

# Templates for Use and Misuse Cases in Mobile and Multi-Channel Systems

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**Abstract.** Use cases is a popular representation format for functional requirements, and misuse cases have similarly been explored for security and safety threats and requirements implied by these. The literature has several suggested templates and writing guidelines for textual use cases, but these templates tend not to include information about the location where actions are performed, nor about the equipment used. In multi-channel information systems supporting mobile work processes, such information would be highly relevant. This paper therefore presents extended templates and writing guidelines for use and misuse cases where such information is included.

**Keywords:** Use cases, misuse cases, multi-channel, mobile, information systems, security

## 1 Introduction

Use cases [1] have proven helpful for the elicitation of, communication about and documentation of requirements [2]. While use case diagrams give an overview of the system's functionality, it is the textual step-by-step use cases that provide the details of what is really required of a function [3]. Hence, requirements quality will depend heavily on the contents of these textual use cases, both in terms of writing the right things (i.e., having the necessary fields of information, e.g., as suggested by a template) and writing the things right (i.e., presenting each slot of information in a well-written way which is clear and easy to understand). Therefore, a number of templates have been suggested for textual use cases, e.g., [3-5], and there also exists proposed templates for misuse cases [6] and related security use cases [7]. Also, there has been research on writing guidelines for use cases, especially concerning the sentence styles used in action steps, e.g. [8-10].

In the design of templates, there is a trade-off between, on the one hand, the wish to keep the template simple, and on the other hand, the desire to include all information that might be of importance. Normally, the location or context of the user while per-

forming the various actions of a use case has not been considered important enough for inclusion in such templates. These are understandable omissions in use cases for a traditional information system. The location of the user (e.g., whether sitting in city A or B, in office D or E) is not of much importance for the functional requirements and subsequent design of the computerized information systems. Nor is it of much importance to document the type of equipment used - often it would be some standard desktop PC, and if not, it might also be considered a premature design decision to specify the type of equipment already in a use or misuse case.

However, for mobile and multi-channel information systems, the capture of location is often relevant already in the requirements stage. And in many enterprises, work processes are becoming gradually more mobile. Also, in such systems the need or possibility for the user to access the systems through various types of equipment, sometimes stationary, sometimes mobile, i.e., in general terms *multi-channel* [11], may be a given design constraint already from the business case or product concept stage, rather than a premature design decision. E.g., if this or that mobile gadget could not be used, the product simply would not sell, or the work process simply could not be supported. In other publications we have looked at the adaptation of modeling notations for business processes to include location [12-14], and in yet other publications at templates for traditional "system shall" requirements for mobile systems [15]. The goal of the current paper is to look at similar extensions concerning mobile and multi-channel varieties of textual use and misuse cases.

The research questions for this paper are as follows:

**RQ1:** To what extent do existing templates for use cases support the specification of mobile and multi-channel systems?

**RQ2:** What extra fields or adaptations might be relevant to introduce in templates for mobile and multi-channel use and misuse cases, compared to templates for more traditional stationary systems?

**RQ3:** Can such additions to templates make it easier to write good use (and misuse) cases, or will the additions instead make the templates more complex to understand?

The rest of the paper is structured as follows: Section 2 reviews some templates for normal use cases. Section 3 then discusses adaptations of these templates to capture multi-channel systems. Section 4 concludes the paper.

## 2 Existing templates

Various templates have been suggested for the textual description of use cases. Kulak and Guiney [5] suggests a template consisting of the following parts: 1) Use Case Name, 2) Iteration: *Facade, filled, focused, finished* – denoting how refined the description is. 3) Summary: One or two sentences describing the interaction. 4) Basic course of events, 5) Alternative paths, 6) Exception paths, 7) Extension points, 8) Triggers, 9) Assumptions, 10) Preconditions, 11) Postconditions, 12) Related business rules, 13) Author and Date. None of these fields are suitable for entering any information about a mobile or multi-channel usage context. This, of course, does not prevent

the entering of such information, for instance directly in the use case name (e.g., “Order meal while driving”, “Order meal by mobile phone” – or even “Order meal by mobile phone while driving”), or in the use case summary or course of events. But then this information will be mixed together with all other information in the use case, so there will be no systematic capturing of mobile and multi-channel aspects, and hard to see or search afterwards which use cases have special needs in this respect. Different types of equipment could also be specified in the alternative paths, but the disadvantage of this – as argued by [3] – is that one then has to choose one equipment type as the primary one and other as alternatives, while really all might be equally fine.

