Plan Authoring Applications for Emergency Management

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Abstract: In this paper we present a semi-formal tool using the concept of process modelling for emergency management developed within our project InfoStrom. This is meant to be an aid for rescue forces, energy providers and public authorities, whose measures and terminologies generally differentiate. Also, they do not have up-to-date documents and manuals available that could be adapted to new types of emergency (natural disaster, technical casualties as well as terrorist attacks) or be analysed for efficiency. Our approach intends to provide the ground for formal modelling as enabler for analysis, comparison and process customisation to synchronise plans of different domains and to make them transparent for any involved organisation.

1 Introduction

Natural disasters, technical casualties as well as terrorist attacks can affect many people directly. Not only get people harmed and values damaged, but also an extensive interruption of the electric current can be caused. At first sight, hospitals, police stations and communication operators have emergency generators to supply them with energy. But after a longer period than about eight hours, when the petrol reserves are exhausted, most generators stop their service and due to cascade effects the problem becomes serious, like the events in Japan showed [GST10, Per11].

When responding to and recovering from disasters a high level of coordination is necessary for all participating rescue and technical relief forces. Despite of great geographical distances between headquarters and the different units, rescue forces have to coordinate their actions and measures to save lives and material values efficiently. The responsibilities of rescue forces and their measures in case of a crisis are defined by regulations depending on the kind, the size and the location of the incident. Also, due to the federal structure of the state, the responsibilities are delegated to the level of municipalities. In some cases, adjoining municipalities are having totally different procedures and terminologies. Hence, regional or national crisis plans, i.e. MANV, ÜMANV[1] or service regulations, have to be

[1] Regional support in case of a mass-casualty incident; German: (Überörtliche Unterstützung beim) Massenanfall an Verletzten

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adapted to the local structures, constraints and terminologies to prevent misapprehensions. Those documents only supply a limited account of models for processes; that is why adjustments with regard to different situations are hard to make [HPT11, SB09]; due to the individuality of a county's or a municipality's operational procedures it is obviously best to let the stakeholders themselves accurately model the individual action plans for crisis response.

2 Intention

This plan authoring application is being developed within our project *InfoStrom* [IK11] to let stakeholders that take a part during a power blackout generate plans of their measures. The project strives to foster the collaboration of several geographically dispersed rescue organisations by developing plans of operational procedures to be prepared in case of a power blackout. Varying organisational structures and terminologies between rescue forces, energy providers and administration departments aggravate any form of comprehension to any stranger to one specific domain. The key is to make terminologies of different domains understandable to anyone. This can be done by a form of unification when elements of a terminology are abstracted to a level where they can be compared. But, on an abstracted level, a model of a plan is not applicable for specific operations anymore. A way has to be found to represent regional plans of operational procedures abstractly, but also to offer different rescue forces the option to adapt these plans to the specific circumstances and to develop custom models of the process chains used in practise.

Yet, there are a couple of commercial programs supporting rescue forces with an operation. There is, for instance, the *Crisis Commander* [Com11], that offers a web platform, where current notifications can be displayed, new documents can be created and information is collected. Also, in a crisis different executives and teams can 'meet' in this web portal to exchange plans and to communicate. Adresses and contacts of many resources can be stored. Though plans can be shared on the platform is not meant to develop them in this tool in advance of a crisis, also plans are not represented in a way users of other domains can understand them easier.

Also, there is the *Intergraph Planning & Response* of Intergraph SG\&I Deutschland GmbH [Int11]; this tool is meant to support the executives of an operation and offers a lot of information about and visualisation of the scene of a disaster. A user is very free with the possibilities of an individual configuration of the application. Also, it supports the management of plans of action as well as checklists and resources and shows all processes of the operation in a time line. This tool is a good example for features that are necessary to give an overview over an operation to defend a crisis. Though the application also meant for different domains, like, for instance, industry, police, fire brigades and transportation companies, only the members of crisis teams are supposed to use it, when the disaster already happened. The provided functions focus on the management of a real-time operation and only short-term planning in case of emergency.

Our intention is to provide rescue forces, energy providers and administration departments

with a tool for planning their processes as a preparation of the case of emergency in the long run. It shall be very easy to use, to be customisable to the user's individual needs and presuppose no more than the skill to use office software and the knowledge of the own specific domain. The created plans shall be represented in a familiar way, like checklists, but also be graphically shown in an intuitive way that makes it possible to see dependencies more clear and to arrange the elements of a plan in a better way. Also, plans that have been made shall be understandable to stakeholders of different domains by an adaption of the terminology.

