A Framework for Customizing Public Services

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Abstract—Processes are the main constituents of public services and as such demand correct and complete execution. Increasingly however, governments feel the pressing need to deliver public services more quickly and personalized to the needs of local communities or citizens. This not only jeopardizes their quality but also requires them to form teams that combine deep technical and programming knowledge with business experts.

It is the aim of this research project to deliver a framework that allows non IT-experts to customize prefabricated and generic processes by parameterizing them. This customization revolves around reference guidelines that accommodate multiple-viewpoints in a consistent manner.

Keywords— Process, Public service, Reusability, Reference Guidelines, Customization, T-Shaped Framework

I. INTRODUCTION

The two key aspects of this research are: ensuring completeness while defining processes for public services and reducing development cost of public services for electronic Government (eGovernment). Processes constitute the key fabric of today’s enterprises while being propelled by distributed computing technologies that typically rely on the Internet. Processes are often created by ad hoc methods and frequently suffer from incompleteness that impairs their capabilities to cater value in a systematic and predictable way. Incompleteness refers to required set of tasks and attributes to execute a process. Incomplete processes impede achieving the process goals. In order to avoid such risk, service organizations today are keen to find reusable processes.

The advantage of a reusable process is two-fold. Firstly, reusable processes are defined based on the ‘best cases’; thus, they are less prone to incompleteness than the processes defined from scratch. Secondly, process reusability reduces development cost.

An important shortcoming of reusable processes is: they are generic that neither considers specific usage nor specific context (e.g., organization). Thus, the completeness of reusable process can only be insured from global (generic) but not from local (context) perspective. For instance, a permission process is a reusable process contains activities from global perspective because the process is generic and it does not consider any specific usage or context. In this setting, the permission process cannot guarantee the completeness when it is to be used in specific usage such as residence permission or driving license permission; because, usage specificity triggers new requirements that lead to the customization of reusable processes.

Customization entails techniques to tailor the processes to serve specific usage as well as contexts. Customization of a process is not a trivial task because it needs extensive expertise on process and its related technologies. Additionally, customization requires expertise from diverse fields since processes encapsulate services that have various views incorporating quality view, security view, and policy view. Strictly speaking, it is not easy for a core expert to cover such a wide variety of knowledge originating from disparate domains. Thus, public service organization must hire experts from different fields for customizing reusable processes. Due to high cost of experts from various domains, the total development cost remains high even though the processes can be reused. Therefore, “reusable process reduces service development cost partially but not completely”.

In recent years, numbers of researches have been started to define the reusable processes for eGovernment. These reusable processes can be customized but, the solution that can guide the customization is largely missing, which is a strong requirement for cost effective service development. This research aims to provide a solution for customizing reusable processes for public services. It is worth to mention that process customization is a collective task including tailoring different views (e.g., quality view) of services and also tailoring the control flow. Control flow determines the order of activities (aka services) in a process. In this paper, our focus is strictly on providing the solution for customizing the views of services. The customization of control flow of the processes is not within the scope of this paper. We assume that the control flow of the reusable processes is well-defined since they are based on the ‘best cases’.

In this article, we propose a T-Shaped framework that facilitates customizing reusable processes to fit into specific usage and context. The primary goal of the proposed solution is

This research reported in this paper is sponsored by the EU FP7 as part of the COCKPIT project and from the European Community’s Seventh Framework Programme FP7/2007-2013 under grant agreement 215483 (S-Cube). It was supported, in part, by Science Foundation Ireland grant 03/CE2/I303_1 to Lero – the Irish Software Engineering Research Centre (www.lero.ie).
to reduce the development cost especially the expert cost. The cost-effectiveness may influence many public service organizations to adopt IT for delivering services electronically. In addition, the T-Shaped framework aims at supporting public service organizations to define services by ascertaining completeness.

The T-Shaped framework serves as the guiding principle for service providers without the need of having intense knowledge on processes as well as their related technologies. The T-Shaped framework contains a large set of parameters derived from various fields and list of operators that are important to the process customization of public services. To the best of our knowledge, no such a solution has been proposed within the public service domain.

We organize this article as follows: section II illustrates the motivation of this research. An example of reusable process is presented in this section and used in the subsequent sections to demonstrate the core capability of the proposed solution. The fundamental concept of this research is explained in section III. Section IV describes our main contribution which is, the “T-Shaped framework”. Section V explains the related works and finally section VI concludes this research work and briefly outlines the future extension.

