A Pattern Language of Multi-Organizational Collaboration in Public Sector in Developing Countries

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Researchers have extensively discussed the importance of collaborative efforts between public organizations, especially in developing countries. For outsourcing projects to be delivered successfully, collaboration is seen as a vital business trait. Due to low economy in often developing countries, several public organizations may not have access to the required resources. Therefore, sharing the 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 might be facilitated by sharing infrastructure, public data, consultations, computer networks, lessons learned, and building capacity of stakeholders. Despite lack of resources, public organizations distributed across the country faced other obstacles such as inadequate infrastructure for collaboration. This study discusses a comprehensive collaboration between public organizations to share existing resources with other public organizations. During this study, we attempt to document 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.

Categories and Subject Descriptors: [**Software and its engineering**] Patterns

General Terms: Patterns
Additional Key Words and Phrases: Software development, collaboration, software engineering, public sector, developing countries, organizational patterns

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1. INTRODUCTION

By collaborating across public, private, and administrative boundaries, local government leaders can amplify their influence over economic development and get more from their assets than they could alone. Leaders and project managers can leverage the resources of their own organizations and the resources of other organizations, expanding opportunities and raising levels of development. As a result of the collaboration, partners and stakeholders can benefit from each other's assets and achieve mutual goals by overcoming barriers between them. Among these are providing partners with a greater range of support and collaboration opportunities, reducing risk and share costs, providing additional human resources, and providing access to additional resources [Clayton et al.(2017), Rantanen et al.(2004), Guimón(2013)]. Additionally, the benefits of collaboration in organi-

zations include sharing resources, synergy, overcoming obstacles, increased community awareness, and access to constituents and funding.

Several public organizations in developing countries don't have the necessary infrastructure, funds, capacities, public data, networks, and other resources. Therefore, public organizations should collaborate, share infrastructure, and other resources to overcome the mentioned challenges. Increasingly, multi-organizational collaboration has become an effective method of achieving more than any organization can achieve alone [Bryson et al.(2006)]. 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 but required [Bryson et al.(2006), Vangen and Huxham(2003)]. Organizations need to adapt their structures for a teamwork-friendly environment, just as there is a need to keep team resources functional. Lack of trust, ineffective communication, and unstable momentum are challenges of a successful organization or team collaboration. 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 [Coplien and Harrison(2004)], which date from the late 70's [Alexander et al.(1977), Alexander(1979)]. 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 recognizers, and these patterns already exist. Thus, there are still problems selecting a model that is appropriate for a particular existing problem [Frťala and Vranić(2015), Birukou(2010)].

A pattern can be selected using a variety of methods, one of which is to follow the patterns within a pattern language. This includes patterns and a set of rules for assembling those patterns in a meaningful sequence [Coplien and Harrison(2004)]. 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 [Sulaiman Khail and Vranić(2017), Seidel(2017)].

The rest of the paper is structured as follows. Section 2 describes the project setting we explored for organizational patterns of multi-organizational collaboration in public sector in developing countries. Section 3 explains the story behind the patterns and the pattern format we used. Sections 4–10 present the actual patterns. Section 11 concludes the paper.

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.

Our eNID technical team worked on the project for almost a decade. The rest of the 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. 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.

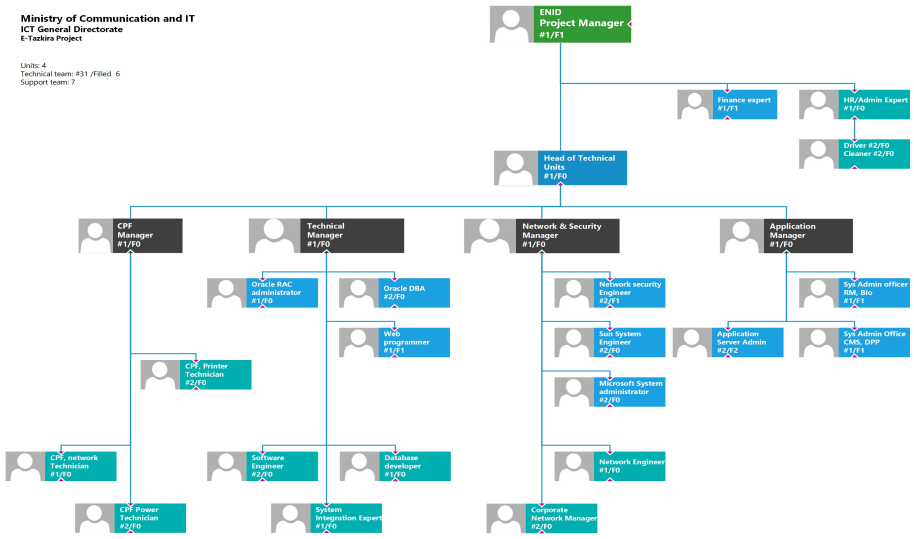

Fig. 1. Organigram of the eNID project.

