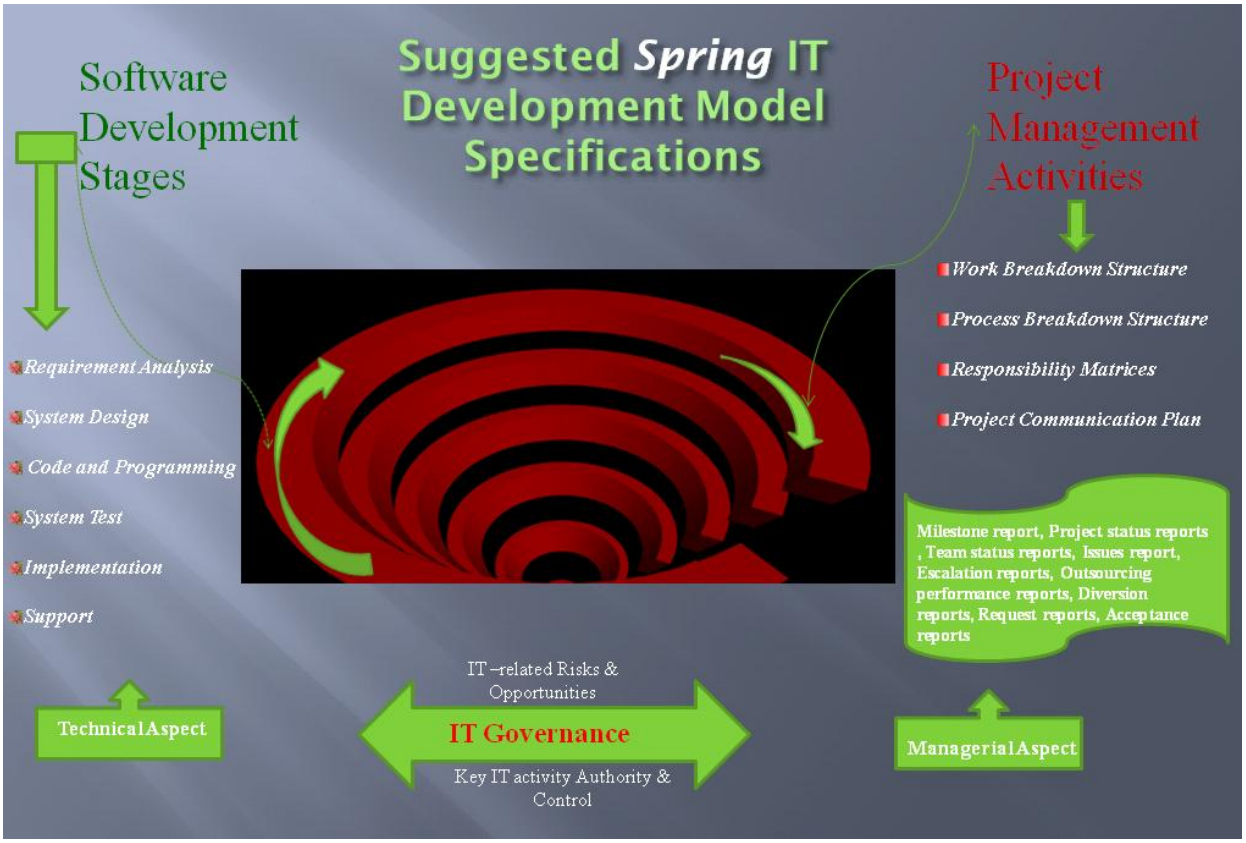

Figure 4: Spring development model specifications

6.1 IT governance the unique attribute of spring model

IT governance component is the unique characteristic of the spring methodology. According to De Haes, and Van Grembergen**,** IT governance is the most important discipline in current information technology area [20]. Sharma, Stone, and Ekinci stated that most enterprises concentrate on their IT total system development including strategies, policies and budgets, neglecting the important role of solid governance in achieving desired results [21]. Sharma, Stone, and Ekinci also emphasized that top management involvement and efficient project management considerations are two major factors for a successful implementation of IT governance [21].

Research has shown that project governance and management methodologies are two high ranked factors that influence the success of IT system development **[22].** An acceptable IT governance translation will help senior project managers to obtain the objective measurable rules. These rules are as follows **[23]:**

- IT resources description
- IT-related business risk
- IT-related opportunities
- Actual value of projects organizational strategies
- IT strategies alignment

The IT governance component of spiral model provides the framework for several models to reduce several complex risks **[24].** According to Pras, supporting functional model, information model, and communication model combined with the development process are essential for any IT governance [25]. Therefore, the flexibility of Spring Model in using different models for IT governance enables developers to choose appropriate models adapting with the environmental characteristics and attributes. Yajiong, Huigang, and Boulton declared that the well- designed IT governance will provide reliability for properly governing each stage of the decision process [26].

Posthumus, Solms, and King stated that: "IT governance is an aspect of the broader corporate governance function, ensuring that IT is aligned with business goals and delivers value through its investments" [27]. Once the successful governance of IT and related information resources has been proven effective, adding value to an organization and contributing towards its competitive advantage, the implementation of IT governance can be claimed as an intellectual property and should be treated as such.

6.2 IT governance and maturity model

As previously mentioned, spring model satisfies the major criteria to be a maturity model. Each iteration in Spring Model provides repeatability and precise definition and both dimensions in surface and depth (technical and managerial aspects) cover managing and optimization, which is essential for maturity model in IT governance **[28].** Spring methodology has the core axis baseline to control the drive from the resource planning stage to implementation phase focusing on the IT governance and project goals.

