

The Need for Suitable User Interfaces for Mobile Devices in On Site Inspection in Health and Safety at Work

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Abstract: *Mobile ICT is starting to find its way into public administration. The support of field work such as inspections, which mainly consist in the acquisition and processing of information, is a first approach. But the support of field work requires substantial adaptations of mobile ICT and devices in return, especially with regard to the design of user interfaces of mobile devices and computer applications. On the other hand, the mobile support will cause a shift of work steps from stationary workplaces to field work and will have an impact on documentation and decision-making. Mobility rules out the extensive use of keypads for data entry. This problem has to be solved by technology, for example by automation of working steps, context recognition and alternative methods of entering information like speech or handwriting recognition. Therefore the exact needs have to be analysed today for a systematic development.*

Keywords: Mobilized Administration, legally compatible technique design, suitable user interfaces, documentation of administrative acting and design of mobile devices.

1. Introduction

Mobile Government has become a new trend within the public administration. (Knopp 2005; Franz 2005) The use of mobile ICT¹ leads to new ways of performing services in field work. The devices are still getting smaller; the contents are digitally available and usable without media discontinuity. The adaptation of user interfaces to mobile working is crucial for realising the potential of mobile administration. Considering documentation as a typical example of administrative field work, the following article describes the demands on the design of mobile ICT and in particular the demands on the design of user interfaces. In order to find these demands, the needs of field workers for electronic aids have to be carefully scrutinised. To illustrate the following considerations, the supervision of protection at work is chosen as an example. The article reveals the need for interface design, the potentials of mobile ICT support for administrative field work as well as possible risks.

1.1 The importance of documentation for administrative field work

Administrative field work mainly consists of three elements: comprehending a situation, decision-making and documenting the actions as well as the situation. Mobile ICT can support all of them. Documentation is singled out because it illustrates the need for suitable user interfaces best. The duty to document and to keep records results from the rule of law and applies to any administrative action in a constitutional state. By means of documentation every action of the administration becomes traceable and understandable and citizens have the possibility to check the legitimacy of the action. Documentation makes it easier to control the executive power, especially in situations where it is onerous for an affected person. Furthermore, the duty is allusively stated in the draft of a European constitution, because the administration is obliged to concede access to its records by Art. II-101 sec. 2 b) and c) European Constitution. Another purpose of documentation is to disassociate knowledge about administrative actions and procedures from single persons in order to make it available for every authorized public servant. The more independently and individually a public servant acts, the more the need for documentation increases. Regarding the example of protection at work regulation, a trend towards self-regulation of industry and ruling by objectives is caused by the European regulation on protection at work. However, Art. 4 sec. 2 of the Council Directive 89/391/EEC on protection at work demands just as well, that the member states have to guarantee adequate supervision and controls. The respon-

¹ Information and Communication Technology

sible public servants have to judge quite independently on site whether or not the objectives of the regulation are achieved and make decisions. Mobile ICT will help to execute many more of the necessary procedures locally and to boost the individual and autonomous decision-making of the government official even more. These decisions mostly have an onerous effect for the affected employer, too. Therefore, the superior authority has to be able to control the actions and for this needs comprehensive documentation. In addition, the governmental or even the European control institutions have to be able to evaluate whether an adequate control and supervision is guaranteed or whether or not additional legal measures on protection at work have to be taken. This purpose requires more statistical documentation.² The increasing need for documentation therefore extends to the actions taken, the detected faults and the decisions with their reasons. Faults and measures of protection can well be recorded by multimedia-based means, e.g. by pictures or films. The actions taken can partly be recorded schematically. But it may also be necessary to make remarks using free-text fields. Due to the interconnectedness of public servants, documentation can theoretically be performed on site and without media discontinuity.

