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# Mobile Apps in Engineering: A Process-Driven Analysis of Business Potentials and Technical Challenges

Eva Hoos[a]*, Christoph Gröger[a], Bernhard Mitschang[a]

[a]*Graduate School advanced Manufacturing Engineering, University of Stuttgart, Nobelstr. 12, 70569 Stuttgart, Germany*
*Corresponding author. Tel.: +49 711 685 88437; fax: +49 711 685 78437 *E-mail address*: eva.hoos@gsame.uni-stuttgart.de

**Abstract**

Mobile apps on smartphones and tablet PCs are more and more employed in enterprises to optimize business processes, e.g. by elimination of paper-based data collection. With respect to engineering, mobile apps provide a huge potential for increased flexibility and efficiency due to their anywhere and anytime characteristics, e.g., for product testing in the field. However, not every usage of mobile apps is beneficial from a business point of view and existing apps for engineering represent only rudimentary front-ends for stationary IT systems without an app-oriented redesign. Hence, there are three core challenges to leverage the potential of mobile apps in engineering: (1) identifying value-added app usage scenarios from a process point of view, (2) realizing a task-oriented and context-aware user interface design and (3) mastering technical obstacles at the app implementation. In this paper, we address these challenges by a case-oriented analysis of selected engineering processes in the automotive industry in order to identify engineering tasks suited for the usage of mobile apps. On this basis, we design corresponding engineering apps and analyze their business potentials. Moreover, we derive common technological challenges for the development of engineering apps, e.g. data synchronization aspects, and highlight further research issues.


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## 1. Introduction

Globalization and individualization lead to shorter product life cycles as well as a higher complexity and variety of products [1, 2]. These factors require both more flexible and more efficient engineering processes to retain competitiveness of industry companies. Especially, facilitating mobile and cooperative work of engineers is an important success factor in this context [3]. However, existing engineering IT systems, e.g., CAD systems, represent monolithic desktop applications with a complex and multi-functioned front-end and prevent the IT-driven improvement of engineering processes.

With the raise of smart phones and tablets, a new type of software called mobile apps is currently gaining attention in enterprise IT. Compared to desktop applications, mobile apps offer novel possibilities for IT-based process optimization due to (1) their anywhere and anytime characteristics, (2) their easy-to-use touchscreen-based handling and (3) their task-oriented and context-aware design [4]. With respect to engineering, the exploitation of this unique feature set of mobile apps provides a huge potential for increased flexibility and efficiency of engineering tasks while reducing their complexity [5]. For instance, during a test run of a new car complaints can occur. At the moment, the recording of these complaints is paper-based. A mobile app could enable the test driver to record the complaint description digitally and enrich the description by photos, location data or voice recordings. This would significantly increase the efficiency and flexibility due the digitalization of the task and its location-independent execution anywhere and anytime.

Despite these potentials of mobile apps in engineering, not every usage is beneficial from a business point of view, e.g., when apps are solely used at a stationary workplace without an analysis of the business process. Besides, existing mobile apps for engineering, e. g., Teamcenter Mobility [6] or AutoCAD 360 [7], just represent rudimentary front-ends for stationary IT systems without an app-oriented redesign, e. g., missing a task-oriented user interface or an integration of


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context data. Furthermore, technical aspects, such as resource constraints of mobile devices, have to be considered, in order to successfully implement engineering apps [8]. Hence, there are three core challenges to leverage the potential of mobile apps in engineering: (1) *identifying value-added app usage scenarios* from a process point of view, (2) realizing a *strictly task-oriented and context-aware user interface design* and (3) *mastering technical obstacles* at the app implementation.

In this paper, we address these challenges by a case-oriented analysis of selected engineering processes in the automotive industry comprising business-oriented and technological aspects in order to identify engineering tasks suited for the usage of mobile apps. On this basis, we design corresponding engineering apps to support these tasks and analyze their business impact on the respective processes. Moreover, we derive common technical challenges for the development of engineering apps and highlight future research issues.

