A FRAMEWORK FOR RESEARCHING PUBLIC ADMINISTRATION DECISION MAKING PROCESSES*

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Abstract

How decisions are made is a major concern for researchers and practitioners in public administration. So far, the approach to this problem was top-down. Researchers and practitioners were concerned with the legal framework, procedures and best practices of general applicability. Some of the issues tackled at the top level are: decisional transparency, citizens' participation in public decisions, the legal procedures of public decision making etc. Research approaches rely on data gathered through surveys, questionnaires etc. Instead of using this general-to-particular approach, this paper argues that a bottom-up approach to researching public decision making processes is possible and valuable. Therefore, the main contribution of this paper is the introduction of a coherent framework, that enables research to be conducted based on automatic extraction of models from large numbers of individual cases of public decision making processes. Some of the research questions that could be answered by employing this framework are: 'what was the actual decision process used for a particular decision?', 'is a particular decision process in line with the legal framework?', 'are two different decisions made based on the same process?' etc.

The framework that we introduce consists of a model that depicts the data-view of the decision making process and a methodology that enables such a model to be created from the data available in public municipalities. We also provide means to analyze the model in connection with case study data. The validation of the framework is done through a case study conducted at the level of Cluj-Napoca Municipality.

Keywords: public administration decision making process, data model of public decisions, decision data model, conformance checking of public decision processes.

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1. Introduction

The decision making in public administration is clearly an important issue for various stakeholders like citizens, researchers or public employees. Each of those stakeholders has a different point of view and interest in public decision making. For example, let's assume a choice needs to be made between an investment in a new train station or in a new sport center. Citizens are interested in the decision outcome, so they would argue on the criteria used for ranking the two alternatives (like economic impact, usefulness, number of possible users, operating expenses etc.). Researchers in law are concerned with the legal framework of such a decision (e.g. who should make the decision, who and how should be consulted). Researchers in public policy are concerned, for example, with issues related to how decisional transparency should be achieved, or if the decision actually expresses the will of the contributors. The employees of the municipality making the decision (mayor, lawyers and architects) are interested in the lawful procedure for such a decision (e.g. what are the legal steps to be followed, which are the legal periods for some activities etc.). As one can see, no matter the stakeholder, the approach to this decision is top-down. That is, there is a general framework (laws, regulations, procedures) that is used for every instance of a decision.

In this paper, we advocate a bottom-up approach. That is, we look at the records of individual decisions (paper trail, information system logs and observations) and build a general model. Why would anyone be interested in such a bottom-up approach? Because the model we build shows what actually happened in large number of decision instances. We argue that such an approach is an alternative to other research methods such as interviews, questionnaires or case studies. Once a model is extracted, it can be used for conformance checking (e.g. internal control or external auditing) or management purposes (e.g. calculate performance indicators or find bottlenecks). It also can be checked for conformity against another model (e.g. extracted from the legal framework), so that deviations can be highlighted. Ultimately, we aim to prove that a municipality employing the tools we introduce in this paper will improve its efficiency. But until then, this paper aims to show that the proposed approach is possible, and that there are clear advantages gained from looking at reality from this point of view. Therefore, for now, the target audience is made of academics rather than practitioners, and our goal is to raise interest and spark discussions on the proposed framework.

The paper is organized as follows: in the next section we discuss some similar approaches and argue how our proposed approach is different. In the third section we first define the basic notions used throughout the paper. Then, we introduce the proposed model and the framework that enable its creation and subsequent use. In the fourth section we illustrate our approach using a case study on Cluj-Napoca Municipality. We show how the framework was employed in a real setting, the model we extracted, and the conclusions that can be stated based on the comparison between the extracted model and the one created based on the law text. We close this article with overall conclusions regarding the proposed framework for researching decision

making processes in public administration, and with outlying our future plans for researching this topic.

2. Related work

In what follows, we briefly argue how our framework relates to previous researches. First, we will approach the area of decision making, with the goal of clearing up our point of view over the decision making processes. Then, we will show how decision making is applied in public administration while stressing our process-oriented point of view. Once the process perspective is established, we will tackle the notations available for depicting process models in an effort to explain why we need a new type of model, namely the Decision Data Model (DDM). In the end, we will discuss some papers that approach the problem of public administration processes from various angles, and explain how our proposal is different.

In our view, a public administration decision-making process is a set of data elements (e.g. name of companies participating in an auction, each company's bid etc.) processed in some manner by public employees so that a final choice is produced (e.g. the name of the auction winner). Our overall research question can be stated as 'the decision process performed in a public administration task is tightly coupled with the decision outcome'. The framework introduced in this paper adds a quantitative aspect to the 'decision-making process', through the Decision Data Model (DDM). In what follows, we will argue this point of view and motivate the research question.

Decision making is the cognitive (mental) process resulting in the selection of one alternative action among several possible choices (French *et al.*, 2009). The output (final product) of every decision is one, and just one, choice among several decision alternatives. In the recent years, decision making behavior domain focused on researching the processes that lead to the actual choice (Weber and Johnson, 2009). The decision making literature approach is top-down (i.e., a general framework is applied to instance decisions). Over time, decision making theory was revolutionized four times (in the 1950s, 1970s, 1990s and 2000s), as a consequence of major shifts in principles used to explain human judgment (Payne and Venkatraman, 2011). The last three revolutions stressed out the importance of the process of decision making. The approach introduced in this paper is linked to information processing. Therefore, we support the statement that the choice of a decision alternative is a direct consequence of how information is processed during the decision making process. In public administration, information is available in the form of documents, forms or regulations, while we see information processing as the activities performed by public employees.

