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DEVELOPING A REFERENCE FRAMEWORK TO SELECT SOFTWARE PROCESS FOR EGOVERNMENT PROJECTS: EVIDENCE FROM INDUSTRY

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KeyWords

ABSTRACT

The eGovernment project's success highly depends on the use of an appropriate software development process. The appropriate software development process is dependent on the situational factors of the development setting. These include team, project and organization factors. However, no reference framework of the situational determinants that affect the eGovernment software process is currently available. Therefore, the objective of this study is to develop an initial reference framework for eGovernment project development, defining the factors which affect the process tailoring and selection. The empirical investigation of some projects is carried out to identify factors, using interviews as data collection research method. The systematic approach of thematic analysis is applied to analyze data and generate the framework. The resultant framework consists of 6 main categories, 17 sub-categories and 52 individual determinants that define the software development process of eGovernment project. It is believed that the situational determinants initial reference framework given here presents a strong and comprehensive reference framework for the software development process selection in eGovernment project. The resultant reference framework signifies a significant contribution to the eGovernment field in particular, and to the software engineering domain in general. In addition, the framework provides support to eGovernment practitioners in defining and selecting the context-oriented software process. Moreover, this framework is useful in developing an outline of the situational features of the eGovernment development setting, and provides a strong foundation for eGovernment software development process tailoring, definition and selection

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1. INTRODUCTION

Governments have used eGovernment projects in innovative ways to better serve their citizens (Abbas et al.,. 2011; Anna and Kei, 2005). eGovernment implementation strategies vary across government department and across countries. eGovernment projects are the software development projects, however with a broader context with respect to objectives and options for development (Elder and Garman, 2008; Heeks, 2006). It is vital to use a software process method to increase success rate, when initiating any eGovernment project. The definition and management of the software development process (SDP) are challenging tasks for practitioners (Khan et al., 2017; Elder and Garman, 2008; Heeks, 2006) The required project/software quality are not likely to be accomplished without giving proper attention to the "software development process" (Baharom et al., 2014.; Gregory et al., 2016; Iqbal et al., 2015; Valle et al., 2017).   Existing research shows that generally organizations do not clearly establish software development processes because they face difficulty in defining processes consistent with their business requirements (Larrucea et al. 2016). Most of the organizations lack employee expertise, do not have enough resources, lack of funds, cost and time, commitment and lack of knowledge and information (Larrucea et al., 2016; Raza and Faria, 2016). Such issues are very common in eGovernment sectors (Elder and Garman, 2008). So, implementation of eGovernment projects are often considered challenging (Choudrie et al., 2017).

A number of software development methods are available, but no single process is suitable for all projects. For practitioners, determining the specific methodology for a given project is critical (Nasir and Sahibuddin, 2011; Vijayasarathy, and Butler, 2016). As there is no "silver bullet" available for all type of projects (Chevers et al., 2017; Boehm et al., 2006). The software development process is context-dependent (Clarke et al., 2015.; Kruchten, 2013). The selection of an appropriate software development process will likely consider several contextual factors, including project, organizational, and team characteristics etc. (Clarke et al., 2015; Khan and Malik, 2017; Kruchten, 2013; Vijayasarathy, and Butler, 2016). The relationship between the key situational characteristics and software development process contribute towards informed decision making (Vijayasarathy, and Butler, 2016). Therefore, software development process tailoring (SPT) and definition as per the context is always required for every project (Vijayasarathy, and Butler, 2016). However, the appropriate definition of project-specific SDP for eGovernment projects has been a quite challenging task; particularly in developing nations (Heeks., 2002).

Many studies regarding the SDP and its selection have been carried out in the private sector (Elder and Garman, 2008). The research on SDP is very limited in eGovernment domain (Heeks, 2002; Nawi et al., 2012; Walsham and Sahay, 2006). Although a number of characteristics for eGovernment project success are reported, such as infrastructure, strong management, and policies. However, the situational circumstances which might affect the SDP of eGovernment projects is still unaddressed. In addition, a reference framework that can guide the practitioners about the multiple dimensions of the context affecting the development process and its tailoring in eGovernment projects does not exist. Therefore, the purpose of this study is to develop a reference framework for eGovernment sector. This study analyzes few eGovernment projects and produces a broad reference framework for eGovernment project development. We analyze the information using thematic analysis approach, and produces an initial reference framework providing with the set of situational factors that affect the selection and tailoring of the development process in the eGovernment field. In addition to the previous findings of contextual factors, the knowledge provided in this study is quite useful in forming the portfolio of context-oriented SDPs in eGovernment projects.

The subsequent paper is structured as: Section 2 and Section 3 discusses the eGovernment and private sector, and Software Development Process and Tailoring context respectively. Section 4 and Section 5 states the problem in practice and the rationale to develop the initial reference framework. Section 6 provides with the research methodology. Section 7 states the projects investigated for data collection. Section 8 describes the thematic analysis approach, and Section 9 discusses the results, including the categories formed. Section 10 provides with the discussion of the study. Section 11 concludes the study, and future work is presented.