3 Solution approach

In a first approach of modelling processes for rescue services, the measures of the ÜMANV were represented and correlated with the business process modelling tool *ARIS Business Architect* using *Event-driven Process Chains (EPC)* (see Fig. 3.1). This formal model language allows to analyse the operational procedures of crisis defence, to make them comparable and thereby to optimise them [Ars08]. The readability of these processes has been evaluated very positive by experts; a disadvantage is, however, the complexity of the used modelling environment. Also the terminology of the used items inside ARIS is different to the one of rescue services and cannot be adapted within the model architect [PR09].

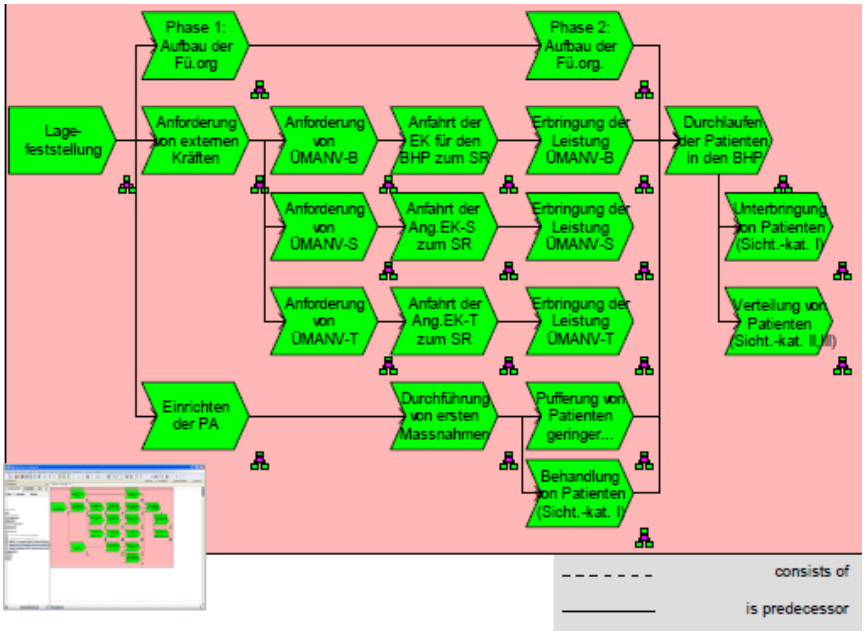

Figure 3.1: First approach: process modelling with *ARIS Enterprise Architect*

In a second approach a tool common in the office world was modified so that clients can work on their commonly used office environment. Therefore, an *Excel* sheet was created that allows i.e. fire fighters ore policemen, as experts of their domain, to build up a tabular plan with distinct tabs and types of action. These actions can be selected from a given list. Each plan is represented (see Fig. 3.2) by a tree (1) containing nodes that can be filled with information within an individual tab (2). Again, the measures of the ÜMANV were modelled and the nodes were named after its elements. The explorer view (1) allows the navigation through the given elements and the element nodes below them, i.e. actions, measures and measure carriers [Har10].