One of the most common situations encountered in practice are multi-criteria decision making problems (MCDM). Such a problem arises when one of several solutions needs to be chosen considering several criterions (e.g. choosing between a Mercedes or BMW car considering price, power and color). There are many scientifically sound ways of solving MCDM problems (French *et al.*, 2009; Turban *et al.*, 2010). The intuitive solution to such a problem is to assign some weights to each criterion, then compare

for each criterion the alternatives against each other and, in the end, calculate the grand total as the sum of each weighted criterions. This basic solution is applied, for example, in public auctions. Let's assume there is an auction opened for building a sports center. The winner of the auction might be determined by calculating a grand total out of a weight of 60% for the price offer and 40% for the technical quality. Besides the auction example, one could think of granting social housing where the alternatives are the applicants and the criteria are the time spent on the waiting list, the number of members of the family, the income etc. Our process-oriented approach to public decision making will output a model that will depict graphically how all the data elements were used in the effort to evaluate the decision alternatives so that one will be chosen.

An objection to our interpretation on the decision process can be raised by mentioning that decision making is affected by three factors that cannot be captured in a model: the problem context (e.g. are there decisions about a similar issue, how urgent the decision is etc.), the social context (e.g. who is making the decision, how many decision makers etc.) and the cognitive factors (what is the knowledge, experience or prejudices of the decision maker, what is his attitude towards risk etc.) (French *et al.*, 2009; Catană and Pučko, 2012). Because of variance of these factors, no two decisions are the same even if the main problem is similar (French *et al.*, 2009). We argue that the approach of extracting a model from a large number of decision instances, combined with enough flexibility when it comes to adding new behavior to an existing model, can show an objective view of the process and abstract from the psychological or social factors.

According to the timeframe affected by them, decisions can be classified as strategic, tactical or operational. Also, decision processes range from structured to unstructured. Strategic decisions are usually unstructured because involve creativity since the decision maker is placed in an environment that needs exploration and has little previous examples of similar decisions. On the other hand, operational decisions are repetitive and require little or no innovative actions from the decision maker. We aim to research both structured and unstructured decisions. In a previous article (Petruşel, 2012c) we introduced a framework for researching business strategic decisions that can be applied to public decisions as well. In this paper we prefer to illustrate our framework with an example of operational decision making (i.e. issuing building permits), since it is a major concern for improving public administration daily activity as well as the citizens' satisfaction.

In the 1990s there was a definite trend in moving towards a new public management NPM (Hood, 1991) which advocated re-organizing public administration as an enterprise. Suggestions on how to apply enterprise architectures in public administration are available for some while (Peristeras and Tarabanis, 2000; Janssen and Cresswell, 2005). The current trend advocates public governance and e-government and argue new models and success criteria (Bovaird and Loffler, 2003). Some possible ways to accelerate public administration's shift towards e-government is either by creating semantic process models (Buchmann and Meza, 2012; Becker *et al.*, 2006) or by orchestrating processes by using web services (Janssen *et al.*, 2006). But such proposals

rely on experts that are required to manually produce the required models. Meanwhile, it was shown that it is possible to model processes by automatically extracting them from enterprise systems databases (van der Aalst *et al.*, 2004). We seek to enable the transition to better public governance using mined models rather than manually created ones. The framework introduced in this paper automatically (or semi-automatically) extracts DDM models, so that understanding and documenting what has actually happened in the public administration is possible. Automatically extracting public decision-making process models also creates the necessary premises for increased transparency as defined in Dragoș *et al.* (2012). Therefore, this framework fits both into NPN and the newer Public Governance paradigms.

The choice of models that can be used for depicting processes (workflows) is quite large (e.g. Petri Nets, Extended Petri Nets, YAWL (Yet Another Workflow Language), BPMN (Business Process Modeling Notation) (van der Aalst, 2011)). The graphical notation most used by experts in modeling real business processes is BPMN. It is expressive but it cannot be automatically verified for correctness (which is a non-trivial task for average sized models), and it cannot be executed (e.g. for running simulations) (Ko *et al.*, 2009). All of those notations belong to the class of imperative models and are best fitted for dealing with rigidly prescribed processes. The downside of imperative modeling notations is that adding extra behavior leads to increased complexity (size) of the model. There is also the declarative way of modeling processes which, basically, sets some constrains and allows any behavior which is not strictly in contradiction with the constraints (Pesic *et al.*, 2007). This is best fitted for very loosely prescribed models. It might seem that using the imperative approach is best fitted for the public administration domain, since a lot of the behavior is enforced by law. One modeling notation that balances between prescribing activity sequences and flexibility is the Product Data Model (PDM) (Reijers *et al.*, 2003) and its derivation, the Decision Data Model (DDM) (Petrușel *et al.*, 2011). PDMs were used as a design approach to model processes (i.e. the expert draws the model based on textual descriptions that can be find in the law). The PDM was used to model the process of granting citizenship in the Netherlands (Vanderfeesten, 2008). Our own previous research was aimed at automatically extracting (mining) a DDM straight from logs available in enterprise information systems (Petrușel *et al.*, 2011). Such logs capture how different instances (cases) of the same process were handled (what actually happened). We also created the formal framework that allows us to aggregate DDMs in order to create reference models (Petrușel, 2012a) and to compare two DDM (two instance models or one instance with a reference model). Further details on the DDM are available in sub-section 3.3.