II. MOTIVATING EXAMPLE

In this section, we illustrate the motivation of this research. Figure 1 shows a generic permission process which is independent of any specific usage and context. The permission process contains generic elements including two participants (or actors) Citizen and Municipality, tasks, and flows that sequence the execution of tasks.

In the above process (Figure 1), there are two different pools that separate the activities need to be performed by the citizen and municipality. In citizen pool (the upper one), citizen send completed application form attaching the required documents to the municipality for a permission. The municipality decides the approval or rejection based on the limitations and many other factors. The process is vividly specific to public service domain but not specific to any usage or context. The process abstracts the specificity and captures the activities from the global point of view. In particular, Prepare Required Documents, Fill Application, check validity of the documents and approve or reject application are the recurring tasks of any permission process. Thus, the process is ‘complete’ from the global perspective.

Now, the generic process in Figure 1 can be reused across the municipalities since the core tasks are common. A generic process abstracts from a specific usage, i.e. it can be applied for many scenarios but needs to be customized before it is in practice [7]. For instance, the municipality of Tilburg wants to reuse the permission process for ‘permission for building construction’. This specificity drives the customization of this

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**Figure 1. Reusable permission process.**

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the legal experts will be able to customize the part of the process that deals with laws, regulations and norms. This separation of concerns eases the customization providing each stakeholder involved lucid understanding what to customize. In addition, these views underpin ensuring the completeness that not only consider the tasks but also required policies and qualities. Figure 2 shows the views of T-Shaped framework.

The T-Shaped framework includes a Legal View that represents policy and security related aspects associated with a process. The policy and security aspects can be varied depending on the usage as well as context. The primary source of the policy aspects is legislations. These policies are composed of rules used to restrict a task in a process, for instance, application for residence permission can be approved only by responsible officer. The T-Shaped framework includes parameters that support expressing these rules. The legal view also includes security aspects to ensure the security of information exchange between participants in particular, public administrator and citizen. The framework allows users to specify the parameters that are required for specific usage or context.

![Figure 2. Simplified meta-model T-Shaped solution concept.](image)

Finally, the Participant View describes the actors involved in a process. The users can rename the actors to specific context. For instance, the actor Municipality in motivating example (see Figure 1) can be renamed to Tilburg Municipality.

The segmentation of views assists verification of post-customization completeness of a process ensuring that the process covers not the only required tasks but also required policies and performances.

IV. T-SHAPED FRAMEWORK

In this section, we describe the T-Shaped framework that enables a user to perform customization. Before going into details about the framework, it is important to mention that the framework at current stage considers only the top-down approach to develop public services. The framework do not take the bottom up approach into account due to fact that bottom up approach needs to deal with more complex situation such as abstraction of running processes defined in complex language in particular, Business Process Execution Language(BPEL). The future extension of this research may deal with bottom up solution.

Like classical framework, T-Shaped framework consists of solution interface and process customization backend environment. Figure 3 shows T-Shaped solution framework. The solution interface is the front-end environment for process customization.

![Figure 3. T-Shaped solution framework](image)

A public service provider uses the interface to query the reusable processes and to perform the customization of processes. It allows user to perform all customization operations processed by backend environment. The backend environment consists of Process Repository and Reference Guidelines.

The process repository contains the reusable processes. Essentially, these processes can be provided by the public

Service quality is another important aspect in service oriented environment especially from the service client perspective quality is the primary requirement. Like legal requirements, quality is a non-functional requirement. The satisfaction of service client depends plainly on the level of quality of services provided by the service providers. Thus, service providers today largely concentrate on quality requirements of the services. In this frame of mind, we offer a separate view called Quality View for presenting the quality requirements of services. These requirements can be parameterized using the customization framework since it contains a large set of quality parameters. Essentially, the key quality aspect of a process is performance which primarily involves time based parameters such as Response time, Processing Time and so on.

The Task View describes the tasks which are operations performed by activities. For instance, payment activity perform process invoice and send invoice tasks. The proposed framework allows users adding, pruning, and renaming tasks of a process activity.
service providers or any public service consortium such as non-profit standard organization. A public service provider finds a required process in the repository and then tailors (customizes) the process using reference guideline.

The Reference Guideline contains a set of instructions a large set of parameters that underpin customizing the reusable processes. Table I shows list of parameters from various domains. The guideline enables the service providers tailoring process without having prior knowledge. However, a process can be tailored in a multiplicity of 1 to n. This means that a context independent process can be customized to usage specific and then context specific processes. This is called stratified customization approach. We discuss the stratified customization later in this section.