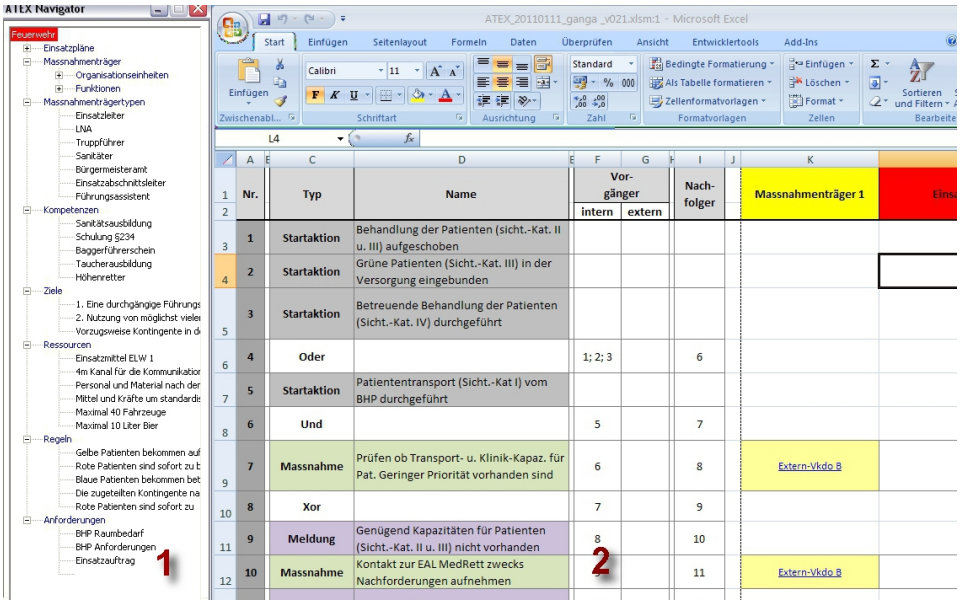

Figure 3.2: Second approach: *Excel*-version of a plan modelling application

The disadvantage of this approach was the complexity of functionalities and the representation of the result. Manual editing of functions and individual operators can only be done by macros and offers only a limited number of options. The tabs (2) that specify the elements by actions cannot be represented in a uniform graphical way due to their differentiation; this hampers the usability of the tool extremely.

Because of that, a new approach has been launched that shall contain the benefits listed above. Therefore, the specification of a documented plan of operational procedures, i.e. for resolving the crisis caused by an extensive power failure, is abstracted and reduced to its basic elements. The idea is that a user does not pick from a given pool of process types (actions, states) and arranges them to a plan, but to let the user be the author of his plan himself. The user has the choice to select process types and the terminology of a certain domain, but he can also edit the pre-defined types and define new ones. He shall be free to customise his own environment, the elements of the graphical user interface shall be

arranged user friendly and due to the recognition of a similarity to custom programs (i.e. *Excel*, *Word*) the user shall find easy access to this application. On the abstract level the process types, however named, are only defined by actions or states. Being arranged to a plan it shall be comparable with other plans by translating the used terminology to the terminology of another domain by analysing its elements.

The plan authoring application is currently being developed as a semi-formal modelling tool for InfoStrom and named *PLAN-T* ("*Plan your actions-Tool*"). Its structure should be consistent and the model according to software standards [MVI98]. Like a plant a plan should grow over the time, when filled with information, and take its individual shape due to the conditions of the process types within the procedures. The usability of the program plays a great role because people of many different domains (policemen, fire fighters, representatives of the energy providers and the departments) shall be able to model their procedures in the case of a power blackout. Therefore, the user is guided through the application by simple and mainly optional decisions, i.e. about what kind of process types he wants to use, and by the representation of the plan with three different views that are going to be explained later. The first decision the user is asked to make is to choose between pre-defined terminologies of certain domains (fire brigade, energy provider, etc.) or a custom terminology (see Fig. 3.3). The options are mainly to be optional to let a user choose himself when he completes any information and whcih of them.

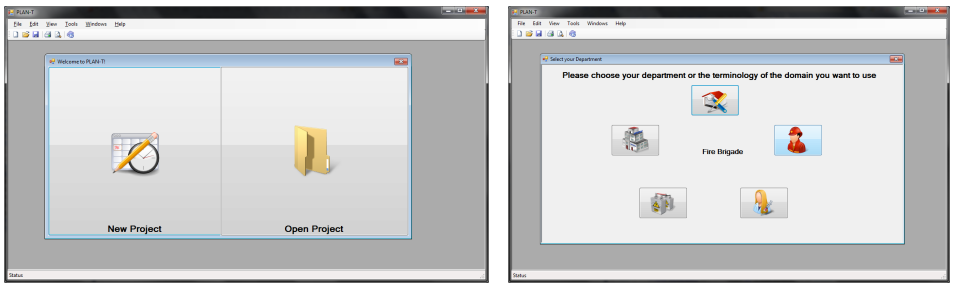

Figure 3.3: Opening Screen and the choice of a domain

When the user creates and arranges actions and states containing information about predecessors, successors and conditions a tree is formed, where the root node is determined to be the state of a shortly received emergency call. Process types can be arranged in- or excluding each other thanks to several condition options; this leads to the structure of a procedure tree within the plan tree. A user is free to choose from a list of template domain specific process types to edit them according to the own needs or to generate and name own element types that can be arranged and re-used. Editable template types for actions are, for instance, "message" or "measure" and for states, for instance, "strategic-" or "tactical-state".

