# Designing Digital Workplace Environments

## An Agile Framework for Large-Scale End-User Participation

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***Abstract*— For companies, knowledge is the central and decisive resource for success. Today, however, knowledge must flow more than ever before in order to meet the requirements of shorter innovation cycles and an increasingly agile working environment. The distribution and generation of knowledge requires a digital workplace environment that facilitates communication and collaboration between employees and their environment. The digital workplace acts as both a technical enabler and an attractive feature, thus making a major contribution to organizational performance and recruiting, retaining and motivating staff. Such an infrastructure, which connects users, makes them capable of working ubiquitously. Due to the complexity and ambiguities of such an endeavour it can only be rolled out and developed on an ongoing basis in close interaction with users. Therefore, this contribution proposes an agile framework for large-scale end-user participation in developing digital workplace environments based on an agile design approach that actively and continuously involves employees.**

***Keywords — digital workplace, agile, user participation, SCRUM, KANO, large-scale, framework***

## I. Introduction

The number of employees in Europe (EU-27) who manage their work with the use of information technology (IT) continues to increase steadily and reached a penetration rate of 59% in 2015 [1]. The daily work of these people is dominated by knowledge intensive tasks and IT-supported activities. For example, knowledge workers spend about two thirds of their working time on computer-supported communication, collaboration and documentation [2]. The process of knowledge work is emergent and requires self-regulation in reception and distribution of information and social interaction to improve and renew knowledge [3, 4]. Intensive involvement in the network of knowledge carriers is essential for the performance of knowledge workers [5]. Knowledge-intensive organisations of the future will thus replace hierarchies with network structures and replace control by self-organisation [6]. Since the structures of cooperation in such organisations are hardly predictable, it is obvious to transfer the principles of individualisation, self-organisation and autonomy to the design of the work environment and thus the IT workplace equipment.

With the comprehensive digitisation of many areas of life, the demands on IT support at the workplace are also increasing, as the trend towards consumerisation implies [7]. Therefore, it is important for companies to offer an attractive working environment to current and future employees that also includes the suitable IT.

The developments described above are accompanied by a paradigm shift in the design of digital workplace environments: System design follows user needs instead of user needs follows system design. Therefore, this article examines the question of how individual user needs can be systematically integrated into the development process of collaborative work environments

## II. Existing Theories and Related Work

### *A. The IT workplace environment as a design subject*

As little attention has been paid to the IT workplace environment as a design subject so far. There is no consistent or single approach that has become established to this day. Among others, the terms "PC/desktop workplace" [8], "IT workplace" [9], "(shared) workplace system" [10, 11] and "digital workplace" [12] are common. However, this does not imply a uniform understanding and delimitation of the term “workplace”. The common denominator of these definitions is the understanding that they describe the relation to a clearly delimitable, spatial area in which people within the company's working environment interact with work equipment and objects. However, this close understanding cannot be maintained due to social and technological developments. The importance of IT usage outside a spatially fixed and determinable area has become too significant due to increasingly flexible and diverse forms of work that are not limited to a particular place or time period.

In the context of this article, the digital workplace environment is to be defined as part of the IT infrastructure that is visible or experienceable for the user embedded in an organisational and processual structure, with the help of which he or she can perform his or her work activities being characterised by information, communication and collaboration. The digital workplace environment in this understanding includes in particular:

- software and software components (e.g., applications, application components, client operating systems),
- hardware and hardware components (e.g., workstation terminals, telephony or audiovisual terminals, peripherals),
- availability of data and services,
- user support in form of organisational resources and service levels to ensure functional efficiency (e.g., staff, tutorials, etc. and support times, response times, etc.).

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### B. User Participation as critical factor

Many publications and studies demand that customer satisfaction and loyalty can be increased through greater individualisation and user orientation of IT, resulting in a shift away from one-size fits all to tailor-made IT environments [12-14]. In line with these ambitions, comprehensive knowledge of target groups and their requirements are proposed as a starting point for IT management [15] as well as they are proposed as an essential factor in most agile approaches e.g., in software development [16, 17]. Hence customer orientation and individualisation can be achieved by direct participation and integration of users in IT projects. They know best the processes and tasks as well as the context in which IT systems have to operate. For example, the Chaos Report of the Standish Group sees user participation in its first report [18] and mainly since then up to the most recent version [19] as one of the main factors for success of IT projects.

