# Devising DEMO Guidelines and Process Patterns and Validating Comprehensiveness and Conciseness

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**Abstract.** This case study paper presents DEMO models of a very complex process of urban construction licensing from a city hall. From our practical experience in this project, we elicit some guidelines and process patterns that may be useful to other similar projects and also guide DEMO modelers in similar scenarios of process complexity. From the metrics we got from this case study, we provide an empirical validation of DEMO's qualities of comprehensiveness and conciseness. Thanks to the nature of the transaction axiom, we managed to uncover hidden or neglected important process steps, not captured in the results of models previously obtained by the use of a flowchart approach.

**Keywords:** Enterprise engineering, DEMO, case study, guidelines, process pattern, validation.

## 1 Introduction

Enterprise Engineering aims to develop thorough theories, methods and tools to design, engineer and implement organizations. After decades of experience and progress in the discipline of software engineering, many software design guidelines and patterns have been elicited that guide software engineers in their work, making it more effective. Even though the Design and Engineering Methodology for Organizations (DEMO) has a set of proposed generic method steps and some proposed ways of working, as well as sound theories behind it, we claim that this is far from sufficient for a widespread adoption of DEMO. We consider that a good number of very complex real life DEMO projects, as well as important lessons learned – in the form of guidelines and process patterns – have to be presented to the scientific and practitioner communities, so that such lessons can be reused in other projects and then, the body of knowledge of these guidelines and patterns themselves, further improved. We envision a future where a good enterprise engineer will be a person with a high degree of knowledge in guidelines and process patterns that complement proposed methods.

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This paper aims to be a relevant step in the path to that vision while presenting the DEMO models of a very complex process of urban construction licensing from a real-world city hall. From our practical experience in this project we elicit some guidelines and process patterns that may be very useful to other projects and also guide DEMO modelers in similar scenarios of process complexity. Furthermore, from metrics we got from this case study, we provide an empirical validation of DEMO's qualities of comprehensiveness and conciseness. Thanks to the nature of the transaction axiom, we managed to uncover hidden or neglected important process steps, not captured in the results of models previously obtained by the use of a flowchart approach.

Section 2 presents our Research method and problem. Next, in section 3, we present DEMO - Operation and Transaction Axioms. Section 4 has our Project steps, case models and description obtained from a series of meetings. Section 5 explores our results of Lessons learned and devising guidelines and process patterns. In section 6 we do our Validation of DEMO's conciseness and comprehensiveness and finally, in section 7, we present our Conclusions.

## 2 Research Method and Problem

On this section we present the research method used as well as the motivation behind this paper. A set of seven guidelines are proposed in [1] for understanding, executing, and evaluating research in Information Systems (IS). In order to assess how the design artifacts presented in this paper meets IS research standards we use the respective guidelines, as described below.

*Guideline 1: Design as an Artifact* - in this paper three main artifacts are presented: (1) DEMO models of a very complex real life process, (2) a set of guidelines and process patterns that were devised from this case and (3) a validation of the claimed DEMO qualities of comprehensiveness and conciseness.

*Guideline 2: Problem Relevance* - There is a great lack of guidelines and process patterns to complement already proposed Ways of Working of DEMO and this hinders a more widespread adoption of this method. Another problem that seems to impede such adoption is the lack of published large real life cases and convincing validations of the claimed qualities for this method.

*Guideline 3: Design Evaluation* - To evaluate the utility of the design artifact we applied the "*Case Study*" technique from Hevner's observational evaluation method. With a long process of analysis of the existing documentation, meetings with the city hall's collaborators, validations of the produced models, and production and analysis of certain metrics of this project, it was possible to reach and ground the conclusions presented in this paper.

*Guideline 4: Research Contributions* - The huge complexity of the modeled process is a rich source of knowledge that may be reused in similar contexts and also for facilitating widespread adoption of DEMO, as well, as a training example of a complex case. The guidelines and process patterns we identified seem to be useful and generic enough to be reused in other projects and contribute to the body of knowledge of DEMO Ways of Working. The first guideline aims to avoid the necessity of rolling

back or canceling many useless c-acts and c-facts, by only starting sequential enclosed transactions after the previous one has been accepted. The second artifact is a pattern to be applied in DEMO's process model that helps us deal with cases of parallel join of and type, where one transaction needs to wait for multiple transactions possibly being executed in parallel. The third artifact can be considered as both a guideline and a pattern and aims to facilitate complex decision processes, by proposing the creation of a transaction that may be initiated in multiple points throughout the process if needed.

*Guideline 5: Research Rigor* - The process used follows a rigorous step-by-step logical reasoning, using the solid theoretical foundations from DEMO as properly explained throughout the whole document.

