

A Pattern Language of Multi-Organizations' Collaboration at Public Sector in Developing Countries

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In developing countries, researchers have extensively discussed the importance of collaborative efforts between public organizations. For outsourcing projects to be delivered successfully, collaboration is seen as a vital business trait. It involves two stages: the first stage involves the development of a collective identity through discursive practices, the second stage consists of translating the conversations into synergistic action. Shared resources, expertise, and lessons learned could be a good practice for governments, particularly in developing nations. Several public organizations are assigned individual tasks and responsibilities in different sectors. Collaboration with other public organizations has been facilitated by sharing infrastructure, public data ¹, consultations, computer networks, lessons learned, and training employees of other public organizations. Multi-organizations' collaboration continues to face a number of challenges, including coordination between public organizations, security, privacy, responsibilities, government rules and regulations, and tasks allocation. Specifically, this study provides a comprehensive collaboration between public organizations to share existing resources with other public organizations. During this study, we attempt to discover some newly observed organizational patterns. We interlink them into a language that can assist both researchers and practitioners in understanding how to convince public organizations to collaborate.

CCS Concepts: • **Software and its engineering** → **Patterns**.

Additional Key Words and Phrases: Software Development, Collaboration, Software Engineering, Public Sector, Developing Countries, Organizational Patterns

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¹Public data means that some information about people should not be considered private. Public data can be a person's first name, last name, iris, biometric, blood group, education, nationality, etc. Such information is needed by several public organizations such as the passport department, national ID distribution department, statistics department, and so on.

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1 INTRODUCTION

Several public organizations in developing and least developed countries don't have the necessary infrastructure, funds, capacities, data, networks, and other resources. Despite this, all public organizations work towards common goals that usually serve their citizens. Thus, public organizations can collaborate, share infrastructure, and other resources to overcome the challenges that some other organizations are facing. Increasingly, multi-organizational collaboration has become an effective method of achieving more than any organization can achieve alone[4].

However, there is the possibility of significant conflict when these organizations pursue considerably different objectives. In some cases, all parties recognize that the conflict is dysfunctional, and they wish to change their relationships in these situations. Since the process of collaboration is not straightforward, they are uncertain of the most effective methods for achieving this goal. The existing literature indicates that collaboration is challenging [4, 15] and is frequently unsuccessful. This way, the focus is on the methods to facilitate collaboration among public organizations through organizational patterns.

Patterns are recurring structures that solve actual problems within a context [5], which date from the late 70's [1, 2]. A pattern illustrates a recurring problem-solving process with an explanation that ties them together within a given context. Patterns are available in every organization and field for achieving certain goals.

Patterns are neither newly discovered phenomena nor created by humans, but humans are pattern recognisers, and these patterns already exist. Thus, there are still problems selecting a model that is appropriate for a particular existing problem [3, 7]. A pattern can be selected using a variety of methods, one of which is to follow patterns in a pattern language. This includes patterns and a set of rules for assembling those patterns in a meaningful sequence [5]. Several patterns are combined into a pattern language to describe how to design a whole solution. It is imperative that we fully understand the pattern itself and its pattern language so we can operate a suitable organizational pattern and perform better [12, 13].

2 THE DEVELOPMENT OF THE ELECTRONIC NATIONAL IDENTITY DOCUMENT SYSTEM

A question arises, where do the patterns come from?

Here, we briefly discuss the platform from which the newly discovered patterns were extracted based on our observation and experience. The platform is an outsourced electronic National Identity Document (eNID) system that involves several public organizations. The involved public organizations were trying to achieve the common goals of the same project. The same experience and lessons learned might be helpful for all types of projects or platforms where collaboration is required between several public organizations.

The outsourced project (the whole solution) was considered a case study based on personal experience and observations as a project manager of the eNID project. Our eNID technical team worked on the project for almost a decade, the rest of roles are illustrated by (Figure 1). The eNID team was located in the Ministry of Communications and IT (MCIT) of Afghanistan. The main contractor's headquarter was located in UAE with several scattered subcontractors worldwide. MCIT had only direct communication with the main contractor remotely. During the process of implementing the project, several advantages and disadvantages were observed. It was a national project based on electronic government in Afghanistan. The ministry of communications and IT (the public sector) was the project owner. The main contractor was from the private sector, Firm ABC (*fake name due to privacy*). Firm ABC had several joint ventures, subcontractors, and sub-subcontractors worldwide. The eNID project was not only software development, but it was a whole solution outsourcing.