1.2 *The use of mobile devices for documentation*

The mobilisation of administration is based on the interconnectedness of the field working public servants. This is made possible by the increasing network coverage of broadband cellular mobile radio like UMTS. However, the mobile device used occupies a central position. Basically all mobile devices can be used, from extended cellular phones and PDAs to laptops, which are equivalent to desktop PCs. But not all of these devices are capable of really supporting the procedures of mobile administration. The documenting field working public servant has to enter information about actions and situations while he is moving, standing or even using his hands for examinations. Furthermore, the information has to be integrated into existing information or structures. Therefore, the mobile public servant needs access to the existing information and the possibility to record all this information directly using his mobile device. But in field work the environmental conditions for these processes are entirely different from the conditions at a work place in an office, where most of the records have been made so far. The mobile device has to cope with these differences taking the role of an intermediary between applications systems of the administration and the mobile public servant.

2. *Factors influencing mobile documentation*

ICT-supported mobile documentation takes place in different contexts and depends on the specific task. The task defines the environmental factors, the input modes and, consequently, the design of the user interface. Furthermore, the input modes have to meet legal demands.

2.1 *The influence of environmental factors*

The ergonomics of mobile documentation in the field of supervision of protection at work depend on several environmental factors which vary from company to company. In combination with the ergonomics of mobile devices these factors influence input and output modes. Disturbing factors like background sounds, noise and agitation occur especially within crafts enterprises. These factors as well as the fact that the mobile public servant is pressed for time and under close observation affect his concentration and distract him from reading and entering (huge amounts of) data. Furthermore, bad or changing lighting conditions can make reading and typing of long texts in small font sizes difficult. All environmental factors mentioned can affect the mobile documentation in a negative way. Therefore, mobile devices used for mobile documentation should offer a selection of different input and output modes.

The mobile device should provide a touch screen monitor and have a display with a minimum size of nine or twelve inches. It could have a holder which makes it easier to carry the mobile device. In addition, the display of the mobile device should be powerful regarding the adjustment of brightness and contrast. The mobile device should use sensors (sensor data) to adjust the presentation automatically to the lighting conditions. For use in factories and similar places the mobile device should not be sensitive to dirt and humidity. The mobile device should also remain handy.

² German Labour Inspectorates hence compile extensive annual reports on protection at work.

Assuming that the mobile device used for mobile documentation has a display with a minimum size of nine to twelve inches, there has to be a possibility for depositing the mobile device in order to enter data by typing for a longer period of time in an ergonomic manner. Because there are no possibilities or no suitable possibilities for depositing the mobile device, it has to be carried along and data has to be entered while the mobile public servant is in motion. There are two ways to solve the problem: the reduction of input or to the implementation of alternative input modes like speech and handwriting recognition. Problems regarding speech recognition particularly occur in factories and similar places with lots of background noise. As a consequence the spoken text often can not be transformed into machine-readable text. This leads to specific requirements with regard to speech recognition software.

2.2 *State-of-the-art*

Input and output modes influence human-computer-interaction. Keyboards of mobile devices are often very small and thus make typing difficult. This leads to a reduced input rate. (Zitzmann 2006) Most mobile devices do not have comfortable and ergonomic user interfaces, although there are several device alternatives in form of hardware keyboards (Zitzmann 2006), e.g. foldable keyboards (Hewlett Packard, Anycor), soft keyboards (Zitzmann 2006) like touchpads or touchscreens and new techniques like keyboard projectors (Celluon, hama) or electronic pens like the one developed by the Fraunhofer Technologie-Entwicklungsgruppe.³ All alternatives imply that additional devices have to be carried along, and some of them also require (projection) screens or places for depositing the device. Additional devices have a certain weight to carry, have no ergonomic form, and do not facilitate data entry.

