Towards Controlling the Acceptance Factors for a Collaborative Platform in Engineering Design

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Abstract. This paper might serve as a guide to take step towards a better acceptance of computer-based Knowledge management (KM) tools in institutional setting. At first time, it investigates a set of factors with different origins which are proved to have an effect on usage decision. Secondly, we set a list of candidate factor which are supposed to influence future users of a collaborative KM platform (Dimocode). At the end, we develop a methodology to take into account the selected factors and master their positive or negative impacts. The contents of this paper would be an appropriate framework in the way of Knowledge management systems (KMS) deployment.

Keywords: acceptance factors, collaborative, platforms, engineering design

1 Introduction: the controversial success of KMS

Engineers involved in a design process use and create a large amount of technical knowledge during their daily work. Managing this knowledge is claimed to be a way of improving the efficiency of these engineering design activities by fostering knowledge formalization and sharing [1].

Collaborative platforms are often presented as a relevant support for knowledge management activities. They rely on information repositories and provide users with different means of interaction, either with the documents or with other users. Based on the assumption that intensive collaboration between engineers will support knowledge sharing, some research works report successful implementations of such collaborative platforms in the engineering design domain [2]. However, even if the idea of these platforms seems to be attractive and useful to the users, some research works rise into question the relevance of IT systems for applications such as knowledge management or organisational memory systems [3]. The main challenges IT is facing with regarding the potential success of such systems are discussed both in terms of technical challenges and organisational ones [4] and despite their importance, the latter seem to be often underestimated, leading to disappointing results.

The issue of identifying and overcoming these organisational challenges is at the heart of our concern, as we are working on the development and the implementation of a new collaborative platform. This platform, namely DIMOCODE, will be dedicated to the sharing of calculation models of electrical components between design engineers and calculation experts. In addition to the sharing of the models' documents, DIMOCODE is also meant to support a knowledge network, thus giving more value to these calculation models. In this paper, we try to identify which factors will play a particular role in the acceptance of a collaborative platform, and which animation policy should be engaged in order to ensure a successful deployment.

The following section gives an overview of the state of the art regarding the acceptance factors of knowledge management systems (KMS). The forthcoming DIMOCODE collaborative platform is then briefly presented in section 3. Finally, section 4 draws some propositions regarding the main acceptance factors of the platform and the technological and organizational leverage for action related with those factors.

2 Acceptance factors in the literature

The degree in which individuals interact with a system, is seen as the key point in successful implementation of a KMS [5] and [6]. Nevertheless, many studies in the literature report failures in KMS deployment due to their underutilisation by individuals [7] and [8]. That is why, knowing how to foster the employees to use such devices and to embrace them in their daily work practices remains a major concern in the institutional setting [9]. Since the 70s studies on factors likely to affect human intention to use a system, this issue appears to be a crucial research field needed to promote KMS adoption in organisations [8]. Given that one can deal with a KMS either to feed it with his narratives or to seek suitable information, both knowledge sharing and knowledge seeking situations have been tried to be taken into account in our acceptance factors analysis.

A synthesis of several theoretical models of KMS usage suggested by different studies [10] and [7], has highlighted a fourfold dimension to what can be assigned each of the acceptance factors. These four dimensions are: *1) Organisational context*: some authors argue that the organisational settings, in which teams are embedded, can play an outstanding role on how a technology is framed and enacted [8] and [11]. *2) Tool:* many papers account for the perceived characteristics of the system itself as determinant for an effective KMS usage. 3) *Users:* the intrinsic characteristics of potential users are also highlighted [7] as another dimensions of KMS acceptance 4) Task: the nature of task which is supposed to be assisted by KM tool could alter the form of information exchange, thus that makes it harder or easier contrariwise [7]. This classification approach yields to consider four main classes of factors respectively called: organizational factors, system related factors, user related factors and task related factors. A second way has been also derived from our literature review to classify the causal factors might be separating them depending on their inhibitory or stimulating effects on KMS usage behavior into two categories. Table 1 combines both the fourfold dimension and effect-based classification visions by connecting to each category a set of deterrent (italic) and incentive (normal) factors. Each of the factors only comes with a very short description but the related bibliographical references can help those who are seeking to know more about them.

Table 1. KMS acceptance factors in the literature.

