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Modeling for Accountability: The Case of the Virtual Business Counter

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ABSTRACT

In face of pressure from politicians and constituents public agencies have to collaborate with each other to offer a one-stop shop. The emphasis shifts from vertical to horizontal coordination and integration, which requires the making of commitments between public agencies and the fulfillment of these commitments. Consequently accountability shifts from hierarchical to commitment-based accountability. In this paper we propose an agent-based modeling approach aimed at modeling coordination of activities and commitments. Software agents are used to simulate the actors and dynamic behavior of the organization network. Our approach supports decision-makers to improve cross-agency business processes and checks if the commitment loop of request, promises, reports on status of the commitments and justification is completed. We apply the proposed modeling approach in a case study of a virtual business counter and test the approach using a number of interviews.

Keywords

Business modeling, simulation, e-government, accountability, case study, collaboration, virtual business counter

INTRODUCTION

Politicians pay an overwhelming attention for more customer-oriented services provisions. Public administrations are urged by politicians to stay closer to citizens' every-day life, and act more proactively (Peristeras and Tarabanis, 2000). Collaboration between government agencies is necessary for integrated services provision. Within the public administrations at these different levels, many different more or less autonomous agencies exist, each responsible for a certain set of tasks. Due to this fragmented nature of governments, the activities that make up a single, atomic governmental service, such as a building license, are often performed by different governmental agencies (Wimmer, 2002). The agencies are governed by a hierarchy as part of their historical heritages. Public agencies are more and more involved in 'spaces of flows' within the network society, i.e. cross-agency process and information flows (Castells, 1996). These approaches rely on networking between stakeholders, goodwill, mutual trust and softer forms than laws like service level agreements between agencies. The creation of a networking needs an overcoming of the initial resistance of agencies and demands control and accountability mechanisms relying on process-based. The emphasis on accountabilities becomes even stronger due to the increasing number of partnerships with private firms (Shamsul Haque, 2001).

Electronic government as a means to improve governmental service-delivery has largely failed in addressing the problem of governmental fragmentation in an adequate manner. Many governmental websites were developed on an agency-to-agency basis with little tendency to develop a centralized website (Gant and Gant, 2002), and in this explosion of websites, the hyperlink often became the substitute for properly integrated systems (Bannister and Walsh, 2002). A great long-term public sector concern is the need for focusing on efficient and efficient application integration (Beynon-Davies and Williams, 2003).

The legal setting determines the functions and powers assigned to public bodies and their organizational and financial autonomy (Ongaro, 2004). Many of the organizational functions and roles are founded in laws and regulations. These organizations have a legal responsibility for services provision and are free to design their own information architecture. Consequently, public sector reengineering gives much autonomy to the agencies. This autonomy has resulted in that necessary changes have not occurred, benefits are not realized and the systems have fallen into dispute and disuse (Hackney

and McBride, 1995). Public sector organizations have been criticized for failing to engage in a process whereby time, money, and efforts were invested in bringing about the required change in culture, gaining commitment, organizational structure and business processes, transparency and reward systems required by changes in technology (McIvor, McHugh and Cadden, 2002). Discussions of e-government integration activities often resolve into speculations about what should be done (Jaeger, 2003). The benefits of information sharing and integration have not been attained due to incompatible operating systems, platforms, and high costs of maintenance coupled with a lack of understanding of the true purpose, value and power of integrated information systems (McIvor et al., 2002).

Conceptual modeling is an important step in developing a computer-based application that collects adequate stakeholder requirements about the application domain (Lin and Lin, 2004). Modeling and visualizing the existing situation can help decision-makers coming from various agencies to design accountable, cross-agency business processes and information systems. Modeling can help to understand the process and avoid speculations about behavior prior to implementation. *The goal of this paper is to develop a modeling approach aimed at modeling accountable, cross-agency business processes.* This paper is part of ongoing research into the dynamic modeling of e-government, which has unique aspects that need to be accounted for (e.g. Janssen and Cresswell, 2005).

This paper is structured as follows. In the following section we discuss the research methodology. In the next sections we discuss accountability for cross-agency processes. In the section thereafter we discuss existing modeling approaches. Based on the needs for modeling accountability and elements of existing modeling approach we propose an agent-based modeling approach aimed at modeling the coordination of activities and commitment. We use modeling approach in a case study of the design of a virtual business counter in public administration. In the last section we draw conclusions.

