

Mobile devices and applications for factory planning and operation

Mobile Anwendungen im Rahmen der Fabrikplanung und des Fabrikbetriebs

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Abstract: Driven by current changes in the market and accelerated by the possibilities modern mobile devices offer to the planner, there is a necessity to organise production and planning processes more efficiently. This paper is going to highlight the deployment of mobile devices in the factory planning process based on the VDI guideline 5200 “factory planning”. Furthermore, the VDI guideline 4499 is going to be taken into consideration concerning the possibility of changes in information technologies. It will discuss fields of application and identifies possible directions of development for future planning tools. In this context, the use of a quadcopter to support the data acquisition is going to be explained. Additionally, the relation towards future simulation applications is given.

1 Introduction

In times of constant and fierce competition in a globalized world, it is of major importance to make operating and planning data available beyond the daily work environment (Bracht 2002, Schenk 2009). In addition, there is the need for tools to improve the daily work of engineers (Westkämper 2012). In this context, the Digital Factory undertakes the task, to enable companies to withstand the high pressure of competition in the market by providing information like plant and process layout (Bracht and Masurat 2005, Bracht et al. 2011).

A major aim of the Digital Factory is to provide the user with non-redundant and user-specific data which is both, current and consistent (VDI 4499, part 1, Reichert 2009). In this regard, the utilization of mobile devices offers a vast potential. Due to the usage of mobile devices it is possible to receive information at a corresponding location (Amberg and Lang 2011). Furthermore, a fast data exchange is allowed which simplifies communication during the planning period. Additionally, it is possible to evaluate and to add specific information to the simulation of different scenarios already on the plant field. In the future, it will be possible to carry out

simulation processes and to access the results on-site by the use of mobile devices and cloud services. This makes it much easier to get the right information and impression during the planning process (Spillner 2011).

Based on both, a research of available mobile applications on the consumer and business market on the one hand, and a functional analysis of mobile devices on the other hand, this paper points out new possible applications for the Digital Factory. The interaction between features such as camera, GPS and motion detection leads to new and unknown opportunities. In this context, self-developed applications will be taken into consideration. These applications will be evaluated by practical examples.

Actual examinations at the IMAB were focused on apps, which originate from known system suppliers and also show potential for the use in the factory planning process. The potential has been constituted by the support and simplification of general planning tasks of the factory planner. Figure 1 gives a classified overview of existing applications, which includes benefits for the planner during the factory planning process.

Factory planning	IT-support		Benefit	
Phases	Selected mobile applications			
Project idea Problem identification Target planning	SketchBook Project management Brainstorming	Mind Map To Do Monitoring task	Support of project management	
Actual condition-analysis	Cloud Measure apps Fotoapps	CAD Product information PLM	Photogrammetry ERP GPS measure	Support of data acquisition
Rough planning	Iteration	Cloud CAD	Mind Map Brainstorming	Planning support Participative planning
Fine planning		Cloud CAD	CAD Viewer Augmented Reality	Presentation of results
Realization	Cloud CAD Documentation	Interactive documentation Construction diary ERP	Augmented Reality	Target-actual comparison with AR
Operation	Cloud Interactive documentation	Documentation Augmented Reality	ERP	Location- and userspecific information

Figure 1: Classified overview of existing applications for the factory planning process

As a result, there are mainly applications, which can be quickly integrated into existing processes and which are able to generate benefits. These advantages consist primarily of saved time, support of a consistent data management, a targeted and appropriate user support as well as modularity.

By combining the hardware features, it is possible to obtain completely new functionalities for areas like planning, manufacturing or servicing and maintenance requirements (Yüzgülec et al. 2013). Due to the fact, that it is now possible to link the camera with positioning functions and the internet, the user is able to send pictures with specific information like the actual location. Furthermore, the usage of interactive installation or servicing apps makes it possible to facilitate the work and therefore to reduce mistakes.