### TABLE I. THE PARAMETERS AND OPERATORS FOR PROCESS CUSTOMIZATION

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Security Parameters</th>
<th>Policy Parameters</th>
<th>Scheduling Parameters</th>
<th>Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Response</td>
<td>Non-Non-Non-Non-Non</td>
<td>Best effort, Best effort, Best effort, Best effort, Best effort, Best effort, Best effort</td>
<td>Add, Add, Add, Add, Add, Add, Add</td>
</tr>
<tr>
<td>Time</td>
<td>Repudiation</td>
<td>Repudiation, Repudiation, Repudiation, Repudiation, Repudiation, Repudiation, Repudiation, Repudiation</td>
<td>Guaranteed, Guaranteed, Guaranteed, Guaranteed, Guaranteed, Guaranteed, Guaranteed, Guaranteed</td>
<td>Prune, Prune, Prune, Prune, Prune, Prune, Prune, Prune</td>
</tr>
<tr>
<td>Waiting</td>
<td>Time</td>
<td>Time, Delay, Time, Delay, Time, Delay, Time, Delay</td>
<td>Post-condition, Post-condition, Post-condition, Post-condition, Post-condition, Post-condition, Post-condition, Post-condition</td>
<td>Select, Select, Select, Select, Select, Select, Select, Select</td>
</tr>
<tr>
<td>Throughput</td>
<td>Precision</td>
<td>Throughput, Precision, Throughput, Precision, Throughput, Precision, Throughput, Precision</td>
<td>Inclusion, Inclusion, Inclusion, Inclusion, Inclusion, Inclusion, Inclusion, Inclusion</td>
<td>Rename, Rename, Rename, Rename, Rename, Rename, Rename, Rename</td>
</tr>
<tr>
<td>Confidentiality</td>
<td></td>
<td>Confidentiality, Confidentiality, Confidentiality, Confidentiality, Confidentiality, Confidentiality, Confidentiality, Confidentiality</td>
<td>Exclusion, Exclusion, Exclusion, Exclusion, Exclusion, Exclusion, Exclusion, Exclusion</td>
<td>Add, Add, Add, Add, Add, Add, Add, Add</td>
</tr>
</tbody>
</table>

Now, how does the proposed framework support the customization? The answer is merely, the parameterization. Parameterization plays a pivotal role in customization: the parameterization process allows setting parameters of target solution [7]. In order to facilitate the parameterization, the T-shaped framework integrates reference guideline. Reference guideline is the main component of T-Shaped framework and one of the primary focuses of this research. It is the culmination of a set of customization parameters that are used to fine-tune the reusable processes. Table I is an extended table of parameters that are included in the reference guideline.

Additionally, in order to perform the parameterization, the T-Shaped framework provides a list of primitives or operators that are shown in the Table I. They are briefly described in the following:

1. **Rename**: Renaming is about (re-)labeling different parts of target process. For instance, a task ‘Prepare Required Document’ of source process may be renamed as ‘Prepare Documents’ in the target process. In addition, the Tilburg municipality may want to rename the actor “Gemeente Tilburg” instead of “Municipality”.

2. **Refine**: This primitive is used to refine the process and the tasks as well. Refinement of tasks denotes the decomposition of a task into sub-tasks. For instance, `prepare permission application` is a task may be refined to `prepare document and fill application`.

3. **Add**: A task can be added in the process using this primitive. A service provider may find a task that need to be added for the target solution.

4. **Prune**: A task can be removed from the process using this primitive. A public service administrator may find a task that is not necessary for target process.

5. **Select**: This primitive is used to select parameters from the list.

Apart from the above operators, the T-Shaped framework facilitates Value Tagging. It allows specifying target value for performance parameters for instance, `processing time = 5 days`. We plan to include a window with drop-down list for selecting parameter and a ‘textbox’ to specify the values.

The reference guideline is an incremental work that is planned to be extended in our future work. Currently, we concentrate on defining the parameters and the operators that can support the efficient customization of generic processes. The guideline is the outcome of extensive literature studies and intensive analysis on public service requirements. It is influenced by the works of various researchers including [1], [13] and [14]. The main focus of these works was on constraint related research specifically performance constraints, security constraints, policy constraints, and scheduling constraints. [10] proposed an interesting work that influences the key idea of this research in particular, depositing the parameters into a repository, which support process customization. The process of eliciting the parameters that are included in reference guidelines has been influenced by the model proposed by [4] [9].