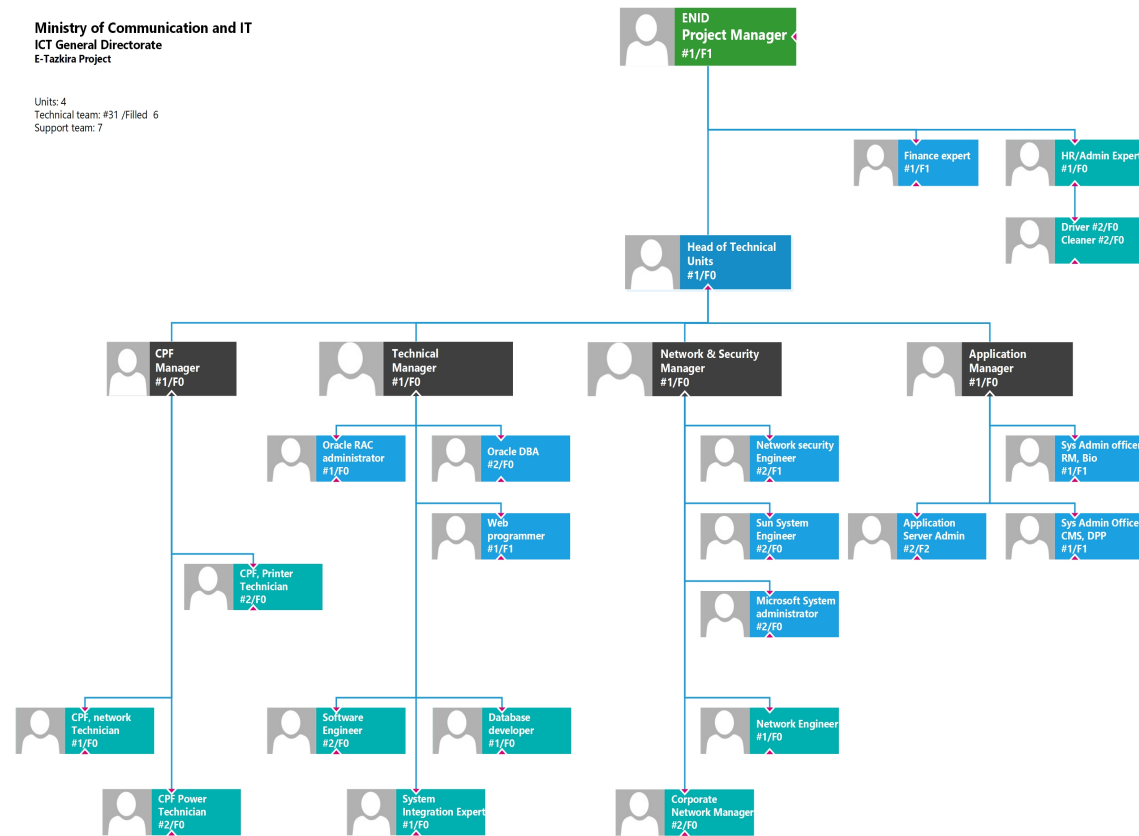


Fig. 1. Organigram of eNID Project.

The project had many modules such as Resident Management (RM) or eTazkira, Driving License (DL), Vehicle Registration (VR), Public Key Infrastructure (PKI), bio-metrics, interconnection (interconn), infrastructure development, point-to-point network building, maintenance, support, capacity building, etc. A *module* in this paper means a business module or a particular independent activity. It is neither considered a specific phase in the software development life cycle, nor a part of software development.

