Abstract— The growing number of smart devices sold on the market and their falling prices open many possibilities to use them in many situations and to support different processes. These devices allow users to work from any place using the distributed model of communication or they can be used thanks to their positioning services in new situations and contexts to support business processes in completely new ways. The contribution introduces some possible extensions to the well known Business process modelling notation in order to express the mobility in process via widely used BPMN diagrams.

Keywords— Business process, BPMN, mobility, mobile object.

I. INTRODUCTION

Almost every business objects contains some mobility – the mobility of participants, mobility of artifacts, of information, data, devices etc. The mostly used notation for business process description does not have tools how to express or highlight the mobility concepts. The paper tries to make some suggestions to reclaim it partly. At the beginning of the paper it is necessary to introduce some basic terms and concepts.

A. Mobile objects

Mobile object is every object which can migrate, move and change its own position in the space. The process of the migration can be initiated in different ways – object can migrate by its own choice using own mechanism of movement, or it can be carried by other objects etc. Concrete types of object’s mobility will be discussed in the following part of the contribution.

B. Law of Mobility

According to [1] “the law of mobility observes that the value of any product or service increases with its mobility”. It means that the product which could be carried with the user will be used more often than the immobile product and that the mobile product could work with or adapt to some contextual conditions.

C. Law of Mobility preservation

Another law of mobility stated by the author of the paper says that the mobility is preserved in the sense that mobility in process cannot disappear, even after the process reengineering for example. If the mobility of one object is cancelled it must be replaced by the mobility of another object or participant of the process.

D. Basic characteristics of mobile processes

Business processes consists of ordered set of activities leading to realization of some business objective [2]. Each process is raised (implemented) in the scope of some organization unit but may cooperate with business processes of other organization units. We will try to characterise processes possessing some mobility elements i.e. mobile processes. Each business process is implemented in the scope of one organization but may cooperate with business processes of other organizations. The principal problem is characterization of processes possessing elements of mobility – mobile processes. Basic characteristics of mobile processes are introduced by Valiente a Haiden [3]:

- Position indeterminateness – position of some participant changes in time and so it cannot be accessed in the same way as participant whose position is stable. In addition to it the position of such a participant is not possible to find without communication.
- Decision, coordination and management depends on location of process participant – some decision may for example depend on participant’s position and other location dependent context

II. MOBILITY TYPES

A. By type of participant’s movement

Krisstofénsen [4] subdivides types of participant’s mobility in the following way:

- Wandering – participant performs some activity while moving between locations that are restricted to some rather small local space (building, grove...),
- Visiting – participant performs activities in various locations,
- Travelling – activities are performed during some tour (for example by some means of transport)

B. By type of activity

Basic categorization of mobile objects (participants) can be described by the kind of their activity in a business process:

- Packages – the aim of the object is to deliver some additional information (artifact) to the target place. They act as a subject of the transportation, so the transportation service is
not provided by the packages, but by the Carriers (will be mentioned later)

Questioners – objects/participants migrating in order to gain some information from different places

Carriers – often external providers of transportation services for other less or non-mobile objects/participants; they visit one or more destinations and load or unload the shipment there.

Experts – objects/participants that provide a service, which is not offered in the target environment by the local entities. The service is mainly requested by the destination environment. After the expert has finished the work it either returns back or it continues to the next destination.

Managers – they can help with administration of other objects or participants in the requesting destination (leader, (regional) manager, director, etc.)

Nomads – objects/participants migrating over the room in order to find better place for their existence. The migration is initiated by the object or by the original environment.

Examples: people, offices, companies etc.

C. By technology

Real mobility – in some resources called physical mobility [5]. The mobility of the participant or of the real object (PDA, Smartphone, Netbook, terminal, PNA, ...)

Software mobility – sometimes defined as logical mobility. The migration of some software snippets or threads among different locations (devices).

The combination of both types of mobility is also very useful because it brings the possibility to build for example the software client of a mobile device in relation to the actual local conditions. The mobile client could be really thin in case that the mobile network coverage is excellent, but it can be getting thicker if the coverage is getting worse. We call this concept as thickening client.