Even if we could not find any Romanian scientific study on the matter, we believe that the same law is actually enforced (slightly) differently from one public institution to another. This was the observation that sparked the research in CoSELoG[1] project.

1 http://www.win.tue.nl/coselog/wiki/start

In this project, the researchers studied the processes actually performed in 10 Dutch Municipalities. It was found that, given a process enforced by a law, different versions were enacted by each municipality. The CoSELoG solution is to create a configurable process model that will be the starting point for the model actually employed by each municipality. We solve the different variations of a problem by incorporating all the different implemented versions in a single model.

Our basic approach is to collect data about the individual decision-making process (workflow) and then extract a model out of it. This is the main focus of the process mining research domain. In process mining a log of activities is outputted from the information systems that are used in managing various aspects of a business (e.g. ERP, CRM, SCM systems). Then, using various algorithms and methods, a process model is automatically created. Process mining research started a decade ago (van der Aalst and van Hee, 2002). Since then, the field expanded quickly and a large number of algorithms were developed (van der Aalst, 2011). When it comes to studying Cluj-Napoca Municipality, there are no available logs stored in the information system database, with a structure that can be mined using process mining. We speculate this is due to the unawareness of decision makers of the benefits of mining models from logs, low investments in information systems or low employee implementation due to usability issues (Mocean and Buchmann, 2012).

Applying process mining in enterprises for conformity checks against regulations was proposed in van der Aalst *et al.* (2010). Auditing basically means examining actual facts and checking them against organization's statements. The idea of conformance checking is closely related to auditing. Checking what really happened in the organization and comparing the facts against laws is one of the main outcomes of our approach, as well.

The existence of a correlation between the strategic decision making process and decision effectiveness was proved (Dean and Sharfman, 1996). It was also established that there is a direct correlation between the available information for the decision process and the quality of a decision (Keller and Staelin, 1987). Therefore, there are two aspects that we need to pre-determine when it comes to decision process: the general strategy employed and the processing of information. The general strategy employed in public administration is usually available as a law, law's application norms or internal rules. The information processing is usually opaque but can be re-created based on the database records or the 'paper trail' like documents attached to folders. The aim of this paper is to connect an instance of the public administration decision making process (e.g. one request for building permit) with the decision outcome (e.g. the approval or rejection of the permit), and to depict it as a DDM. Then, we need to apply the aggregation rules we laid out in Petruşel (2012a) on a sufficient number of instance DDMs so we can get an overview of the actual decision process employed in the public organization.

In cognitive sciences it was established that a user creates a mental model of how software works when interacting with it (Storey *et al.*, 1999). We argue that the same

holds true for the interaction of citizens with the public administration. Before starting the actual interaction with the public administration, the citizen needs to create a mental model of the activities he needs to perform. We argue that, if the mental model is incomplete or incorrect, the interaction will be flawed. If the mental model is in line with what actually happens in reality, the satisfaction is maximized. Therefore, there is a clear need to align the mental models of the citizens with the mental models of the public employees and with the processes actually performed. This can be done by using the framework and the models proposed in this paper. Also from cognitive sciences, it is stated that a representation of a problem has a great impact on the human ability to solve it (Hastie, 2001). Therefore, giving problem statement as a visual model, we seek to improve the satisfaction degree of citizens when interacting with the public administration.

3. The framework for researching public administration decision making processes

As shown in the previous section, the quality of decision making in public administration is directly linked to the process leading to that decision. In this section we will introduce a framework that allows any researcher to look at public administration decision processes in order to evaluate their quality. The assumption we use is: 'the better the process, the better the decision'.

3.1. Prerequisites

This sub-section introduces the notions used throughout the paper. It is intended as an introduction in process modeling for non-specialist readers.

A process is a series of actions (steps) taken to achieve an end. A process model is the graphical representation of the steps (activities) in a process. A process instance (case) is one execution of a process. For example, when dealing with building permits some activities that need to be done by a citizen in order to get the permit are: register a request, pay fees, show property proof etc. One process instance is the building permit request by John, another one is the request of Mary etc.

The decision process is the sequence of steps (physical or mental) that need to be taken in order to make a decision about an issue. The decision is the actual alternative chosen after a decision process is executed. For example, the decision process related to building permits (from the public administration point of view) involves activities like 'checking the filed documents', 'cross-checking solemn statements', 'choosing one of the alternatives' etc. A decision process instance is the execution of the decision process activities about John's request while the actual decision is to approve this particular request.

A public administration decision process is usually data-driven (is based on quantitative data). For example, the decision to issue a building permit is made if the owner of the land requests it (yes/no) or if the building area is less than 50% of the land area etc. The opposite type of decision is the one based on personal perceptions (e.g. the choice to vote for one or another candidate at the elections).

3.2. The research framework

In Figure 1 we introduce the framework that can be used to research any public administration process. The basic approach is to create two models: one for the desired process and one for the as-is process.