The template suggested by the Rational Unified Process [4] contains many of the same entries. Its basic form runs 1. Use Case Name, 1.1 Brief Description, 1.2 Actors, 1.3 Triggers; 2. Flow of events, 2.1 Basic Flow, 2.2 Alternative Flows, 2.2.1 Condition 1, (what to do), 2.2.2 Condition 2 ..., etc.; 3. Special Requirements, 3.1 Platform ..., ...; 4. Preconditions, 5. Postconditions, 6. Extension Points. As can be seen, this is quite similar to Kulak and Guiney's template. The most notable deviation is the inclusion of a section for **special requirements**, such as platform requirements. This has the purpose of covering for instance non-functional requirements related to the use case, and special requirements for the equipment used (multi-channel) or location/environment where the system must be able to operate (mobile) could go here. However, all kinds of non-functional requirements are intended to go here, not only what platform or equipment to use, but also performance, usability, etc. If there are many such requirements, the ones particularly related to mobile and multi-channel needs will be mixed with a lot of other stuff.

The template suggested by Cockburn [3] has some deviations from the above, although many fields are overlapping. Most relevant for our purpose is the field called **Technology and Data variations list**. This partly fills the same purpose as the "Special requirements" section in RUP, but Cockburn's field is somewhat more specific, not meant to cover all kinds of non-functional requirements. The intention is rather to capture various ways to do the same, e.g., that the user may use fax, phone or a web form, may pay by cash, check or card, that the price may be typed in or read by a bar scanner – or that the user might access the system using a PC or a mobile phone. Thus, “technology and data variations” would be a fitting slot for multi-channel needs (i.e., what equipment can access the system) but not so much for providing mobility information – although one might of course put something there which is not a 100% in accordance with the label. Still, it would also contain a lot of information, which has nothing to do with the mobile and multi-channel usage context.

Sindre & Opdahl [6] have proposed a template for misuse cases. Inspired by the above templates, it has many of the same fields, plus some extra ones specifically meant for misuse cases. For our purpose, however, the most relevant field is “Technology and data variations list”, which the authors based on the similar field in the Cockburn template – except that it here means that the *misuser* might use different types of technology, e.g., perform an SQL injection attack by a wired desktop PC, a portable PC, or a smartphone; spread a virus by email attachment, a link to a web page, a CD-rom or memory stick, and similar. It thus also suffers from the same weaknesses as the field in the Cockburn template, namely that many different types of

information might go in there – some of which is multi-channel information and some of which is not, and that mobility information does not quite fit.

Security use cases, as proposed by Firesmith, have no field which would fit for specifying the mobile or multi-channel usage context in the template suggested in [7], and has no field similar to the "Technology and data variations" of Cockburn either.

All in all, the situation for the reviewed templates can be summed up in Table 1. There are some relevant fields, and the other templates that do not have anything, could easily be extended with similar fields. However, even with the fields available, there is the problem that mobile and multi-channel information is mixed together with many other kinds of information, which means that it will be hard to search or get an overview over in a large specification. For instance, putting a number of different requirements in the "Special requirements" section in RUP would work fine if they were captured in XML and tagged appropriately, so that the analyst could afterwards quickly get an overview over, e.g., what different mobile contexts or equipment types must be supported in the system. If everything is written in plain text and with different terms used by different people, this will be harder to achieve.