III. DISCOVERING THE MOBILITY

Steadily growing mobile technology market brings the possibility of mobilisation of up to now immobile processes. There exist some methods of discovering the mobility potential in business processes. Two of them will be briefly mentioned here.

A. Mobile opportunity

Valiente and Heijden [3] described a method enabling to discover opportunity for making use mobile technology for support of business processes. The method is based on gradual implementation of the following five steps

• First step describes business process by means of so called P-Graf. Its notation resembles that of BPMN. Diagrams depict various participants in trails, and also activities performed, and objects created in the course of time.

• The second step. Participants are provided by information about their location. It enables manifestation of mobility in the process but it is not very visible and unique. Consequently this step is enriched by categorisation of location types from the point of view of position indeterminateness. Mobility is considered also. Then it is possible to determine if examined processes are stationary or have mobility potential.

• The third step identifies important decision points. Decisions coming from objects in various tracks are modelled namely. Exchange of information among tracks with various locations is solved in this step. Here is potential for making use of distributed and/or mobile solution. The second purpose of this step is to denote by means of dotted lines coordinating managerial messages into the P graf. These messages are also used for supervision activities in various tracks by one participant in one specialized track.

• The fourth step (complication of location). Its essence is in mobilization of at least one track of P graph. Position indeterminateness of business process is increased in such a way and at the same time it is raised the possibility for using mobile technology and mobile approach. This is of course not necessary in case some of the participants were found mobile in previous step.

• The fifth step (evaluation of opportunity) It evaluates the effectiveness of the solution found in previous step. Influence of proposed solution to various other participants of the process is inspected also. Only proposals increasing substantially effectiveness of examined process or bringing other benefits for participants in other tracks of the process are analysed.

B. Process landscaping

Köhler and Gruhn [6] expanded previous method by other possibility for looking up mobile opportunity. They suppose opportunity for mobile solution mainly in case that at least one of the following assumptions holds:

• Position indeterminateness (already known) occurs in the examined process.

• This indeterminateness is given externally.

• Cooperation and coordination with external resources is required.

Process landscaping method is directed to analysis of process model and identification of mobile business processes. The essence of the method is in dividing modelling process into more layers with varied (and growing) level of details

Key processes of the business are identified in the first step of the method. The organization of the business is taken into account also. Processes which were found are assigned to adequate organization units of the business. Various relations exist among various processes and it is suitable to record them in the model. Processes are potentially mobile if several organization units take part in their implementation.

These potentially mobile processes are focussed on in the second step of the method. These processes are examined in more details. More detailed model is developed in such a way. This model already includes also all sub-processes. Classification sub-processes to organization units and participants of the process to organization units is again recorded. Sub-processes realized in cooperation of more participants and units are again mainly focussed on. They are
potentially mobile again.

Attention in the third step is concentrated on processes that cooperate with external resources. These processes cross the border of organization unit and it is again rather probable, that they can have some mobile parts.

Such processes are examined in the fourth step (fourth level of details and are again broken down to sub processes. During this step the method identifies mobile processes more exactly. Possibility to introduce mobile information system is at the point of the process, where the border between two organisation units is crossed. Basic insufficiency of this method is in the fact, that in its steps is not stressed mobility of organization unit participant of the process and method is focussed mainly on investigating of transitions of control and information flows among by position distinguished units. In spite of the fact that position uncertainty is mentioned in initial assumptions of the method, it is not stressed and identified at the level of steps or layers of analysis. Mobile and distributed solutions are not distinguished in such a way. So it is suitable to extend the method by other step which will distinguish processes potentially mobile and potentially distributed. Mobile processes may be understood as a special case of distributed processes.

Last step (layer) of analysis should focus on only such sub processes among which inter organization units border is crossed and in addition to it at least one of them is not stationary (its position is not given and may change according to above mentioned types of mobility).