Figure 2 illustrates some common problems observed during the eNID project. The common challenges are listed as follows. There were several layers of subcontracts involving the main contractor and subcontractors. In the contract document, there were several issues: 1. the SLAs that the service provider was required to follow were not mentioned; 2. penalties were not mentioned when the contractor failed to deliver the promised deliverable; 3. ownership of the source code was not specified to be transferred to the project owner; 4. the payments process method was based on time instead of deliverables; and 5. there were no explicit provisions to address any conflict between the project owner and the contractor. Hierarchical communication and coordination among involved parties always took a long time. Such hierarchical communication has caused a delay in deliverables.

Conversely, several best practices were experienced during and after the handover process:

The contract document was amended three times, and the required terms and conditions were added to the contract

document. A circular, technology-mediated, inter-organizational communication platform with simultaneous communication capability was proposed. As a result, if the business modules are independent and their integration and management are not a challenge, we recommend multi-sourcing the modules to expert vendors rather than dealing with sub-subcontractors. To overcome or at least reduce the mentioned challenges, an appropriate language based on organizational patterns is proposed.

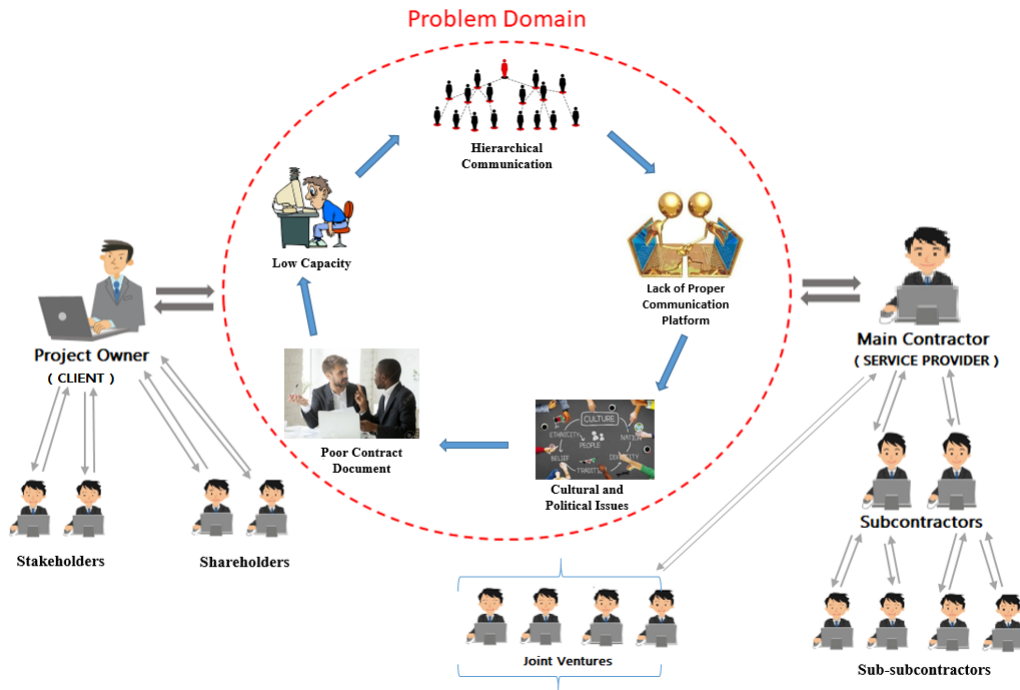


Fig. 2. Common problems observed during the case study.

3 THE PATTERNS

This paper documents seven patterns (*highlighted in blue in Figure 3*) of the multi-agent collaboration system outsourcing in the public sector of developing countries. We have observed these patterns in practice during the last decade while we were engaged with a system outsourced project by public sector to the private sector in Afghanistan. Iterative, creative, and recurring structures and best practices were being taken into consideration while documenting the mentioned patterns [4–6, 8, 9, 15].

Further, we studied the current literature, analyzed documentation, and interviewed experts and researchers. We collected the most appropriate, relevant, and accurate information and recurring structures in the public sector system outsourcing projects of developing countries where multiple stakeholders were involved, as many research studies confirm the issue in recent literature [4–6, 8, 9, 15].