Augmented Reality is a new derivative of the Virtual Reality Technology which enables the user to experience the real and the virtual world simultaneously. Due to this fact, the level of immersion increases which facilitates the recognition of divergences. Possible fields of application are construction sites or the logistics sector, in order to minimize the time that is spend on searching for components or goods (Schreiber and Zimmermann 2011).

2 State of the art

There are many different mobile devices of various manufacturers on the market available. According to a survey of Bitkom, one in eight users in Germany use mobile devices (Bitkom 2012). These include devices like smartphones, Tablet-PCs and netbooks, which all combine a low weight on the one hand, and handy dimensions on the other hand. Therefore, they are very suitable for mobile usage (Fig. 2).

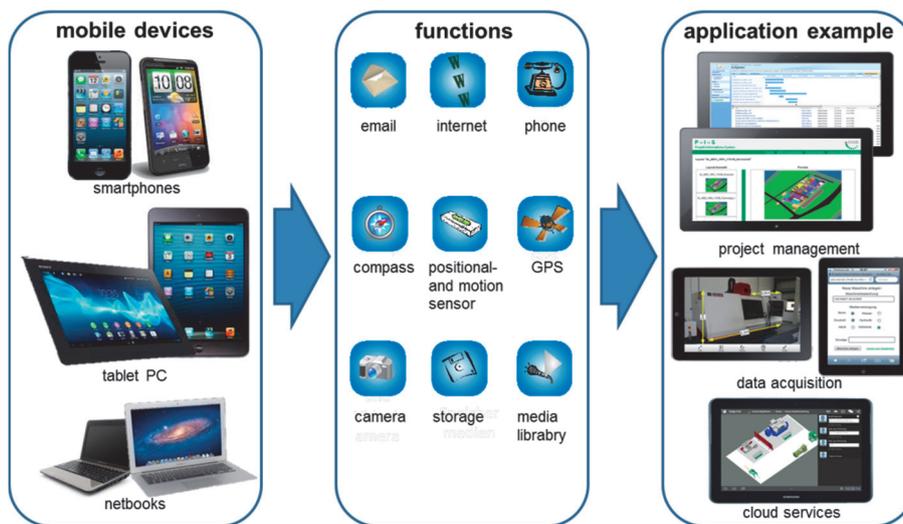


Figure 2: Functionalities and fields of application of mobile devices

As a result of the focus on highest possible portability, the devices distinguish themselves only by technical means. Tablet-PCs and smartphones combine various functionalities, whose diversity could yet only be reached through the usage of separate hardware. Most devices possess high-definition cameras, as well as a variety of office applications. Beyond that they offer different possibilities of

communication like phone, email, internet or videotelephony (Maske 2012). Caused by the rapid development of mobile devices in the last couple of years, the hardware offers a high computing power, which makes their usage within the factory planning possible. As an example, data can be gathered with the integrated camera and can be forwarded to fellow workers. Furthermore, it is possible to process the data by using special programs.

Mobile devices accomplish a growing importance on the industrial field. Especially the digital factory sector identified the usage of such communication devices and deployed them respectively. Mobile devices support the factory planning already significantly. There are still a couple of situations in the factory planning process, where the integration of this hardware is desired. This fact is going to be described in the following.

Factory planning serves the deployment of necessary data and information. Following the VDI guideline 5200, the factory planning process consists of seven different phases, which enable a successful execution. It starts with the setting of objectives. In this phase, the project objectives have to be described and work packages have to be specified. The second phase contains the establishment of the project basis, which consists of the procurement and the evaluation of information. The concept planning is made up of the structure planning, ideal planning and the following real planning. This includes the definition of concepts, which merge within the fourth phase into the so-called detailed planning. Subsequently the preparation of specifications of services is drawn up, which leads to the user requirements and the functional specifications. During the following preparation for realization the offer procurement and the awarding of contracts take place. Aside from that, the implementation planning leads the project to a starting point. Phase six regards the monitoring realization, which addresses the coordination, monitoring and documentation of realization. The last stage covers the ramp-up support. This phase supports the attainment of previously within the factory objectives declared levels of performance. The level of attainment is as a result expressed through the factory evaluation.