The impact of successful participation of users in IT projects has already been extensively investigated in both practical and scientific literature. Thus, in [20] clearly positive effects of user participation are found on system success by a comparative evaluation of 86 individual studies. Basically, it can be assumed that the ambiguity and uncertainty for developers increases with complexity of tasks that arise in an organisation [21]. User participation leads to a reduction in complexity and reducing the probability of failures. The relevance of user participation thus increases with the complexity of the systems to be designed.

In terms of user participation, as in [20], referring to [22], two distinct aspects can be differentiated, which have to be considered within the term participation:

The first aspect "user participation", in the narrow sense, refers to the active participation of the user in the development process. This aspect of participation includes the concrete behaviour and activities of users during the development process. The user participation thereby includes the identification of requirements, solution design, development and evaluation of the object to be designed.

The second aspect "inclusion of users" or "user involvement" is a more psychological aspect, which includes, for example, the personal importance of the system for users.

Table 1 shows the number of positive and negative correlations identified in the meta-study between the aspects of user participation and categories of system success [20]. The number of identified relationships can be seen as an indication of relevance in terms of the criteria for system success.

In addition to the clearly positive effect of user participation in the overall findings and the clear statement of the effect on user satisfaction, detailed attention should be paid to the effect on the factor "System Use", which refers to the intensity of use of a developed system. In collaboration systems where the benefit for the individual user increases when the number of users increases (network effect [23]), a critical number of users can be reached at an early stage.

TABLE I. CORRELATIONS BETWEEN ASPECTS OF USER PARTICIPATION/USER INVOLVEMENT AND SYSTEM SUCCESS

| Categories of system success | Aspects of user participation (broad sense)[1] | |
|---|---|---|
| | *User participation (narrow sense)* | *User involvement* |
| User satisfaction | 28/1 | 23/1 |
| System use | 8/0 | 7/0 |
| System quality | 9/0 | 3/0 |
| Data quality | - | 6/2 |
| Project in time and budget | 5/3 | - |
| Ease of use | 1/0 | - |

### C. Organisational Requirements for User Participation

The following section summarises the basic user-centric design principles in context of developing a framework:

#### 1) Consistency of participation

The more intensively and extensively users are involved in the design process, the greater the benefit of user participation. User-integration should therefore take place in every phase of system design [20]. However, there is also a marginal benefit of participation. It is therefore possible to reach a point where users can no longer contribute to the improvement of a system and he or she feels that the resources contributed are wasted [24].

#### 2) Type of integration

It is advisable to allow users to freely express change requests, ideas and suggestions as well as to let him/her choose according to his/her preferences and needs [24].

#### 3) Participation of experts and key personnel

The expertise of users involved in software projects is repeatedly cited as a crucial success factor. In particular, knowledge of the functional design of a system is considered relevant. This group of experienced users tends to reject systems that have emerged without their participation. This is frequently not the case for users with less expertise, even with low participation.

#### 4) Project communication

Communication between users and developers significantly determines the probability of success of a development project. [25] indicates in its meta-study that specific proposals for suitable methods are rarely made. According to this study, the main focus of a communication process is on the selection of users to be involved, the design of communication structures, the type and timing of communication and feedback. [26] mentions in addition the importance of a clear division of roles between participants and the presence of a clear vision of the final outcome.

## III. DEVELOPMENT OF AN AGILE FRAMEWORK FOR PARTICIPATORY DESIGN OF DIGITAL WORKPLACE ENVIRONMENT

In this section a structured and agile approach for user participation in case of the design of a digital workplace

[1] x/y = positive/negative correlation

environment will be presented. Concerning the primary target to increase user involvement the approach is based on various expedient paradigms. It is characterised by the basic ideas of action research [27], participatory design [28, 29], design thinking [30] and agile methods [31].

Based on participatory design, the proposed framework makes use of the direct and broadest possible participation of actual and prospective users. As shown in the previous section, broadest possible and cross-stage user participation is crucial for effective system design. Design Thinking formulates goal-oriented steps and paradigms which, starting from the problem, are to lead systematically to a solution**.** Design thinking is suitable to deal with ambiguity and provides user-centricity and flexibility in its approach to tackle complex problems. The role of Design Thinking in the proposed framework is essential for gaining a broad understanding of the user's fundamental challenges and for gathering initial ideas to develop innovative solutions.