Factor	Short description	References
Organisational factors		
Cooperative culture	An organisational culture conductive to knowledge sharing causes the employees to recognize the benefits of knowledge sharing behavior.	[12], [11], [9]
Reciprocity	Knowledge providers share their experiences when there will be a great chance of returning from others.	[9], [13], [14]
Episodic change	Under a high rate of episodic context change, people are reluctant to adopt a sharing behavior.	[11],[17]
Resource availability	A sufficient amount of time and a fast access can multiply the interactions with implemented system.	[8], [9]
Psychological safety	Legitimates the errors in well-intentioned actions	[11], [15]
Pro-sharing norms	The rules of teamwork are meant to enhance and facilitate the knowledge sharing climate.	[6], [10]
Generalised trust	The members are more inclined to share their skills with those who are trustworthy and whom they believe in their skills and goodwill.	[10],[13],[15]
Supervisory control	Feeling monitored by a superior can improve the willingness of people to make use of KMS irrespective of their contribution interest.	[13],[15]
Organisational reward	Moral or material incentives are sometimes proved to promote KMS usage.	[6],[8],[10], [12],[14]
User-related factors		
Image of self	The information contributed to KMS could bring a good reputation to his author.	[10],[11],[14]
Self-confidence	Perceived conviction in his abilities to face and solve the problems may foster the contribution.	[5],[9],[10]
Altruism	Satisfaction due to benefit another from one's experience and skills.	[10]
Loss of power	Reluctance to disseminate his knowledge using KMS fear of losing the resulting superiority.	[10]
Identification	Commitment to membership in the virtual communities of the KMS.	[7],[9],[10], [12]

System-related factors		
Contribution cost	The amount of time and energy required to contribute.	[9],[10],[13], [14],[15]
Research cost	The expense of time and energy to find sought information in knowledge base.	[9],[14]
Perceived usefulness	Quality of contents, task-technology-fit and awareness of potential benefits	[7], [9]
Ease of use	Easier is a software to manipulate, more it will be used.	[5],[6],[8],[9]
Task-related factors		
Task interdependence	When there is an obligation to share resources and expertise with others in order to achieve his aim.	[6],[10]
Task Tacitness	The proportion of tacit knowledge upon explicit one, needed to perform a task using KM tool.	[6],[9]

However, we believe the factors distribution into a fourfold dimension as suggested by the table.1 gives rise to an issue in the sense that certain factors, whatever deterrent or incentive they are, own a multidimensional nature and could correlate at the same time with more than a single dimension. For instance, we assume that spreading a cooperative culture between staff, having organizational conditions conductive to cooperation will not only be sufficient; but individual intrinsic characteristic might also largely determine the adoption of such a behavior. This type of assumptions led us to draw the model form Fig.1 taking into account the multidimensionality property of factors. This model will serve to define some requirements of the Dimocode platform which is now briefly presented.

3 What is the DIMOCODE Platform?

With the DIMOCODE platform, we are interested by the problematic of capitalization and reuse of numerical models for the simulation and optimization of energetic system designed by engineers. We call energetic systems, systems like cars, buildings, or planes, it means systems that uses electric, mechanical, or hydraulic energy. For the simulation, and the optimization of those systems, engineers use physical and mathematical models in order to compute the characteristics of those systems: consumed energy, efficiency, weight, cost...

We made the hypothesis that the knowledge around those physical and mathematical models is composed of two aspects: *1)* Explicit knowledge: the file containing the models with their physical and mathematical equations, with the associated documentation explaining the assumptions, the limits of use, …*2)* Implicit or tacit knowledge: this is the skill developed by the expert who has developed the model.

So the goal of the DIMOCODE platform is to capitalize all the explicit knowledge and to provide experts and users of model with the opportunity to exchange their knowledge by having possibilities to work in a collaborative way around those models.

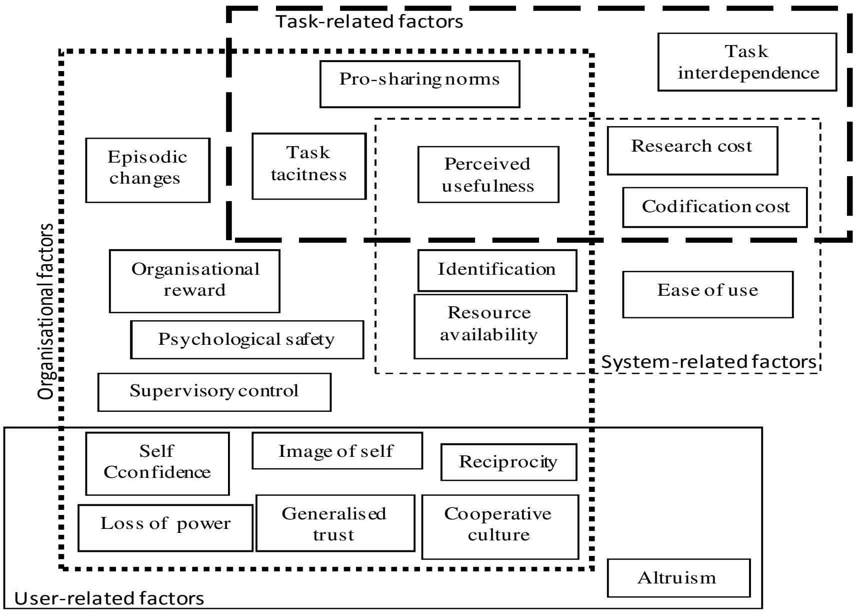

Fig1. The multidimensional nature of acceptance factors

The explicit knowledge can be stored and exchanged thanks to the possibility of creating a workspace for each model. In this workspace, the expert who has developed the model can expose all the files containing the equations and all the information and documentation for his models.

