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A PROCESS VIEW ON END USER RESISTANCE DURING CONSTRUCTION IT IMPLEMENTATIONS

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SUMMARY: *Architectural, Engineering, and Construction (AEC) researchers have characterised user resistance as one of the major barriers to the widespread diffusion of VDC technologies. These researchers have mainly argued that resistance is a dysfunctional characteristic of change recipients that hinders successful change. Contrary to this conceptualization, many change management researchers see resistance as important and necessary attribute of individuals during any change process, be it successful or unsuccessful. These researchers suggest reconceptualising user resistance from a negative individual psychological characteristic of users to an important function of the change process itself. This paper argues that such a process conceptualization of user resistance is more valuable to understand change processes during the implementation of Construction IT than the conceptualisation of resistance as individual user characteristic. The paper shows the value of the process conceptualization by analyzing ethnographic interviews with change recipients from two construction projects. In line with the proposed re-conceptualisation, the analysis of the interviews from a process perspective suggests that user-resistance is not always a negative barrier, but oftentimes a necessary and important part of a Construction IT implementation. The interviews show that resistance can lead to an ongoing discourse about the technology between change agents and change recipients which is an important antecedent of a successful implementation. The paper, therefore, suggests that Construction IT change agents start involving resistant Construction IT recipients within an ongoing discussion that focuses on the immediate benefits the technologies offer to improve the day to day work processes of AEC professionals.*

KEYWORDS: *Technology, Implementation, User resistance, Preventive innovations, Virtual Design and Construction*

REFERENCE: *Hartmann T, Fischer M (2009) A process view on end-user resistance during construction IT implementations, Journal of Information Technology in Construction (ITcon), Vol. 14, Special Issue Next Generation Construction IT: Technology Foresight, Future Studies, Roadmapping, and Scenario Planning, pg. 353-365, http://www.itcon.org/2009/23*

1. INTRODUCTION

"First I pushed off against it, I did not want to do it, all the old men, a lot of us don't like changing. But it's like, once we got the full scope of how these things work and I started getting into it using it on the project, I'll back it up on any project from now on."

Construction Supervisor about the implementation of a VDC technology.

Direct accounts of change recipients, such as the one cited above, that at the same time indicate individual resistance to use a technology and the success of a same technology implementation on a project are seldom in

the Architectural, Engineering, and Construction (AEC) literature. The concept of user resistance is largely a one-sided concept that depicts resistance as a dysfunctional psychological problem of individual users and, in this way, as one of the major barrier for the implementation of Construction IT (see, e.g., Andrews et al. 2006, Hjelt & Bjoerk 2006; Wikforss & Löfgren 2007; Adriaanse 2007; Davis & Songer 2008). Change agents and technology managers who try to implement and diffuse Construction ITs, therefore, mainly suggest changing recipients by somehow removing their resistance to use the new technology.

Despite this large focus on resistance as a barrier to Construction IT implementations, AEC researchers have, so far, not been able to develop coherent and applicable management strategies to change the resistance of individual users. Few tools and recommendations exist that help managers with removing resistance from users. Due to this lack of strategic recommendations this conceptualization of user resistance helps change agents little with changing the behaviour of potential users. Further, it is, in general, questionable whether it is possible or advisable to change user behaviour just for the sake of overcoming resistance to use a technology. Incentives for pure technology use, instead of overall productivity goals, might cause end-users to blindly use the technology without an effort to improve work processes (Ford et al. 2008). Even worse such incentive strategies that solely focus on changing users without considering the details of the Construction IT application at hand can have the negative effect that inefficient new technologies diffuse without end users questioning the implementation effort. Due to all these reasons and despite the wide-spread use of the concept of user resistance as individual characteristic, the concept, so far, lacks general value to inform the AEC industry of how to improve Construction IT implementations.

Contrary with the conceptualization of user resistance as negative end user attribute, researchers have suggested to consider user resistance as a natural and essential function of any change process. The main argument of these researchers is that most changes within organizations start with a critical engagement of individuals within the organization (Weick 1995, p.33). This paper explores the power of this re-conceptualization for developing new strategies of managing the implementation of Construction ITs. In particular, the paper illustrates the value of this re-conceptualization by reporting the findings of an in depth analysis of interviews with change recipients that we conducted on two construction projects. Further, the paper shows the power of this re-conceptualization to support the management of Construction IT implementations by providing strategic recommendations for change agents that are derived from findings of the interview analysis. We hope that the suggested re-conceptualisation can help the construction industry as a whole to overcome the problems it faces with the implementation of new Construction IT applications.