RESEARCH METHODOLOGY

The main motivation of this study is *how* can the modeling of cross-agency business processes support the creation of accountable processes. We answer this by posing the following research questions.

- 1) What makes up cross-agency accountability?
- 2) What modeling approaches exist for modeling cross-agency accountability?
- 3) Develop a modeling approach and evaluate its ability to model accountable, cross-agency processes?

The first two questions are answered by conducting a literature review into accountability and different modeling approaches. By analyzing which existing modeling approaches are suitable to model the distinguished aspects of accountability an agent-based modeling approach was proposed.

The testing of the developed modeling approach was done by first applying the dynamic modeling approach within a case study involving cross-agency business processes. Case research is useful in our situation as we deal with a broad and complex phenomenon, the existing body of knowledge is insufficient to permit the posing of causal questions, and modeling approaches cannot be studied outside the context in which it occurs (Yin 1989). The models of the case study were made using action research following the dynamic modeling approach (Sol, 1982; Janssen & Cresswell, 2005). Action research or applied case study research is focused on 'how to' questions (Checkland, 1981). The researcher became involved with the situation being studied. In this paper we are not interested the application of dynamic modeling approach, instead we are only interested in the evaluation of the distinguished features aimed at modeling accountability mechanisms. As depicted in figure 1, we want to evaluate if the proposed constructs help to diagnose the accountability of the existing 'as is' situation and helps to check if complete commitment loops are designed for the new 'to be' situation.

Evaluation data was collected using six semi-structured interviews. The interviews were aimed at evaluating the effectiveness of the accountability constructs and identifying opportunities for improvement. The interviews covered the history, an in-depth discussion of the model structure, the modeling constructs, and of the benefits and disadvantages of the model. Two representatives representing the management and administrative staff level from each of the organizations involved were interviewed. All interviewees had no or limited modeling knowledge.

ACCOUNTABILITY

In spite of its significance, public accountability is not a well-defined term (Meijer, 2001). Accountability involves a relationship between two parties, where one party is held responsible for the performance on some objective and the use of resources to accomplish this objective. Broadly conceived, accountability implies answerability for one's actions or inactions and to be responsible for their consequences (Roberts, 2002).

In the past accountability was relatively simple, cooperation was based on pre-defined relationships, often determined by law, and systems were tested prior to operations. Existing accountability mechanisms are designed for vertical accountability relationships, and these are inadequate for horizontal or 'networked' accountability across public agencies (Ryan and Walsh,

2004). In a networked environment organizations interactions are often based on loosely defined relationships, however, The legal setting still determines the functions and powers assigned to public bodies and their organizational and financial autonomy (Ongaro, 2004). Many of the organizational functions and roles are founded in laws and regulations. These organizations have a legal responsibility for services provision and are free to design their own information architecture to accomplish the execution of these responsibilities.