2. DIFFERENCE BETWEEN EGOVERNMENT SECTOR AND PRIVATE SECTOR

eGovernment projects are essentially the software development projects (Elder and Garman, 2008; Heeks, 2006). However, the context of eGovernment projects differs from private sector projects (Heeks, 2002; Elder and Garman, 2008; Heeks, 2006). eGovernment projects stand within a broader context (Heeks, 2006); i.e. of citizens, management, public agencies, IT vendors, politics, culture, and so on. It includes and affects all these factors. Not only does eGovernment affect these factors; it is also affected by these factors (Heeks, 2006). Whereas, this is not the case with the private software development (Heeks, 2006). The difference with respect to context occurs due to fundamental differences in ownership, aim, value, external stakeholders, funding and control (Editorial Board, 2017). Therefore, eGovernment and private sector are quite different to each other (Elder and Garman, 2008).

The differences between the two sectors suggest that development in the private sector cannot be appropriate to the public sector (Editorial Board, 2017). Thus, the public sector procedures must be researched in its own right (Editorial Board, 2017).

3. SOFTWARE DEVELOPMENT PROCESS AND TAILORING CONTEXT

The software development process tailoring is the activity of modifying a process to meet a specific project requirements (Bass, 2016; Xu and Ramesh, 2015). To create processes from scratch every time is risky and involves high overhead (Xu and Ramesh,

2015). As a result, they are created by adapting present standards and processes (Xu and Ramesh, 2015). Sometimes, the choice of appropriate methodology might be based on industry supported practices and managerial decisions (Nasir and Sahibuddin, 2011; Vijayasarathy, and Butler ., 2016). At other times, organizations might rely on some standards to achieve consistency (Vijayasarathy, and Butler., 2016). For software process, the factors that matter are: "context, context, and context" (Clarke et al., 2015; Kruchten, 2013). The SDP is context dependent (Clarke and Connor, 2012; Clarke et al., 2015; Kruchten, 2013; Xu and Ramesh, 2008). And needs to be tailored as per the context (Clarke and Connor, 2012).

4. PROBLEM STATEMENT

Although the need for software development process tailoring is universally accepted, the existing research in the field has addressed the normal software development and its process in the private sector. The research for the public sector is rather limited. In addition, missing are the basic factors to be considered while tailoring the software development process of any eGovernment project, and as a result, a catalog of known and proven criteria for tailoring that assist eGovernment practitioners, specifically managers in the definition, selection and tailoring of the SDP for eGovernment project.

5. RATIONALE FOR REFERENCE FRAMEWORK

The process of software development process tailoring and definition has received much attention, however the research investigation regarding the factors that define the context of the eGovernment project is inadequate. The eGovernment practitioners have to deal with process selection in every project, but lack the knowledge of the situational factors that define the project context. Therefore, they require an initial reference framework that can assist them in process tailoring and selection. In order to address the concern, a broad reference framework for eGovernment projects has been developed. The reference framework is envisioned to provide a list of major situational factors which affect the SDP of eGovernment projects, which will help to improve the knowledge of eGovernment practitioners in identifying situational factors and the context of the project. The factors in the framework are provided for further action and discussion.

6. RESEARCH METHODOLOGY

6.1. Study Design and Research Strategy

The qualitative approach is used to conduct the study. The qualitative analysis helps to study information in natural settings (Bradley et al., 2007), with complete summary of a phenomenon. Among the qualitative methods, case study analysis approach is used as primary method to assess the projects and to investigate the situational factors influencing the selection of the software process of eGovernment projects. Case study intends to reveal the details from the participants' viewpoint (Ridder, 2017; Yin, 2013).

6.2. Sample and Data Collection

The participants were the individuals who were part of the selected projects' development, including client (for whom project was developed), vendor(an organization which developed the project), and the supervisory committee (the team which supervises the project development). The participants of the eGovernment projects were deliberately sampled (N=30) from multiple projects, having varying roles and experiences. The participant roles include project managers, project directors, team leads, senior analyst, program managers, coordinators). Ten participants from each project were selected, and none of them refused to respond. Face-to-face semi-structured interviews were conducted, consisting of 35-40 minutes duration. The interview sessions consisted of general questions about the process tailoring, and specific ones regarding the procedure and the critical determinants. Literature review of the situational factors that impact the software process helped to form the interview guide. The data collection came to an end when the saturation for the situational factors was reached.

6.3. Data Analysis

The study comprises of iterative collection and analysis of the data. Interviews were recorded and transcribed. The software NVivo 10 was used to organize the collected information. Thematic analysis was performed to analyze the data. The authors discussed the data interpretations on a regular basis. First author developed the initial codes independently. Other authors developed their codes using a subset of transcripts, and the researchers discussed to check the codes and conclude them. Then the authors organized and grouped the codes, and the themes were identified, named "Main Theme", "Sub-Theme", and the "Factor". Notes were made in order to support the preparation of codes and themes, which helped to increase the consistency. A review session was maintained to increase analysis trustworthiness.

7. SELECTED EGOVERNMENT PROJECTS

In this research, three case studies are intended to underpin the required information, which are implemented in Khyber Pakhtunkhwa Province of Pakistan. These were conducted to elicit overall information regarding the contextual factors that are important and considered in the SPT for eGovernment project. The brief description and discussion regarding the projects in given in the following sections respectively.

7.1. Special Branch Information System (SBIS) Project

The SBIS project under study is working successfully and fulfilling all requirements of concerned department of Special Branch. Special branch is a huge affiliated police department. The organization is spread across the province, and has more than 4000 employees. The project intended to control the terrorism in the country. It improved the efficiency of the department. Initially, all the work was done manually, which arose many challenges. After digitization, Special Branch is working in an efficient manner.