IV. BPMN AND MOBILITY

BPMN is common tool for formal description and analysis of business processes. It offers structured and well readable notation which is suitable either for communication with customers, for simulation purposes or even for automatic or semi-automatic generation of some pieces of IT systems covering the problem area. The right and fully equipped mobile solution is based on the position tracking, data collection services and on the remote access to inner-firm resources (like ERP, CRM), using some slightly modified way of distributed access. The location based services can trigger new kind of events that could be followed by set of activities in a business process. These new events will be introduced later in this section.

A. Event management

BPMN in the current version supports number of different events which could then be divided into sublevels depending on the way events act and on their task in the activity and sub-process sequence. The basic events will be mentioned in the following text.

Start event – shows where the business process begins and is depicted as a thin-lined circle

Intermediate event – occurs within the process activity sequence and represents some things that could happen between activities. It is depicted by double-lined circle (as to the boundary shape) and by some icon representing concrete type of event (like none event, timer event, message event, signal event and other 6 advanced intermediate events. Starting with BPMN 1.1 the events could be subdivided into two groups of events – throwing events and catching events. A catching event stops the control flow until depicted events occurs, while the throwing events fires immediately the trigger. The throwing events’ graphic representation use the filled version of icons placed inside the double lined circle.

End event – indicates the end of the process or of the part of the process, it is depicted as a bold lined circle.

![Fig. 1 Notation of location based events - place achieved (A), position update (B) and conditional positional event (C).](image)

B. Location based events

The support of mobility inside event management in BPMN is very poor. Mobility (understood as using some mobile technology to support processes) brings some time management improvements in comparison with non supported processes and it can augment the process by some location specific and location sensitive information. The support of some mobility concepts in BPMN can be useful for the development of genuine mobile IT and business solutions. Author of the contribution suggests to enrich BPMN notation by new event types in order to express some aspects of mobility. These mobility events could be following (see symbols on Fig. 1):

- Position (place) achieved event
  The event occurs if the mobile participant has reached the requested place. The form of event can be both catching and throwing. In the catching form the process waits until the mobile participant comes to the predefined place, in the throwing form the event is raised whenever the participant enters the place
- Position (place) update event
  The event indicates for the process significant change in participant’s position. This event is supposed to be mainly throwing event, which means that process can respond to the location change with some specific activities.
- Conditional positional event
  This event offers to express more general positional changes. The event occurs for instance when the participant enters some region in the predefined maximum distance from
the destination or the participant entered some country region etc. Some kind of expression language for this could be later useful. This event type could be again both throwing and catching.

It is supposed that these events may act either as starting, intermediate or ending events.

C. Mobile participant

Another problem of using BPMN regarding mobility is marking or accentuation of mobility of a participant in the model. One solution brought P-Graphs mentioned in previous sections. Every participant lane is marked with the position and the type of participant’s mobility (stationery or mobile - visiting, travelling and wandering). The author’s suggestion for the modelling of participant in BPMN can be summarised as follows:

• to extract the mobile participant out of the pool of the organization to model his process in its own pool,
• to give the participant name including the type of his mobility and
• modelling the interaction between mobile participant and his organisation pool using common message flow and the BPMN choreography.
• Additionally there is also possible to subdivide the pool of mobile participant in more swimlanes. One of them corresponds to the mobile participant and others represent mobile technologies used for the mobility support of the process.

D. Examples

Let us assume the travelling salesmen providing the ordering support service at the customer’s place using mobile terminal and application (Fig. 2). The sub-process starts with the location event (place achieved) and ends with a sending message event which can send the order to the pool of the company.

![Fig. 2 Mobile order process initiated by location event.](image)

Another example (Fig. 3) shows the simplest way of extracting the mobile participant into separate pool and the communication between the mobile carrier and its company’s pool using the position update event.

![Fig. 2 Location update event example.](image)

V. CONCLUSION

The mobility is very important aspect of business process modelling. The number of mobile terminals equipped with GPS module massively grows and it brings the possibility to use the localisation and contextual information in different types of mobile applications and different areas of business. The missing support of mobility modelling in BPMN is crucial for the correct description of such mobility including processes. The concept of extension of BPMN introduced in this contribution will be further developed by the author.

REFERENCES