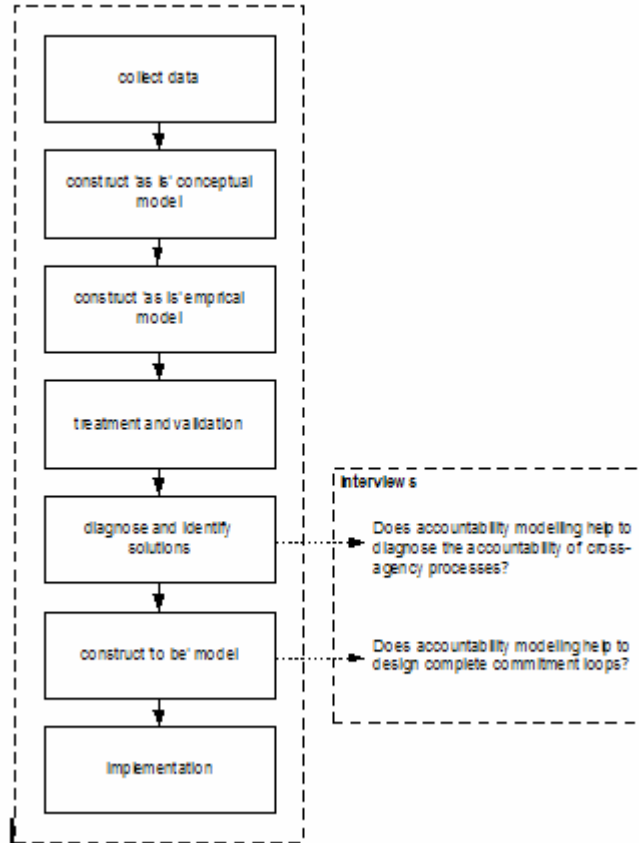


Figure 1. Dynamic modeling approach and testing

This results in a huge accountability problem, in the course of which emphasis swift form legal accountability towards more softer forms of accountability. It is unclear who is responsible if one’s data is lost due to somebody else system failure, who is responsible for ensuring the lead time and so on. Although there is agreement that accountability in government is a necessary condition, there is no consensus about what makes up a good accountability system (Roberts, 2002). The development of an accountability system is a balance between feasibility and desirability. The ideal of a complete transparent system is only reachable at great expenses and time efforts.

In government law limits the choice of actions and accountability requires departments and agencies to account for its actions. Department and agencies need to fulfill the obligations according to the responsibilities delegated. To support decision-makers these obligations and the fulfillment of obligations should be modeled and checked on completeness to avoid flaws. Most approaches to modeling business processes and systems either rely on black-box models or on flow models. Therefore most approaches do not embody an appropriate understanding of the notion of commitments loops, and consequently they do not provide effective support (Dietz, 2001). In contrary to traditional business modeling a much greater emphasis should be given to the modeling of the delegation of responsibilities and the accounting for it’s action. This should be a conscious step in the implementation of e-government information systems.

MODELING FOR ACCOUNTABILITY

Most modeling approach are specific to one organization and to its network and based on the modeling of business processes. Aspects of accountability are often neglected by the modeling approach or the whole modeling approach deals only with one

of these aspects. There is a need for uniting these elements for the purpose of e-government modeling. We have to integrate two types of coordination, the coordination of activities and coordination of commitments.

Malone and Crowston (1994) found that the need for coordination arises from constraints imposed on the performance of tasks by the interdependent nature of these tasks. These interdependencies arise from the mutual use of common objects to carry out a task. In their view, coordination theory is *coordination of activities* and provides an approach to the study of *processes* (Crowston, 1997). The process view implies a way of looking at organizations based on the processes they perform rather than the functional units, divisions or departments they are divided into. Process models can serve as a communication aid to analyze the process and determining the ways it can be improved. Simulation of business processes is based on this coordination of activities. Process simulation constitutes one of the most widely used applications of management science / operational research, as it allows for understanding the essence of business systems, identifying opportunities for change, and evaluating the effect of proposed changes on key performance indicators (Law and Kelton 1999).

Coordination of commitments based on relationships proposes an approach to coordination emphasizing networks of commitments that organizations establish through intentional acts of speech (Winograd and Flores, 1987). The background of this coordination approach can be found in the speech-act theory of Austin (1962) and the theory of commitments by Searle (1979). This is closely related to the *Actor-Network Theory* (ANT) of Callon (1986) and Latour (1987), which begins from the proposition that relationships between hybrid entities, human and non-human, are fundamental to understanding actions. Networks are fundamental to ANT in the sense that it views set of relations or associations as the means by which the world is both built and stratified. Coordination of commitments emphasizes language acts through which people coordinate, instead of emphasizing tasks performed using resources as in the coordination of activities approach (Medina-Mora, Winograd, Flores and Flores, 1992). Coordination can be described by a generic structure of a coordination loop, also referred to as an action workflow loop approach (Medina-Mora et al., 1992). Winograd and Flores define coordination as the communication of 1) requests, 2) promises, and 3) reports on the status of the commitment. For the purpose of accountability we add a fourth step, the justification of the performance.

Commitment or action workflow loops show explicitly the actions leading to the completion of an agreement between parties. In this way it can be used to analyze the direct connection between incomplete loops and breakdowns such as persistently dissatisfied buyers, wasted effort in complaint loops, lack of trust or proper market credibility (Medina-Mora et al., 1992). As a result analysis focuses on issues like Service Level Agreements (SLA), negotiation, performance metrics and trust-based relationships. Interorganizational networks can be described in such a way that organizations neither know nor care what activities other organizations undertake, this is called *management by interface*. Coordination is primarily focused on the management of the complete cycle, on the individual responsibility of actors and the provision of information.