The tool is separated into three different views; within any of them the input can be exported into textual documents or diagrams:

1. *Explorer View* of the plan tree and containing procedures/procedure trees (see (1) in

Fig. 3.4)

2. *Tabular View* of the elements and actions in sequence of proceeding analogue to the checklists used by rescue services containing all significant information (see (2) in Fig. 3.4 and Fig. 3.5)

3. *Graphical View* of the visualised graph of a selected procedure or the total plan (see (3) in Fig. 3.4 and Fig. 3.6)

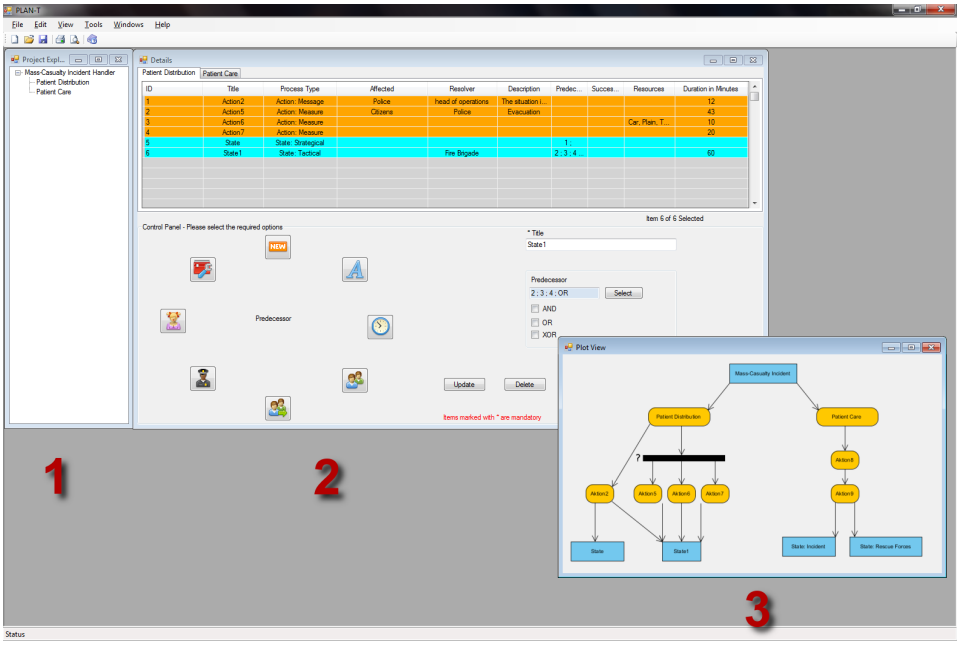

Figure 3.4: Overview

In the *Explorer View* the skeleton of the plan tree is visualised. A new procedure can be added to the main plan and can inherit other procedures as well; each one is represented by an individual tab in the *Tabular View*.

A tab in the *Tabular View* contains a checklist of process types that are used in a certain procedure. In the columns the different "parameters" of a process type are represented: a significant title, an extensive description in plain text, information about the people affected, resources, duration of the action and references to predecessor and successor actions. The user can add new, edit or delete process types, define them himself or choose from a certain terminology (i.e. fire brigades using "measures"). Also he can fill each type with the information represented in the columns. But these are optional; the user shall be free in his modelling and not be forced to spend time to provide information he does not need. In this view tools shall be simulated that most domains office workers are familiar with: checklists and *Excel*. In difference to *Excel* a user does not make any changes in

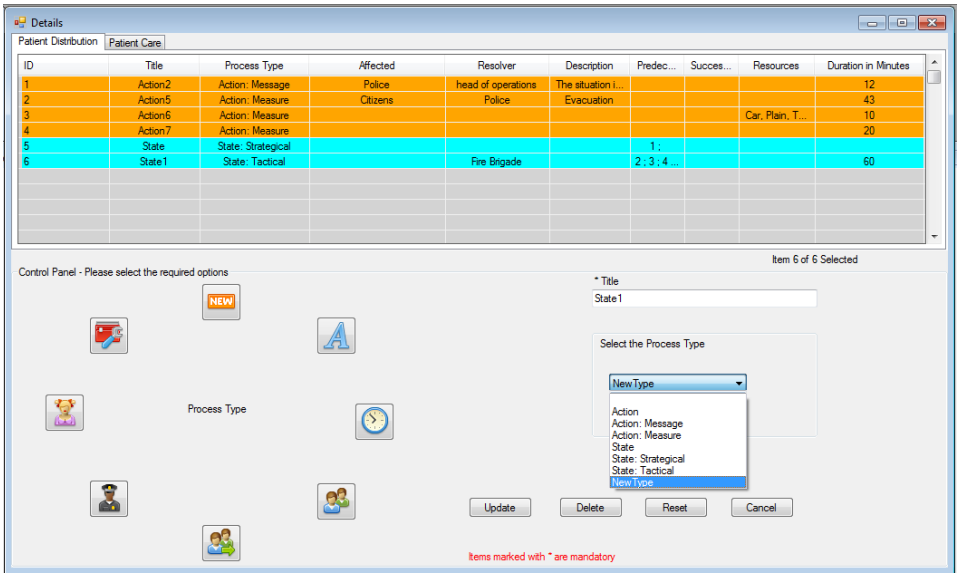

Figure 3.5: Tabular view of checklists and the tools to build new types of actions

the cells directly, but can change its content by selecting a row and filling the information requested by the parameter fields on the buttom of the window. If a cell is selected the parameter editor for the column of the row is shown directly. Thus a user shall not be confused by filling out cells in a tabular without any guidance, but shall be offered an editor, where all possible choices of information input is described.