The factory planning process, as outlined before, contains a vast potential through the integration of mobile devices. This does not only result in a more mobile and adjustable availability of data, but also lead to a usage of all the available functionalities of such a device. The deployment of mobile devices has increased rapidly throughout the last few years, which is specifically caused by the possibility to be able to gather and forward information from any location. Besides known possibilities of communication such as phone, internet and email, the user is now able to locate, process and convey his or her position through the use of GPS. Furthermore, the user can take pictures of different objects, which can be altered, named, scaled and forwarded (as mentioned in chapter 3). Especially the conjunction of these particular functions enables the user to exploit the whole potential of smartphones and tablet PC's. Mobile devices gain more and more acceptance and are expected to be increasingly integrated within the factory planning process.

The following section shall highlight the possibilities mobile applications could, and partly already do provide to the factory planning process.

3 Employment of mobile devices in the digital factory

After taking place in the consumer sector, mobile devices take on greater significance in the industrial world. The following figure 3 shows, how mobile devices support the digital factory within the factory planning.

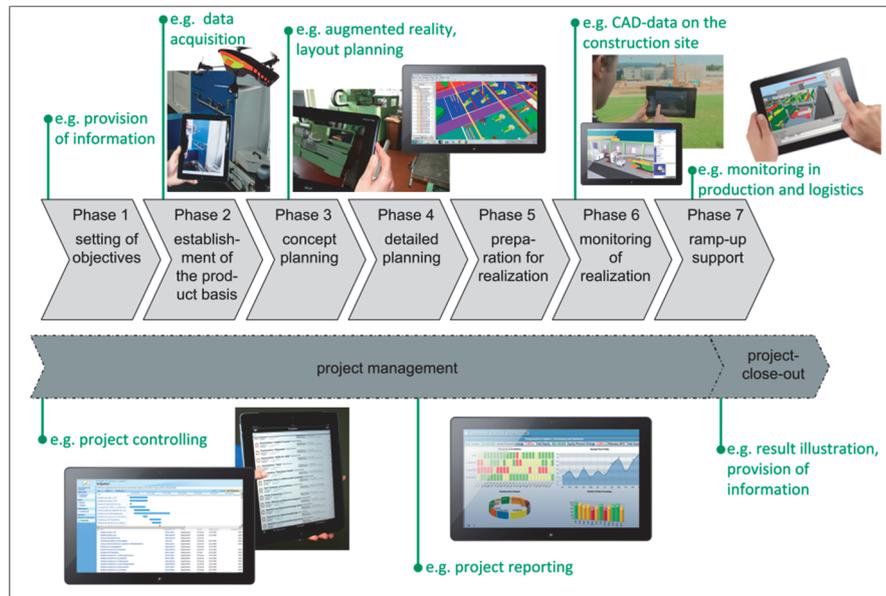


Figure 3: Employment of mobile devices throughout the factory planning process

There are various mobile applications, which can be used during the different stages of the factory planning process. In the project management field, which covers the entire process, there are numerous applications that can be used to keep all team members up to date concerning all project-related information. Furthermore, it is possible to use these applications to observe milestones, share information and to allocate responsibilities. A possibility offered through specific applications that is noteworthy, is that it is possible to take existing information and to convert these information into Gantt-diagrams that deliver an overview of the current status of the project. To cite an example for these specific kinds of applications, there is “Merlin-Project Management”. In this regard the app “Shareplus”, which will be dealt with in chapter 4, is to be mentioned. This application enables the user to perform all the important functions from any location around the world with an internet connection.