SCRUM is used as agile approach. It is an interactive and customizable process model that is particularly suitable for projects [32] characterised by volatile and ambiguous requirements and undefined implementation paths and outcomes. Within SCRUM various agile practices (e.g., user stories or epics for requirements specification or KANO for requirements prioritization) can be used for effectively organizing and managing projects. SCRUM delivers three main artifacts: product backlog and sprint backlog as well as a product increment. The product backlog is an ordered list of all product requirements. The sprint backlog is a subset of the product backlog items chosen to be implemented within the next iteration (sprint) to complete the increment. Sprint review and retrospective are essential parts of SCRUM as they allow adaptation to changing requirements and prioritization between iterations. For project management only parts of SCRUM can be used or adapted, but the result is no longer SCRUM [31]. Due to its application in volatile and ambiguous environments SCRUM is a very good basis for a comprehensive approach to the design of a framework for the specification of digital workplace environments.

The aim of the proposed framework is to systematically derive fields of action for the design of digital workplace environments. Starting from project definition, through requirements assessment and prioritisation. Within this development cycle action research plays an important role. Fundamental to action research are direct and reciprocal effects between human and organisational behavior occurring by technology usage; action research aims at gaining knowledge out of real-world situations and at the same time affecting these situations while being part of it.

Based on the foregoing considerations, the various phases of the framework and its specific implementation are suggested as follows:

### *A. Initialisation Phase (Phase 1)*

In the first phase, a core team should be built up. It consists of responsibles from the company who are striving for a reorientation of their digital workplace environment and, if necessary, technology partners or (external) consultants. Already at this stage it is advisable to involve user representatives.

As a starting point a first rough idea of the project goal or problem definition, which forms the basis for subsequent phases of the workplace development has to be formulated. This includes, in particular, the creation of assumptions about future user groups. Thus, they differ in their working style, e. g. with regard to their mobility, range of use and depth of use and communication relationships, both internally and externally. The range of roles ranges from power users with their extensive demand for high-performance IT support to production staff for specific applications.

After these preliminary considerations, the project is widely announced and interested users are invited to participate. User participation follows according to the aforementioned organisational requirements for user participation. A (virtual) community of these users can be formed. The community should be preferably representative for the company as a whole and builds a starting point for all subsequent phases of the proposed framework. Employees who are ready to participate can register online by entering their profile data relevant for their working style. The procedure proposed hardly sets any limits to the number of users involved.

For a reliable monitoring of the project's success a zero measurement is carried out in this phase. The measurement covers the user satisfaction concerning performance and functionality of the existing working environment. The zero measurement serves as a reference point for the satisfaction measurement after conversion of the increment.

### *B. Planning Phase - Identifying Action Areas (Phase 2)*

After the initiation phase, it is important to identify the areas in which there is a need for action to change or improve the workplace environment. This task is often characterised by ambiguity and high uncertainty, therefore an agile approach is of major importance. Frequently, the actual problem or the design object in a narrower sense is not yet explicitly and clearly defined.

Design Thinking is an approach that is able to support this phase. It allows the direct participation of users and corresponds to the requirements of the Media Richness Theory for intensive and synchronous communication in a complex and unclear context [33]. The Design Thinking approach assures customer or user centricity and comprehensive awareness of usage context. Further it helps identifying correlated organisational action areas [34].

The Design Thinking cycle (Fig. 1) consists of several phases between which jumping forward and backward is possible and desired. It is crucial to assemble teams who will then be working on the development of the new digital workplace environment for a certain working style.