### A. Customization

This section explains the customization of different views (describe in section 3) on a reusable process using T-Shaped framework. As it is mentioned earlier, the T-Shaped framework facilitates stratified customization which is an approach to promote customization of a reusable process to usage and context specific stratum (process) in a multiplicity of 1 to n. Figure 4 depicts the stratified customization approach with an example.

![Figure 4. The stratified customization approach with example.](image-url)
However, the meta-reference model (in the above figure) is a reusable process model containing the elements from the global perspective that is independent of usage and context. Customization produces the reference model containing the elements and characteristics for specific usage but not context and finally the solution model is a concrete solution for specific contexts. The example in Figure 4 demonstrates the context-specific customization process. We provide the example of context-specific customization approach using dotted lines. The meta-reference model in the example is the permission process that is customized to permission process for residence permit which is not yet a concrete solution. The final customization produces the concrete solution which is residence permit for Tilburg Municipality. We describe the customization of processes more detail in the followings:

(i) Customization of Legal View

T-Shaped framework allows customizing policies and securities in legal view. The policies as well as the securities are indeed the non-functional requirements of a service. These requirements are of critical for the desired outcome of the processes. In particular, policies of public service organizations lead the execution of a process. The class diagram of legal view is shown in Figure 5. The class diagram guides how to customize the legal view of generic processes.

![Figure 5. The class diagram of Legal View.](image)

An example of reference guidelines of customizing legal view is demonstrated in Table II.

<table>
<thead>
<tr>
<th>Process Description</th>
<th>Process Goals</th>
<th>Policy Description</th>
<th>Security</th>
<th>Policy Parameters</th>
<th>Security Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>The generic permission process can be used for defining permission services.</td>
<td>Permission for Residence</td>
<td>The permission application can be approved by the responsible offices.</td>
<td>Any tampering of the document will be considered as the violation of security.</td>
<td>Segregation of duty: It is used to determine the separation of actions performed by Tamper¬roof: It ensures that the data cannot be tampered by any adversary.</td>
<td></td>
</tr>
</tbody>
</table>

These guidelines of T-Shaped framework enable public service providers to customize reusable process without having intense knowledge on legal aspects of processes. Furthermore, the reference guidelines support the public service administrator enormously to verify the completeness of policy and security specification of processes.

(ii) Customization of Quality View

The quality view is a vital customization aspect since it deals with the performance of a process associated with services. It entails performance-related parameters that are used to tweak the desired process performance. The parameters are mostly quantitative, thus, the T-Shaped framework allows users not only to specify the parameters but also to specify their values. The class diagram of quality view is shown in Figure 6 and an example of guidelines is presented in Table III.

![Figure 6. The class diagram of Quality View.](image)

<table>
<thead>
<tr>
<th>Performance Parameters</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waiting time: It indicates the duration for waiting.</td>
<td>Waiting Time Threshold = 30. Measuring Unit = Days.</td>
</tr>
<tr>
<td>Processing time: This indicates the total processing duration.</td>
<td>Processing Threshold = 25. Measuring Unit = Days.</td>
</tr>
</tbody>
</table>

In order to perform the customization of quality view T-Shaped includes Select operator which allows users to select parameters from reference guideline for the tasks of processes. T-Shaped also facilitates tagging the value of quality parameters.

The T-shaped framework allows public service providers selecting required performance parameters from a rich set of
parameters (see Table I containing list of performance parameters) and specifying expected values. It also allows specifying the units (e.g., hours, days etc.) to measure the performance of services.

(iii) Customization of Task View

The task view of T-shaped framework deals with the tasks of processes. A process is composed of tasks that can be renamed, refined or pruned during customization. Additionally, a new task can be added in the process. In this setting the T-Shaped framework provides add, prune, rename, and refine operators to perform the customization. Furthermore, the execution of tasks may need to follow particular order for instance, the task ‘fill application’ should be executed after the execution of tasks ‘prepare documents’. The T-Shaped framework allows users to schedule the execution of tasks using scheduling parameters (see Table I). Figure 7 presents the class diagram of tasks view and example of guidelines is presented in Table IV.

(iv) Customization of Participant View

The participant view is concerned with the partners involved in the process. Generically, participants view requires minimal customization particularly renaming the participants. The T-Shaped framework provides rename operator that allows user to rename the participants which is a context specific customization.