The paper is structured as follows: The next section provides a brief introduction and critique about the concept of user resistance as a characteristic of individuals. Based on this critique, the next section then summarizes the relevant literature about the concept of user resistance as necessary characteristic of the change process itself. Then, the paper introduces the research methodology we use and summarizes the research results and findings. The paper continues with the limitations of the research approach and concludes with the implications of the findings of this research on current Construction IT implementations and by suggesting a number of Construction IT implementation strategies.

2. A CRITIQUE OF USER RESISTANCE AS INDIVIDUAL CHARACTERISTIC

Resistance to change is traditionally one of the widely used concepts in the change management literature. Therefore, it is not surprising that AEC researchers have used the concept during many studies that analyze the diffusion and implementation of new Construction IT in AEC companies and on AEC projects. Overall, AEC researchers have identified user resistance as one of the main barriers to a widespread diffusion of Construction IT. For example, Andrews et al. (2006) have identified resistance as a barrier to the uptake of Information and Communication Technologies (ICT) to support sustainable design, Hjelt and Björk (2006), as well as Guillermo et al. (2006), as a barrier to the uptake of e-business applications, Wikforss and Löfgren (2007) and Adriaanse (2007) as a barrier towards the use of communication technologies. Most of these authors suggest managing resistance during the implementation of new Construction IT by first identifying resistant users (Davis & Songer 2008) and then "removing the resistance of the construction industry to change" (Andrews et al. 2006). In other words, these authors suggest changing human behaviour to make change recipients less resistance.

In the broader change management literature, however, researchers have criticized this, in the AEC industry prevailing, use of the concept of user resistance as a negative individual attribute due to two reasons. The first reasons these researchers mention is that the concept of user resistance is mainly used by change agents that try to implement or diffuse a technology. These change agents are often biased and use the concept one-sided attributing all problems during the implementation of a technology on the resistance of change recipients. At the

same time, these change agents treat the technology as fixed and in this way whitewash designers and producers of their responsibility to provide mature technologies with the potential to sustainably improve organizational performance.

The second reason that researchers have used to criticise the conceptualization of user resistance as an individual attribute is that change agents can label almost any response of adopters of a new technology, "from a smirk or a glassy look of inattention to insubordination and sabotage" as resistance (Caruth et al. 1985; Knowles & Linn 2004; Meston & Kings 1996; cited in Ford et al. 2008). Researchers have developed a myriad of studies to find attributes of individual users that show or can predict their resistance to use new technologies. Some of these researchers even claim that it is possible to a priori identify resistant users from a population using psychological tests. However, so far, psychological research has not found any strong predictors that managers could use to identify possible resistant users before the implementation of a new technology. There are no consistent findings that show that personal attributes such as age, gender, or other demographic characteristics, nor psychological constructs such as patience, tolerance, rigidity, or problem solving style are good predictors of user resistance (Bauer 1995a). Overall, the concept itself has become so blurry that it does not support managers and researchers in understanding change implementations and improve them accordingly. Therefore, researchers were not able to develop management tools or strategies to "cure" resistant users and improve the implementation of the technology accordingly.

Due to these two reasons, it is not surprising that, management research has not only criticized the conceptualization of user resistance as personal attribute, but also suggested that "the concept of resistance to change has lost its value and should be abandoned" (Dent & Goldberg 1999; Piderit 2000; cited by Ford et al. 2008). Other researchers, including ourselves, still stress the value of the user resistance concept, but suggest considering resistance as an essential part of the change process and not as an individual attribute of change recipients. The next section will outline this re-conceptualisation of user resistance in detail.

3. RE-CONCEPTUALISING USER RESISTANCE AS ATTRIBUTE OF THE CHANGE PROCESS

The concept of user resistance as a part of the change process originates in theories about the sociology of knowledge and organizational sense-making. Researchers in the field of sociology of knowledge have described "resentment" as a generative factor for advancing human thought, and concepts such as the "art of mistrust" can be traced back to Nietzsche (Berger & Luckmann 1990: p.7). In his seminal treatise about organizational sense-making, Weick (1995: p. 136) states that acts of sense-making about changing environments in organizations rarely consists "of acts of appreciation", but mainly involve an ongoing argumentative dialog.