*Guideline 6: Design as a Search Process* - This paper has the advantage of having DEMO as base, which provides a set of coherent and solid definitions for many organizational concepts which constitute "laws" that help direct the construction of the artifacts. The artifacts themselves resulted from highly interactive process of many meetings with the organization's collaborators where we kept searching missing details of processes and also guidelines and patterns that could be useful and reused in similar contexts. Also by looking at particular metrics of our project efforts we managed to realize one of our aims: to validate some of DEMO's most important qualities.

*Guideline 7: Communication of Research* - To communicate our research and conclusions we are using this paper.

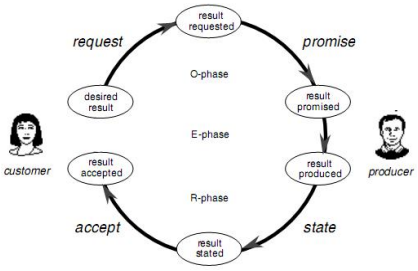


**Fig. 1.** Actors Interaction with Production and Coordination Worlds[2]

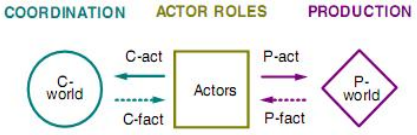


**Fig. 2.** Actors Interaction with Production and Coordination Worlds[2]

## 3 DEMO - Operation and Transaction Axioms

In the Ψ-theory [2] – on which DEMO is based – the operation axiom [3] states that, in organizations – that are considered systems – subjects perform two kinds of acts: production acts (P-acts) that have an effect in the production world and coordination acts (C-acts) that have an effect on the coordination world. Each of these worlds can be considered as the set of effects and/or facts produced by the acts of the system. Subjects are actors performing an actor role responsible for the execution of these acts. At any moment, these worlds are in a particular state specified by the C-facts and P-facts respectively occurred until that moment in time. When active, actors take the current state of the P-world and the C-world into account. C-facts serve as agenda for

actors, which they constantly try to deal with. In other words, actors interact by means of creating and dealing with C-facts. This interaction between the actors and the worlds is illustrated in Figure 1. It depicts the operational principle of organizations where actors are committed to deal adequately with their agenda. The production acts contribute towards the organization's objectives by bringing about or delivering products and/or services to the organization's environment and coordination acts are the way actors enter into and comply with commitments towards achieving a certain production fact [4]. Examples of P-facts belonging to a pizzeria's P-world can be: *"Pizza #120 has been ordered"* or *"Pizza #233 has been delivered";* whilst examples of C-facts belonging to the pizzeria's C-world can be: the request of the production fact *"Pizza #120 has been ordered"* (calling the pizzeria and requesting a desired pizza) or the acceptance of the production fact *"Pizza #233 has been delivered"* (accepting the pizza brought by the delivery man).

According to the Ψ-theory's transaction axiom the coordination acts follow a certain path along a generic universal pattern called transaction [3]. The transaction pattern has three phases: (1) the order phase, were the initiating actor role of the transaction expresses his wishes in the shape of a request, and the executing actor role promises to produce the desired result; (2) the execution phase where the executing actor role produces in fact the desired result; and (3) the result phase, where the executing actor role states the produced result and the initiating actor role accepts that result, thus effectively concluding the transaction. This sequence is known as the basic transaction pattern, illustrated in Figure 1, and only considers the "happy case" where everything happens according to the expected outcomes. All these five mandatory steps must happen so that a new production fact is realized. In [4] we find the universal transaction pattern that also considers many other coordination acts, including cancellations and rejections that may happen at every step of the "happy path". Even though all transactions go through the four – social commitment – coordination acts of request, promise, state and accept, these may be performed tacitly, i.e. without any kind of explicit communication happening. This may happen due to the traditional "no news is good news" rule or pure forgetfulness which can lead to severe business breakdown. Thus the importance of always considering the full transaction pattern and the initiator and executor roles when designing organizations [4].

## 4 Project Steps, Case Models and Description

In figures 3, 4 and 5 we present the 3 parts of our actor transaction diagram and in figure 6 we present part of the process structure diagram of this case. In the text that follows we present the full case description of this process. This description can be considered as a general explanation of the operation of this process, structured around the final result of the modeled transactions. These final models were the result of a lengthy process of several meetings that took place with the involved stakeholders from the city hall, namely: a lawyer, an architect, an engineer and the city councilman. We started by realizing a Performa-Informa-Forma (PIF) and a Coordination-Actor-Production (CAP) analysis [3] of the flowcharts provided to us in our first