More and more dynamic modeling approaches are object based. *Object orientated* analysis deals with the issues of complexity based on the principles of abstraction and modularity. Abstraction based on classification and generalization creates hierarchies of object classes, whereas aggregation hierarchies depict relations on the aggregate classes and their component classes. Object orientation is closely related to *software agents*. An object becomes an autonomous agent by the fact that it can control its actions, has cognitive capabilities, and has interactions with its environment using effectors and sensors (Janssen, 2001). Jennings (2000) argues that agent-based modeling employees a worldview that is similar to the perspective of a network of interdependent actors. We add to this that the concept of agents is closely connected to the concept of accountability as there can be an (legal) accountability per agent. Teams of agents interact to fulfill their responsibilities and can delegate tasks to other agents. Software agents seem to be suitable for modeling cross-agency business processes *and* relationship between agencies, thus is suitable for unifying the two coordination views, coordination of activities and commitments.

Modeling for accountability needs an agent-based approach that can be used to model the coordination of activities *and* commitments. In this section we extend the dynamic modeling approach to include the coordination of commitments using the concept of agents. Our modeling approach aims at supporting distributed decision-making, including the negotiation about commitments and optimizing cross-organizational business processes by providing insight into the current situation and modeling alternative situations using animation to support 'what-if' analysis. Our modeling approach supports the specification phase by checking if each trigger results into the start of a business process and a complete commitment loop is accomplished.

MODELLING CONSTRUCTS

In order to model the network it is necessary to identify the actors, or active entities, and business processes. Active entities include the customers, public agencies, service providers, information systems, departments, and employees participating in the business processes. *Actors entities* are aimed at representing an entity having some (delegated) responsibility, having a

number of roles to commit to this responsibilities and which is executed using internal processes. An actor is implemented as software agents having autonomous, multi-threaded objects, which is able to communicate with other agents. An actor has one or more relationship with other actors as schematically shown in figure 2.

The second aspect model is necessary to model the activities used to perform organizational roles. Actors can be described by a number of *roles* as shown in figure 2. The notion of roles is intuitive; humans think and express themselves in terms of roles. The advantage of using roles is that a role can be reused for different actors. A *role* can be modeled in terms of the processes that need to be accomplished given its position (Zambonelli, Jennings, Wooldridge, 2001). Thus a role can be made up of several processes. The coordination of commitments requires that a commitment role consists of *all* processes necessary to request and negotiate (agree on) a commitment, monitor the status and evaluate the commitments. The modeling environment should support the identification if a commitment loop is incomplete, i.e. does not include all roles. We therefore define pre-defined building blocks consisting of commitment roles and messages with can be customized to model a particular situation.

A business process described the subsequent steps performed by each actor. Following the coordination of tasks processes are necessary to execute roles and are made up of tasks and decisions. In this way the activities and accompanying responsibilities of a single actor are emphasized and the actor's personal coordination of tasks. Task structures can be recursive, a task can be a task structure.