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: the SLAs that the service provider was required to follow were not mentioned, penalties were not mentioned when the contractor failed to deliver the promised deliverable, ownership of the source code was not specified to be transferred to the project owner, the payments process method was based on time instead of deliverables, and 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 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.

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

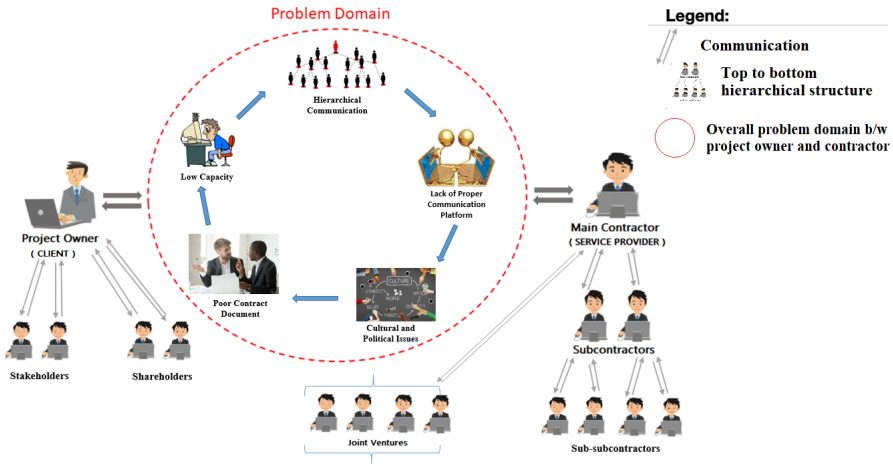

Fig. 2. Common problems observed during the eNID project.

into consideration while documenting the mentioned patterns [Bryson et al.(2006), Mendes Calo et al.(2012), Vangen and Huxham(2003), Coplien and Harrison(2004), Fan et al.(2014), Gajendran and Brewer(2012)].

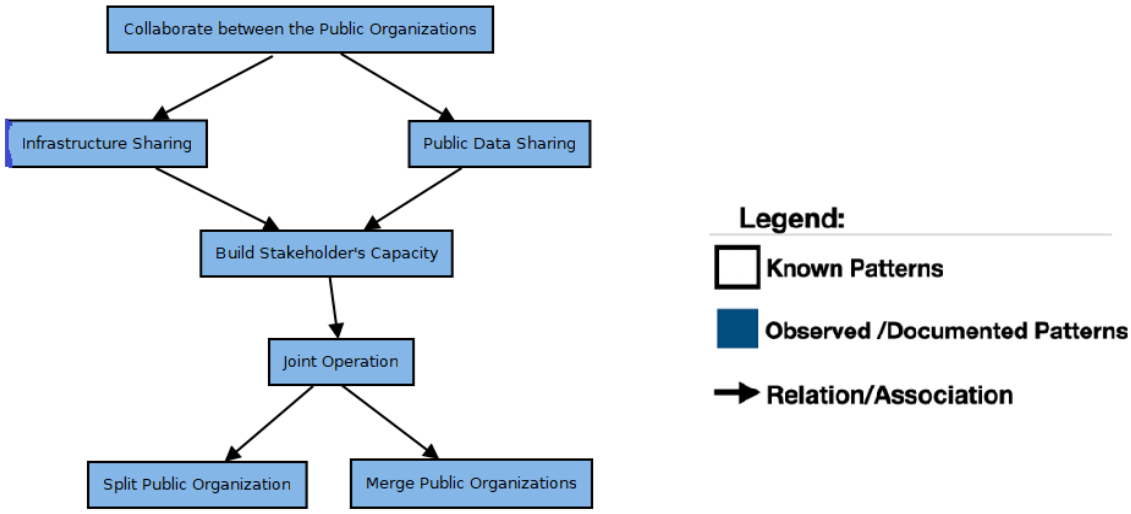

Fig. 3. Organizational patterns of multi-organizational collaboration in public sector.