The desired process is manually created by a designer starting from the applicable laws and regulations. The public managers at all levels (mayor, department heads, office heads) also contribute to this model since the law is usually not prescribing to the detail the actual activities and their order, but rather gives a context and some guiding principles. On the other hand, the as-is process is automatically created from the records of the actual instances of the process. Those instances are usually stored in the databases of the information systems used within the public organization. For example, the Municipality of Cluj-Napoca uses a Document Management System (DMS) that stores the date when a document is processed (e.g. when it was first registered, from which bureau to which bureau the request was forwarded, the persons that dealt with the request, the date when the solution was communicated to the citizen etc.). Information systems' databases are a rich source of information and in some countries this data is enough for creating the model (see the case of the Netherlands (van der Aalst, 2011)). If the information systems used by the public administration are less developed, it is possible to rely on data collected manually by the researcher. This means filling information gaps by interviewing or observing public employees.

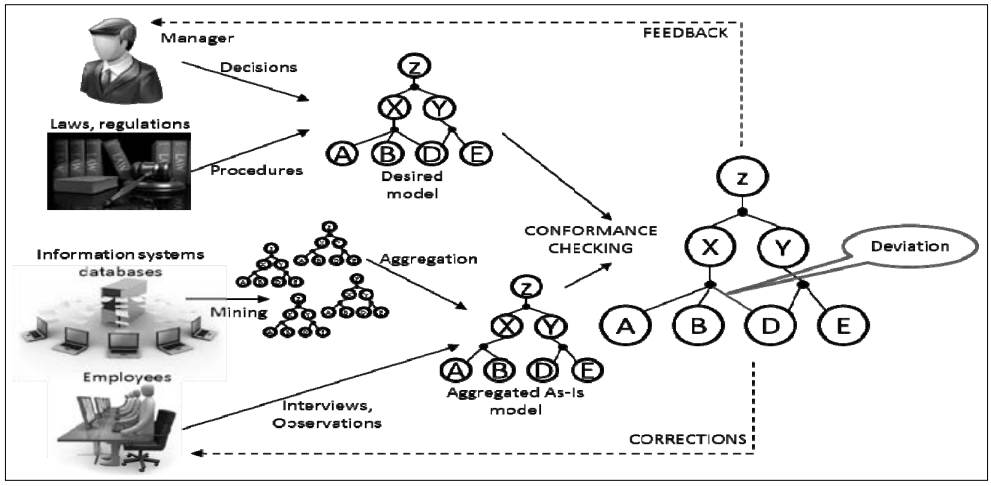

Figure 1: Decision Process Research Framework

The creation of the As-is model is performed in two steps. First, a DDM is created for each process instance that is under research (i.e. selecting a sample of 50 Building Permit requests will produce 50 models). How an individual process is extracted was discussed in Dolean and Petrușel (2011). Then, all the individual models are combined into an aggregated model (Petrușel, 2012a). A running example that will allow a better understanding of the aggregation step is shown in Figure 5.

Once the two models are created we can compare them. Comparing the Desired process model to the As-is model is called Conformance Checking because we aim to discover if what actually happens in reality is in line with the law requirements. The output of the conformance checking step is a list of deviations from the As-is model. The formal approach of DDM comparison is briefly discussed in the next sub-section. Once the deviation points are identified, there are two outcomes. On one hand, the deviations are presented to managers who can decide: whether the deviations are acceptable and no corrections are necessary; or whether the deviations break the law and corrective measures are required. Ideally, the deviation could reveal a better way of conducting work and be a starting point for a law/regulation improvement proposal. On the other hand, the model and the deviations are discussed with the employees so they are able to get an overview of the process and make necessary adjustments to improve the quality and the speed of their daily work.

3.3. The decision process model

Since the intended audience of this paper is made of non-specialists in business process modeling, we will abandon a formal approach in favor of an example-driven presentation.

A Process Model (see Figure 2 and Figure 3) consists of activities that are performed by the actors of the process and of gateways that determine the routing rules of the model (possible paths that can be followed through the model). The flow (sequence) is indicated by arrows. An activity is graphically represented as a rectangle and a connector by a diamond. A connector can be a split (when there are multiple arrows going out) or join (when there are multiple arrows going in). The connectors can be: XOR split/join (only one of the outgoing/incoming arrows is followed) AND split/join (all the outgoing/incoming arrows are followed) and OR split/join (any number and combination of the outgoing/incoming arrows are followed). For example, in the model shown in Figure 2 there is an XOR join (first gateway) and an XOR split (second gateway).

We will use as an example the case of building permit issuing. Models in Figure 2 and Figure 3 are manually created based on Law no. 50/1991 (latest update is by Law no. 269/2011) and on its application methodology Order no. 839/2009. The art. 2 of this law states that the building permit will be issued only after the following steps are respected: a) a city planning certificate is requested and issued; b) there is a point of view of the competent authority on the environment impact of the project; c) if the environment impact needs to be further investigated the person that requests the building permit must notify the public authority that the request is maintained; d) an environment certificate is issued, if it was required; e) the technical documentation is created; f) the technical documentation is checked and evaluated by the competent public authority; g) the building permit is signed by authorized persons in the public authority.