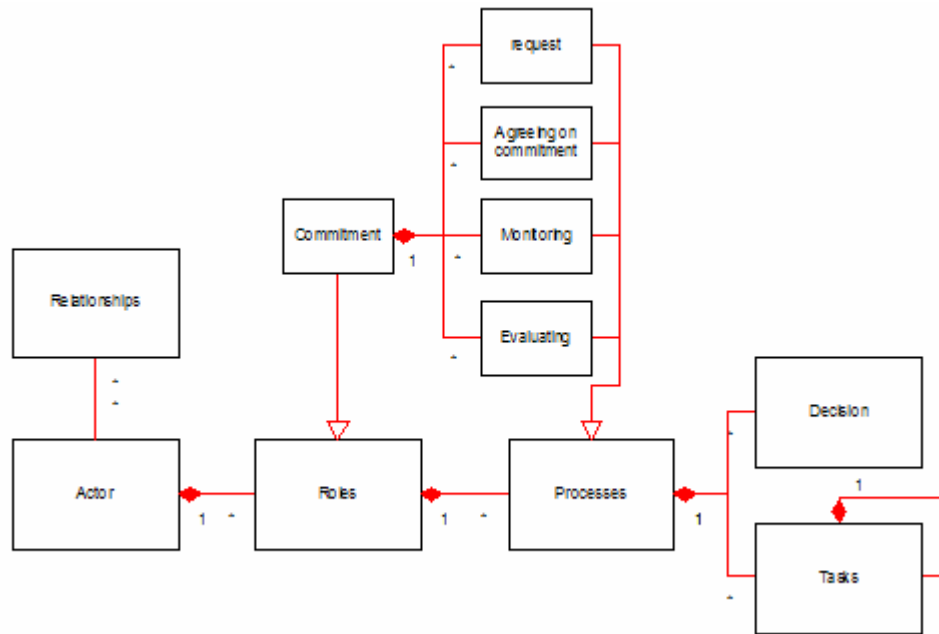


Figure 2. Relationship between modeling constructs

The next step is looking at the relationship between the entities. The relationship can be described by looking at the messages, i.e. passive objects, exchanged between the active entities. A number of standard messages can be defined that are necessary to complete a coordination of commitments loop. The messages are based on the action workflow loop of request, negotiation, performance and satisfaction (Medina-Mora et al., 1992) and shown in figure 3. First a request and promise messages are necessary to make long-term agreements about the quality of service provisioning and could include response times, exceptions and so on. When a single service is requested, the principal can make monitor the progress using the status report request and an answer can be given using the report status. On the long term the principal need to justify the quality of service. These roles, processes and messages can be extended for modeling the complexity of commitment loops using pre-defined building blocks. Our modeling approach prescribed the joined roles, message of a commitment loop without considering the detailed, situation-dependent specifications.

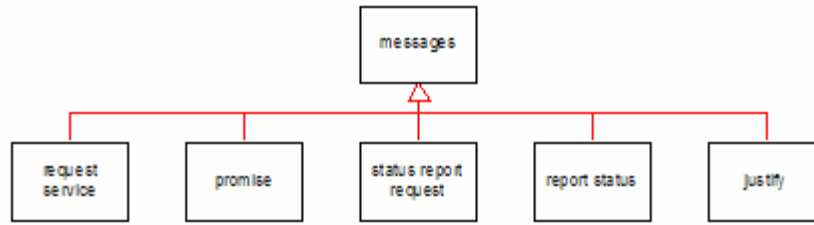


Figure 3. Type of messages

CASE STUDY: VIRTUAL BUSINESS COUNTER

The proposed modeling approach is aimed at addressing cases concerning the accountability of cross-agency business processes. In the Netherlands three different projects have been initiated to design an integrated, one-stop shop virtual counter. The creation of a one-stop virtual business counter needs the collaboration of Municipalities, Chambers of Commerce and Dutch Taxes. All three agencies provide services to private businesses, e.g. when an entrepreneur wants to start a new company, the company needs to be registered in the business registry operated by the Chambers of Commerce, will need to pay taxes and might need municipalities services like a parking permit, information about office locations and so on. Collaboration is complicated as the three agencies deal with separate geographical regions, i.e. there are about 470 municipalities (this number is decreasing as municipalities merge), 22 Chambers of Commerce and 19 Taxes regions. The benefits of the three projects remained limited despite the high ambitions and investments made in these projects. The implementations of the three virtual business counter remains largely limited to a website containing hyperlinks to the information and services on the websites of the organizations involved. So far decision-making between the three parties has largely been focused on technical issues, like web-hosting, the layout of the webpage and which of the existing services should be presented on the webpage. Whereas the participants feel that the main decisions that should be taken are the allocating of tasks, roles and responsibilities, legal responsibility and liability, service levels, quality assurance and the development of new cross-departmental services.