Another, simpler, more comfortable, and lightweight alternative is multimodal dialog systems, which have been an object of research in the context of Human-Computer-Communication for a long time. Along with manual input modes, verbal and visual communication modes are investigated. Several scientific projects are concerned with the implementation of speech technology in various systems. The SmartKom project, for example, has developed a multimodal dialogue system that combined speech understanding and “video-based recognition of natural gestures and facial expressions”. (SmartKom) One main goal of the SmartWeb project⁴ is to enable multi-modal access to the semantic web by using advanced language and speech technology. „Questions can be formulated freely in spoken natural language and can be supported by pointing gestures on the touch screen.” (BMBF 2006) Another multimodal system is the M3i Mobile ShopAssist which enables user interaction via speech, handwriting, and gestures. (BMBF 2006)

Online and offline speech recognition can be distinguished. Online speech recognition means that the text is dictated (via microphone) directly into the computer, transformed, presented and corrected immediately. Offline speech recognition means that the recording is carried out by using a digital recorder; here the transformation takes place later on. (Funk 2004) According to practical and legal requirements, online speech recognition is more appropriate for mobile documentation, because for further processing it is important that no delay occurs. The transformed written document can only replace the spoken original if it is confirmed.

Speech recognition is already used in judicial proceedings, in particular at courts (e.g. at the district court Reutlingen). Important success factors are trainings for users in order to minimise errors in the transformation of spoken text. (Working Party „Digitales Diktieren“ 2005) Today, speech recognition systems can recognise up to 100,000 words. (Haas, Gallwitz, Kornwachs, Schröder 2004) Some systems are already able to recognize whether or not the request of a user is addressed to the system itself or to someone else. These systems classify the user's focus of attention by using information from multimodal input obtained from the microphone and camera. (Chair of Pattern Recognition, University of Erlangen 2006) The error rate depends on factors like pronunciation /articulation, dialect, grammatical complexity and background noise. Vocabulary range rather affects the required computing power than the error rate. (Haas, Gallwitz, Kornwachs, Schröder 2004) The speech recognition software available on the market has a relatively good quality regarding the error rates and the handling of the software. (Stiftung Warentest) The error rates range from three to five per cent. (Working Party „Digitales Diktieren“ 2005; Haas, Gallwitz, Kornwachs, Schröder 2004) But these rates can only be achieved in a quiet environment.

An alternative to speech recognition is the recognition of handwriting. Handwriting recognition in the area of biometrics identifies solely the characteristics of the signature in order to authenticate and

³ <http://www.teg.fraunhofer.de/german/projekte/index.html>. Retrieved Apr 27, 2006.

⁴ <http://smartweb.dfki.de/>. Mobile Broadband Access to the Semantic Web.

identify a person. Handwriting recognition is already used on tablet PCs (e.g. Toshiba, HP, Sony, Lenovo).

Speech and handwriting recognition systems are adaptive systems. The user has to train the system to recognize his pronunciation and handwriting before using the system. (Stiftung Warentest 2004, 39) The efficiency of these systems is still limited, particularly with regard to the error rates which have to be very low for mobile documentation. In addition, the systems are not yet resistant enough against interferences. By means of context recognition, disturbing environmental factors could be recognized so that unsuitable input and output modes could be automatically deactivated.⁵ For example, the automatic deactivation of speech input modes at too much background noise would avoid multiple erroneous inputs or interpretations that would cost time and cause extra work.

From an economic point of view, the use of speech and handwriting recognition systems is profitable only at low error rates so that the advantage of fast input is not foiled by long review times. A gradual implementation could first of all concentrate on speech and handwriting recognition with standardized inputs and later on enable more complex inputs and the input of longer texts to be carried out. These options depend on the design of graphic user interfaces.

2.3 *Complexity of graphic user interfaces*

The design of IT-systems is closely related to the design of business processes. (Becker, Algermissen, Delfmann & Niehaves 2004) Business processes within the administration and the documentation of these processes are characterised by information processing, (Wimmer, Traunmüller & Lenk 2001) and the acquisition of a lot of data. Some data can be imported from other systems, but most data has to be entered manually. In addition, there are several legal requirements. Thus, user interfaces of IT-systems in the administration are often very complex because they support the processing of individual cases as well as extensive documentation. They consist of several windows, templates, tables, and different types of menus.