7.2. Prison Management Information System (PMIS) Project

The PMIS project under study is working successfully and helping to maintain the complete database for the prisoners' information, and its quick retrieval of the required information. Such automation of modern IT systems in prison has increased the efficiency and transparency. PMIS has envisaged and automated all facets of Prison department.

7.3. e-Police Project

The e-Police project has been developed considering the difficulties which people face while registering complaints at the police station. Initially, the process of registering the complaints was manual and cumbersome. However, after the automation, the system is running successfully and has provided easy access to users. The automated project is providing different functionalities to the police department.

8. THEMATIC ANALYSIS

In the thematic analysis method, the subjects are categorized into codes, sub-themes and the main themes. The main themes define prominent categories of the data, wherein sub themes are semi-prominent category, and the codes are the characteristics at the lowest level. The codes are the factors in our case. Thematic analysis method consists of some steps for data analysis.

Step 1: Familiarizing yourself with your data:

In this step, retrieved data is transcribed and studied over and over to get knowledge about the content. It helps to note down initial ideas. In this thesis, the collected data are based on interviews conducted.

Step 2: Generating Initial Code:

It is the second step of thematic analysis in which data is analyzed to elicit semantic information related to the desired purpose. This semantic information is converted into code which presents feature of the data. Codes are basically short segment of meaningful clusters.

Step 3: Searching for themes

Different themes are generated where collected codes are adjusted. For this, mind maps or tables or code names are used to put them under related theme. This step actually helps to identify the relationship between code, sub-themes and themes.

Step 4: Reviewing themes

This step consists of the refinement of the developed sub-themes and themes. After reviewing it, there might be an amalgamation of themes into single theme or divergence of a single theme into multiple themes. Coherence is also identified between the extracted code and theme.

Step 5: Defining and naming the themes

In this step, the codes are ordered to generate final themes. Final themes are named and written in detail analysis.

Step 6: Producing the report

This step aims to report the extracted information.

9. RESULTS

This section describes about the execution of thematic analysis and the major details are provided, to understand the approach applied to develop the complete reference framework. The key result, the reference framework for eGovernment projects comprising of the situational factors that affect their SDP is presented as well (refer to Figure.1, Figure.2, and Table 1 to Table 6).

A. Familiarizing with the data

It is necessary to get complete and concrete knowledge about the data which has to be analyzed. Here, in this study, data are collected using semi-structured interviews and the archival records, of the three projects. First, the recorded interviews were transcribed into written form and thoroughly studied to get prior knowledge. It gave ample information to understand the SDP of the

projects.

B. Generating code

After reading and getting knowledge about the data, semantic information in the form of codes is elicited related to the desired purpose. This semantic information is converted into word or collection of words which presented features of data. Codes are basically short segment of meaningful clusters. According to the scope of our study, codes were generated from transcribed data that were related to the contextual factors considered important for process definition of the project(s). The sub-themes are created based on the mentioned codes/factors.

C. Searching for themes

In this phase, codes which are generated in the second step are manipulated to form the categories for each code. After collecting a long list of codes, same type of codes is set together in a category that represents the same type of characteristic. For example, codes like team size, team distribution, and the turnover rate is included in the category "Team". The created categories are named as the sub-theme. Different themes are generated where collected codes are adjusted. This step actually helps to identify the relationship between code and themes, but yet these are not the final theme for thematic analysis. In the next step, a broader category for codes and sub-themes are formed, named as the main theme.

D. Review and Naming the Themes

Themes devised in the searching for themes phase are not considered as final. Those themes were reviewed to make sure the analysis is going in the right direction. In the review phase of thematic analysis, it is compulsory to analyze created themes in order to remove if there is any uncertainty. In this case, created themes were thoroughly reviewed and it showed coherence together meaningfully.
Figure.1 shows a satisfactory map of sub-themes with each code (factor). It is important to review again and consider how it fits into the broader overall "story" about the information of the contextual factors, to ensure that the themes do not overlap. For this, a broader category was devised which encompass sub-themes depicting same characteristics. These are named as the main theme. Sub-themes are essentially themes within a main theme. Figure.2 provides the information about the main themes and sub themes.

E. Defining the themes

Name of themes and sub themes are finalized after detailed analysis in the above step. This step is regarding defining the main themes where detail of each theme is given. Table 1 to Table 6 illustrates the main theme wise complete information about the reference framework categories. Few statements of the interviewees and the implication of the theme is given as well.

9.1. Reporting the themes

Major factors that influence the tailoring and selection of the SDP in eGovernment projects are identified and classified into six categories: the personnel, internal factors, external factors, objectives, requirements, and organization. The implication and interviewees' quotes are given as well in Tables 1 to 6.

9.1.1. Personnel

The factor in this main theme is:

- **Team**

The team has great importance in the eGovernment project, which can never be neglected. It is the development team, which plans and develops the eGovernment project. It is necessary that all the factors related to team are well understood and made use of. The team size is among the major concerns that might increase or decrease the project effectiveness. The team members must be competent and mature, having all relevant knowledge for better development of the project. The success or failure of any eGovernment project relies on the entire team.

9.1.2. Internal Factors

The factors in this main theme are:

- **Development**

The development of the eGovernment project is a critical phase, as such projects are meant to define the overall success standard of the nation. A major element of the development is the prototyping, so that the concerns and issues are removed before implementation.

- *Management*

The management of the organization, and of the project plays vital role in the success of any eGovernment project. The managers must be experienced, competent and efficient in order to carry out the eGovernment project smoothly. The management of all three projects worked hard to achieve their set goals in time.