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 [Coplien and Harrison(2004), Bryson et al.(2006), Gajendran and Brewer(2012), Vangen and Huxham(2003), Fan et al.(2014), Mendes Calo et al.(2012)].

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 may not have access to 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 the eNID project, and sometimes the cooperation and coordination between the organizations was a challenging task, therefore the government decided to merge the eNID department of MCIT, CSO and the 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 [Coplien and Harrison(2004)] with the conflict of the most prominent contradicting forces expressed in the *but* form proposed by Vranić and Vranić [Vranić and Vranić(2019)].

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.

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– 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 quality services with insufficient resources. Thus, improving coordination and enhancing collaboration between public agencies sharing their existing resources is necessary.

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Often public organizations tend to provide quality services to their citizens, but some of them do not have the required collaboration and coordination.

Several public organizations work for almost similar goals, or work for different modules of a common whole project, but they do not have proper cooperation ans collaboration with each other. Collaboration among public institutions may create various forms of uncertainty, but trust between involved organizations can help to solve the issues.

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.

Inter-organizational collaboration is required within the public sector due to the complex operations run by various organizations and services involved in public service provision. Collaboration among public institutions may create various forms of uncertainty, such as the inability to reconcile intra-organizational strategies, priorities, and resources. Trust between partners can assist in solving these potential ambiguities.

Collaborating with other organizations, which is positive cooperation, entails building long-term relationships, exchanging resources, and collaborating on shared goals [Kożuch and Przygodzka(2012), Kożuch(2011), Bullinger et al.(2010)].

5. INFRASTRUCTURE SHARING

. . . a public organization has a well-equipped infrastructure. Everything 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. Nevertheless, the other organizations do not have access to such infrastructure nor do they have the funds needed to do so.

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In general, public organizations tend to provide quality services to citizens. A public organization owns the required infrastructure. Other public organizations involved in the project also require the same infrastructure, but the other organizations may not have access to it.

Often organizations 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 other organizations try to use the project owner's infrastructure, but they are not allowed due to the government's rules and regulations.

Therefore:

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

Infrastructure sharing or providing shared e-government services is a better solution for developing countries with limited budgets. Janssen and Wagenaar [Janssen and Wagenaar(2004)] assert that the flexibility services of e-government can be achieved by using shared e-government from the perspective of motives and management. To support the collaborative decision-making process, Chun et al. [Chun et al.(2010)] investigate the role of openness and transparency in developing shared e-government. They include the public in the inception of new government policies. The concept of shared e-government was developed by Janssen et al. [Niehaves and Krause(2010)] by considering the IT infrastructure, including services centers and service networks.

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 and their customers or stakeholders to store such data in several locations. Additionally, the customers don't prefer to waste their time and provide similar data such as iris, biometric, and other personnel data several times.

Each organization prefer to get first hand data and store it themselves, 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.

Generally, organizations prefer privacy of their data, but several public organizations don't contain their own required data. Data should be stored in several locations for security reasons, but redundant information can lead to some data centers not updating certain information. In general, people prefer to provide their information if some public organization needs it, but are tired of giving the same information to multiple 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 citizens to provide biometric and demographic data only once.

Essentially, public data or information sharing involves parties exchanging information so that one party may access data collected by another. In the case of public organizations, it is called public data sharing. It requires implementing various initiatives, including providing appropriate technical solutions, adopting standards, establishing formal agreements between organizations, and changing business processes to make data and information accessible to others [Pardo et al.(2004), Caffrey(2000), Dawes and Prefontaine(2003), Gil-Garcia et al.(2005)]. Through inter-organizational collaboration, public data sharing helps government agencies provide better public services and solve critical problems.

Organizations in the public and private sectors are increasingly relying on information-sharing projects. Organizations usually decide to move forward with information-sharing projects based on the expected benefits, such as improved services, operational savings, and increased effectiveness. Since terrorist activity and other illegal activities must be monitored and dealt with, information sharing between public organizations has increased substantially. Besides law enforcement, health care, public education, economic development, and geographical information are included [Fan et al.(2014)]. Through Government Information Sharing, 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 [Mendes Calo et al.(2012)].

7. BUILD STAKEHOLDER'S CAPACITY

. . . few public organizations work on a same project to achieve common goals 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 may not have enough funds for their technical team to build their capacity. The project owner adds a module with the name of (stakeholder's capacity) to the project's contract for building capacity of other organizations involved.

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Each public organization tends to build capacity of their own staff. But several involved organizations may not have access to the required resources.