**Table 1:** Support for mobile and multi-channel aspects in various templates

Template	Mobility	Multi-channel	Comments
Kulak & Guiney	–	–	In name, summary, basic or alternative paths
RUP	Special re-requirements	Special requirements	Mixed with all other kinds of non-functional requirements
Cockburn	–	Technology & data variations list	Mixed with other tech&data variations which have nothing to do with mobility
Misuse cases	–	Technology & data variations list	Same as above
Security use cases	–	–	In name, summary or paths

### 3 Adding the mobile context in textual use and misuse cases

There are several aspects of the usage context that might be of particular relevance in mobile systems. In [16] a categorization is provided as follows:

- The spatio-temporal context describes aspects related to time and space. It contains attributes like time, location, direction, speed and track.
- The environmental context captures the entities that surround the user, for example, physical objects, services, temperature, light, humidity and noise.
- The personal context describes the user state. It consists of the physiological and the mental contexts. The physiological context may contain information like pulse, blood pressure, and weight. The mental context may include elements such as like mood, expertise, anger and stress.
- The task context describes what the user and collaborators are doing. The task context may be described with explicit goals or the task breakdown structure.

- The social context describes the social aspects of the user context. It may, for instance, contain information about friends, co-workers, relatives, ...etc.
- The information context – the information that is available at a given time.

As stated in the Introduction, there is a trade-off between including all the information that might be relevant and keeping a template fairly simple. Hence, it would be too much to introduce a field for each bullet point above. Instead we propose one single additional field called **Usage context**, which could then contain information like the following:

- the location (place) of the user, for instance "in office", "in car", "at client's site", "in forest", similar to how this is represented in BPCM [14].
- the task context of the user – here not meaning the use case itself, but other tasks that the user must perform in parallel. Hall [17] distinguishes between *monochronicity* and *polychronicity*. In the former, people seek to structure their tasks sequentially, one at a time, if possible according to a plan. In the latter, people do several things simultaneously, placing less importance on planned order. New technologies seem to increase monochronicity in some situations and polychronicity in others. Many contemporary systems require steps to be carried out in strict sequence with little flexibility for individual variations of temporal order and few possibilities for carrying out several processes in parallel. Because mobile devices have small screen sizes and memories, monochronicity is strengthened, as it is less convenient to open several windows handling different applications in parallel. On the other hand, polychronicity is increased in many mobile settings, e.g., talking on the phone with a client while driving.
- the equipment and network characteristics [16] that the user might use for performing the use case, e.g., "desktop PC", "car computer communicating on UMTS", "PDA", "cell phone".

Preferably, the use case would be represented internally in a standardized formal format such as XML, so that it is easier afterwards to analyze and search the specification, possibly also using domain and requirements ontologies for completeness checking. An example of parts of a DTD for a use case is shown below, but just including some fields from the overview above:

```
<?xml version="1.0"?>
<!DOCTYPE use case [
  <!ELEMENT name          (#PCDATA)>
  <!ELEMENT primary actor (#PCDATA)>
  <!ELEMENT summary      (#PCDATA)>
  <!ELEMENT basic path (step,step*)>
  ....
  <!ELEMENT usage context (location, task, equipment)>
  <!ELEMENT location     (#PCDATA)>
  <!ELEMENT task         (#PCDATA)>
  <!ELEMENT equipment    (#PCDATA)>
  ....
  <!ELEMENT author      (#PCDATA)>
  <!ELEMENT date        (#PCDATA)>
]>
```

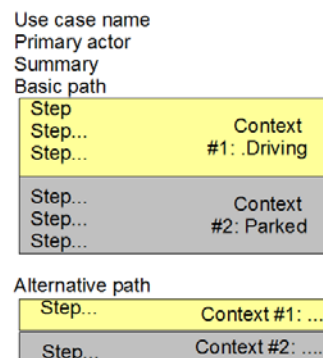
The fields proposed by us are shown in bold and could also be included in misuse cases and security use cases. The proposal to use XML does not mean that the devel-

oper or end-user should have to write or read XML specifications, these would be for the underlying conceptual model, while use cases could be presented in natural language for the stakeholders, and written with a support tool generating the XML.