The art 5. states that before the city planning certificate is requested (i.e. before the first step in art. 2) there are other authorizations that need to be obtained. Art. 7 lists the documents needed for the technical documentation.

The art. 7/12 states that the major criterion used to make the decision to grant the building permit is the completeness of the required documents. There are no statements of other criterions that should be considered when deciding if the building permit is granted or rejected.

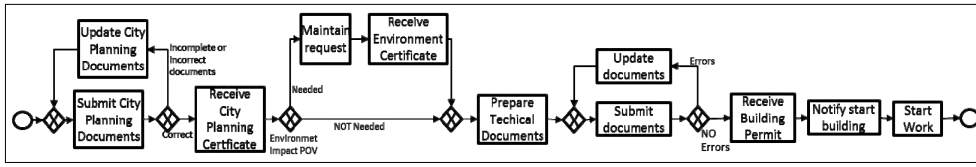

Figure 2: Process model of the citizen's point of view over getting a building permit

A general view over the activities that should be performed by a citizen, based on art. 2, is modeled in Figure 2 using BPMN. Figure 3 shows the same process seen from the employee's point of view. This model is also created on the law description. This model shows the internal procedure and is related with the decision making process.

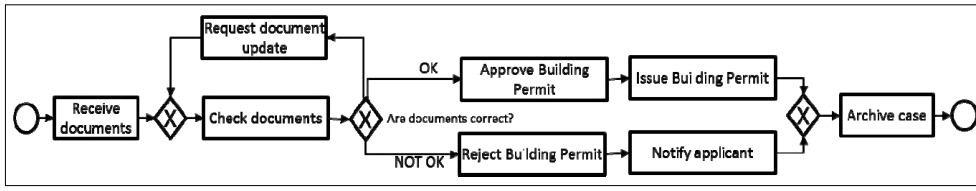

Figure 3: Process model of the public employee's point of view over getting a building permit

A Decision Data Model (DDM) consists of:

- Data elements (D). A data element is an item that is relevant for the decision. A data element has a name and a value. For example, a data element in the building permit decision process is the tax receipt with a value of 1,000 RON.
- Operations (O). An operation takes as an input some data elements and as outputs one or more other data elements. An operation can be putting together the building project brief of the building permit request documentation by combining the architecture, structure and utilities projects. An operation can be executed only if all the inputs are available. Therefore, a DDM has executable semantics. This means that such a model can be used for 'running' or 'replaying' a process instance (execute the steps of the process in a certain sequence). There are two types of operations: ones that have as an input at least a data element (e.g. OP1 from Figure 4) and others that have as input the empty set and produce the leaf elements of the model (for simplicity reasons those operations are not depicted in Figure 4). The latter introduce data elements readily available to the decision

maker (e.g. the data element 'the form is "correctly addressed" by the applicant' has the value 'true' which is obtained with a simple check).

D and O form a hyper-graph which is connected and acyclic. That is, all elements are connected with other elements such that there are no loops in the model.

Returning to the example of building permit issuing, the DDM that describes the data-centric view of the decision making process is shown in Figure 4. The building permit documentation is composed of mandatory documents and other documents that are needed only in certain situations. For example, in order to make the decision on approving or rejecting the building permit request, the public employee needs to check the land ownership (proved by a valid land registry excerpt) and the area characteristics (set in the cadastral plan). The semantics of OP2 is that continuing with checking other documents (e.g. tax payment receipt) or rejecting the request, can be made only after those two documents were examined. The DDM model can be used to guide a public employee in any instance of the building permit decision making process.

The difference between the DDM and a process model is that it depicts how data (or forms) should be processed in order to make the decision. A process model shows what activities should be performed in order to process the request. Actually, the DDM in Figure 4 describes what happens during check documents activity of the process model shown in Figure 3.

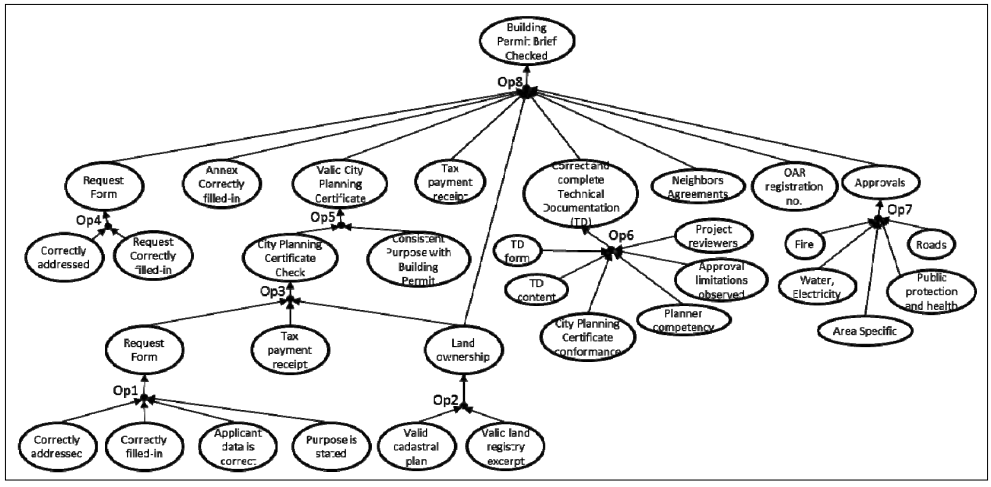

Figure 4: Desired Decision Making Process Model for Building Permit

We argue that the DDM is a better choice than process models when it comes to modeling public administration processes because it allows activities to be modeled together with data elements (forms, documents, variables). This point of view was partly argued in Vanderfeesten *et al.* (2011). Also, in our previous work we proved through experiments that a DDM is easier to understand and use (by non-specialists in process models) than a workflow model in the context of decision making processes (Petruşel and Stanciu, 2012b).