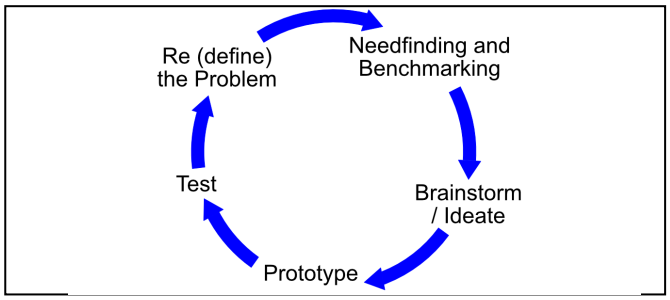


Fig. 1. Design Thinking Cycle ([30])

The demand for interdisciplinary teams within design thinking projects is met by involving representatives of IT department (e. g. system architects and product managers) as well as participants from other departments, such as business planning and human resources. Above all, however, two or three representatives of the future users should be represented in each working group. Overall a restriction to approximately 40-60 users is meaningful.

In the first step, the problem definition phase, the team refines the problem area taking into account all conditions and influencing factors. This is done by framing and reframing [35]. First of all, the assumptions relevant for the initial question are collected. Exemplary questions can be e. g. which essential basic conditions (costs, infrastructure, design, strategy) of the new workplace for employee groups to be defined (such as knowledge workers, executives, sales representatives) should be clearly defined. These assumptions need to be specified explicitly but in many cases are defined only implicitly. The assumptions can thus be checked for validity and, if necessary, reformulated.

In the phase of needfinding it is necessary to explore the specific working environment of the user. This phase is supported by the implementation of the persona concept. The descriptions of the working styles are supplemented by a comprehensive input from real employees.

The working styles describe typical and recurrent working situation in a structured way for delimitable categories of employees (e. g. typical workplaces, infrastructure/tools and working hours), their tasks and challenges, their points of contact within and outside the company and the way in which they have communicated so far. Based on this basis, the team works together to develop an idea of what the future working environment of these people could look like.

The ideation phase translates the generated conceptions of the future workplace into initial proposals for solutions for the use of IT. Key is to identify technologies, tools and/or features that will (more) be needed in the future or that should not/less be used in the future. As usual in brainstorming, the first step is to produce a large number of solution ideas.

The best ideas of the ideation step are finally implemented in a prototype. The aim is not to create an executable working environment, but rather to create a tangible object that can be used to explain the future working environment to third parties.

### C. Requirements Elicitation (Phase 3)

The involvement of users promises, as described before, considerable positive effects. In order to leverage this potential, the user must be able to participate in the entire workplace development process. This applies in particular to the steps of creating and defining requirements. Because, as Yourdon puts it: "*If you don't understand the users requirements, it doesn't matter how to code it*" [36]. It is therefore important to understand the requirements as fully and clearly as possible. Common methods such as interviews, workshops, observation etc. are very time-consuming, both for the executors and for the participants or the observers. In order to ensure that all requirements are covered as fully as possible, a considerable number of interviews or workshops must be conducted. In addition, it is sometimes necessary to have joint attendance times that are difficult to achieve, especially in highly distributed organisations.

In the procedure described here, the requirements are therefore recorded in the form of user stories. User stories are used to capture the who, what and why of a requirement from the user's point of view in a simple and concise way [37].

In addition to his or her actual requirement, the user formulates the "what" with the situation or role in which he or she finds himself or herself, as well as the context in which this requirement is relevant, the "who" and the benefit he or she expects from the realised requirement, the "why". This additional information facilitates the selection of relevant stories and design decisions. The user stories are comparably easy to write even for non-experts because of their brevity and clear structuring guidelines. There is no limit to the number of users involved within this step.

### D. Requirement Prioritisation (Phase 4)

The aim of this phase is to maximise the benefits (time savings, quality improvements and user satisfaction) of the new digital workplace environment. To date, however, the list of requirements collected has often tended to be seen as a flat list and the requirements it contains can sometimes have very different values for the user and the company. In order to increase user acceptance, the most important requirements should therefore be met in an early version. A prompt implementation of most, if not all, all elicited user stories is usually viable. Thus, the prioritisation of user stories plays a crucial role to roll out the functions with the greatest benefit for users and organisation in a timely manner.

Many of the common prioritisation methods used in agile development, however, reach their limits with large quantities of items to be prioritised and a large number of participants [38]. The majority of the approaches [39] are based on a direct comparison of requirements (e.g., the Hundred Dollar Method and the Analytical Hierarchy Process), an assessment by experts (e.g., MoSCoW) or presuppose the personal presence of the users.