Any graphic user interface is a virtual work place and supports the communication with the underlying system. The design of graphic user interfaces is of great importance for orientation and navigation as well as for efficient data entry. The goal is to design a user interface that meets the users' needs, reduces complexity, or makes complexity manageable. (Park, Pernod, Trachte & Zwister 2003, 9) The support of extensive on-site and mobile documentation through the use of mobile devices makes high demand on the design of user interfaces. Therefore, the mobile context as well as the users' needs have to be analysed and taken into account. For example, due to the pressure of time, extensive search processes or scrolling are not acceptable. This requires a new design of structures and user guidance.

There are already guidelines for the design of web-based e-government applications like PAS 1020. (DIN 2005, 6) For the design of graphic user interfaces, norms and standards have to be considered. The European norm EN/ISO-Norm 9241 describes principles for the design of user dialogues. The EC directive 90/270/EEC on work with visual display units says that software has to be appropriate to the task. The design of graphic user interfaces requires the analysis of work organisation and tasks. Software and thus the user interface has to be easy to use and to be adjusted to the context, like for example the task, personal attributes of the user, characteristics of tool usage, and environmental factors. (Gorny 1997, 1)

There are different ways to achieve a reduction of complexity: the reduction of necessary input, the adjustment of the system to the task, the design of interfaces according to established designs, and the menu prompt. There are several grades of adjustment - from automatic adjustment (adaptive systems, suitable for frequently performed tasks) to manual adjustment (adaptable systems, suitable for individual processes). It is important that the user can at any time interfere and adjust the system manually. Furthermore, the adjustment can be caused by a certain occasion or context driven. One option would be to only show exactly the information and data that is needed in a specific moment. The user interface could be adjusted automatically according to a certain cause (matching of situation and information demand). If necessary, the mobile public servant can expand the displayed information. In a further step, only the data required in a certain context could be presented using information from sensors or RFID-tags, for example for recording information from control stamps of fire extinguishers. Inspections that are very well regulated allow the prediction of probable inputs and can thus contribute to a reduction of complexity in the design of graphic user interfaces.

⁵ Gorny describes the deactivation of functionalities in order to avoid simultaneous inputs by different users or when the specific functionality would not work in a certain situation. (Gorny 1997, 7)

In order to raise acceptance, interfaces can be designed according to existing and well established designs. This would lead to recognition of functionalities and make use easier. In some cases the user interface and the system's functionalities are similar to the Microsoft Windows design and functionalities, for example. Thus, a familiar look and feel are provided. (Gorny 1997, 3)

The design of the menu prompt is another possibility to reduce complexity. For example, four basic types of human-computer-interaction can be distinguished: data entry dialogue, command dialogue, selection dialogue and direct manipulation. (Gorny 1997, 7) The menu prompt as well as multimodal interfaces should be designed according to the particular needs.

2.4 *Requirements for multimodal documentation in mobile administration*

To accomplish its functions, electronic as well as mobile documentation has to conform to specific requirements. For all records authenticity, integrity, and completeness must be assured. All relevant facts have to be recorded, especially with regard to discretionary decisions all individually considered facts have to be documented. Thereby, authenticity, integrity, and completeness affect the security of electronic documents, e.g. the security against manipulation, input errors, loss of data, and the reliable assignment of inputs. Further requirements affect the quality of contents and documentation. On site documentation can enhance regular documentation by multimedia-based and electronic support. However, the devices used have to be adjusted to the intended purpose and mobile working in general.

Oral and handwritten inputs have to be transformed automatically. The result of this transformation has to be presented instantly on the screen to keep the process controllable and to avoid falsification. The mobile public servant has to review and to confirm the result; otherwise the input cannot be ascribed to him. The review process also has to be documented, for example by confirming the review. If the review cannot take place instantaneously, the audio recording has to be saved until the transformation is confirmed. The speech recognition system has to classify whether the speaker addresses the system, or someone else, in order to avoid entering data that is irrelevant or not required. The error rate of speech and handwriting recognition systems should not be too high, because any manual correction delays the working process and has a negative effect on mobile work. Uncertainties during the transformation have to be notified in order that they are not overlooked.