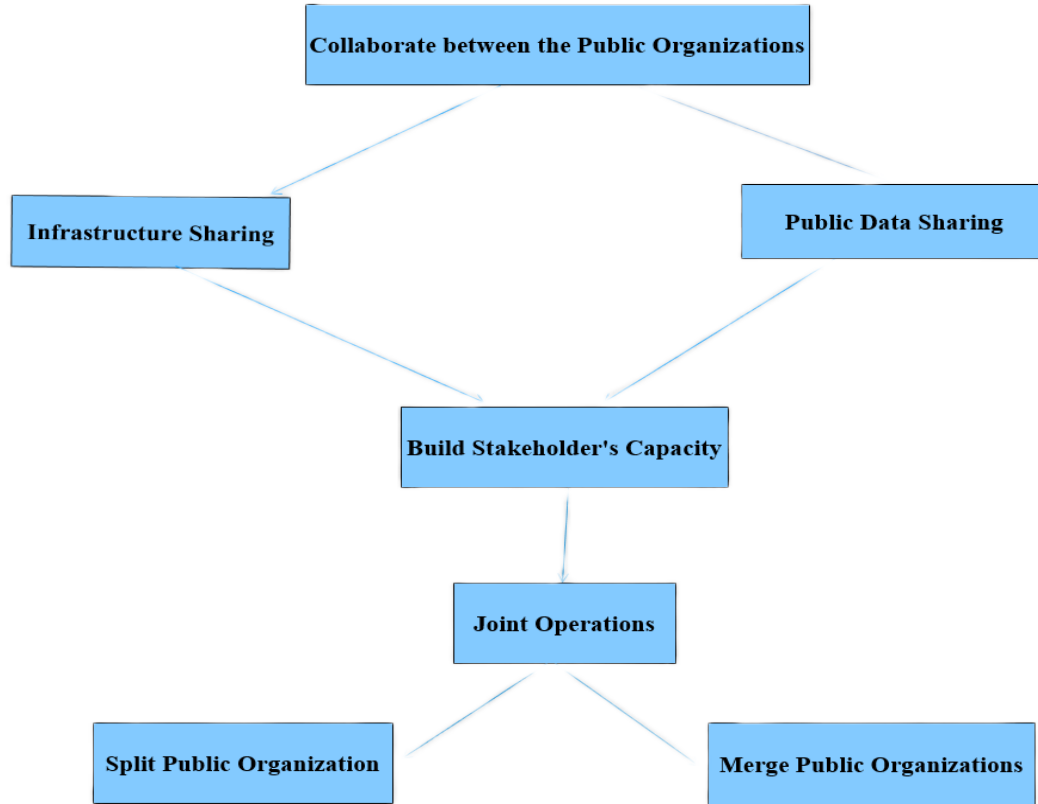


Fig. 3. Organizational Patterns of Multi-Organizations' Collaboration at Public Sector.

3.1 Story behind the Patterns

It is worthwhile to examine the patterns in real-world practice before documenting them. We will tell the readers a short story about MCIT, an Afghan public organization. MCIT was the eNID project owner, and had an outsourcing agreement with the private sector firm ABC, an international IT vendor company with its headquarters in the United Arab Emirates. There is a fake name in the story (*for privacy reasons*), but the rest of the story is true. The corresponding organizational patterns are highlighted in parentheses in the story.

MCIT was facing a shortage of software developers and required resources. It was not just software development, but all of the components of the solution, including third-party software development, network expansion, and hardware procurement. Beside MCIT, there were several other public organizations involved in the eNID project, as was explained in Section 2. The rest of the public organizations were contacting MCIT, and MCIT was the only communication bridge to the main contractor, firm ABC. All the public organizations were dealing with one or few business modules of the eNID project, and it was required to fulfill all the assigned tasks on time to successfully complete the project. Unfortunately, some public organizations lacked of the required resources such as the infrastructure, internet, data, and the required budget. Finally, it was decided to have a collaboration between the involved public organizations (*Collaboration between the Public Organizations, Section 4*), share the existing infrastructure (*Infrastructure Sharing*,

Section 5), and all other resources such as (*Public Data Sharing, Section 6*) with the other involved public organizations to make the project successful.

A stakeholder of MCIT ACCRA was responsible for distributing the eTazkira and resident management system.

It was required to have an expert and well-trained technical team inside ACCRA, but ACCRA was faced with a lack of the required budget for capacity building and training.