The KANO method offers a way out of this problem. It permits an individual examination of the requirements and can be mapped using a standardised questionnaire [40]. This method is based on the empirically supported classification of customer and user requirements into the following attribute classes:

- Basic or must-be quality requirements denote attributes that are expected and absolutely required by the customer. If these requirements are not implemented, great dissatisfaction arises. However, with a high degree of fulfillment, this dissatisfaction is only avoided, and no satisfaction is generated;
- Performance or one-dimensional quality requirements denote attributes where the degree of fulfillment is increasing in proportion to the satisfaction of the user;
- Attractive quality requirements are requirements which, in the event of a high degree of fulfilment, trigger enthusiasm and maximum satisfaction. If they are not implemented, there is no user dissatisfaction;
- Indifferent quality requirements refer to attributes whose implementation generate neither satisfaction nor dissatisfaction;
- Reverse quality requirements are attributes that have an inversely proportional relationship between the degree of fulfillment and user satisfaction. The more they are implemented, the more dissatisfied the user will be.

In order to prioritise the collected user stories, a functional form of questioning (customer's reaction if the request was implemented) and a dysfunctional form of questioning (reaction if the same request was not implemented) are asked for each request. This type of question is again suitable for a query within an online questionnaire.

By combining the answers to the functional and dysfunctional questions, each user can then be assigned to the above-mentioned attribute classes. By counting the frequencies of the assigned categories and certain evaluation rules, a statement about the relevance of a requirement for the working environment can be derived.

As a result of this type of classification, the requirements that were classified with the KANO model can not only be listed relative to each other, according to relevance. This approach also gives an idea of the absolute effect that the realisation of a certain user story will have on user satisfaction.

The sequence of the implementation is now determined according to the characteristics of the above-mentioned attribute classes. Basically, the basic factors must be realised first, then the performance factors and then the enthusiasm factors. For characteristics that appear to be irrelevant for the users, conversion is not necessary.

Particularly in combination with the aforementioned working styles, there may result a profound insight into the users' requirements. In this way, a specific profile of can be created for each working style. For example, requirements can be grouped for specific categories of employees.

### *E. Workplace Implementation (Phase 5)*

Based on prioritisation and grouping of requirements, a sequence of an implementation of the future digital workplace environment can be determined. Basis are the characteristics of the aforementioned attribute classes. Essentially, the basic factors must be realised first, then the performance factors and finally the enthusiasm factors. For characteristics that appear to be irrelevant for the users, an implementation is unnecessary.

Workplace implementation is a project in itself; with its own planning, execution, monitoring and closing phases. Workplace implementation can also be conducted using agile methods. Dependencies to existing IT Infrastructure Library (ITIL) operations frameworks must be taken into account. The implementation phase is not part of this framework but can be backed by existing approaches [41-43].

### *F. Satisfaction Measurement (Phase 6)*

In the Review Phase satisfaction measurements are an important part of the approach. They are carried out at certain time intervals after the introduction of new functions or functional enhancements of the digital workplace environment. Satisfaction measurements serve to evaluate the effectiveness of changes from the employees' point of view with regard to their working behaviour and productivity.

Feedback from satisfaction measurement can be used for various purposes. On the one hand, the systematically collected feedback can be used to make adjustments in the prioritization and configuration of individual workplace features (similar to the tasks of a sprint review at SCRUM). On the other hand, satisfaction measurement can be useful to adapt the procedure itself by revealing shortcomings, which originate from the proposed framework itself, i.e. from requirement collection, prioritization or from satisfaction measurement (similar to the tasks of the retrospective at SCRUM). In addition, there is the potential that satisfaction measurement becomes an integrative and continuous part of the company's IT management, in that the results of the measurement also provide the basis for user satisfaction and the adjustment of IT strategies.

### *G. Summary and Overview - Agile Framework for articipatory Design of Digital Workplace Environments*

The agile framework for designing digital workplace environments in companies consists of 5 main phases (Fig. 2). The first two phases serve to determine the project's basic requirements, to define a starting point and to establish the organisational structure for the execution of the project. In the subsequent phases, the user's requirements for the workplace are gathered and periodised by the users.