According to German procedural law most decisions can normally be form-free. But the recordings of deficiencies performed by the supervision of protection on the work can reach a certain amount. It can consist of several individual facts and lead to diverse legal consequences. For this reason, a text-based form of decision is more appropriate for documentation. To compile a revision letter on-site or a ruling in combination with the reasoning in written form, the mobile public servant has to be supported by the IT-system considerably. The chosen and prepared legal consequences as well as the associated facts have to be compiled systematically. Recurring text modules, like the instructions on the right to appeal, have to be inserted automatically, and the result has to be easily revisable and clearly arranged even under limited presentation conditions.

3. *The way to mobile user interfaces*

The increasing need for the use of mobile devices supporting documentation on site results in the necessity to compensate for the deficiencies of mobile devices like little displays and key pads by a reasonable, functional and legally validated adaptation of user interfaces. The following considerations will describe how this adaptation can take place step by step and what the development will result in. Acceptance of both mobile public servants and citizens can only be achieved if the possibilities of and demands made on the development are respected in the course of the implementation.

3.1 *The potential progression of the technological changes*

The use of mobile devices can be very beneficial for the administration. But neither the shift of procedures to field work nor the support by mobile ICT will occur at once. The progression will be via single levels of development. The analysis of the various influences on the performance of documentation arrived to the conclusion that numerous adaptations of the tools and supplies for work are required in order that this exemplifying task as well as many of the other tasks can be optimally processed on site. Interconnectedness on its own doesn't yet enable the mobile public servant to do this kind of field work. Presently a slow start in establishing and developing mobile work equipment is detectable. But when a basic configuration is attained, the development will accelerate. Starting from the present

working situation, three levels of development are characterised below, which cover the next ten years. Within level one, mobile devices are established universally. The devices and the software migration to integrated application systems are focussed in doing so. Level two is dominated by the adaptation of user interfaces and the implementation of first automated inputs, which will be accomplished via external hardware as well as by means of context recognition. Level three is the stage, where the problem of connectivity everywhere and the access by mobile 3G networks via satellite is answered. Further process optimisations and more diligent inspections will be carried out.

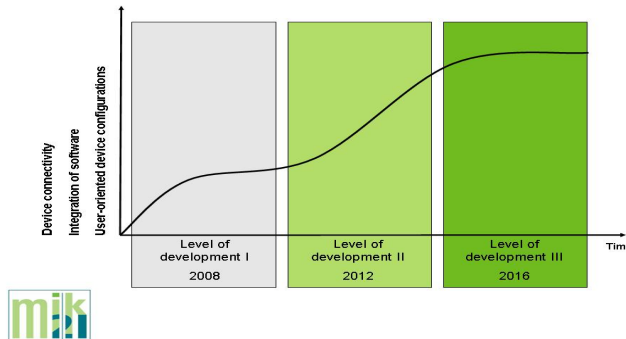


Figure 1: Three levels of development – mobile administrative field work

Level I: The first level of development contains technologies which are presently realised within the scope of pilot projects and promise to optimise the equipment of mobile public servants with standard laptops, for example. Corresponding network coverage, data throughput, and security technologies permit a secure wireless connection to the administration server for the transfer of records and files. Therefore, the information input can take place on site during the inspection. The networking between the field working public servant and the administration server boosts the efficiency of the inspection. Furthermore, quality can be improved by optimising inspections by means of integrated electronic processes. Also an enhancement of the tasks is possible. Additional tasks will consist of providing advice and guidance for self dependant improvements of protection at work.

Level II: The second level aims at the improvement of recording, documenting and reporting processes. Tablet PCs turn out to be much more user friendly in the context of field work. This has to be ascribed to the improved operability of touch-screen typing, handwriting and speech recognition. Integrative software interfaces enable the user to insert pictures or sensor data of external devices to reports or forms. A general digitisation of processes and data input from different devices and software sources takes place. At the same time data availability from any location via broadband data communication and real-time-networking will spread.