Another application, which supports specifically the data acquisition at stage 2 of the factory planning process, is “MyMeasures”. The app enables the user to capture and dimension various machines or factory buildings with the integrated camera of the mobile device. By using an application like “MyMeasures”, the time needed for data acquisition could be shortened. The application, for example, offers the possibility to share pictures of machines with team members, so that they can start creating CAD-models simultaneously. Additionally, the dimensioning feature helps delivering all

needed information. The field of application is being extended by the deployment of a quadcopter or similar devices.

Through this flexible data sharing, a location-independent work is made possible. A supportive feature is the integration of cloud services. By using cloud services, it becomes possible to upload information from any location and at any time, which can be retrieved anywhere through mobile devices. Therefore this kind of usage offers a vast potential, regarding stages 3 to 7 of the factory planning process. There are such applications available for various mobile devices. For example the “Autodesk 360” services from Autodesk, which include cloud services as well as a limited version of the known “AutoCAD” software, which can be used as a viewer for CAD drafts, but additionally provides a basic tool to adapt drawings if needed. This makes on-site activity possible, even if there is no PC available.

Another field of application arises from the start up phase and the later operation of factories and facilities. By the use of mobile devices in this sector it is possible to monitor logistic- or production-related information.

To what extent this exemplarily mentioned utilization can be deployed in the field will be discussed in the following chapter.

4 Practical examples

Project management as an important discipline within the factory planning has lots of benefits by deploying mobile devices and its applications. To these belong the mobile usage of groupware, calendar and email, which increases the availability of these services. Furthermore, the possibility of social software enlarges networking and the provision of information for the personnel.

In first project applications, dedicated applications could be used for the support and communication within the team. Furthermore, information could have held actual and consistent during the whole planning period. One possible software being used in this context, is the SharePlus application, which is also being used at the IMAB (Insitut für Maschinelle Anlagentechnik und Betriebsfestigkeit) at the TU Clausthal for the illustration and revision of different contents, based on the groupware solution SharePoint from Microsoft (Fig. 4)

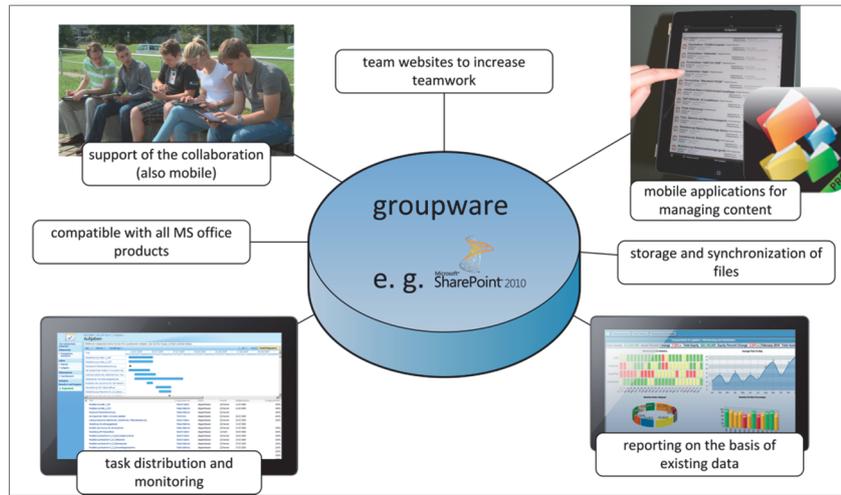


Figure 4: Groupware-Employment within different projects

The hereby deployed functions come down to storage and synchronization of different documents. These can be shared with other team members and be used for the allocation of responsibilities. Afterwards, a report based on existing data can be developed. Additionally the usage of groupware can lead to an increased collaboration. The deployment of mobile devices helped to develop brighter conditions of communication within the project team.

The usage of mobile devices had also various positive effects on the data acquisition, especially for small and mid-sized companies (Fig.5).