- *Project Parameters*

The characteristics that are related to the project are of high importance, such as the project size, project budget, and type. If the characteristics of the project are not considered well, the proper tailoring of the SDP becomes difficult. Therefore, all the identified project factors are critical and need to be understood and considered while tailoring the software process of the project.

Figure 1.Codes and sub-themes

- **Communication**

Communication within team plays an outstanding role in the success of eGovernment projects. A few interviewees of all three projects reported that the communication was not good initially, however, with the passage of time, a better mechanism for communication was made which proved to be effective for the projects.

- **Operation**

The concept of operation is linked to the finance and its execution. The financial operations were considered important in these eGovernment projects, as these were government projects and had high stake. Therefore, the proper financial controlling is the key to the better eGovernment operation and success.

- **Process**

The generic SDP elements must be measured accurately to achieve better definition and selection of the project oriented SDP. The process elements for selecting defined process for SBIS and PMIS was measured at two levels, by the team and by the manager itself. It made the process definition easy and effective. The process elements for e-Police was measured by the manager only.

- **Technology**

The technology is among the most critical factors for the success. It cannot be neglected. The technology was considered as the driving force for better definition and selection of the SDP in all three eGovernment projects under study. Therefore, technology must be given due importance while defining the process for any project.

9.1.3. External Factors

The factors in this main theme are as follows:

- **Business**

The business factor encompasses the legal and contractual concerns for the project. SBIS and PMIS contracts were signed by all stakeholders explicitly, whereas e-Police business was performed implicitly. The business of the particular eGovernment project explains the development and execution of the project.

- **Stakeholders**

The stakeholders have a prominent impact on the project, so their involvement is necessary while defining the SDP. Negotiating with the concerned people of the project is necessary, and always proves to be vital. The stakeholders involved in these eGovernment projects were client, vendor and the executive team (DoIT). All these were completely involved when required.

- **Skills and Knowledge**

Skills and knowledge factor defines the planning and execution of trainings, which are proved to be effective in project-oriented SDP definition and tailoring. The better the trainings given, the more skilled and well-informed people are shaped.

9.1.4. Objectives

The factors in this main theme are as follows:

- **Application**

The application means the system that has to be developed. The characteristics that make up the application important must be considered properly. The success of the SDP for the eGovernment project is dependent on the application and its characteristics.

- **Compliance**

The compliance is the theme that conforms that a certain standard, law or rule is used. The eGovernment projects look for proper ways to adhere to the regulations and compliance controls. The compliance served as a means, for all three projects, to ensure controlled and effective execution of these projects within the set goals.

- **System Effectiveness**

System effectiveness defines the measure of the capability of the project to achieve the specified aims. The system effectiveness for the mentioned eGovernment projects was given due importance and executed as per the goals.

9.1.5. Requirements

The factors in this main theme are:

- **Quality**

The quality of the project is directly dependent on the quality of the requirements. The quality for all mentioned projects was im-

proved at every stage of development, so that an effective and proper SDP could be generated for achieving the success.

9.1.6.   Organization

The factors in this main theme are as follows:

- **Competency**

The competence of the organization defines some evident characteristics that improve the value and enable the efficiency of the company/organization. The eGovernment projects were assigned to competent vendors, those having a high-profile and experienced team.

- **Infrastructure**

The concept of vendor organization's infrastructure played a vital role in the assignment of these eGovernment projects. Therefore, it is considered as a significant factor for better definition of the SDP and ultimately for the project success.

The subjective importance of the themes in the respective projects are also identified in order to build a strong foundation of the reference framework. None of the identified factors have been considered less important, therefore, each of them is critical for SDP definition of the eGovernment projects. This is shown in Table 7.

Figure 2.Reference Framework (Main and sub-themes for situational factors)

9.2. Summary

The observations made in the interviews led to the development of a broad reference framework for eGovernment projects, in iden-tifying the contextual factors and tailoring the SDP. The framework consists of a set of six main categories, seventeen sub-categories of contextual factors that influence the SDP definition in the eGovernment projects. These categories were formed by organizing 52

individual contextual factors that were identified.

10. Discussion

Currently, there is a scarcity of research that has observed the situational context and factors important for SPT of eGovernment project, and to our knowledge, none of the studies have given emphasis on the eGovernment project context and its software process. As the awareness of software process tailoring is increasing, it is vital to understand the situational factors affecting the selection of software process for eGovernment projects, in particular. The results provide us with a base for considering the factors that are important for process selection in eGovernment and to increase success rate, that is the reference framework. The factors which primarily influence the selection of the process are identified. The analysis led to the set of six main categories of situational factors which has strong influence on the SDP in eGovernment projects. These categories were formed on the basis of seventeen sub-categories, and by classifying 52 factors.

It is believed that the reference framework provided here for eGovernment projects is the complete reference framework of the factors that have an impact on software development process of eGovernment projects. Therefore, this framework is significantly valuable for practitioners and researchers. The researchers can easily access a complete, broad and systematically established initial framework, consisting of major situational factors, that can be used as the reference agenda for selecting the software processes. It is a significant reference for researchers in the eGovernment development domain in general, and in the eGovernment software development process and its definition particularly. The vital aspects of the eGovernment development settings should be outlined properly. This primary reference framework that has been developed can be consulted by the practitioners to understand the list of important determinants of the eGovernment software development process, and to improve the practice of software process selection and tailoring. The managers in the domain can examine a number of subjects while making software development process decisions, such as team size, number of stakeholders, and requirements stability.