![Figure 7. The class diagram of Task View.](image)

![Table IV. Example of reference guidelines to customize task view.](image)

From the above discussion, it is clear that the T-Shaped framework is underlying a robust concept composed of multiple views that deal with both functional and non-functional requirements of processes associate services within the domain of public services. The reference guideline of T-Shaped framework is an added value to the public service users for enhancing the understandability on customization of processes. The key aspect of the framework is to enable non-expert users to customize the reusable process, which in consequence diminishes the expert cost.

Considering the completeness, the T-Shaped framework can be deemed as the ideal solution that underpins the verification of completeness because it segments a process into different views. This segmentation provides holistic view of the processes. In consequence, the users can easily identify the elements contained in the process and the elements that are required to be added in the process. For instance, the task view deals only with the tasks of processes, thus, it can display a lucid image of tasks contained in a process. This helps users to identify missing tasks and also tasks that are not required for the processes. Like task view, public service developer can verify the completeness in terms of policy, security, and performance of processes through legal view and quality view.
There are three substantial key concepts in this article revolving around reusability, reference guideline, and public services. In literature review, we seek for related works taking these concepts into account. The concept of reusable process is heavily documented throughout various bodies of literature, where authors argue its meaning within various contexts. The concept of reusability of public service processes is heavily documented throughout various bodies of literature. [15] proposed a research that highlights fragmenting a complex business process into shards that are intended to be flexible and work is enormously interesting especially the life-cycle model for business process modeling using reusable fragments. However, the scope of the work does not solve our problem entirely since we focus not only on facilitating reusability but also a robust guideline for process customization, which add value on the top of reusable fragments.

[5] initially proposed reusable business processes as an approach for large-scale enterprises. Their work has been cited in an extensive number of research works, yet was criticized by [12] with counterarguments on SAP reference model. [7] Proposed a framework with guidelines to transform a model with reference models in particular, the SAP reference model. Strictly speaking, these research results serve different direction and are only conceptually connected to our research. In this paper, we narrow down our scope to public service reusability that has not been considered yet. The closest work related to reusable public service has been proposed by [11], in which the authors presented a modeling view of generic processes. However, their main contribution was to support the Public Administrations to achieve resolution of organizational interoperability and systematically address the homogeneous Service Composition.

Considering the design guidelines, a number of frameworks exist today including [2] and [8]. They provide guidelines for designing interoperable systems and application. However, these frameworks deliver detailed information and guidelines about central government systems only; they fail to introduce specific information and overall business rules regarding local administration portals and services [3]. [6] proposed a model for service design, which is closely related to this research. The model incorporates elements of requirement balance, design reuse, and service quality. But it does not cover the holistic view of reusable service design the way T-Shaped framework covers. Considering non-functional aspect, it covers only the quality view of services but does not entail the legal view which is highly significant for public service design. Additionally, the reference guidelines of T-Shaped framework provide a rich set of customization parameters that are absence in the model. Above all, the T-Shaped framework is intensively specific to public service domain, for which it covers the requirement of public service design more efficiently. Fairly speaking, there is no solution approach available that entails a repository of cross-domain parameters to support multi-modal customization of the processes that associate public services.

The T-Shaped framework described in this article aims at delivering a set of comprehensive guidelines for customizing reusable processes. In this frame of mind, a reference guideline is integrated in the framework. This guideline is a collection of operators and a rich set of parameters from multiple domains to guide a non-expert user for customizing a reusable process which is independent of any specific context. The objective of this research is to underpin the cost-efficient service development in public service domain. By using this framework service providers will be able to reap this benefit since the service development cost will be diminished significantly. Additionally, with the help of comprehensive views that are underlying the T-Shaped framework, public service organizations will be able to verify the completeness of their services.

Truly speaking, it is not easy to achieve cost-effectiveness and completeness that we have envisaged in this article. It requires a robust and more comprehensive reference guideline which is richer with adequate number of parameters and operators that support rigorous customization. The framework that has been introduced in this paper is core research in nature that requires extensions and refinement. In future work, we plan for improvements and extensions of the reference guideline. We will enrich the reference guideline by feeding more parameters to support customization more effectively and efficiently.

A prototypical implementation is the subject of an ongoing work. We rely on the Eclipse Modelling Framework (EMF) to formally specify our solution framework model. By using EMF, we have automatically generated the Java code for graphically reading, customizing, and manipulating public service processes.

**REFERENCES**