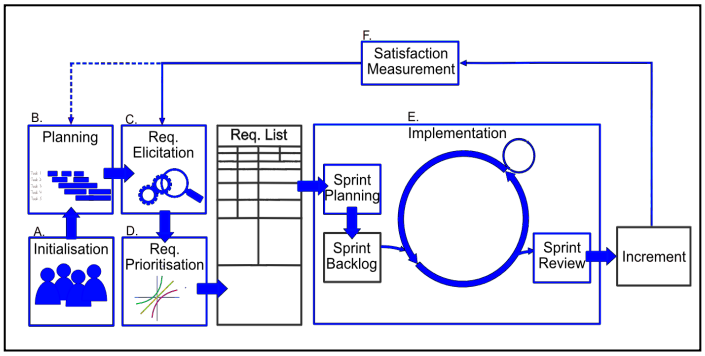


Fig. 2. Agile framework for participatory specification of digital workplace environments

These steps can be repeated several times and experiences from previous runs can be incorporated and refined. The obtained results form the requirements list (product backlog) and its initial prioritization. User stories can be merged into epics (merged user stories) and can be introduced iteratively in the organization at various stages of iterative development, and further elaborated and tested incrementally.

The implementation step itself is not part of the proposed framework. However, backlog and prioritisation must be taken into account during implementation. Implementation can be carried out in an agile approach as well, thus leading to various increments based on the Product backlog. The implementation can make use of the proposed framework to further refine requirements and add new requirements to the product backlog, resulting from the implementation step.

A user satisfaction measurement can be carried out at the end of the implementation step or at the end of the implementation of the most important assessed features in the form of increments. The user satisfaction measurement can measure the overall degree of fulfilment of the implemented functions achieved from the user's point of view can and forms a basis for adaptation measures in the further procedure.

In the 5 main phases several artifacts are created. Some of these are identical to the SCRUM, some of them are additional (Fig. 3):

- *problem definition*, to represent an initial idea of the project goal as well as assumptions about future user groups;
- *working styles*, to represent a detailed specification on how the digital workplace environment is expected to be used by different user groups. Working styles become increasingly precise in the course of the project due to iterations and the collection of additional requirements and their prioritisation;
- *user community,* to handle elicitation of requirements, prioritisation and measurement of satisfaction. The user community is the primary contact group for the procedure and should be determined as representative as possible on the basis of the problem definition;
- *requirements list*, to represent and handle the "product backlog". The requirements list is an ordered list of prioritized requirements that have been gathered by the use of large-scale user participation. The requirements list is refined in several interactions of requirements gathering and prioritization;
- *zero measurement,* to represent the initial measurement of user satisfaction with functionality and performance of existing workplace environment;
- *user-specific requirements*, to represent prioritized list of requirements for specific user groups;
- *sprint backlog*, to represent a subset of product backlog items to be implemented within the next increment;
- *satisfaction measurement,* to represent the measurement of user satisfaction with functionality and performance of the digitally enhanced working environment;
- *increment,* to represent containing most important features

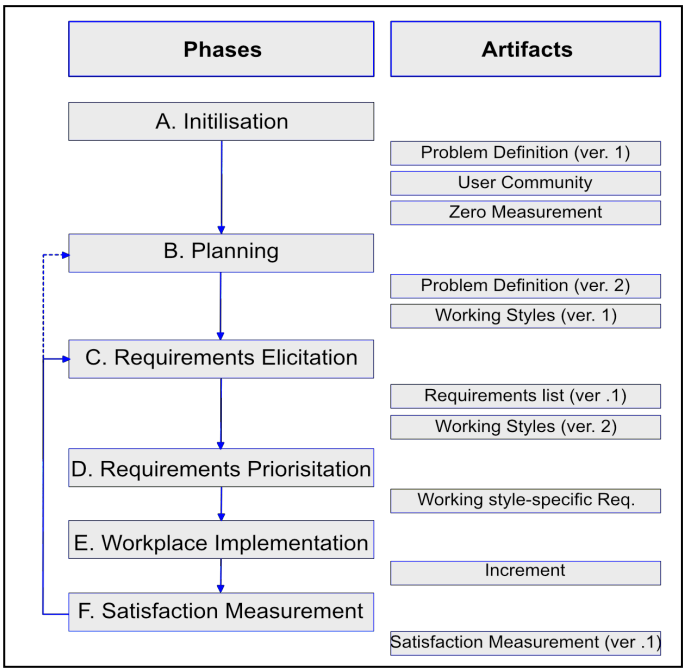


Fig. 3. Overview of artifacts resulting from proposed phases of Agile Framework for Large-Scale End-User Participation

## IV. FINDINGS

The presented results are based on 10 completed projects for the design of digital workplace environments in which the presented approach was applied. The company's size ranged from 5,000 to 250,000 users from various industries such as energy supply, automotive suppliers and service providers.