Change researchers following this tradition suggest that resistance is necessary for individuals to understand, engage with, and use new technologies (Ford et al. 2008). Therefore, they treat user resistance not as a reaction to a change that involves mistrust, but as a rejection of parts of the change based on careful and thoughtful investigation of aspects of the change (Knowles & Linn 2004). In this view, during every change process, change recipients pursue parts of a proposed change and reject other parts (Wegener et al. 2004). Thoughtfulness is the important attribute that helps change recipients to determine what to pursue and what to reject. Thoughtfulness, in turn, is triggered by resistance because only resistance enables change recipients to critically engage with the change. In summary, these researchers argue that user resistance increases process awareness, serves as an early warning system about issues and expectations, helps to evaluate new processes around a technology, and triggers important and ongoing reinvention processes to improve the technology and its related processes during use (Bauer 1995b). From this perspective, resistance is an important and necessary function of every change process as it ensures meaningful and thoughtful organizational change. Additionally, in this conceptualization resistance acts as a safeguard against the diffusion of inefficient technologies. Researchers in this tradition even warn change agents that the absence of resistance is a sign of disengagement (Wegener et al. 2004).

Drawing on this change management research, this paper considers user resistance not, in general, as a barrier to the necessary change during the implementation of Construction IT. Contrary, this paper suggests that user resistance is essential to increase the likelihood of a successful implementation, as it creates awareness among users, establishes momentum for change due to a critical discourse about the new technology, and eliminates impractical elements of the technology (Ford et al. 2008; Knowles & Linn 2004).

4. RESEARCH METHODOLOGY

By large, we developed our understanding about 'user resistance' and how it applies to the implementation of Construction IT during participant research (Jorgenson 1989) on seven AEC projects. On these projects, the first author worked closely together with project teams and participated in Construction IT implementations. Table 1 summarized the types of projects and the level of involvement of the first author.

Table 1 - Projects the first author conducted participant research between 2004 and 2007

Project	Facility Built	Days on Project	Meetings Joint	Construction IT implemented
1	Subway Station	350	>20	4D System, ICT System, Cost Control System
2	Highway	5	3	4D System
3	Bridge	5	3	4D System
4	City Block	12	3	4D System
5	Hospital	15	8	MEP Coordination System
6	Hospital	2	1	MEP Coordination System

The close involvement with project teams enabled the first author to experience the change process and how the process is influenced by user resistance from the viewpoint of the project team members. Only this viewpoint allowed the first author to observe user resistance on projects that implemented Construction ITs successful. This is because change agents, in general, do not reflect about problems with successful implementations. After the participant research on the projects, the first author, with the help of the second author, then matched these experiences with the existing literature about user resistance. In this way, we provide evidence for the generality of our findings (Eisenhardt's 1989) that goes beyond what we could have shown by simply analysing our research results in isolation. Additionally, the second author who was not involved with the projects critically examined all data analysis and literature matching efforts for any biases in the findings that might have been caused by a too close involvement of the first author with the projects (Bartunek & Louis 1996).

While we generated the general ideas of the paper during this participatory research, this paper focuses in detail on an analysis of ethnographic interviews that we conducted after the participatory research (Spradley 1979). Following a case study research strategy (Yin 2003), the two projects on which we conducted the interviews are cases that successfully implemented Construction IT to coordinate the design and construction of Mechanical, Electrical, and Plumbing (MEP) systems in California. Therefore, these two cases are especially suited to illustrate that user resistance is a necessary part of the change process during the implementation of Construction ITs.

Additionally, MEP coordination systems are a representative case for a Construction IT application. Researchers and practitioners see the improvement of the design and construction of MEP systems as one of the major opportunities to enable AEC projects to build facilities faster at lesser cost. They have this belief mainly because MEP systems account for about 40-60% of the total construction costs of a project and have become increasingly complex in the last couple of years (Khanzode et al. 2006). One of the major issues with respect to the design and installation of MEP systems is that, usually, different contractors are responsible for the design of the different systems yet their design and construction are highly intertwined. Therefore, it is very challenging to coordinate the different contractors and integrate the different system designs to avoid conflicts during system installation. Traditionally, practitioners manually overlay 2D drawings representing the various system designs to identify and resolve conflicts before contractors start to install the physical systems on site. VDC Technologies that use 3D CAD models to automatically check for interferences in the different system designs promise to improve this manual and cumbersome coordination routine (Khanzode et al. 2006; Staub-French & Khanzode 2007). Furthermore, the use of 3D models enables the project participants to easily generate lists of quantities that estimators can use to estimate the cost of the project (Staub-French et al. 2003).