Beneficiary or stakeholder organizations strive to perform their relevant tasks. But their staff do not have the required skills. The other organizations prefer to build their staff's capacity. But they do not have the required budget.

Therefore:

Add a module called (capacity building) to the contract for all organizations involved in the project. Create a capacity-building plan in consultation with stakeholders that summarizes the capacity assessment results and identifies all the priority areas of the organizations involved. Ensure that all organizations' staff is trained with the skills necessary for the project's success.

Developing capacity development activities that are genuinely relevant to the needs of local stakeholders or organizations is essential when designing projects. The involvement of multiple stakeholders can also enhance ownership of project activities and outcomes. The success of a project depends on the participation of qualified and expert stakeholders.

There are several examples of this pattern.[1] In Colombia, Ecopetrol has partnered with key oil companies and IFC to help civil society organizations. In Peru, Minera Yanacocha partners with IFC to provide modern financial management systems and on-the-job training to the local municipality receiving the mine's tax revenues. In Uganda, DFCU Bank provides basic financial training to current and prospective female clients and women's organizations on topics ranging from developing good saving habits to applying for bank loans. Chilean gold mining company Kinross Maricunga, located in the Andes near indigenous communities and a national park, has offered training programs to help local communities establish ecotourism-based businesses. Around the world, BHP Billiton's community relations professionals participate in practice-based training programs aimed at improving their knowledge, skills, and competencies.

8. JOINT OPERATIONS

. . . the vendor (service provider) has just completed the outsourced complex system (the whole solution). The system is not well documented. 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.

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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.

[1] https://www.ifc.org/wps/wcm/connect/3f7e01ec-e6ff-4b1b-bab3-6c857ebcde15/12014chapter5-.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-3f7e01ec-e6ff-4b1b-bab3-6c857ebcde15-jqeKUP3

The system was developed, deployed and installed. But the system is not well documented. The system 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.

Therefore:

Sign a joint operation contract with the vendor company that developed the system. The contract duration depends on the system's complexity and the capability of the project owner. Drive the system jointly with the vendor company for the required 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.

In a joint operation, the organizations involved with common control have rights to assets and obligations for liabilities related to the arrangement. They are referred to as joint operators. Usually, the service provider organization that has developed and is familiar with the system jointly runs a system with a system owner organization for a while. During the joint operation, the project owner organization learns how to run the system independently. Additionally, better documentation of both (the developer manual and the user manual) must be developed.

9. SPLIT PUBLIC ORGANIZATION

. . . two or more goals in different sectors are being pursued simultaneously by a single public organization in some developing countries. In such case, the 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/or 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 might be difficult. A public organization may achieve two or more different goals in different sectors, but achieving the deliverables on time seems problematic.

Therefore:

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

Based on an organization's application of the common elements of common purpose, coordinated effort, division of labor, a hierarchy of authority, centralization/decentralization, and formalization, the resulting structure will typically be divided into one of four overall departmental structures: functional, product, customer, and geographic.

Each public organization's mandates and work areas should be clearly defined before splitting. Six critical lessons should be kept in mind while splitting a public organization:

(1) Split a public organization according to different sectors, areas of work, and responsibilities

(2) Organize steering committees and separate management offices

(3) Identify the right teams for the projects

(4) Identify and manage risks in the project's plan

(5) It is more important to focus on speed than perfection

(6) Maintain relentless communication

10. MERGE PUBLIC ORGANIZATIONS

. . . two or more public organizations work in the public sector. Their mandates and work areas are close to each other. They perform almost similar tasks.

Several public organizations may pursue similar tasks achieving a few goals in different areas and sectors in developing countries. But there is often interference in their work scope, authorities, and responsibilities. Accomplishing tasks take longer, and there are often blame games among public organizations.

Several public organizations may 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 similar services to citizens, but taking responsibility in such a shared platform is problematic. Additionally, coordination, communication, and bureaucratic activities between public organizations take longer.

Therefore:

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

Often, it is necessary to combine several public organizations into a single entity. Especially useful for organizations with multiple subsidiaries. During the eNID project (see Section 2) implementation, we dealt with several public organizations. We witnessed conflicts of ownership of data, infrastructure, responsibilities, and authorities. Finally, the mentioned issues were solved by combing the organizations involved in a single public organization.

11. 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 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.

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 and specifying rules and regulations to enhance the collaboration in multi-organizational settings. It will also evaluate whether the patterns described in this paper can help other public organizations from developing countries.

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