While researching what actually happens in real life, we will build one DDM for each instance of the research decision (i.e. each building permit documentation reviewed by the public employees). Those individual DDMs need to be aggregated into one single DDM that will be comparable with the one modeled according to the law. Aggregation of DDMs was approached in a more formal and detailed manner in Petrușel (2012a).

Finally, after the desired DDM is created and the as-is aggregated DDM is available, we need to compare the two DDMs in order to find and analyze deviations. We approached the similarity of DDM data elements in Petrușel (2012a). This problem can be stated as: 'Given two models DDM1 and DDM2, calculate a score, between 0 and 1, that will give a quantitative measure to the similarity of the two models'. This is calculated by doing a pairwise comparison of all the elements in the two models and assigning 1 point for identical elements and 0 points for mismatching elements.

4. Case study on Cluj-Napoca Municipality

This section is intended to show that the proposed framework works in real life and it produces interesting results when researching the decision making processes in a municipality.

The point we try to prove is: 'The decision making process for granting the building permit may be improved by following the proposed framework'. At this point in our research, we define improved as 'closer aligned with law requirements'. Basically, we aim to pinpoint differences, if any, between the desired model and the as-is model.

Design of the case study – the case study is composed of several steps. Each step aims to create an artifact and is marked as complete when it is outputted.

1. Define the studied process. The most important activity at this stage is to create several candidate processes to be researched and to pick the most relevant one. Then, for the selected process the boundaries of the research need to be defined precisely.
2. Look up all possible laws and regulations regarding the studied process. These laws go from national laws up to internal directives.
3. Create manually the model presenting the law point of view.
4. Introduce the law model to the public managers. Based on their feedback, update it and create the desired model.
5. Mine the database of the information system(s) used by the organization. If there is a complex system that logs details on all activities, use all the instances of the process. Otherwise, select a statistically relevant sample and manually extract information from the database. If there is insufficient information, interview the employees about the selected cases (or select currently running cases and observe).
6. Create the individual as-is models.
7. Create the aggregated as-is model.
8. Calculate similarity of the models (a score between 0 and 1).
9. Create a list with deviations. Analyze each deviation to determine its severity.

10. Introduce the list of serious deviations to the public managers. Interview them, and collect comments. Propose changes to the process.
11. Introduce the list of serious deviations to the employees, along with the comments of the managers.
12. The research output is an evaluation of the conformity of the enacted process with the regulations. This is derived from the found deviations and the public managers' response to them.
13. Alternative approach:
    - at step 5 measure some qualitative or quantitative metrics of the process (e.g. the average time for processing the request, or the citizens' satisfaction level with regard to the process);
    - at step 10 agree with public managers on a list of improvements to the process;
    - return after a while to the public organization to evaluate the implementation and impact of the proposed changes by measuring again the metrics;

During our study of the building permit granting at Cluj-Napoca Municipality we implemented the research approach introduced above. Here are some comments and observations for each step:

1. In order to establish the decision process to be researched, we interviewed individuals both from academia and from public administration. One of the common areas of interest was urban planning. Therefore, the process of granting building permits within the city was selected. We found out that this process stretches over two separate bureaus. One is dealing with the actual building permits while the other is dealing with the city planning certificates. We decided to research the entire process, therefore we contacted both bureaus.
2. The rules governing building permits are set out in Law no. 50/1991 (updated by Law no. 269/2011) along with application methodology in Order no. 839/2009. There are some other issues related to Building Permits that can be found in Law no. 350/2001.
3. The manually created DDM, based on those law texts, is shown in Figure 4.
4. The model was discussed with the managers of both City Planning as well as Building Permits Bureaus. Their feedback confirmed that the models we created (Figure 3 and Figure 4) are in line with existing laws and regulations. However, they suggested that the model is correct when applied to some cases, has some items that are not necessary for other cases, and that other special cases are not covered by the model (those cases were intentionally left out to keep the size and complexity of the model manageable). There were two changes to the model. First, checking if the building limitations are observed is actually done when the city planning certificate is issued. Later, the inspector checking the building permit paperwork does not check it anymore and assumes the city planning check was already done. This is illustrated in the model by moving the building limitations observed data element from the operation producing building permit brief checked data element to the operation producing city planning certificate check element. Second, it is not checked if the project was registered with the Order of