As a result, the provided initial framework is a quite beneficial reference checklist for eGovernment practitioners when defining and selecting the software development processes for the project. Additionally, the initial reference framework can help when examining the extent of the contextual changes within the eGovernment project settings, and to improve their software development process resulting in a context-oriented development process

Table 1: Main Theme "Personnel"

Sub-theme	Code(Factor)	Significant Statement Example	Implication
Team	Size	"Team size determines the iterations that are required. It is one of the key criteria when selecting a software process"	The team size is an indicator for the effort of team coordination. The smaller teams located in a single room can directly communicate the need for formalization.
	Distribution	"When it comes to effective negotiation, the distribution of team matters a lot. I am not sure about other organizations but team distribution is quite significant in our project"	Team distribution influences the interaction pattern in a project. Teams located in a single room can directly communicate while distributed teams need a more formalized communication.
	Turnover	"Turnover is an important element in success definition. Our personnel turnover was low, therefore we were able to get the result that continuity of technical excellence and know-how was high"	When any important team member leaves the team, the important knowledge will be lost. Additionally, the entrance of a new member will affect the project as well.
	Experience	"The experience possessed by our team and managers was one of the most defining factor for this project's success"	It is very important to be skilled enough to perform tasks properly.
	Previous Cooperation	"The cooperation which had been established previously among teams facilitated us a lot"	If the team have worked together in some previous projects, the familiarity can ease the team members communication.
	Good Cooperation	"There was a healthy and good cooperation in our team which was a facilitator for this project"	If the team works in a good and collaborative way the rate of issues can decrease.
	Domain Knowledge	"It is necessary for teams to familiarize themselves with the domain and have sufficient knowledge"	Little or missing knowledge w.r.t. the actual domain is a risk
	Tool Knowledge	"The development team must have the knowledge of necessary tools"	Little or missing knowledge w.r.t. the actual tools is a risk
	Technology Knowledge	"The team should be familiar with the technology used in the project. It was another important factor for our success"	Little or missing knowledge w.r.t. the technology is a risk
	Process Knowledge	"I would say that the process knowledge is very important for productivity in teams, as it enhances their efficiency and confidence to work"	Little or missing knowledge w.r.t. the process to be used is a risk

Table 2A: Main Theme "Internal Factors"

Sub-theme	Code(Factor)	Significant Statement Example	Implication
Development	Prototyping	"Prototyping does affect the project and its deliverables"	The prototypes is a useful strategy to mitigate risks and to improve performance.
Management	Management availability	"In critical project settings, a missing top management availability is a risk"	Top management is always required for problems solving and to make project important decisions.
	Management commitment	"There must be proper commitment by the management at each stage"	If the management representatives are committed, the risks are reduced abundantly.
	Management support	"It is important to have the management's support in critical situations"	The top management should actively support a project.
Project Parameters	Clear project proposal	"The foremost thing for any project is to have a clear project proposal, as it contains basic goals and requirements essential for the project's success"	A clear project proposal is an essential artifact. A blurry proposal is always a challenge.
	Project budget	"Project budget highly influences the degree of formalism in a project"	Project budget defines the level of effectiveness in a project. It requires a strict controlling w.r.t. costs.
	Project duration	"The correct selection of a software process needs to pay attention to the project duration"	The project duration is a factor directly influencing the software process.
	Project type	"The project type defined multiple facets of our software process e.g., requirements elicitation, planning, etc. Therefore, project type is a factor that needs emphasis"	The type of the software project influences the software process's structures in general.
	Project role	"The project role needs to be considered for proper planning and execution of project. In our PMIS project, project role played vital role for process"	The software development process is influenced by the project role, as it characterizes a particular project from other projects.

Table 2B: Main Theme "Internal Factors"

Sub-theme	Code(Factor)	Significant Statement Example	Implication
Project Parameters	Project Artifacts	"There is an increased need for documented project arte-facts for process descriptions and proper process selec-tion"	If there is no documentation for the project under development, higher efforts are re-quired to analyze the project.
	Project Size	"Size of project is the most important factor to consider while planning"	If the project size is not evaluated properly, the rate of risks increases.
	Feasibility Study/ Kick-off Meet-ing	"The kick-off plan/feasibility study provide a clear path for software process and project execution. It provided us with consistency as well"	The feasibility study has a great influence on the project success.
Communication	Stakeholders' collabora-tion/involvement	"The stakeholder involvement/collaboration in this project was quite beneficial for us, but sometimes excess of involvement becomes tiresome"	The involvement of required stakeholders and collaboration among them is an integral suc-cess factor.
Operation	Financial controlling	"The emphasis on a financial controlling is important if a project is critical w.r.t. the project budget. In our case, it was a success contributing factor"	Proper financial controlling can help in a con-trolled project planning, decision making and execution.
Process	Measurement	"The measurement of software development process elements provide the management with status informa-tion, to measure the project's performance and to control the project's efforts"	Measurement using KPIs is important for any project's success.
Technology	Technical support	"A known technical environment with proper support is essential to reduce project risks and failures"	The lack of technical support may cause straight failure of project.
	Tool infrastructure	"The definition of a proper tool infrastructure for a project gives required information w.r.t tools and tech-nology before start of the project. It helps to make re-quired arrangements for tools accordingly"	The tools that are to be used must be defined in time.