In order to offer a possibility to exchange the implicit or tacit knowledge, some functionalities have been implemented like:

- In the workspace of each model, there is a forum that allows users of models to ask question to the expert who has developed the model: this is a semi-formal way in order to offer the possibility to made explicit some knowledge aspects which are not clear, or simply not explained
- Experts can also work together around their model, with their simulation and optimization simulation tool, by using virtual meeting rooms in the platform: the idea is here to have the possibility to work together at the same moment on the same problem using the model.

In addition to the model workspace and its associated interaction facilities, the platform is also meant to support communities of practices around the simulation of energetic systems. Thus, it comes with a community workspace in which users have the opportunity to structure a community in order to share their knowledge around a specific practice. One can for example organise online (or offline) events, share documents or stories, define projects. The issue is now to define technical and organizational requirement in order to insure a successful deployment of the platform.

4 Technological and organizational requirements for the Dimocode platform

It comes from section 2 that many factors may influence the behavior of individuals who contribute to KMS. The approach which was followed in order to take account of these factors for the specification requirement of Dimocode is now presented in three different steps: selecting primary factors, defining strategies in order to manage these factors, and defining leverage for action related with these strategies. The latter will lead us to define both technological and organizational requirements.

4.1 Selecting primary factors

From the initial set of factors listed in section 2, a selection of primary ones is proposed, based on the specific aims and context of Dimocode.

Dimocode is an open platform, transverse to existing organizations (laboratories, companies…) whose future users are members of. The organizational context in which they work is so quite varied. Moreover, being external and independent from these organizations, Dimocode's capacity of action on these organizational contexts is very limited. This led us to remove from our selection those of the factors that are mainly related with the organizational context. Nevertheless, it is to be considered that the Dimocode platform will also come with some kind of organization which overlaps with those sometimes highly structured and hierarchical of companies. As an example, it could be proposed to introduce within Dimocode an economic reward system for the contributors, regardless of the local policies of companies. For the particular case of this factor of organizational reward, the choice has yet been made to remove it from the selection, due to some issues in predicting its effect [8]. Again, this characteristic of being independent from already existing organizations led us to remove from our selection those of the factors that are mainly related with the task of the users inside their company. Coming from the outside makes it difficult to have leverage on the purely task related factors.

Finally, a finer evaluation of the relevance of each of the remaining factors, which is not developed in this paper, led us to focus on the list of ten primary factors which are: Reciprocity, Resource availability, Psychological safety, Pro-sharing norms, Generalised trust, Image of self, Altruism, Identification, Contribution cost, Research cost, Perceived usefulness, and Ease of use.

At this stage of the method, the grid of factors form Fig.1 also proved to be a very useful tool in order to increase both our understanding of the global context of the platform to be developed, and our awareness of threats and opportunities.

4.2 Defining the main strategies

Because of the plausible role of the retained factors in using a KMS, controlling for their positive or negative effect is perceived as being a priority in the goal of insuring a dynamic life for the DIMOCODE platform and reaching a mass usage of it. In this way, once the primary factors have been selected, the second step of the approach was to associate each of them with one or more strategies in order either to develop its positive effect or to limit the negative one (see Table 2 for an example).

4.3 Identifying leverage for action

To support the defined strategies, we have looked for the levers of action making it possible to put into action and materialise them. The levers of action connected to each factor are considered to be able to act on the impact of primary factors and moderate it and are essentially composed of some platform animation policies and/or some features already built into the last version of the Dimocode platform. Table.2 gives an example of a strategy associated with *Image of self* and the corresponding levers of action.

Table 2. Strategies and levers of action for moderating the effect of retained acceptance factors

Factor	Strategy	Leverage for action	
		Organisational	Technical
Image of self	Making the contributors visible	Identification of most relevant contributions	Publication on news pages of the communities
		Organizing invited online conferences from the expert	Visio-conference facilities

5 Conclusion

Despite collaborative platforms are meant to be a good means for sharing the technical knowledge between engineers, the deployment of such systems often leads to disappointing results, mainly due to a poor contribution level from the users. The paper deals with the case of the future Dimocode platform, which will be dedicated towards the sharing of simulation models for energetic systems.

Based on a literature survey, 20 acceptance factors have been identified and it was suggested a four-dimensional classification to structure these factors, The proposed classification accounts for the multidimensional nature of a large part of these factors, and made it possible to select the most relevant of the factors for the Dimocode context. Finally, a strategy and related leverage for action were associated to each of these primary factors, leading to a more complete set of requirements for the Dimocode platform.

This approach on the Dimocode platform might be considered as the preliminary draft of a more general method to account for acceptance factors in KMS requirement specification.

Among the limitations of this work, one has to consider that the multidimensional nature of some of the factors still has to be consolidated. Another point of importance is the Generalised influence between some of the acceptance factors which was not discussed in this paper.

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