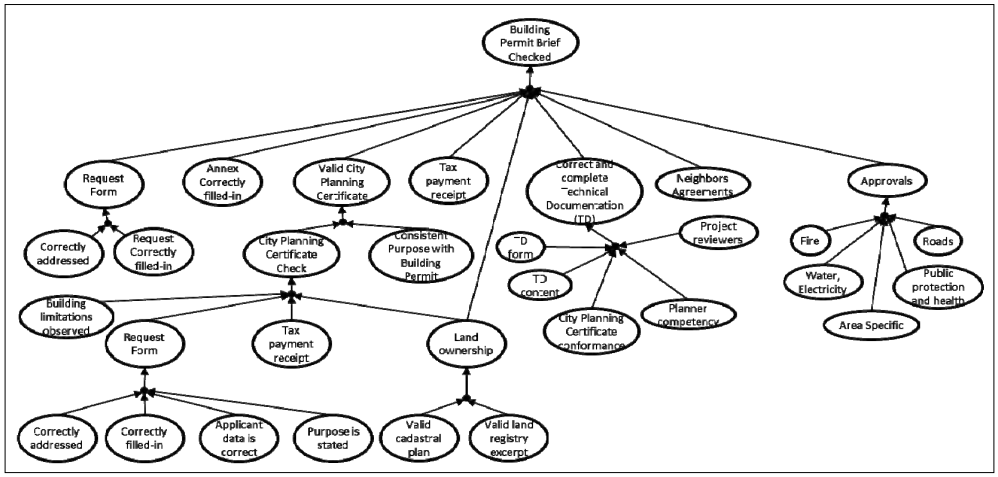

Figure 5: The desired process after interviews with bureau mangers

Romanian Architect (OAR). This is implied by the existence of the tax payment receipt issued by OAR. Therefore, the desired model is introduced in Figure 5.

5. There was no database of activity logs that could be mined. Therefore, we manually created the logs by observing the activity of two inspectors in charge with checking city planning and building permits requests. We asked the inspectors to 'think aloud' (i.e. to say out loud what they were doing and what they were checking). We took notes of the activity performed and its duration. The only software that records activities is the Document Management System. However, the information is only global (i.e. the system records when the file is submitted to the Registration Desk, when it gets to the inspector, when is forwarded from the inspector to the secretary etc.).
6. The two as-is models created based on the observations are shown in Figure 6. Those models depict the activity of two inspectors while checking the documents submitted so that the building permit will be granted.