Table 3: Main Theme "External Factors"

Sub-theme	Code (Factor)	Significant Statement Example	Implication
Business	Legal aspects	"eGovernment projects are really critical in terms of legal aspects. In case of not delivering the ordered software in time or not as per the desired functionality, alternative claims from government side occur. Furthermore, laws and regulations play important role for formal project software process"	The legal aspects for the project needs to be considered and followed.
	Type of contract	"I think the software development process is highly influenced by the contract type. It leads to multiple strategies to handle customer requests"	The type of the contract has huge influence on the selection of the software development process.
Stakeholders	Number of Stakeholders	"The organization must pay attention to the number of stakeholders by defining suitable communication and reporting pattern in order to get a desired and defined software development process"	Number of stakeholders should be known in advance in order to negotiate effectively.
	Organization's Stakeholder availability	"The availability of stakeholders who are part of organization is a success factor. The absence of stakeholder availability can cause delays"	The concerned stakeholders must be available whenever required. It plays vital role in project success.
	Stakeholder background	"The stakeholder background played vital role for important decision making in this project"	The background of the stakeholder is also important to be known for proper process definition.
	Client process	"Sometimes, the clients have their own software process and wants us to use that, in that case we need to plan such a process that can be aligned with their process and requirements. It is also an important factor for process selection"	The software development process selection is also influenced by the process option given by the client.
	Client availability	"I have learnt that the client's availability has a direct influence on the customer satisfaction. We have achieved in this project as planned due to the availability of client whenever needed"	The software development process selection is influenced by the availability of client.
Skills and Knowledge	Trainings	"There should be proper training sessions to get an efficient workforce. It can be done through open discussions and frequent meetings and workshops. Trainings are important to define the software development process for projects in all fields"	The proper trainings are an integral component of success in any discipline.

Table 4: Main Theme "Objectives"

Sub-theme	Code (Factor)	Significant Statement Example	Implication
Application	Complexity	"The complexity of this project was assessed quite thoroughly in the kickoff meeting, so that we do not miss anything important. Such thorough analysis helped us a lot in process selection"	The application complexity directly influences the software development process.
	Degree of innovation	"If the degree of innovation and novelty is known, the rate of risks in process definition can be reduced"	The innovation degree has great influence on a more controlled software process definition.
	Domain	"The system domain needs to be known for process tailoring, as it guides about the required standards, norms, and values that need to be considered in a project"	An adequate software development process can be selected if the application domain is analyzed properly
Compliance	Safety & Security	"A well defined software process for a project cannot be created without the key features of safety & security. I can say this with assurity that this factor was one of the vital ones in our project"	The characteristics of security and safety must be given due importance for success.
	System integration test	"All the requirements for integration must be known and incorporated in the process in order to define it correctly"	The system integration testing is also a vital activity for project and process success.
System Effectiveness	User Interface	"Yes, the user interface is very important. It need to be defined as it directly influence the success of eGovernment projects"	The user interface is an essential part of a project, and is equally important for software process.
	Customer Satisfaction	"Customer satisfaction is very crucial in creating a long-term association with the customers. It increases trust level"	The customer satisfaction is the fulcrum of project's success.

Table 5: Main Theme "Requirements"

Sub-theme	Code (Factor)	Significant Statement Example	Implication
Quality	Requirements stability	"The eGovernment projects can only be delivered successfully, if we consider requirements stability and make plan accordingly. It is because the requirements' characteristics directly influences the entire process"	There is huge risk if the requirements are not stable.
	Requirements flexibility	"There must be proper flexibility in requirements, as it has influence on the entire project"	There is huge risk if the requirements are not flexible.
	Requirements rigidity	"The rigidity in requirements should be minimum. So that the process and project progress does not gets hindered, if any change is required"	There is huge risk if the requirements are rigid.
	Requirements changeability	"The requirement changes that are performed effectively impact the complete project positively. I am saying this, as I have experienced it"	There is huge risk if the requirements change very frequently.
	Requirements standard	"The standard requirements are among the most positively contributing factor for process selection and project success"	There must be standard requirements.

Table 6: Main Theme "Organization"

Sub-theme	Code/Factor	Significant Statement Example	Implication
Competency	Maturity	"The organization should be mature enough to negotiate with the customers technically. Such maturity of organization matters a lot for customer and increases trust level"	The maturity of an organization matters a lot for increasing trust level.
	Stability	"The stability of an organization is a key factor to be considered by customers. eGovernment projects are so critical that these cannot be given to any disturbed company. A stable organization are therefore be promoted and considered by customers"	A stable organization can deliver better and productive results.
Infrastructure	Structure	"An increased levels of success have been witnessed where organizations maintain their structures"	The organizational structure matters a lot for projects in public sector.
	Facilities	"The facilities that are provided by the organization to its employees affect their efficiency. Therefore, we can say that the facilities provided by the organization are important for better performance and successful development"	An organization should provide proper facilities to its employees, if success is to be achieved.
	Size	"Yes, the size of an organization is also an important factor to be considered for process definition and project success"	The size of the organization matters a lot.