meeting. These analysis gave origin to a first version of the Transaction Result Table (TRT) and of the Actor Transaction Diagram (ATD). These were used as a base for the second meeting where some corrections were made and new information was gathered and refinements were introduced into the models. During the iterations of this process frequently new information would be reminded either in the form of other flowcharts or process steps that were not written anywhere but were somehow following the national law and existed only in the minds of the city hall's collaborators. After several iterations of the previous steps, done until we got a relatively stable ATD, we produced the Process Structure Diagram (PSD) that aims to serve as a basis to configure a future workflow system to automate most of the executed work, currently mostly paper based. While validating this diagram, new information in the form of new process steps and new process step inter-dependencies would be found, which lead to the specification of even more transactions and new versions of the TRT, ATD and PSD. In our experience of this project we witnessed in practice the power of the operation and transaction axioms of DEMO. Compared to other modeling approaches, the fact that we keep asking to the interviewees about all the steps of each transaction and all the time clarifying who initiates and who executes each transaction allows us to uncover many hidden or tacit responsibilities and process steps. After this summary of our project steps, the full case description follows which will serve as a basis for the presentation of our contributions.

A citizen comes to the city hall and heads to the construction department desk and expresses the wish to acquire a license for a construction bringing the respective project's documents. The clerk initiates the procedure by creating a new process instance in the system and stamps the delivered documents with the date, the kind, the application number and the number of pages and then verifies the citizen's signature. The clerk assigns a process manager to this process instance and requests the citizen to pay the fee relating to the registration of a new process. Afterwards, the clerk delivers the documents to the process manager. He then initiates a preliminary analysis, verifying the

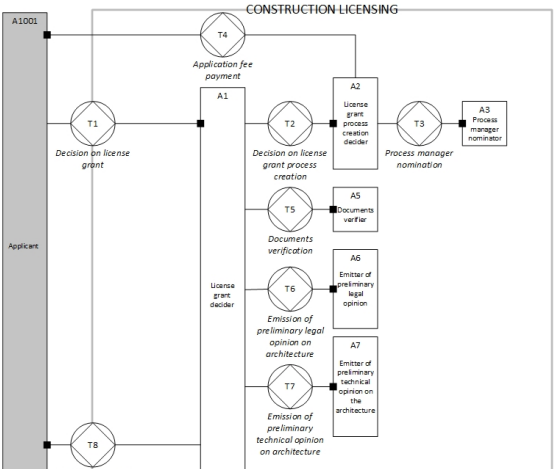


**Fig. 3.** Construction licensing ATD - part 1

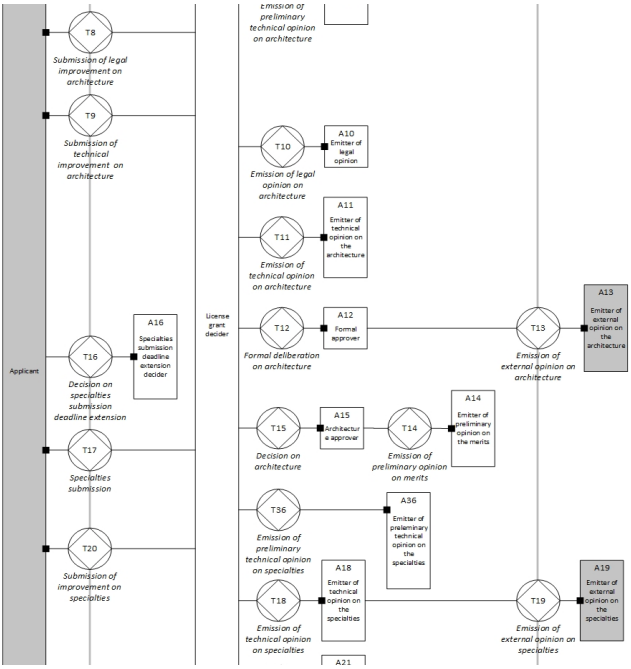


**Fig. 4.** Construction Licensing ATD - part 2

delivered documents and specifying in a check list the documents that were delivered and the ones that are missing. He then forwards all documents to the legal office.

The lawyer then makes a preliminary legal analysis of the documents and emits a preliminary juridical opinion where eventual missing legal documents are pointed out. The process is then forwarded to the architecture office where the architect analyzes the document and issues a preliminary opinion on the architecture project. If problems arise from these analysis, the citizen is notified by the city hall with an official letter requesting the submission of improvements in legal and/or technical aspects. After the eventual legal improvement, the lawyer may then issue a final legal opinion on the licensing request. After the eventual architecture improvement is submitted, the architect will issue the final technical opinion on the architecture. The chief of the urban and planning division checks the legal and architecture opinions issued about this process and assesses the necessity to ask for further external opinions on the matter. As soon as there is the emission of the external opinion on the architecture, the chief of division confirms all the opinions and the process is forwarded to the city councilman that makes a final appreciation of the architecture, assessing if all the administrative acts, either internal or external, are acceptable. If there is no need for the emission of a preliminary opinion on the final merit by the lawyer, the approval of the architecture will take place. Otherwise, it can be concluded that the project has no conditions to be executed and the process will come to an end, where an opinion is emitted that states the construction as infeasible. The process manager is then alerted to notify the