In summary, the proposed framework has proven its worth in practice. However, based on the empirical experience gained in practical use, changes have to be made to the framework, which will be described in detail below. At the same time, during the implementation of the framework in various companies, it could be observed that there are often similar fields of action and challenges in the design of digital workplace environments. These will also be explained in detail in this section.

### *A. Findings in Initialisation and Planning phase*

In the initialisation and planning phase, the high degree of uncertainty can be significantly reduced, and expectations clarified or controlled. The focal points and fields of action that have to be dealt with in the project are clearly evident. These are often the increase in mobility and flexibility of the IT work environment. In addition, clear ideas for the benefit of collaborative working environments and the extent of change

that will be necessary in the future are developed. In particular, there is often a need for action in the area of cooperation culture.

With regard to the identification of the fields of action, the most significant adjustments were made to the procedure presented here. Originally, the fields of action were identified via an online questionnaire, in which the relevance of certain trends and developments for employees and companies was recorded. However, it turned out that this form of survey severely restricted the scope for relevant topics and did not do to satisfy the individual requirements of users and companies.

### *B. Findings in Requirements Elicitation phase*

On average, one participating user contributes about four requirements. The understanding of the task is very high. On average, only about 5% of the recorded requirements are outside the scope defined or cannot be used for further work. The overlaps in terms of content of the requirements (usually at least three user stories to one goal/desire) can be used by merging several similar user stories to ensure a high degree of clarity and unambiguousness of the requirements. Thus, gaps in the requirements and weaknesses in the formulation can be compensated for.

The supplementary information for informing participating users and the choice of media through used to communicate are decisive for the quantity and quality of received requirements. At this point, both the involvement and the level of knowledge of users regarding the project is still very inhomogeneous. Therefore, experience shows that both unidirectional and multidirectional ways of communication should be offered in this phase. In this manner, individual information needs and preferences for communication channels are satisfied, resulting in sufficient communication depth for users with a high demand for information as well as the conservation of the resources of users with a low demand for contextual information. Multinational companies should collect the requirements in several languages. Because linguistic skills have a decisive influence on the quantity and quality of submitted user stories.

### *C. Findings in Requirement Prioritisation phase*

The KANO questionnaire is well received and understood in conjunction with the supplementary instruction video. The response rates range between 30% and 60% in the majority of the surveys carried out the high rate of acceptance by users. The number of implausible answers can be used to check whether the requirements and the questions were understood. Overall, the proportion of such responses in the surveys carried out is generally around 1%. Thus, a good understanding on the part of the participants can generally be assumed.

The participants' assessments of the requirements are characterised by strong realism. If the requirements gathering includes very “futuristic” wishes, in-depth examination of requirements indicate evidence that high-priority requirements are indeed highly relevant for everyday work whereas futuristic requirements are generally considered less relevant by other users. However, such requirements can still be important, as they point out starting points for future developments of the digital workplace environment. These requests are suitable for periodic review and reassessment by the users. They can form the basis for a holistic management cycle based on the presented method.

The evaluation of group-specific requirements has proven to be extremely meaningful. It is common for certain user groups (e. g. the field service or knowledge workers) to rely more heavily on certain functionalities than others. At the same time there can be user groups that reject such requirements. If deviations like these in relevance of requirements are detected, a widespread rollout of these functionalities can often be avoided. In this way, considerable hardware and license costs can be prevented. The classification of users into groups should not be based on demographic characteristics, hierarchical assignments, job descriptions and or membership of certain organisational units. Instead, it is recommended that the clustering in user groups should be carried out on the basis of the requirements prioritisation results.