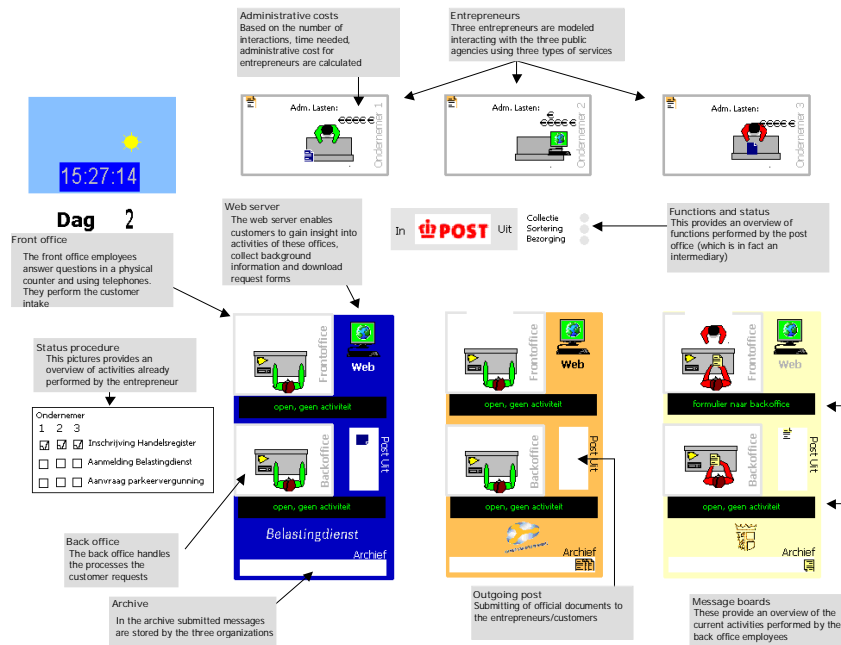


Figure 4. Screenshot of the 'as is' model

The use of our modeling approach was aimed at supporting the participants to address the accountability aspects and support decision-making by the agency managers. Using the agent-based modeling approach, first a simulation model of the 'as is' or 'current' situation was made. A screenshot of the simulation model of the 'as is' situation including an explanation is shown in figure 4. At the bottom of the figure the back-offices of the three government agencies, municipality, chamber of commerce and taxes, are shown. At the right side of the back-offices the status of the requested services are shown. In the

middle the post office is shown, with acts as an intermediary between the entrepreneurs and government agencies. At the right side of the counter the activities performed are written down. At the top three entrepreneurs having a need for services from the virtual counter are modeled. Also miscommunication, mistakes in data and processing faults are modeled.

In the current organization the three local government organizations can be viewed as functional units, each with a highly specialized set of responsibilities and expertise. Even the simplest business tasks tend to cross the functional units and require the coordination and cooperation of different functional units. The virtual counter should support cross-organization processes and simulation should visualize processes instead of functions and responsibilities.

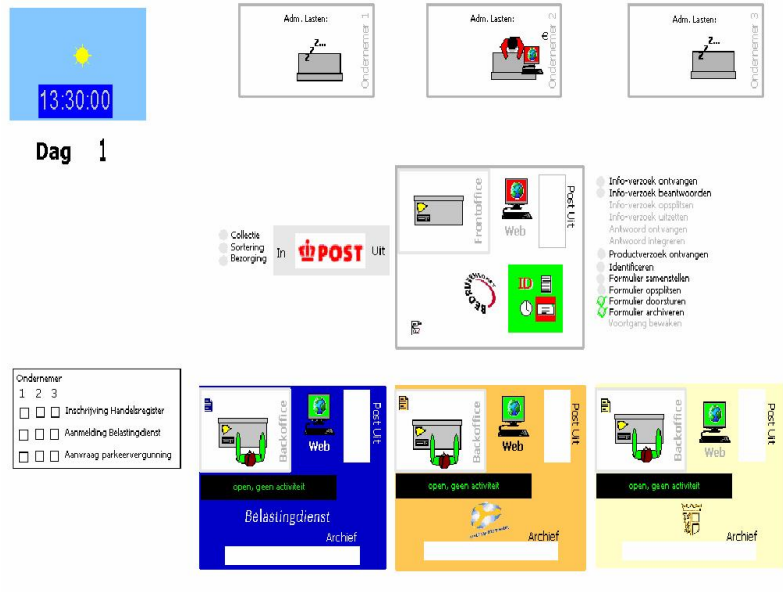


Figure 5. Screenshot of the ‘to be’ model

In figure 6 the interactions for a complete commitment loop are shown for a parking permit. The completeness of such commitments loop was checked within each model. It happened a number of times that this loop was incomplete and a commitment was not completed. It was striking that often the reports on the justification of the decisions s was excluded. A screenshot of a model simulating both a virtual and physical counter is shown in figure 5. In the middle of this figure the physical and virtual counter are shown with make up the one-stop virtual business counter. At the right side the activities performed by the one-stop business counter are shown.