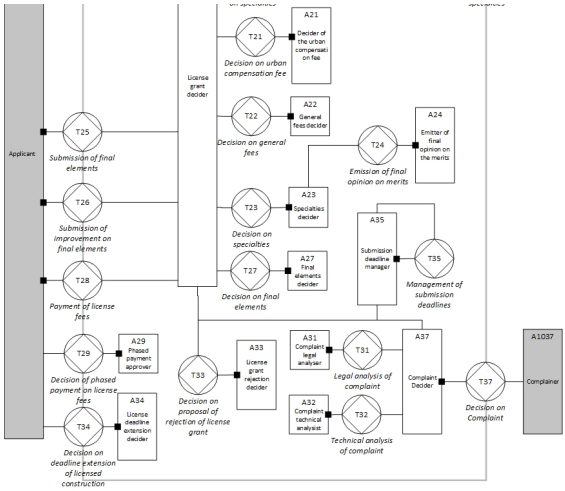


**Fig. 5.** Construction Licensing ATD - part 3

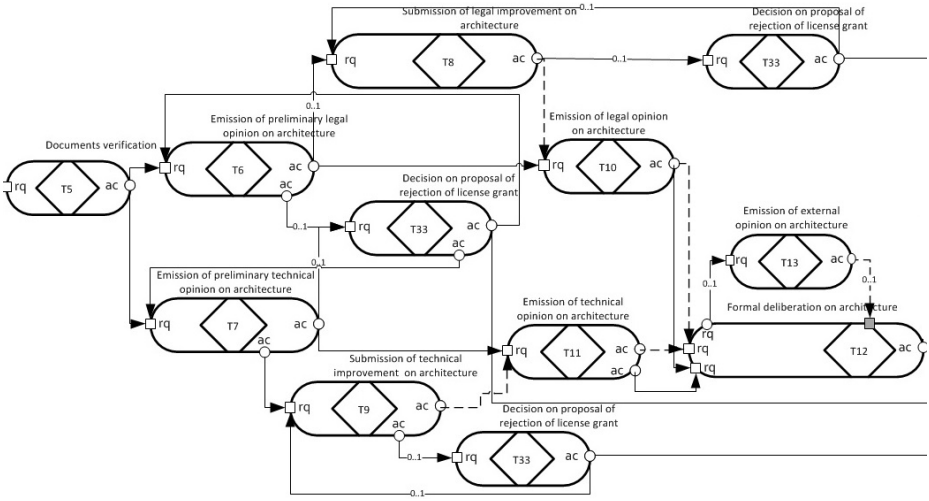


**Fig. 6.** Construction Licensing PSD (partial view)

citizen of the result of the municipal administrative acts that culminated in the rejection of the license. In the case of a positive decision, the citizen receives a notification of the approval of the architecture project together with a request to submit the specialties project, that is, the detailing of the several relevant technical designs for the complete construction project. If, by any reasons, the citizen does not deliver the specialties project within a 6 month time frame, he still can ask for a one time prorogation of the delivery date and for a period not longer then 3 months as long as he can supply proper grounding for such request. If the deadline is not respected, the city hall will terminate the process with a decision on rejecting the license. After the citizen

submits the specialties project, the engineer of the technical services of construction department analyzes the content of the documents, and emits a technical opinion on the specialties. When there is the need to consult with external entities, the request of an external technical opinion on the specialties is made and after the reception of the external opinion, the engineer emits his final technical opinion. The process is then forwarded to the civil engineer in charge of the technical services of construction for analysis. The emission of the preliminary technical opinion over the specialties projects may conclude that there are aspects that need to be revised by the citizen. When this happens, the process manager, requests the citizen, in a notification, to submit an improvement on the specialties documents which, when delivered, is forwarded to the responsible civil engineer of the technical services of construction for a new appreciation. The civil engineer then emits his final opinion in the form of a legal opinion. This opinion can be positive if the project fulfills all the current legal obligations or negative if there is any objection. When everything is according to the law and requirements, the civil engineer, after emitting the opinion, includes a proposal on the fee to be paid by the citizen, and then the process is forwarded to the architecture office. The nominated architect is asked to decide on the urbanization compensation fees to be applied and that is followed by the decision on applicable taxes done by the technical coordinator. This information is then presented to the city councilman that will, in his turn, decide over the specialties taking into consideration the whole process. He approves the specialties if the process is according to the laws and rejects it if there are any flaws. If any legal questions arise and so that all ambiguities are answered, the city councilman may request another legal opinion on the merits of the project before his final decision. As soon as the lawyer emits his final appreciation of merit, the process is forwarded again to the city councilman so that he may decide over the specialties. After the decision and with proper authorization by the city councilman, the citizen is notified regarding the final appreciation of the specialties and is asked to submit to the city hall the final elements (documents and other details) indispensable for obtaining the construction license. When the citizen submits the final elements to the city hall, the city councilman verifies them and if any irregularity is detected he requests that the citizen submits an improvement on the final elements so he can remedy the process. When the city councilman receives the process including these final improvements, he evaluates the final elements and decides to approve them or not. If the decision is positive he will in turn decide in a positive way on the main decision of the granting of the construction license. The citizen is informed by a notification about the decision and on the fee of urban charges to be paid. If the citizen cannot afford the total amount of the urban charges at once he may request the city hall to approve a phased payment. This request is delivered to the process manager that forwards it to the city councilman. He then verifies the argumentation and makes the decision regarding the phased payment of the urban charges.