MCIT provided a chance for ACCRA's personnel to get trained for the project's success.

Therefore, MCIT added a module of Training and Capacity Building (TCB) to the contract with the firm ABC and provided a chance for enhancing the stakeholder's capacity (*Build Stakeholder's Capacity, Section 7*).

While the system was successfully developed by the contractor firm ABC and was handed over to the project owner MCIT, the technical team of MCIT was entirely unfamiliar with the system to run the system as required. Firm ABC was required to jointly run the system with MCIT Technical team for at least six months (*Joint Operation, Section 8*). Furthermore, ACCRA organization was split into two entities, eNID and ACCRA (*Split Public Organization, Section 9*). eNID was responsible only for distributing and issuing the eNID cards and the ACCRA organization was responsible for civil registration and birth certificates. As was explained in the previous section that several public organizations were involved in eNID project, and sometimes the cooperation and coordination between the organizations was a challenging task, therefore the government decided to merge eNID department of MCIT, CSO and eNID department of ACCRA to have a single infrastructure and management (*Merge Public Organizations, Section 10*).

3.2 Pattern Format

We expressed the patterns (Sections 4 - 10) in Coplien and Harrison's pattern format [5] with the conflict of the most prominent contradicting forces expressed in the *but* form proposed by Vranić and Vranić [17].

This is the format:

<Pattern Name>

... the context in which the pattern occurs.



The text in bold describes the actual problem as a conflict of the two most prominent contradicting forces.

Therefore:

Here, the text in bold describes the solution.

– An optional part with resulting consequences upon applying the given pattern.



– Optional description to explain the pattern.

4 COLLABORATE BETWEEN THE PUBLIC ORGANIZATIONS

... public organizations in developing countries typically don't have all the required resources. It is neither feasible nor efficient to provide better services with insufficient resources. Improving coordination and enhancing collaboration between public agencies sharing their existing resources is necessary.



Often public organizations tends to provide better services to their civilians, but some of them do not have the required collaboration and coordination.

Generally the public organizations prefer to provide better services to the civilians, but often of them don't have proper cooperation with each other.

Several public organizations work for almost similar goals or work for different modules of a common whole project, but they do not have collaboration with each other.

Therefore:

Build a cooperation and collaboration board composed of the relevant or similar public organizations. Share the upcoming development plans with each other. Look for the possible collaboration and cooperation such as infrastructure sharing, data and best practices sharing, etc.

5 INFRASTRUCTURE SHARING

... a public organization has a well-equipped infrastructure. All the stuff is available, such as the network, the required hardware, software, funds, and interconnection. The other organizations involved also need the same infrastructure to achieve the common goal. However, the other organization lacks such an infrastructure.



In general, all public organizations tend to provide services to civilians. A public organization owns the required infrastructure. Other public organizations involved in the project also require the same infrastructure, but the other organization lacks it. One of the public organizations, such as the project owner owns the required infrastructure, but the rest of the public organizations involved (stakeholders) do not have the same required infrastructure.

The stakeholders prefer to have such a separate infrastructure for their internal usage, but they do not have a sufficient budget. It is financially neither feasible nor efficient to buy such infrastructure due to limited or a lack of financial resources.

The stakeholders try to use the project owner's infrastructure, but they are not allowed.

Therefore:

Share the existing infrastructure with the other public entities. Edit the existing policy, strategy or law; if there is a need to edit. As a result, the whole project will succeed, and there will be an opportunity to provide better services to civilians.

6 PUBLIC DATA SHARING

... few public organizations deal in similar biographic, demographic, and other types of data. It is neither feasible nor efficient for public organizations nor their customers or stakeholders to store such data in several locations.



Each organization prefer to get the first hand data and store it their own, but it is quite challenging for customers and the public organizations to issue biometrics, iris, and other public data several times to each organization. Furthermore, it is difficult for public organizations as well to store redundant information that may cause mistakes in information modification and storage in several locations.

Each organization prefers to have its data, but several public organizations don't contain their data, while often public organizations provide services to civilians.

It is better to save data in several locations, but redundant information can lead to some data centers not updating certain information.