The plan or just a specific procedure is visualised in the *Graphical View* as a graph, if information about all predecessors and successors of the process types is provided. Otherwise it is listed in the order creation. Different colours represent different types of process types. Both in the *Tabular View* and in the *Graphical View* actions are represented in orange colour, states are visualised cyan. The arrow between two blobs of process types represents the predecessor/successor-relationship, a fork with a question mark and an 'x' shows an 'or' or 'xor' condition. This view shall not only visualise the relations of the process types created in the *Tabular View*, but also make it possible to add new ones and rearrange them in a better way. From the top to the buttom of the view the blobs are ordered chronological. If a duration is given for a certain process type the represention can be improved by duration-dependend distances between the blobs. In further development our aim is also to implement a time line and different levels of time for fine and coarse time represantation. In business and project management graphical representations of networks are used to show the different milestones and their dependencies. With the information about the time a milestone takes a critical path can be estimated that reveals the shortest duration possible, but also which milestones can lead to a delay of the total duration of a plan. Transfered to crisis management the chronological order of actions and their dependencies could be improved to decrease the duration of an operation to solve a crisis faster.

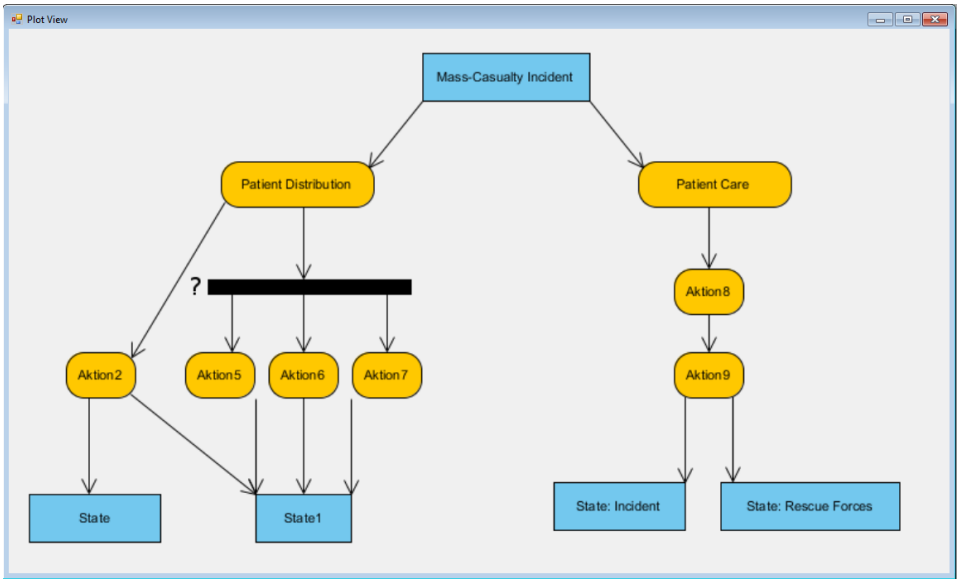

Figure 3.6: Graphical view of the modelled plan

The views have been ordered in way it is common with the *Explorer View* on the left side and the *Tabular View* in the middle. This view can be changed with the *Graphical View*, also all three views can be displayed at once. The windows are free movable, thus a user shall built his custom environment and get better into the application.

4 Conclusion

Because the idea of using a modelling tool, where the user is authoring his individual procedures, is still in a phase of maturation and designing, the screenshots still lack of many functions and descriptions that are still in progress of development. Also, further user tests must be conducted to evaluate its usability and user acceptance. This is done in cooperation with the authorities and rescue services of the county of Rhein-Erft and the county Siegen-Wittgenstein. Provided, the presented approach has a positive user response, further developments of this tool can help documenting the operational procedures. It can show the differences between the official service regulations and the procedures used in practise when they are generated correctly by a stakeholder. The resulting documents and diagrams could simply help a third person comprehending, analysing, comparing and optimising processes within any participating institution. Also, already existing plans can be designed and compared. If and how this might be working, is analysed within our project *InfoStrom* with the special view on the case of power blackouts by connecting the plans made by rescue forces and the authorities.

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