While the licensing process happens or even after it has been approved a third party with interest may go to the city hall examine ongoing processes, and, if considering that there is some harm, he or she may submit a written complaint in the urban division. The process manager will deliver the complaint of the opposing third party to the licensing office of the city councilman so that the licensing process or the

construction itself may be halted, and the reasons that lead to the complaint may be analyzed. The complainant can add further information to the process and assist in the decision making of the licensing of the construction. The city councilman is informed immediately whenever a complaint of a construction process is made, and if needed, may ask the legal office if there is grounding or if it reports to questions of private rights to which the city hall has no jurisdiction. To that end the lawyer is asked to issue his legal opinion on the complaint. After issuing his legal opinion, the lawyer may also send the process to the technical office of architecture asking for a technical appreciation. After gathering the information regarding the groundings of the complaint the city councilman makes a final decision on the complaint.

When close to the stipulated end date conceded for the conclusion of the construction, if the contractor realizes that more time is needed, he informs the person responsible for the request, and this person goes to the city hall to request that the stipulated deadline for the conclusion of the construction may be extended. The city councilman analyzes the request and makes his decision after which the process manager informs the citizen. At any moment in the whole process whenever someone considers that the license must be rejected, a proposal for a decision on rejection is made and it is requested that the city councilman takes such decision. He will make a decision on this proposal and if the decision is to reject, then the license will be declined and such declination will be communicated to the citizen. If he decides not to reject then a request of the previous process step is made so that a new appreciation is made so that the process can continue where it was.

## 5 Lessons Learned and Devising Guidelines and Process Patterns

While modeling this very complex process that has nearly 40 transactions, we faced several instances of having to choose between different alternative ways to model certain process flows and inter-dependencies. Solutions or guidelines for handling and deciding on such alternatives cannot be found in currently proposed DEMO Ways of Working. We devised alternatives for certain modeling problems and took decisions which seemed the best and most elegant way to solve such problems. From this experience we produced the following set of guidelines and process patterns, proposed to be part of the DEMO Way-of-Working's knowledge base.

From the modeled process of our case, we see that actor role *license grant decider* has a pivotal role in the process, in the sense that it coordinates the execution of all of the transactions directly enclosed in transaction *T01 - license grant decision*. Now the question arose on how to specify the causal links that initiate each of the enclosed transactions. By following the guidelines described in DEMO Way of Working version 2 [3], one would have to specify that *when T01 is requested* then all enclosed transactions at the next level are also requested. The respective action rule would be something like: *when T01 is requested then T02 must be requested; T05 must be requested; T06 must be requested* etc. Then the action rules that handle the request of their respective transaction would have the form: *when T05 is requested and T02 is*

*accepted then*... where the acceptance of T02 would be a conditional link between T02 accept and T05 request. From a pure conceptual point of view and in small processes like the ones on the examples of the library and the pizzeria in [3] (p. 192) such modeling option makes sense. But from a practical point of view, and taking in account that the Process Model is supposed to directly guide the design of a workflow process in a Workflow Management System [3] (p. 83), that option does not make sense. In our case, the action rule that deals with T01 request would lead to the request of around 10 other transactions. Being the case that, in many real life instances of this process, execution does not reach even half of the way when the license grant is declined. That would lead to the necessity of rolling back or canceling many useless c-acts and c-facts. The alternative option and guideline that we propose is that, *whenever there are transactions enclosed in a higher level transaction and these enclosed transactions are, by nature, executed in a sequential fashion, then only after the acceptance of the preceding transaction should we execute the act of requesting the next transaction*. This is the guideline that is followed throughout our case and visible in the PSD in Figure 6. Following this guideline also results in a simpler and cleaner diagram with less line clutter that would result of following the standard old-fashioned approach. This guideline can be seen as the application of LEAN principles [5] to enrich DEMO's body of knowledge as to reduce "process waste" and inefficiencies.