Stakeholders prefer to provide their information if some public organization requires it, but they are fed up with giving the same information to several different public organizations.

Therefore:

Share public data with other public organizations. All the involved public organizations will have similar access to a same data bank. Additionally, edition and deletion in a single location will be easier to all public entities. Furthermore, it will be also easier for the civilians to provide biometric and demographic data only once.

Since terrorist activity and other illegal activities must be monitored and dealt with, information sharing between government agencies has increased substantially. Besides law enforcement, health care, public education, economic development, and geographical information are included [6].

A hierarchy of administration has been used primarily by Chinese government agencies. Different functional agencies have implemented silos that manage information resources independently of one another. Currently, most government agencies in China have set up their information systems, but information sharing has been restricted to vertical functions due to several factors. Information isolation has resulted from this [6].

Through Government Information Sharing (GIS), public departments and agencies can share and integrate information between public and private institutions. By sharing information, companies can become more efficient, avoid duplication of processes, update the same data, improve the quality of their services and procedures, remove inconsistent data, reduce errors, and increase transparency[9].

7 BUILD STAKEHOLDER'S CAPACITY

... few public organizations work on the same single project to achieve the same goal together. One organization is the project owner and has enough funds and other resources for the project. The same organization also provides technical support for the other organizations involved. One or a few other key organisations do not have enough funds for their technical team to build their capacity. In addition, their current technical employees are not able to perform their relevant tasks as required. Finally, the project owner adds a module with the name of (stakeholder's capacity) to the project's contract.



Each public organization builds capacity for their own staff. The stakeholder that works with the project owner on the same project and for the same goals lacks the funding to build up the capacity of its own personnel.

Beneficiary or stakeholder organizations strive to perform their relevant tasks. But their staff do not have the required skills.

The stakeholder wants to build their staff's capacity. But the stakeholder does not have the required budget.

The stakeholder is eager to participate in the training package designed for the project owner's staff. But, it is not mentioned in the contract, and their staff are not allowed to participate.

Therefore:

Build the capacity of other public organizations (the stakeholders) who require it. When the stakeholder does not have specific funds but still aims to achieve the same objective as the project owner. In result, it will have a positive impact on the whole project towards success.

8 JOINT OPERATIONS

. . . the vendor (service provider) has just completed the outsourced system. It was submitted to the project owner (client). It was deployed and installed. The system is fully operational, and it is ready to be used. However, the technical team of the client organization is unfamiliar and unsure of how to operate it alone.



The technical team of the client organization is eager to run the entire solution alone, and build their own capabilities. But due to various reasons, such as required skills, lack of the necessary roles for all modules, unfamiliarity with the newly developed system, it is challenging to run the newly developed system alone.

The system was developed, deployed and installed. It is ready for operation, but the technical team is unfamiliar with the system, and might not be able to run the entire solution alone.

Several modules exist and several roles are required to run the system, but the current small technical team is not sufficient, and recruiting new staff will take a long time. Furthermore, it might not be financially feasible for all public organizations to have such a big team.

If there are errors or bugs in the system, they should be corrected immediately. But the system is vendor-locked and the technical team does not have access to the source code.

Therefore:

Sign a joint operation contract with the vendor company that developed the system. The contract duration should be at least six months. Drive the system jointly with the vendor company for the mentioned period. Meanwhile, the local technical team will learn how to run the system independently in the future. Additionally, they will learn how to solve any technical issues that may arise in the future. The technical team will learn to handle it on their own.

9 SPLIT PUBLIC ORGANIZATION

. . . two or more goals in different sectors are being pursued simultaneously by a single public organization in developing countries. Public organizations should be divided according to their goals, mandates, and sectors to improve the performance and quality of deliverables in the specified period..



A single public organization deals with two or more different goals in different areas and sectors, but achieving the deliverables on time with better quality is challenging.

A public organization may achieve two or more different goals in different areas, but attaining the best result and providing better services to civilians is challenging.

A public organization may achieve two or more different goals in different sectors, but achieving the deliverables on time is challenging.

Therefore:

Divide the public organization into two or more distinct public organizations based on their area of work and sector so they can concentrate on their tasks and responsibilities and achieve better results within the given timeline.