Table 7: Contextual factors within the projects

Theme	Factor	Frequency1/30	Saliency2		
			SBIS	PMIS	ePolice
Team	Size	25	High	High	High
	Distribution	15	Moderate	High	Moderate
	Turnover	18	High	Moderate	Moderate
	Experience	30	High	High	High
	Previous Cooperation	15	Moderate	Moderate	High
	Good Cooperation	20	Moderate	Moderate	Moderate
	Domain Knowledge	30	High	High	High
	Tool Knowledge	22	Moderate	Moderate	Moderate
	Technology Knowledge	27	High	High	High
	Process Knowledge	30	High	High	High
Development	Prototyping	22	Moderate	Moderate	High
Management	Management availability	25	High	High	High
	Management commitment	30	High	High	High
	Management support	30	High	High	High
Project Parameters	Clear project proposal	30	High	High	High
	Project budget	25	High	High	High
	Project duration	20	Moderate	Moderate	Moderate
	Project type	15	Moderate	Moderate	Moderate
	Project role	15	Moderate	Moderate	Moderate
	Project Artifacts	25	Moderate	High	Moderate
	Project Size	20	Moderate	Moderate	Moderate
	Feasibility Study/ Kick-off Meeting	28	High	High	High
Communication	Stakeholders' collaboration/involvement	20	Moderate	Moderate	Moderate
Operation	Financial controlling	23	High	High	Moderate
Process	Measurement	25	Moderate	High	Moderate
Technology	Technical support	30	High	High	High
	Tool infrastructure	26	High	High	High
Business	Legal aspects	18	Moderate	Moderate	Moderate
	Type of contract	20	High	Moderate	Moderate
Stakeholders	Number of Stakeholders	17	High	High	High

	Organization's Stakeholder availability	18		High	High	High
	Stakeholder background	15		High	High	High
	Client process	20		Moderate	Moderate	Moderate
	Client availability	25		Moderate	Moderate	High
Skills and Knowledge	Trainings	30		High	Moderate	High
Application	Complexity		18	Moderate	Moderate	Moderate
	Degree of innovation		27	High	High	High
	Domain		26	Moderate	Moderate	Moderate
Compliance	Safety & Security	30		High	High	High
	System integration test		23	Moderate	Moderate	Moderate
System Effectiveness	User Interface	27		Moderate	Moderate	Moderate
	Customer Satisfaction		30	High	High	High
Quality	Requirements stability	20		Moderate	Moderate	Moderate
	Requirements flexibility		24	Moderate	Moderate	Moderate
	Requirements rigidity		18	High	High	High
	Requirements changeability		30	Moderate	Moderate	Moderate
	Requirements standard		30	High	Moderate	Moderate
Competency	Maturity	30		High	High	High
	Stability		28	Moderate	Moderate	Moderate
Infrastructure	Structure	25		Moderate	Moderate	Moderate
	Facilities		20	High	Moderate	Moderate
	Size		26	Moderate	Moderate	Moderate

1 The number of participants who identified the theme.
2 The subjective importance of the theme, assigned on the basis of the researcher's perceptions of how important, or salient, the theme is for eGovernment project and its process.

11. Conclusion and Future Work

The context of the software development is an important aspect to be understood, and researchers believe that context is vital for any project in order to identify the appropriate software development process. The eGovernment software projects have gained much attention worldwide, however, the software development process definition is still unaddressed in the domain, as there is no organized reference framework to understand the context of software development process for eGovernment projects, and the factors that affect the process. The lack of such a framework creates a major problem to find key features of eGovernment development setting, and weakens the ability to understand the context. Such scenario may cause failure in defining and selecting the appropriate software development process for eGovernment projects In order to address this issue, he initial reference framework has been developed to facilitate the eGovernment software development process selection, which has significant implications for research and practice. The critical situational factors for software development process tailoring and selection have been identified that construct the eGovernment software process context, in order to form the framework. The objective of developing a framework is fulfilled consisting of six main categories for software development process selection, seventeen sub-categories and fifty two factors that define the context of the software process for eGovernment projects. As per the empirical investigation, all the identified factors play major role in process selection. Hence, the significance and necessity of the context-oriented software development process for eGovernment project(s) has been justified with the framework.
The future work consists of applying the reference framework for a new eGovernment project, and investigating the results and implications the framework have on the project. It would be providing support to this study. In addition, such investigation will increase the validity of our contributed initial reference framework.

References

[1] Abbas.R   Khalil.S, K. . (2011). Project Management Practices in e-Government Projects: A Case Study of Electronic Government Directorate (EGD) in Pakistan. Intr J Business and Social Science.2(7): 235-243.

[2] Heeks.R. (2002). Information Systems and Developing Countries: Failure, Success, and Local Improvisations. *The Information Society*. 18(2): 101–112.

[3] Nawi.A Ibrahim.O, A. R. . (2012). Government ICT Project Failure Factors: Project Stakeholders' Views. *J RES N INNOV IN IS.* 2(1): 69-77. http://seminar.utmspace.edu.my/myaisprint/

[4] Walsham.G, S. . (2006). Research on Information Systems in Developing Countries: Current Landscape and Future Prospects. *Information Technology for Development*. 12(1): 7–24. http://www.interscience.wiley.com

[5] Anna.Y, A. T. (2005). Challenges in E-Government development: Lessons from two Information Kiosk Projects. *Government Information Quarterly Elsevier Inc.* 22(1): 58-74.

[6] Ali, A., Keung, J., Niazi, M., Hussain, S., & Ahmad, A. (2017). Systematic literature review and empirical investigation of barriers to process improvement in global software development : Client – vendor perspective, *Journal Information and Software Technology*, 87(C): 180–205.https://doi.org/10.1016/j.infsof.2017.03.006.