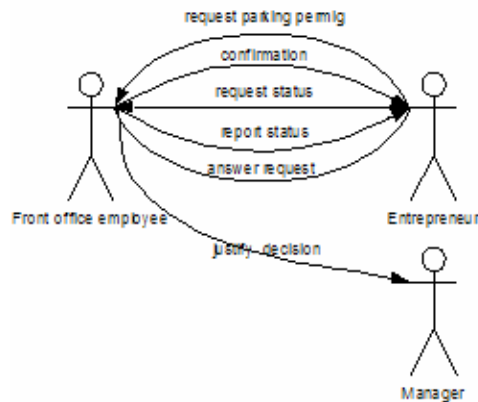


Figure 6. Interactions for a parking permit

The six interviewees are very positive about the realistic illustration of especially the ‘as is’ situation. One interviewee stated (in Dutch) that “*even my manager was able to understand the activities involved in the process*”. Two of the participants were already familiar with simulation, i.e. animation, of business processes based on the coordination of activities paradigm, however, not of them were familiar with simulation of commitments. Most interviewees indicated that the modeling approach is very effective at identifying flaws in commitment loops finding and the showing of the direct connection between incomplete loops and breakdowns. The breakdowns of incomplete loops are visualized, which resulted in the remark of one of the interviewees “*the visualization of incomplete loops seem to show that almost no process was complete*”.

The interviewees found that it also helps to identify the need to reallocate responsibilities among actors. It became clear that the customers should not call the back offices for status information. The interviewees, however, found it sometimes very hard to understand the complex relationships between commitments, performance, reporting and justifying. The following remark was written down “*the software is able to identify the flaws, however, to follow the flow of a complete is difficult as it interferes with other loops and processes*”. These comments suggest that it could be useful to add a separate view to visualize execution of the commitment loops.

CONCLUSIONS

Public agencies operate more and more in organizational networks and key becomes the realization of efficient and accountable cross-agency processes. Conceptual modeling is an important step to support the development of new organizational arrangements. In our literature review we found that the emphasis shifts from vertical to horizontal accountability requiring the making of commitments between public agencies and the fulfillment of these commitments. Motivated by the public organization’s need for distributed decision-making and making of and fulfillment of obligations we proposed an agent-based modeling approach, in which each actors is modeling as an agent using roles and processes. Modeling for accountability needs to captures both a coordination of activities *and* a coordination of commitments view. This enables the modeling of cross-agency business processes and commitments loops consisting of requests, promises, reports on the status of the commitment, and the justification of the performance. We added justification to the commitment loop because accountability requires department and agencies to account for its actions.

The main modeling elements are classified as actor, role, process and message objects. Software agents are used to simulate the actors and dynamic behavior of the organization network. In order to deal with the complexity of modeling commitments and to ensure a complete commitment loop can be modeled, we defined pre-defined building blocks consisting of roles and messages with can be customized to model a particular situation.

We tested the modeling approach in a case study of the design of a virtual business counter and evaluated the usability case study using a number of interviews. The modeling can be used to model commitments and identify flaws in commitment loops. The high-level commitment level ensured several times that a complete commitment loop was implemented. The interviewees indicated that our modeling approach is very effective at identifying incomplete commitment loops finding and changing responsibilities, however, that it is sometimes very hard to understand the complex relationships between commitments, performance and reporting.

The preliminary testing showed that commitments loops are usable to identify incomplete loops, however, the understandability and easiness-of-use by non-modeling experts should be improved. Future research will be focuses on improving the understandability by adding a separate view to visualize execution of the commitment loops.

Government agencies are in the process of creating cross-agency business processes. Our modeling approach can help them to check flaws in their current process and can help to create complete commitments loops and avoid flaws when designing new cross-agency processes. This should help to avoid long-lasting discussions after implementation concerning who is responsible for what, should ensure a higher level of customer service by avoiding unanswered request or request passing the due dates set by laws.

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