Another interesting problem we faced – and no publicly available case shows – is how to specify, in the Process Model, a flow situation of a *parallel join of and type*. In our case, when the architecture project is submitted, after the document verification transaction there is a *parallel fork* of the flow since the emission of legal opinion (T6, T8 and T10) can occur in parallel with the emission of technical opinion (T7, T9 and T11). However, the formal deliberation on architecture (T12) can only proceed if both the previous transactions (T10 and T11) have finished, i.e., have been accepted. So two mandatory conditional links have to connect the accept of the previous transactions with the request of the T12. And we also need two mandatory causal links linking these same c-acts/facts, since whichever transaction finishes first, the request of T12 will have to wait for the accept of the other, and when this accept is a fact, it will finally cause the advancement of the process. Concluding, a proposed process pattern is: in DEMO's Process Model, *one specifies a parallel join of and type of N transactions by linking the accept c-fact of these N transactions with the request c-act of the following transaction, both with a mandatory conditional and a mandatory causal link*. This pattern can be seen as a DEMO counterpart of the workflow pattern known – for both BPMN and UML's activity diagram – as "*Synchronization*" described in [6]. Our pattern is, nevertheless, an innovative contribution, as it was not clear or obvious how that could be done with DEMO. Although we don't find that case in our example, as logical induction, a *parallel join of type or* would be represented in a similar fashion but the *conditional links would be all of optional type*. This can be considered as the DEMO counterpart of the pattern "*exclusive choice"* from [6]. As both these patterns create some considerable clutter in the diagram we propose to the DEMO standard managers to consider the specification of special link kinds with specific symbols to denote these cases of *parallel join* of *and* and *or* types. One could argue that, due to the highly complex nature of the modeled decision process,

a declarative workflow approach like [7] or [8] should be followed as to reduce flow clutter that our proposed guideline seems to imply. But DEMO's underlying theory considers an organization as a system with state changes affecting the world. On top of that, the causal and conditional links in the process model end up being conceptually equivalent to the automata structure of the declarative workflow approach which focuses on constrains and not on the many possible flows. So DEMO's quality of conciseness comes here into play. In the declarative workflow approach, the automata are a really concise way of representing the structure of constrains that represent the possible transition space of a process. DEMO's Process Model realizes the same in a more intuitive fashion, thanks to the notation used in PSD which reminds both BPMN and flowchart elements.

Another pattern we identify is that, in these cases where one is modeling a complex decision process (having as root transaction T01), a negative decision would be the execution of the decline act of T01 and the promise act will already constitute a positive decision. And during the execution of the process, in many possible points of the flow a sub-decision transaction may cause the decline of the global decision T01. Now, looking at our case, we see that, if in any point in the process, some actor role makes some negative decision or opinion, that will cause actor A01 to initiate T33 called *Decision on proposal of rejection of license grant*. Thus, the request of this transaction can be caused by the accept c-fact of many different transactions as we can see on the presented PSD. And a possible outcome is that the executor of T33 may decide that the license grant should not be rejected and the process should continue. In our modeling efforts the question arose: should each of these possible decisions on proposal of rejection be a separate transaction for each point it can happen or is it indeed the same transaction but requested in different points of the process? Since it's the same person/role that takes the decision it makes sense to become only one transaction. And also it is always actor A01 who requests T33 because some intermediary decision transaction decided the there should be a rejection. So A01 will have a very complex action rule that, according to the stage of the whole process, will have to probably repeat a request of some decision transaction that had lead to the proposal of the rejection. Concluding, another guideline and process pattern that we identify and may be generalized and reused in other projects is that *on complex decision processes with many transactions and sub-decisions one should consider specifying a transaction that can be requested whenever it's appropriate and that consists in a decision on the proposal of rejection of the global decision. Such decision transaction can then cause the decline of the main decision transaction or cause the repetition of a request, probably of the transaction that has led to the rejection proposal.* This may, at first sight, seem over-bureaucratic. But such transactions are really needed to clarify responsibilities and opinions of the participants in crucial decisions that involve huge amounts of resources normally allocated to these kind of construction processes. This third artifact ends up showing how the DEMO approach is indeed powerful as it naturally embeds the philosophy that any business process is a tree of transactions [3] and, consequently, a complex decision process will be a tree of decisions. Such a tree structure pattern has been identified in related research like the one found in [9] regarding decision modeling. Our DEMO based approach has the advantage of

using the transaction pattern acts (decline and state) to naturally capture the two possible outcomes of a complex decision (license grant declined and license grant approved) and coherently relate them with other parts of the tree, with the possibility of "resuming" the decision process on the point before the proposal for rejection was issued.