Level III: Mobile devices are especially adapted to the field of activity of the mobile public servant by hardware and software configuration. Data entry is supported by digital and wireless additional equipment like reader, bar code scanner, cameras and sensor-based inspection equipment that is changed corresponding to the location. It is even imaginable to equip the service car with a mobile 3G picocell via satellite for guaranteeing seamless connectivity. New sensor technologies and additional functional modules enhance the objectives and potentials of inspections. The ergonomics for mobile usage and successful promotion of usability factors regarding the software are improved.

3.2 Consideration of the user

A crucial factor in designing socio-technical systems is the consideration of user acceptance, fitness for purpose and user-friendliness. The categories of requirements “fitness for purpose” and “user-friendliness” are main issues in particular for the mobile use of data processing systems. The DIN EN ISO 9241 (CEN, 1995 and 1998) is regarded as standard for the assessment of user-friendliness concerning the directive on work with visual display units too by the EC jurisdiction. This series of standards specifies general demands on working environments, hardware and software. However, these demands are not sufficient and have to be amended by further aspects.

Another important theme in planning user-oriented systems is the consideration of how the user learns about the handling of the system. This learning process is regularly much slower than the technical

progress of the device functionalities. It is technically feasible, for instance, to develop systems for handwriting recognition and voice control. It is practicable too to combine these systems with corresponding software interfaces within the scope of a usage scenario, where they work compatible together. But in doing so it is not guaranteed that the user will like this systems or will even use them. Different factors of ergonomics, psychology and usability are decisive, whether a technical innovation will find user-acceptance in the context of real working environment or everyday life. In principle the three criterions listed below are quoted for the fitness in purpose of software:

1. Effectiveness in order to solve a problem,
2. Efficiency of the handling,
3. Satisfaction of the user working with the software.

The criterion "fitness for purpose" as well as the designing aspects of user-computer-dialogue systems have to be evaluated and adapted to the relevant processes and environmental factors of the precise working context. In detail it is necessary to examine the elements of the fitness for purpose concerning the usage by administrative field workers and the general aspects of usability. This is required to achieve a value-added process result and user-acceptance of future mobile inspectors of protection at work. Usability means, in this context, the effectiveness, efficiency and satisfaction with which specified users achieve goals in particular environments. For the scenario of mobile public servants it will be important to optimise mobile devices and software in such a way that a secure data access, a recording process that reflects adequately the environment and a trouble-free further processing are ensured. Agreement between the expectations of the user and the actual mobile entry process is a very important requirement. An entry dialogue conforms to the expectations of the user, if it is consistent and satisfies the functional and ergonomic needs of the user. Regarding the mobile use of digital systems, there are more complex and enhanced needs than the ones which a stationary workstation poses. Some of the needs are:

- Consistent and secure mobile data access and connectivity
- Prompt availability of corresponding data and software functionalities;
- Sufficient and steady data rates concerning Up- and Downlink;
- Satisfactory power supply for the duration of mobile usage during an inspection;
- Enhanced security systems and elements to give a feed-back if the wireless connection is interrupted or other failures occur;
- Integrated and synchronised interfaces to external equipment like sensor modules

The domain of conformity to expectations of the user shows the complex and specific user requirements which are associated with the scenario of the supervision of protection at work. The constitutive requirements on mobile devices like availability of power supplies and connectivity are only one level, high atop the level of real demands resulting from expectations on the user-friendliness of software and interfaces. A step by step strategy for implementing this technical framework is a precondition for success and acceptance of mobile systems used for inspections like the supervision of protection at work. It is a necessary first step to plan all the levels of development and the availability of basic technologies suitable to the requirements.

3.3 *Legal point of view*

From a legal angle three aspects must be considered in implementing new interfaces and new administrative working procedures. Firstly these innovations must not collide with the aims of procedural rules or tasks of the administration. It would not be conducive to an adequate documentation for instance, if exploratory talks or any impressions were recorded randomly without selection. Documentation should make administrative actions understandable for subsequent scrutinies. Therefore it is important to winnow the relevant from the irrelevant as far as possible. If the mobile equipment results in unnecessary recording because the effort has massively diminished, this would be counterproductive. It would not be conducive to the aims of the administrative tasks as well, if the mobile public servant were not able to review and reconsider the results of automated supporting processes on site, for example preparing an order. Blind trust in automated support systems could eventually interfere with discretion or cause undesirable and ineffective results.