There are several options for the placement of such "usage context" fields within a use case template, partly depending on the scope of the usage context. If it applies to the entire use case, it might be tempting to place the information early. The usage context may have a great impact on the use case paths and the early presentation of this information will then make easier for the reader to understand why the paths have been proposed the way they are. On the other hand, the basic path is normally considered the meat of the use case, and the reader might want to get to this as soon as possible, so that one should avoid putting too many other fields in front of this.

There might also be a distinction between some situations where a certain usage context applies to the entire use case, and other situations where a certain usage context only applies to a part of the use case, maybe even down to a single step. So, sometimes it might suffice to specify one usage context for the entire use case, other times it could be necessary to specify usage contexts relating to single steps or groups of steps. While all of this should be easy to handle in XML, it would also become a challenge how to present such multi-context use cases in an easily understandable way to stakeholders reading the use case in natural language. Of course, usage context information could be written directly in the textual statements of action steps, with some small modifications to existing structure guidelines for use cases. The CREWS guidelines [8] do not quite capture the usage context. Although guideline CG1: "<agent> <move action> <object> from <source> to <destination>" might appear relevant, it handles only the possible movement of the object, not of the user. However, the CP guidelines [10] offer a more generic structure "<subject> <verb> <object> <prepositional phrase>", where the prepositional phrases like "in <location>", "with/by <equipment>" or similar could capture some context information. Another structure that could possibly be added to improve the possibility for mobile and multi-channel use cases would be "<subject> <verb> <object> **while <doing something>**", specifically supporting situations with polychronicity.

Still, writing usage context information directly in the step statements has some disadvantages. First of all, the same usage context would often apply to several steps, where it would be annoying to have it repeated for all these steps. Moreover, the step statements would be longer and harder to comprehend, especially when there are several different context attributes to include, e.g., several different types of equipment that can be used for the step, and several locations that the user could be in, several other tasks that the user might be doing at the same time. This makes it more tempting to look for other alternatives. One possibility could be to use coloured pools distinguishing the contexts, so that the basic path could still be read in a straightforward manner in natural language, without a lot of interfering context information. A simplified example of this is indicated in Figure 1. Tool support should also make it possible to choose whether to present or filter away the information given in the "usage context" field, such filtering would of course also be relevant for most of the other fields in the mainstream templates mentioned earlier.



**Figure 1:** Using colour in textual misuse cases to distinguish usage contexts

## 4 Discussion and Conclusion

The answers to our research questions are as follows:

**RQ1:** *To what extent do the existing templates for use cases support the specification of mobile and multi-channel systems?* Some support was found, notably in the "Special requirements" section of RUP use cases, or in "Technology and data variations" in the template proposed by Cockburn. The disadvantage in both cases is that mobile and multi-channel usage context information is mixed together with many other kinds of information.

**RQ2:** *What extra fields or adaptations might be relevant to introduce in templates for mobile and multi-channel use and misuse cases, compared to templates for more traditional stationary systems?* We have proposed an extra field for usage context, containing sub-fields for location, task context, and equipment. More sub-fields could of course easily be included if necessary.

**RQ3:** *Can such additions to templates make it easier to write good use (and misuse) cases, or will the additions instead make the templates more complex to understand?* This research question is alas not yet answered by the work, which is research in progress. Especially from a misuse case perspective, it can however be argued that the security threats may vary a lot depending on what kind of equipment the employee has, and what the attacker has available. If the employee is using mobile equipment, communication can be intercepted in other ways than with wired equipment. Mobile equipment can also more easily be stolen - and evidently an attacker will have more attacks available if he suddenly possesses the employee's cell phone or portable PC.

An important step for further work will be to make a bigger case study developing example use and misuse case specifications using the additional fields proposed in this paper, to see if these give a clearer picture of the usage context than other ways of writing use and misuse cases, and to see if this again makes the threat picture in misuse cases more easily understandable.

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