## 6 Validation of DEMO's Conciseness and Comprehensiveness

An interesting outcome of this project was the fact that several key decision points in this whole process were not specified as tasks or decisions in the flowcharts but were hidden somewhere in the descriptions of the flowcharts or in the minds of some collaborator. In this section we present a table with a comparison of the tasks present in existing flowcharts for both the license grant process and the complaint process and their DEMO counterparts. We do the same for the roles, namely the responsible roles found in the flowcharts and the initiating and executing organizational functions (that are directly mapped to DEMO actor roles) we found. Later on in this section, we analyze this comparison and devise a set of metrics that serve as an empirical validation of DEMO's qualities of conciseness and comprehensiveness.

| **License Grant Process** | | | | |
|---|---|---|---|---|
| **Flowchart Task** | **Responsible Organizational Role** | **DEMO Transaction** | **Initiating Org. Function** | **Executing Org. Function** |
| 1 Reception of documents; Registration and appointment of a process manager | Clerk | T1 - Decision on license grant (request) | Citizen | City councilman |
| | | T2 - Decision on license grant process creation | Receptionist | City councilman |
| | | T3 - Process manager nomination | Receptionist | Receptionist |
| | | T4 - Application fee payment | Receptionist | Citizen |
| 2 Verification of Architecture documents | Process Manager | T5 - Documents verification | Receptionist | Process manager |
| 3 Preliminary analysis of the legal office | Lawyer | T6 - Emission of preliminary legal opinion on architecture | Process manager | Lawyer |
| 4 Preliminary SAP Analysis: instruction, preliminary assessment | Architect ‖ Process Manager | T7 - Emission of preliminary technical opinion on architecture | Process manager | Architect |
| (If it is contrary to the rules) 5 Order of outright rejection | City councilman ‖ Process Manager | T1 - Decision on license grant (decline) | Citizen | City councilman |
| (if missing information) 6 Order perfecting | City councilman / Process Manager | T8 - Submission of legal improvement | Lawyer | Citizen |
| | | T9 - Submission of technical improvement | Architect | Citizen |

| | | | | |
|---|---|---|---|---|
| 7 Request opinions to external entities | Process Manager | T13 - Emission of external opinion on architecture | Chief of urban planning division | External entity |
| 8 Consideration of the architecture project | Architect \|\| Lawyer | T10 - Emission of legal opinion on architecture | Lawyer | Lawyer |
| | | T11 - Emission of technical opinion on architecture | Architect | Architect |
| 9 Approval of opinions | Chief of the urban planning division | T12 Formal deliberation on architecture | Lawyer, Architect | Chief of urban planning division |
| (if unfavorable) 10 Order of dismissal | City councilman | T15 - Decision on architecture | Chief of urban planning division | City councilman |
| (if favorable) 10 Order of granting | City councilman | T15 - Decision on architecture | Chief of urban planning division | City councilman |
| 11 Notification for submission of specialties project | Process Manager | T16 - Decision on specialties submission deadline extension | City councilman | Lawyer |
| | | T17 - Specialties submission | City councilman | Citizen |
| 12 Verification of specialties and enforceable terms | Civil engineer | T36 - Emission of preliminary technical opinion on specialties | Process Manager | Civil engineer |
| | | T18 - Emission of technical opinion on specialties | Process Manager | Civil engineer |
| 13 Necessary queries to external entities | Process Manager | T19 - Emission of external opinion on specialties | Civil engineer | External entity |
| 14 Determination of deposits, fees for conducting, maintaining and strengthening the primary and secondary urban infrastructures, Compensation and Fees | Technical Coordinator | T21 - Decision on urban compensation fee | Civil engineer | Chief of urban planning division |
| | | T22 Decision on general fees | Chief of urban planning division | Technical Coordinator |
| 15 Final Decision | City councilman | T24 - Emission of final opinion on merits | City councilman | Lawyer |
| | | T23 - Decision on specialities | Technical Coordinator | City councilman |

| **Complaint process** | | | | |
|---|---|---|---|---|
| 1. Receiving of the complaint; Registration and assignment of a process manager | Clerk | T37 - Decision on complaint (promise and infological and datalogical acts) | Citizen | City councilman |
| 2. Determination of existence of process and attaching folder | Process Manager | T37 - Decision on complaint (infological and datalogical acts) | Citizen, Lawyer, Architect, City councilman | City councilman |

| | | | | |
|---|---|---|---|---|
| 3. Verification of the reason for complaint in the construction | Inspector | T38 - Analysis of complain on construction site | Citizen, Lawyer, Architect, City councilman | City councilman, Construction Inspector |
| 4. Injunction assessment of the validity of the claim by legal office | Lawyer | T31 - Legal analysis of complaint | Citizen | Lawyer |
| (if denied) 5. Order notification and file the complaint in the archive | City councilman | T37 - Decision on complaint (state) | Citizen, Lawyer, Architect, City councilman | City councilman |
| 6. Injunction assessment as to whether or not legalize the construction by SAP | Architect | T32 - Technical analysis of complaint | Citizen | Architect |
| 7. Order to formalize project | City councilman / Chief of the urban planning division | T37 - Decision on complaint (state) | Citizen, Lawyer, Architect, City councilman | City councilman |
| 8. Order of embargo | City councilman | T37 - Decision on complaint (state) | Citizen, Lawyer, Architect, City councilman | City councilman |