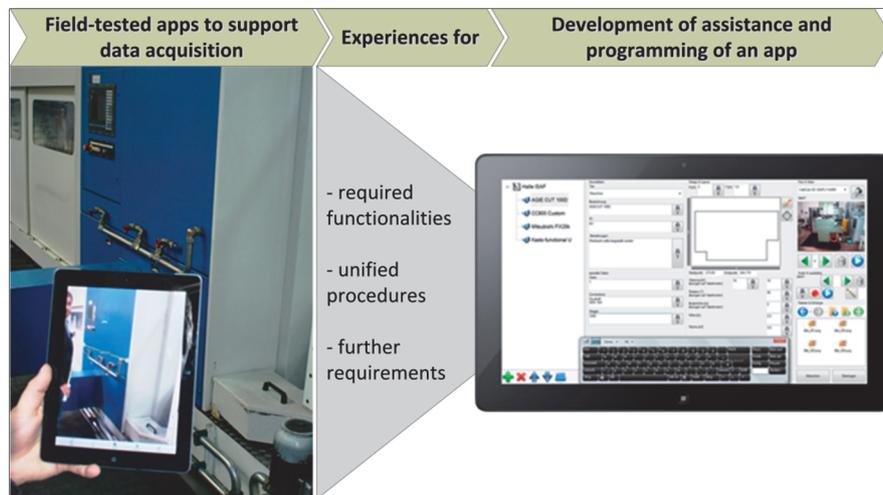


Figure 5: Development of a data acquisition app at the IMAB

These small and mid-sized companies often do not offer important data in the appropriate format. Mobile devices facilitate the digital on-site capturing and make an immediate transfer of information to the server possible.

First of all, commercially available applications have been reviewed in terms of eligibility for the digital factory. Based on various requirements, that have been noticed throughout several tests and experiences of first projects, the IMAB developed an assistant for smart and mobile data acquisition. Practical attempts showed a decrease of time exposure from 40 to 20 minutes per captured machine. In total, a time saving of 30 per cent could be reached compared to the conventional procedure. Due to the fact that necessary data was already available, a minimization of post-treatment could be achieved.

Figure 6 shows the deployment of a drone for a simplification of the data acquisition. Caused by the compact size, high performance, good handling and exceptional flight characteristics, it also can be used for indoor recordings.

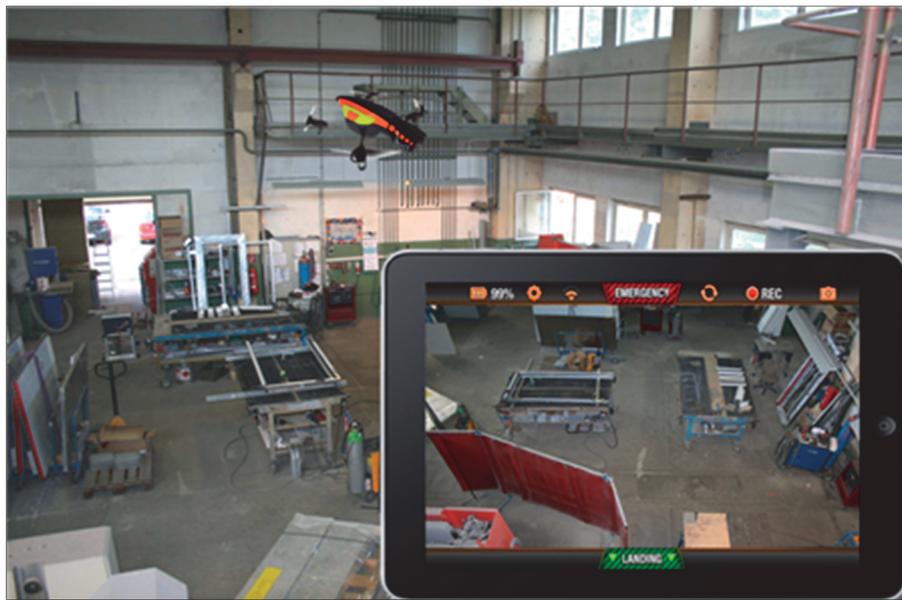


Figure 6: Aerial image with Parrot AR.Drone and Tablet-PC

A quadcopter equipped with a camera can be used for areas that are difficult to access and for the recording of Top-Views. The drone can be controlled with a Tablet-PC and streams the pictures immediately via WLAN to the mobile device.