The remainder of this paper is organized as follows: In Section 2, related work is discussed. Section 3 gives an overview about our approach. The case-oriented analysis of engineering processes in order to identify value-added app usage scenarios is presented in Section 4 including the specification of concrete engineering apps. Section 5 discusses the business potentials of these engineering apps, whereas, in Section 6, technical challenging for their implementation are detailed. Finally, Section 7 concludes the paper and highlights future work.

## 2. Related Work

We distinguish two groups of related work, namely work on the app-oriented analysis of business processes and work on mobile apps in engineering that is, engineering apps. In this paper, the term engineering refers to the product development process in general comprising virtual product design, physical product integration and various engineering support processes [9].

In our previous work, we investigated approaches to systematically analyze business processes and identify value-added app usage scenarios from a business point of view [10]. Existing analysis frameworks, especially [11, 12], do not distinguish between mobile applications running on laptops and mobile apps running on smartphones and tablet PCs with their unique features. Furthermore, the analysis effort is high, because they require a sophisticated process model. Therefore, we developed a holistic analysis framework to systematically identify usage scenarios in business processes benefitting from mobile apps [10]. Our framework comprises a systematic methodology using multi-criteria analysis and portfolio analysis techniques and integrates both technological and business aspects of mobile technology. The result is a classification of process activities according to the best fitting IT technology.

Regarding apps in the engineering domain, there are several works highlighting benefits of the usage of mobile apps [3, 5, 13–15]. However, they give just a high-level view on the potentials without evaluating and systematizing the impact of mobile apps on the process. Some of them present application areas of engineering apps [5, 15]. However, no concrete usage scenarios or use cases for single engineering apps are defined. Besides, Westkämper et al. [3], Neumann et al. [4] and Constantinescu and Lentes [13] introduce the concept of an IT platform that enables engineers to develop their own individual engineering apps. However, they neither present a concrete solution nor concrete engineering apps.

Regarding existing engineering apps, there are only some initial approaches. Gröger et al. analyze existing mobile apps across the product life cycle [16]. This reveals that only a few commercial apps for engineering tasks exist, e. g., Teamcenter Mobility [6] or AutoCAD 360 [7]. In most of the cases, these existing apps represent just mobile front-ends for their backend systems without exploiting unique features of mobile apps, for example enriching functionality by context data. Mourtiz presents two possible mobile apps for product customization and design of manufacturing networks and shows the applicability in an automotive pilot use case [17]. At this, the app development is technology-driven and lacks a process point of view.

## 3. Overview and Approach

We did a case-oriented analysis of selected engineering processes in a large German car manufacturer. Therefore, we applied the 3-step procedure described below. It is important to remark that our approach follows a top-down process point of view. That is, in contrast to existing procedures, it avoids a purely technology-driven approach and comprises a holistic analysis of engineering processes.

1. Analysis of engineering processes and specification of engineering apps
2. Investigation of business potentials of engineering apps
3. Identification of technical challenges in the engineering app development

**Analysis of engineering processes and specification of engineering apps.** This step is based on our analysis framework proposed in [10]. The framework offers a systematic analysis methodology to identify value-added app usage scenarios on the basis of a criteria catalogue for process analysis. The analysis methodology comprises three steps for *process analysis*, *app potential evaluation* and *recommendation generation*. To this end, a high-level process model is needed, which derived based on interviews with the organizational owners of each investigated process. For *process analysis,* we determine the value of each criterion in the criteria catalogue, e.g., mobility of the actor, by conducting a new set of interviews with the process owners. The analysis is terminated if neither the criterion actor nor the criterion task is evaluated as mobile in order to reduce the analysis effort. On the basis of the criteria values, the app potential of each activity is calculated during *app potential evaluation*. Finally, the analyzed activities are positioned according their app potential in the app management portfolio. Thereby, the app potential comprises two dimensions, app capability and mobilization potential. The app capability determines if the application is suited to be realized as an app on mobile touchscreen-based devices, whereas the mobilization potential refers to the suitability of