### *D. Findings in Workplace Implementation phase*

The identification and evaluation of user stories provides a good basis for implementation. The user stories can be combined into coherent epics, whereby prioritization allows the user to focus on the most important functionalities from the user's point of view. The agile approach in the implementation process enables short-term user feedback and appropriate adaptation during implementation as well as a high degree of permanent user participation.

The practical application shows that user participation and the realisation of the important features from the user's point of view are an important aspect for the later acceptance of the solutions. As an additional aspect, it must be taken into account that organisational measures (such as training courses and training on the new working environment) are indispensable in order to promote the application. In conclusion it can be said that a better adaptability will lead to better adoption

### *E. Findings in satisfaction measurement*

The applied process of satisfaction measurement delivers valid results in terms of user satisfaction and potential for improvement. The practical application and evaluation of the satisfaction measurement shows clear evidence that the proposed method contributes to the improvement of IT support in the work environment of employees. For use in practice, especially the question about the reason for dissatisfaction delivers insights of high quality. The results available so far are suitable to support the applied prioritisation approach (Fig. 4). The more important a function be assessed the more dissatisfaction increases case of inaction. Vice versa the realization of unimportant requirement does not result in high increase of satisfaction.

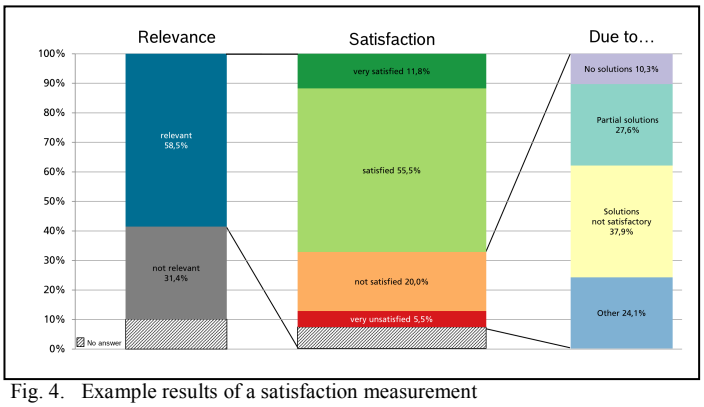


Fig. 4. Example results of a satisfaction measurement

## V. Conclusion

This article describes the basic design principles of user participation in software projects and transform them into a procedure for the user-oriented design of digital workplace environments. The presented framework guarantees a continuous and comprehensive participation of all user groups and makes suggestions for the use of tools as well as the design of communication within the project. As a result, the requirements can be comprehensively collected and validly prioritised.

However, a supplement to the assessment of risks and the expenditure required for implementation is still outstanding. Nevertheless, the procedure provides a basic prerequisite for networked and interdisciplinary cooperation to take place smoothly and so that IT can develop its benefits and innovation potential within workplace design.

The overall view on the projects carried out so far suggests that supporting collaboration between users is particularly important for knowledge-intensive areas and companies. A relevant change in the requirements with regard to other factors such as industry sector or company size cannot yet be determined. At the same time an open exchange of requirements and establishing an appropriate culture within the company is often difficult to accomplish because a comprehensive and open feedback culture is not anchored as part of the corporate culture in most organisations.

Over time, the assignment of requirements to attribute classes in the KANO model changes. Former enthusiasm requirements become self-evident after some time and have to be classified as basic requirements. Due to the temporal shift of the requirements contained in the KANO model, the degree of implementation of the user requirements must subsequently be subjected to continuous controlling. In addition, the permanent development of new requirements within the user community can be expected.

Future research will mainly be directed to the framework being refined to three main direction. First, a fundamental evaluation of the used construct (i.e. identification and evaluation of the user stories, derivation of fields of action and working styles) still has to be conducted to obtain more reliable evidence about the validity of the developed framework. Second, the collection of requirements and the identification of user groups is currently strongly influenced by manual evaluation of the surveys. The potentials of machine learning methods such as text mining and clustering processes for a machine-supported identification of user groups have to be further investigated. Third, the proposed framework builds a continuous micro-cycle of requirements collection, prioritisation and implementation. Therefore, the framework will be a valuable add-on to IT management frameworks, such as ITIL, especially in case of a systematic and integrated management process of requirements management for IT-Services. However, it is currently unclear how the proposed framework can be systematically integrated into existing approaches to IT management.

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