Furthermore the interfaces and the design of the mobile devices influence the security of the recorded data and the information stored at the administration. Here it is necessary to preserve company secrets and to protect individual-related data. This security could be endangered for instance if the speech recognition interface meant that third parties could intercept such secrets. This could occur for example,

if the interface used an unsecured wireless connection that could be eavesdropped from a distance too. On the other hand, in terms of speech or handwriting recognition, it should be remembered that both are applicable as biometric authenticator at the same time too. Used in this way they could even boost security by simultaneously verifying the identity of the intruder.

Finally it should be taken into account that the implementation of new interfaces and new procedures nearly always constitutes a change of working conditions. This may involve employee rights. In consequence early agreements have to be reached. Moreover, the devices as well as the interfaces have to comply with the ruling regulation of protection at work. The criteria of health protection have to be observed in relation to the display-size or display resolution even though the European directive on work with visual display units does not include portable devices. This aspect becomes relevant for the ergonomics of the mobile device too.

3.4 *The implementation of mobile user interfaces*

For developing mobile user interfaces, the characteristics of mobile documentation resulting from the immediate environment (e.g. pressure to be efficient, noise) have to be considered. There are two areas of application where there has to be a technical implementation of organisational reasonable mobile interfaces. On the one hand, graphical user interfaces have to be designed with the aim of reducing complexity while maintaining the logic of the administrative task. On the other hand, the implementation of reasonable multimodal user interfaces for data entry is an area. The purpose here is to increase the efficiency of the documentation on site. An analysis of tasks in cooperation with the users is a precondition for both areas of application. This analysis has to show and to consider the links between the working procedures and the corresponding environmental factors in each case. Complex and easily standardized procedures should be differentiated. The ascertained results should be aligned with the expected characteristics of users. To verify the results, first checks with preliminary models should be accomplished.

The following table shows the characteristics of mobile administrative work (cf. section 1.1), the restrictions caused by environmental factors (cf. section 2.1) and the corresponding potential input and output methods (cf. section 2.2). The given examples are not exhaustive and have to be completed for the implementation of input and output methods according to the particular task.

Characteristics of mobile administrative work / documentation	Suitable input / output methods	Restrictions caused by environmental factors
Acquisition of well structured information and data like	Automated entry / recording Shortcut keys Drop down menus	There are hardly any restrictions that affect the input methods.
Acquisition of individually structured and miscellaneous information or data	Typing Handwriting recognition Speech recognition	Typing is not possible if keyboards cannot be used. Handwriting recognition will hardly work when there is no deposit. Background noise can affect speech recognition negatively.
Acquisition of measuring data	Automated entry Data transfer from measuring device	Interfaces, standards or middleware are required. There are hardly any restrictions caused by environmental factors.
Need for amendment statement of the company / crafts enterprise: <ul style="list-style-type: none"> • Information from IT-system • Verbal information 	Automated data transfer from company's systems Handwriting and speech recognition	Handwriting recognition will hardly work when there is no deposit. Background noise can affect speech recognition negatively.
Navigation within the IT-system Information request (e.g. codes of practice, legal requirements)	Voice control	Background noise can affect voice control mechanisms negatively.
Information output	Voice response	There are hardly any restrictions that affect voice response.

Table 1: Suitable interfaces for characteristic tasks and possible restrictions

Even more than a stationary computer, a mobile device is an individual and personal piece of equipment. As far as possible attention should be paid in an early stage to an individualising design of the mobile device. This refers to all aspects of ergonomics like weight and dimension of the device, but

also to particular configurations and potentials of functionalities like multimodal ways of input and output and last but not least to the reasonable handling of the versatile functionalities. Further it is necessary to use high-quality technology which features a specific capacity and a low error ratio to assure the essential acceptance of the users and to avoid frustrating results (Working party "Digitales Diktieren" 2005).