Sharma, Stone, and Ekinci, emphasized that strategy alignment and return on investment is essential for IT governance. Project completion is another issue that needs to be addressed by IT governance **[29].** Percent complete rule in the spring model illustrated before supports the project completion within a reliable and detailed rule-based approach.

7. CONCLUSION

Professional studies have shown a major lack of project management considerations in a majority of IT system development processes, especially in software development methodologies. This paper introduces a new model for IT system development considering project management criteria. Technical aspects and managerial aspects as two major components of the model provide both engineering support and project control for a perfect development process. In addition, IT governance and the baseline axis including complete process rules provide a bright road map to avoid conflict between the organization objectives and development practices.

8. REFERENCES

[1] Papazoglou, M., & Heuvel, W.J.A.M. van den. 2007 "Business process development lifecycle methodology." Communications of the ACM, 50(10): 79-85.

[2] Kendra, Korin A.; Taplin, Laura J. 2004 "Change Agent Competencies for Information Technology Project Managers." Consulting Psychology Journal: Practice and Research, Vol 56(1), 20-34.

[3] Marchewka, J. T. 2009 "Information Technology Project Management. Providing Measurable Organizational Value", Third Edition. ISBN: 9780470371930. John Wiley & Sons.

[4] Standishgroup, 2010 http://www.standishgroup.com/newsroom/chaos_2009.php Snyder, C., & Cox, J. (1985). "A Dynamic Systems Development Life-Cycle Approach: A Project Management Information System." Journal of Management Information Systems, 2(1): 61-76.

[5] Knahl, M. 2009 "A Conceptual Framework for the Integration of IT Infrastructure Management, IT Service Management and IT Governance." Proceedings of World Academy of Science: Engineering & Technology, 5(2): 447-452.

[9] Boehm, B. 1986 "A Spiral Model of Software Development and Enhancement", ACM SIGSOFT Software Engineering Notes", ACM, 11(4):14-24.

[10] Kerzner, H. 2006 "Project Management Best Practices. Achieving Global Excellence." ISBN: 9780471793687. John Wiley & Sons Inc.

[11] Collier, D. A., Evans, J. R. 2007 "Operations Management. Goods, Services and Value Chains," Second Edition. ISBN: 9780324184709 Cengage.

[12] Nolan, R. L. 2001 "Information technology management from 1960-2000." Harwqards |Business School. June 7.9-301-147.

[13] Sommerville, I. 2006 "Software Engineerin.", 9th ed., Addison-Wesley, 2006.

[14] Glass, R. 2005 IT Failure Rates--70% or 10-15%? IEEE Software, 22(3): 110-111.

[15] Lorenz, M., Kidd, J. 1994 "Object-Oriented Software Metrics." Prentice Hall.

[16] Sommerville, I. 2009 "Software Engineerin.", 9th ed., Addison-Wesley, 2006.

[17] Gray, C. F., Larson, E. W. (2008). Project Management. The Managerial Process, Fourth Edition. ISBN: 9780073525150. McGraw-Hill, a business unit of the McGraw-Hill Companies, Inc.

[18] Wysocki, R. K. (2009) Effective Project Management. Traditional, Agile, Extreme, Fifth Edition. ISBN: 9780470423677. John Wiley & Sons Inc.

[19] Meredith, J. R., Mantel, S. J. 2009 "Project Management. A Managerial Approach." Seventh Edition. ISBN: 9780470226216. John Wiley & Sons Inc.

[20] De Haes, S., & Van Grembergen, W. 2009 "An Exploratory Study into IT Governance Implementations and its Impact on Business/IT Alignment. Information Systems Management." 26(2): 123-137.

[21] Sharma, D., Stone, M., & Ekinci, Y. 2009 "IT governance and project management: A qualitative study." Journal of Database Marketing & Customer Strategy Management, 16(1): 29-50.

[22] Steven De Haes, Wim Van Grembergen. 2009"An Exploratory Study into IT Governance Implementations and its impact on Business/IT Alignment. IS Management." 26(2): 123-137.

[23] Marks, N. 2010 "The Pulse of IT Governance." Internal Auditor, 67(4): 32.

[24] Cooper, D. F., Grey, S., Raymond, G., Walker, P. 2005 "Project Risk Management Guidelines: Managing Risk in Large Projects and Complex

Procurements." 1e. ISBN: 0470022817. John Wiley & Sons, Ltd.

[25] Pras, A., Schonwalder, J., Burgess, M., Festor, O., Perez, G.M., Stadler, R., Stiller, B. 2007 "Key research challenges in network management," Communications Magazine, IEEE , 45 (10): 104-110.

[26] Yajiong, X., Huigang, L., & Boulton, W. 2008 "Information Technology Governance in information technology investment decision processes." The impact of investment characteristics, external environment, and internal context. MIS Quarterly, 32(1): 67-96.

[27] Posthumus, S., Solms, R.V., King, M 2010 "The board and IT governance: The what, who and how." South African Journal of Business Management, 41(3): 23.

[28] Florin, I., & Minodora, U. 2009 "The shift to IT governance - A global approach." Annals of the University of Oradea, Economic Science Series, 18(4): 954-958.

[29] Sharma, D., Stone, M., & Ekinci, Y. 2009 "IT governance and project management: A qualitative study." Journal of Database Marketing & Customer Strategy Management, 16(1): 29-50.