Currently, the application of apps for the support of digital layout planning is being evaluated. In this context, augmented reality and the participation of team members play a vital role.

Especially in the context of simulation, new applications show possible ways of mobile interaction. Figure 7 shows real-time data and forecast data for the information of employees in the start up phase and the later operation of factories and facilities.

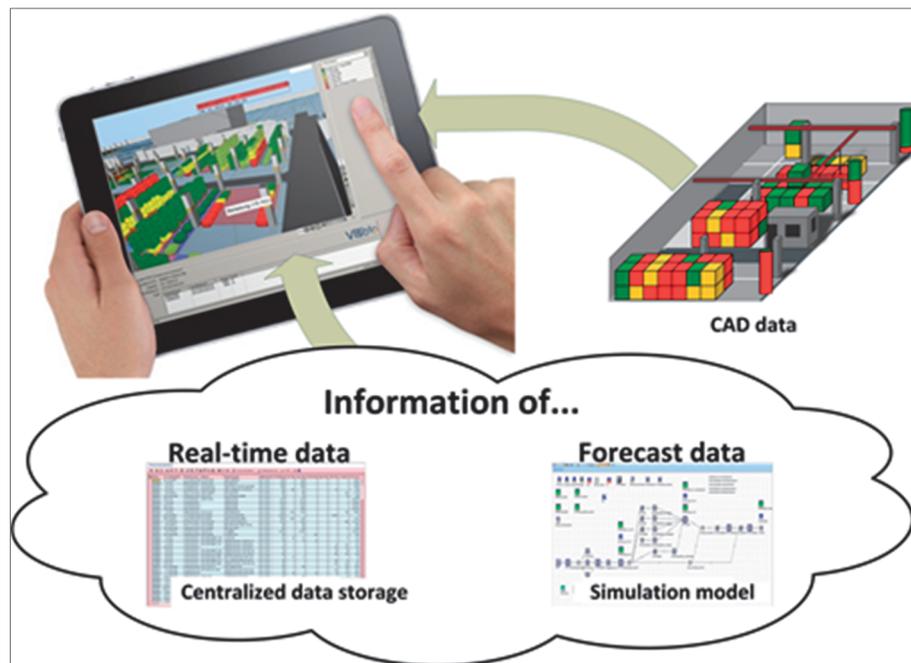


Figure 7: Monitoring of real-time and forecast data based on simulation

The centralized data storage provides the necessary data for mobile application that gives the planner real-time simulation information, which are supported by CAD data on-site (Hackenberg 2011).

To achieve the wanted results, the processes and the usage of modern tools, such as mobile devices have to be optimized.

5 Results

Based on the VDI guideline 5200 “factory planning” and the VDI guideline 4499 “Digital factory”, this paper deduces the first smart applications, which contain a vast potential for the factory planning.

Additionally, self-developed applications were pointed out and evaluated by practical examples. Furthermore, the paper detects possible savings that the new methods can afford. These savings were ensured within the first practical experiences.

Mobile devices offer the possibility to simplify planning processes in order to keep up with competitors by increasing the efficiency of the processes of the product lifecycle. Though the smart factory planning is in its beginnings, first applications proved the vast potential it inherits. One first result is the necessity to adapt the current processes to modern and smart processes for mobile factory planning. In this context, one has to keep in mind, that there are more modern tools like drones besides mobile devices, which support the planner during the planning process. Only

this will lead to the entire exploitation of the potential benefit of mobile devices in the field of factory planning.

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