10 MERGE PUBLIC ORGANIZATIONS

. . . several public organizations pursue similar tasks achieving a few goals in different areas and sectors in developing countries. Often, there is interference in their work scope, authority, and responsibilities. Therefore, coordinating, communicating, and bureaucratic activities between public organizations take longer.



Several public organizations perform similar duties, but the interference between work scope, communication, authority, and responsibilities is problematic.

Several public organizations should work on similar tasks, but the overlap in their work scope is challenging.

It seems easier for several organizations to work on similar tasks, but communication, coordination, and eliminating redundancy in deliverables are difficult.

Several public organizations may provide better similar services to civilians, but taking responsibility is problematic in such a shared platform.

Therefore:

Merge the relevant public organizations into a single organization that performs similar tasks and aims to achieve common goals.

11 RELATED WORK

In public organizations, collaboration is considered challenging to cultivate, even though it is an essential component of delivering successful project outcomes. A research identified five dimensions as an antecedent for collaboration: shared direction, collective action, the competence of the members, power distribution/equality, trust, and communication [8].

However, the study identified five factors that could adversely affect public project collaboration. 1) Consultant fees that are restrictive, often the result of competitive fee tendering. Occasionally, team members have unrealistic expectations, driven by their national/regional political agendas and/or their perceptions/actual deceptions. Client organization bureaucracy, resulting from an excess of stakeholders, and inefficient processes. Nevertheless, the study identified five potential challenges to collaboration in public projects organizations, including tight consultant fees that can result from competitive fee tendering. 1) Unrealistic expectations among team members, sometimes driven by national/regional political agendas and/or perceived/actual deception among team members. A disproportionate number of stakeholders and inefficiencies in the client organization create bureaucracy. 4) The focus on control is driven by the need for concentrated power. 5) Formal protocols to facilitate communication are assumed necessary to counter uncertainty and opportunistic behavior[8].

In a paper written by Yiannis Verginadis et al., Collaboration Patterns and event-driven architectures are discussed in relation to the challenges of virtual organizations. Ad-hoc environments cannot always be defined explicitly in advance. They also contain a number of cooperating nodes that are geographically distributed, posing technological challenges in order to support collaborations as well as coordinate their activities [16].

It has been mainly used to model and implement inter-organizational business processes using patterns within the domain of cross-organizational collaboration. Several patterns have been investigated in the areas of control flows [14], data flow [10], and resources [11], patterns were developed to support inter-organizational collaboration. Our work, however, is different from cross-organizational business process management. We focus on the use of patterns as a joint operations platform between several public organizations work to achieve similar goals.

12 CONCLUSION AND FURTHER WORK

Despite enormous efforts in collaboration between public organizations, currently, existing solutions do not seem to be sufficient. Rather than form coherent pattern languages for collaboration among the public organizations, infrastructure sharing, data sharing, joint operations, and stakeholders' capacity that address operational issues among different entities are fragmented into individual patterns. Another issue is their geographical distance, lack of rules and regulations, authorities, responsibilities, and ownership of resources.

The recovery of patterns in their existing format and structure is challenging. Similarly, section 3 illustrates the significance of the domain specialization of organizational patterns. The section illustrates this by documenting seven newly identified organizational patterns for cooperation, collaboration and better communication between the involved public organizations in developing countries. These patterns were observed and extracted from the mentioned study.

While enormous efforts have been put into managing shared or common joint tasks performed by several public organizations, there is not a satisfactory solution. These findings and lessons learned in this study address methods of improving communication between organizations, cooperation, and collaboration through organizational patterns and pattern language. We relate them to other well-known best practices, establishing a framework for the joint working platform of all involved organizations. This study further contributes by embracing and applying cutting-edge techniques of information retrieval to further enhance the accessibility of organizational patterns. The new observed organizational pattern and pattern language assist less or more in the multi-organizations' collaboration. Further study is required to analyze some public organizations according to their daily tasks based on a qualitative survey to uncover additional patterns and connections between them. In addition, our subsequent study will focus on developing a framework, specifying rules and regulations to enhance the collaboration of multi-organizations.

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