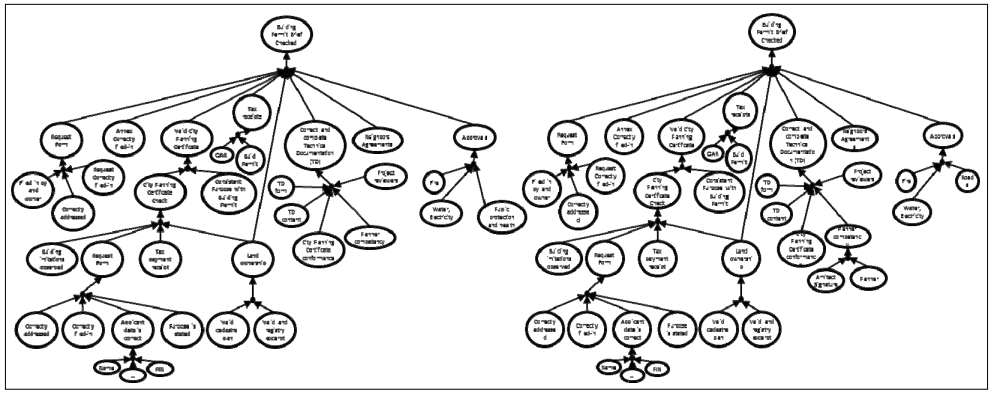

Figure 6: As-is models created based on interviews and observations

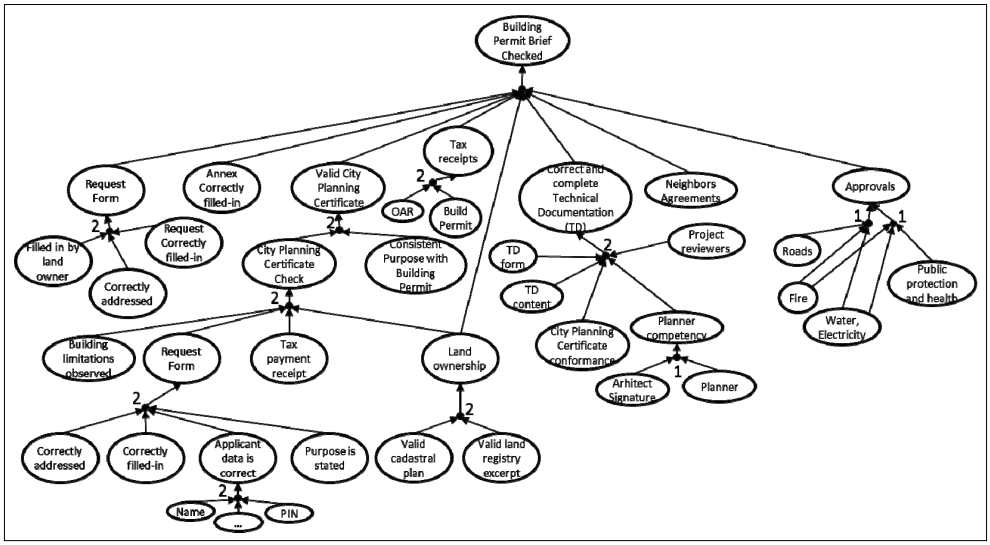

Figure 7: Aggregated as-is DDM

7. The aggregated model created based on the two models in Figure 6 is shown in Figure 7.
8. The similarity score between the desired model (Figure 6) and the aggregated as-is model (Figure 7) calculated using Dice coefficient is 93,75% (i.e. 2*30/(34+30)) and the one calculated with Jaccard coefficient is 88,23% (30/34). As one can see, there is a high degree of similarity. The differences between the two models are:
   - the inspectors check if the request form is filled-in by the land owners not by the building beneficiary. In the observed cases there were instances when the two were different. In the law there is no reference to checking this issue.
   - Planner competency check includes checking architect signature and planner's registration with the professional body. The law states that it should be checked if the Architect is registered with OAR. This is not actually done and is assumed that as long as there is a signature and stamp, those are valid (or maybe the names of the architects in the observed instances were familiar to the inspections.
   - the approvals needed from different entities depend on the type of building to be constructed. In the limited number of observed instances, not all of those approvals were required.
9. There are no critical differences observed. This means that the process is tightly coupled with current laws. The only serious difference is that there is no check of the architect's membership affiliation to the OAR. However, we can see that performing this check would slow down the process and that the presence of a signature and a stamp may give some assurance on the architect's ability to sign such documents.

Risk analysis and mitigations: some of the concerns that limit the validity of the results are:

- The input of an employee during observation or interview might not be reliable. For example, it could be that the employees should follow a lengthy procedure, but during daily routine they short-cut it on purpose. However, when observed, there are high chances that the entire procedure would be followed and not the daily routine.
- We observed only two out of five inspectors. This might limit the conclusions that we reached, since there are differences on how inspectors enact the activities of the same process. However, we found that the main difference is the order of activities, and abstracting for the complete order of activities and focusing on partial order are the strong points of the DDM. In addition, we only observed the daily activity of the two inspectors over a two weeks interval. An extended observation (over a longer interval and including more employees) is currently in the process of being conducted. The results of this extended observation will be made available in a different paper covering also how simulations based on the process models enable improvements of the activity of public administration.
- The research covers only one municipality. We expect that other municipalities enact differently the same process. We hope that the framework presented in this paper will raise interest in this issue, and convince researchers from other cities to join our efforts.

The interview with the bureau managers revealed that there are additional steps to the process introduced in Figure 3. From the process point of view there are differences between the context laid out in the law and its implementation rules. This affects the decision making process since a 'four eyes' principle is imposed (the Bureau managers double-check the folders previously checked by inspectors). This statement was done in an interview. Therefore, we cannot state if the actual check is performed or is a purely formal one, and it is done just because the bureau manager needs to sign the papers.

5. Conclusions

This paper introduced a research framework aimed at extracting decision-making process models from public administration. In order to reach the more ambitious overall goal of improving decision making, we build on the previous finding that the decision outcome is highly correlated with the quality of the decision process leading to it. When it comes to public administration, the decision-making process is the sequence of activities that lead to any decision. This paper aimed just to introduce the research framework, while the findings generated by its use in the Municipality of Cluj-Napoca will be reported in our next paper.

The framework has at its core an existing model, the Decision Data Model (DDM), created as a part of our previous work in business decision process mining and modeling. The DDM balances between the strict order of activities imposed by imperative

models and the very loose order captured by declarative models. Such a model can be created either manually by managers or regulators, semi-manually as a result of observations or completely automatically by mining information systems databases. We illustrated in this paper a semi-manual modeling effort, given the available data.

The framework was illustrated using a case study conducted at the Municipality of Cluj-Napoca, Romania. The case study shows how the process of issuing Building Permits within the city may be modeled, and what insights may be revealed. Our intention is to prove that the framework can be used to investigate what really happens in public administration. The main conclusion of the case study is that there are deviations between actual processes, what managers say the process should be, and what regulations stipulate. Fortunately, for the studied decision process, those differences were not critical. To give a better validation of the framework, we are conducting a broader observation (both as the number of observed employees, process types and instance numbers for each type).

We argue that our framework is relevant both for researchers and practitioners. For the academia, we seek to spark a discussion on a novel way of investigating what really happens in real life. The main point of our proposal is that data, already stored in the databases of the information systems running in public municipalities, can be used for automatic model extraction. Such models bear the promise to improve the efficiency of the public sector activities (e.g. by finding bottlenecks in processes, understaffed or overstaffed positions etc.) as well as the correctness of decisions (e.g. by evaluating if all necessary steps and relevant documents were used). For practitioners, we suggest that managing internal processes will increase the quality of decision making. The first target should be to create models of structured decisions (simple, repetitive ones). Once a model is created, it will enable better communication between employees as well as increased transparency of procedures for the contributors. Once some experience is gathered, more unstructured decisions (complex, one-time) can be managed in the same way.

Besides expanding the study at the Cluj-Napoca Municipality we plan to conduct a similar study in Eindhoven, The Netherlands. Modeling decision processes by applying the framework laid out in this paper will allow us to: create a graphical overview of the processes, compare how the same process is applied in two EU member states and highlight differences in a graphical manner. From our research framework will benefit both academia (public administration and law researchers) as well as the municipalities themselves, since improvements to the processes will be possible. Ultimately, the entire research will improve the life of citizens by improving interaction with the public administration.

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