[7] Baharom, F., Utara, U., & Deraman, A. (2016). A SURVEY ON THE CURRENT PRACTICES OF SOFTWARE DEVELOPMENT PROCESS IN. *Journal of ICT*, 4: 57–76.

[8] Bass, J. M. (2016). Artefacts and agile method tailoring in large-scale offshore software development programmes. *Information and Software Technology*, 75: 1–16. https://doi.org/10.1016/j.infsof.2016.03.001.

[9] Bradley, E. H., Curry, L. A., & Devers, K. J. (2007). Qualitative Data Analysis for Health Services Research : Developing Taxonomy , Themes , and Theory, 1758–1772. https://doi.org/10.1111/j.1475-6773.2006.00684.x.

[10] Chevers, D. A., Mills, A. M., Duggan, E. W., Moore, S. E., Chevers, D. A., Mills, A. M., … Moore, S. E. (2017). Toward a Simplified Software Process Improvement Framework for Small Software Development Organizations for Small Software Development Organizations. *Journal of Global Information Technology Management*, *20*(2), 110–130. https://doi.org/10.1080/1097198X.2017.1321356

[11] Choudrie, J., Zamani, E. D., Umeoji, E., & Emmanuel, A. (2017). Implementing E-government in Lagos State : Understanding the impact of cultural perceptions and working practices. *Government Information Quarterly*, *34*(4), 646–657. https://doi.org/10.1016/j.giq.2017.11.004

[12] Clarke, P., & Connor, R. V. O. (2012). The situational factors that affect the software development process : Towards a comprehensive reference framework, *54*(5), 433–447.

[13] Elder, K. L., & Garman, M. R. (2008). Private versus Public sector research on software project managament: An exploratory study. *Issues in Information Systems*, *9*(2), 466–475.

[14] Clarke. P, Connor. R, Solan. D, Elger. P, Yilmaz. M, Ennis. A, Geritty. M, McGrath. S, and Treanor. R (2015) "Exploring Software Process Variation Arising from Differences in Situational Context", In: *Communications in Computer and Information Science Conference (CCIS)*, 29-42.

[15] Gregory, P., Barroca, L., Sharp, H., Deshpande, A., Taylor, K., Hall, W., & Mk, M. K. (2016). The challenges that challenge : Engaging with agile practitioners ' concerns, *77*, 92–104. https://doi.org/10.1016/j.infsof.2016.04.006

[16] Heeks, R. (2006). Implementing and Managing eGovernment. *SAGE Publications Ltd*.

[17] Editorial Board (2017). Open innovation in the public sector : A research agenda, *Government Information Quarterly*, *34*, 84–89. https://doi.org/10.1016/j.giq.2016.12.002

[18] Iqbal, J., Binti, R., Mohd, A., & Nizam, H. (2015). Software SMEs ' unofficial readiness for CMMI Ò -based software process improvement. *Software Quality Journal*. 24(4): 997-1023https://doi.org/10.1007/s11219-015-9277-3

[19] Khan, H. H., & Malik, M. N. (2017). Software Standards and Software Failures : A Review with the Perspective of Varying Situational Contexts, *EEE Access*, *99*(c), 1–14. https://doi.org/10.1109/ACCESS.2017.2738622

[20] Kruchten, P. (2013). Contextualizing agile software development, *Journal of Software: Evolution and Process*, *25*(4), 351–361. https://doi.org/10.1002/smr

[21] Larrucea, X., Connor, R. V. O., Colomo-palacios, R., & Laporte, C. Y. (2016). Software Process Improvement in Very Small Organizations. *IEEE Software*, *33*(2), 85–89.

[22] Li, M., Boehm, B. W., & Osterweil, L. J. (2006). Unifying the Software Process Spectrum. *Journal of Software*, *17*(4), 649–657. https://doi.org/10.1360/jos170649

[23] Nasir, M. H. N., & Sahibuddin, S. (2011). Critical success factors for software projects : A comparative study. *Scientific Research and Essays*, *6* (10), 2174–2186. https://doi.org/10.5897/SRE10.1171

[24] Vijayasarathy, L. R., & Butler, C. W. (2016). Choice of Software Development Methodologies. *IEEE Software*, *33*(5), 86–94.

[25] Raza, M., & Faria, J. P. (2016). A model for analyzing performance problems and root causes in the personal software process. *Journal of Software Evolution and Process*, *28*(November 2015), 254–271. https://doi.org/10.1002/smr

[26] Ridder, H. (2017). The theory contribution of case study research designs. *Business Research*, *10*(2), 281–305. https://doi.org/10.1007/s40685-017-0045-z

[27] Valle, A. M., Santos, E. A. P., & Loures, E. R. (2017). Applying process mining techniques in software process appraisals. *Information and Software Technology*, *87*, 19–31. https://doi.org/10.1016/j.infsof.2017.01.00

[28] Xu, P. and Ramesh B (2008). Tailoring to Manage Software Development Challenges, *IEEE computer Society*, 39–45.

[29] Xu, P., & Ramesh, B. (2015). Software Process Tailoring : An Empirical Investigation Software Process Tailoring : An Empirical Investigation, *Journal of Management Information System,* 24(2): 293-328. https://doi.org/10.2753/MIS0742-1222240211

[30] Yin, R. K. (2013). Applications of case study research. *Applied Social Research Methods Series*, *34*, 173. https://doi.org/10.1097/FCH.0b013e31822dda9e.