As can be observed in the first table, some of the specified organizational roles responsible for flowchart tasks are not the same as the executing DEMO organizational functions, revealing the ambiguity of the flowchart approach and the much more precise DEMO approach taking in account the existence of the initiator and the executing actor roles which helps a lot to clarify responsibilities. Looking at both tables, there were 9 DEMO transactions that were specified in our project and were missing in the flowcharts, especially in respect to the final part of the license grant process, namely transactions: T14, T20, T25, T26, T27, T28, T29, T33, and T35. Furthermore, we find that 7 flowchart tasks correspond to two or more DEMO transactions (1 corresponds to 4). This means that these flowchart tasks are, due to their ambiguity, indeed hiding at least one of two ontological and human acts in each task. So we can consider that, in average, around 9 other DEMO transactions were also missing in the flowcharts, amounting to around 18 transactions missing in the original contents. In the flowchart relating to the complaint process, we witness a different issue: 5 of the flowchart steps are either ontological transaction steps or infological or datalogical acts of the same transaction. This contributes to show the conciseness quality of DEMO thanks to the aggregation of several ontological and human process steps in one DEMO transaction, thanks to the transaction axiom, and also the power of abstraction from implementation given by DEMO's distinction axiom.

In total, for these two inter-related processes of license grant and complaint, we found, in the given documentation, 23 flowchart tasks spread over diagrams contained in 7 A4 pages, in 4 documents. Due to a lack of clear semantics of a flowchart approach, direct interpretation of these flowcharts was either not easy or not possible. These flowcharts were accompanied by descriptions of the tasks contained in 21 A4 pages, also in 4 documents. These allowed the interpretation of the whole process but in an incomplete way, as several process and responsibility details were missing

(but found by applying DEMO). Such interpretation was difficult because the descriptions had many implementation details and also many complex references to several articles of National law. From the total of 28 pages of content in diagrams and descriptions we could not have a succinct and crisp global view of these processes.

By using DEMO, all this information, as well missing process information not written anywhere, was concisely summarized in a set of 38 transactions presented in 2 A4 pages, in the ATD (actors and transactions) view, or in 2.5 A4 pages, in the PSD (transactions process) view. Thanks to the clear semantics of DEMO and the natural devising of more precise and unambiguous names for the transactions and actor roles, the interpretation of DEMO's diagrams is much clearer and more precise than with the flowchart approach. If just looking at transaction and actor role names is not enough, one can look at our case description centered around the specified transactions that explains the meaning of all such transactions as well as process flow and interdependencies. This description occupies just 2.5 A4 pages

Taking in account that 18 transactions were missing, we can consider that around half of the ontological process was not precisely described in the flowcharts. This evidence clearly validates DEMO's quality of comprehensiveness, stated in [3] as implying that "all relevant issues are covered, that the whole is complete". The process may still not be fully and completely specified, but it is quite impressive that the DEMO approach allowed to discover a "hidden" half of the process and complete it with the other half. Moreover, if that half of the process would have been specified with the flowchart approach, with the same amount of detail the rest of the process was, we assume that we would have around 60 pages of content. By providing a view of the process in 2.5 pages of the PSD, plus 2.5 pages of description (i.e., 5 pages total), we manage to get a reduction of around 90% from the complexity of the original materials while still providing very comprehensive and complete information. This impressive reduction in complexity also strongly validates DEMO's quality of conciseness, stated in [3] as implying that "no superfluous matters are contained in it, that the whole is compact and succinct".

## 7 Conclusions

The results presented in the previous two sections help us to conclude that it is possible and necessary that complex cases like this are communicated to the scientific and practitioner communities so that widespread adoption of DEMO and Enterprise Engineering becomes a reality. The knowledge provided in the case description and associated models is, by itself, a valuable contribution to inspire similar initiatives. We furthermore present guidelines and patterns that we devised from our experience and may be generalized and reused in similar scenarios. Such re-utilization is one of the future lines of future work we envision. The validation we provide, based in our project's metrics is also an important contribution to bring more ground and inspiration for DEMO's application. It is, however, based in a single case and on the impressions of the authors. So another future line of research would be to apply similar metrics and analysis to other complex cases similar to this one. Our next step in this project will be the implementation of a Workflow

Management System supporting this process. After the implementation we intend to realize qualitative and also quantitative validations of some results of this paper and other interesting results we expect to achieve in this enterprise engineering and DEMO project.

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