As the changes will only slowly become accepted by mobile public servants, a continuous advancement of the users' media competences is required to avoid a mobile divide between users and non-users. For example, non-users would continue documenting in handwriting and entering the data later on and thus dispense with mobile direct documentation by not using mobile devices. This would not help them very much. The media competence needed could be generated by realising an innovation-friendly corporate culture in administrations and by training on site, which means supervised on site training. Especially the training on site could be positively useful, because individual problems and obstacles can be recognized and solved at once. Train the trainer programmes can be a very reasonable and effective measure, too (Working party "Digitales Diktieren" 2005).

Another important aspect is the decision whether a simple and low priced or whether an individually configured and more expensive mobile system should be implemented. Wide use requires that the systems remain affordable. But at the same time they should support individual tasks. The use of high-end-devices would not meet the requirements.

4. Conclusions

Documentation is an important element in administrative field work. Mobile devices can support the entry of information and data for documentation purposes. The differences between mobile and stationary working environments pointed out above call for a well-balanced combination of miniaturised devices, digital technology, software, adapted interfaces like speech or handwriting recognition, and mobile communication in order to really support the fulfilment of administrative tasks and help to promote the aims of these tasks. Efficiency and acceptance of mobile working methods strongly depend on the design of the mobile devices. The design of mobile devices, in particular the design of entry functionalities, is a challenging task because mobile systems are subject to considerable limitations compared to stationary systems. In order to support mobile procedures optimally and to finish more working procedures on site, a user orientated and legally reviewed design of user interfaces is needed. Furthermore, the user interfaces have to be aligned with the logical sequence of the tasks. Another crucial factor is the implementation of new kinds of interfaces. The design of mobile devices is in an interdependent relationship with the alteration and the shift of working procedures. The progress in the right direction is essential. Projects on mobilizing administrative procedures threaten to fail if the stated requirements and points are not considered.

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Biography:

Michael Knopp studied law at the Ruprecht-Karls University Heidelberg till 2001 and absolved his probationary period at the Regional Court at Karlsruhe from 2001 to the end of 2003. After that he started as researcher at the Institute of European Media Law (EMR) at Saarbruck in 2003. Since March 2004 he is member of the Project Group Constitution Compatible Technology Development at the University of Kassel. He is doing his PhD thesis on the field of mobile government researching the legal aspects of mobilizing the administration.

Angela Frankfurth studied English and Roman Philology at the Georg-August University Göttingen and Economics at the University of Kassel. Since August 2002 she is working as research assistant at the chair "Information Systems Research" of Prof. Dr. Udo Winand.

Oliver Gerstheimer is Co-Founder and Managing Director of the chilli mind GmbH in Kassel, Germany – an international high-level think tank for strategic service creation in Mobile Business since 2001. Furthermore Oliver is a researcher at the Kassel University, department System-Design, within the government-founded Project (BMBF) mik21. Oliver is graduated Product-Designer and holds an additional degree in Innovation Management & Technology Assessment from University Kassel. For his scientific research in the field of user-centered mobile applications design, he received two scientific scholarships of the Breuninger Foundation (Germany) and Telekom Austria AG (Austria) in 2000. Together with Christian Lupp, Oliver received the Scientific Award 2002 from the Vodafone Foundation for Research in Mobil Communication (Germany). Moreover he is Course director of the Postgraduate Study „Mobile Application Design“ at the University of Art and Design in Zurich – hgk_z (Switzerland).

They are all working in the interdisciplinary research project "mik21" - Migrationskompetenz als Schlüsselfaktor der Oekonomie des 21. Jahrhunderts" (Migration competence as key factor of the 21st century economy, <http://www.mik21.de>). This project is focussing on the research of mobile internet developments concerning the fields of mobile living, mobile working and mobile government.