We characterize the two projects as successful because multiple professionals working on the projects stated that the technology on the projects helped them during their daily work. Additionally, reports have characterized the first project as an outstanding success (e.g. Khanzode et al. 2006). Both projects were lead by the same client organization, were in the same geographical region, and operated under similar contractual agreements.

Therefore, as many contextual factors of the projects are equal we assume that possible noise in the data due to conceptual factors is minimal. Thus, the projects lend themselves to a direct comparison of the findings with respect to the concept of user resistance, without the need to account for other contextual factors.

During data collection we conducted open-ended ethnographic interviews (Spradley, 1979) with professionals working on these projects that we characterized as change recipients. In general, the interviews are a second source of data that enabled us to triangulate our experiences from the participant research work (Miles & Huberman 1994). In this way, the analysis further helped us to sharpen our understanding of 'user resistance' and to illustrate this understanding to the reader. Such ethnographic interviews are a great source of data to analyze the concept of user resistance from the viewpoint of the change recipients (Ford et al. 2008). Overall, we interviewed four professionals on each of the projects. Each of the interviews lasted between 30 and 60 minutes. According to the focus of this paper, we excluded actors that we could clearly identify as change agents from the data analysis. We excluded one actor from each project which left us with three interviews per project for our detailed analysis. Table 2 shows the professionals that were included in the data analysis. We interviewed professionals with a wide range of different responsibilities on the projects. We decided to include such a wide range of different responsibilities because it enabled us to generalize findings across different responsibilities or roles of construction professionals.

Table 2: Professionals we interviewed on the two projects, their position, and interview references coded

Project	Name	Position	Resistance	Potential	Critical Engagement
M	D	Assistant Project Manager	3	4	1
	E	Superintendent	5	6	1
	S	Project Manager	2	7	0
S	B	Estimator	2	6	2
	F	General Foreman	1	5	1
	L	Detailer	2	1	1

We transcribed the interviews and analyzed the transcripts in the qualitative data analysis software NVIVO (Bazeley 2007). In particular, we coded the interviews identifying statements that can be characterized as resistance, statements that indicated the potential of the technology, and statements that indicated a critical engagement with the technology. Table 2 shows how often we found a reference to each type of statement in the transcribed interviews. Additionally, and 4 shows exemplary quotes to illustrate how we coded the interviews in detail. To ensure the confidentially of our informants we abbreviated the names of the projects and the names of the interviewees in both tables. The next section describes the findings from this data analysis and how it matches with the theory about user resistance the paper introduces above.

5. CASE ANALYSIS

If nothing more, the analysis of the interviews illustrates that even on these two successful projects all interviewed professionals showed signs of resistance at some time during the implementation of the technology. The analysis outcomes of the interviews that Table 3 and 4 summarize show that resistance concurrently exists in all but one case together with a feeling that the technology offers the potential to improve the work routines of the respective professional. On one hand, this relates well to the mainstream AEC literature that identifies resistance to change as a frequently occurring phenomenon during technology implementation projects. On the other hand, considering that both of the projects were successful with the implementation, this is a strong indicator for the papers claim that resistance is an essential and necessary part of every successful VDC implementation process. Thus the interviews clearly show that a re-conceptualization of resistance from an attribute of change recipients to an attribute of the change process is also possible during the implementation of Construction IT.

In the interview, statements of resistance are in all cases paired with statements about the potential of the software. Additionally, statements of all but one respondent show a critical engagement with the technology in the form of thoughtful suggestions of how the MEP coordination technology implementation can be improved. In line with the literature that conceptualizes resistance as part of the process, we can label statements indicating potential as persuasion and statements that indicate critical engagement as rejection to implement all details of the MEP coordination system. This enables us to visualize the outcome of the change process (FIG. 1). Doing so

we summarize the statements per project in a graph that qualitatively visualizes the amount of persuasion and resistance on the two projects by summing up statements of respondents about the potential of the MEP coordination system and statements that show critical engagement. In cases where statements of two or more respondents were closely related the figure does not double count the statement but considers it as one statement indicating persuasion or resistance.

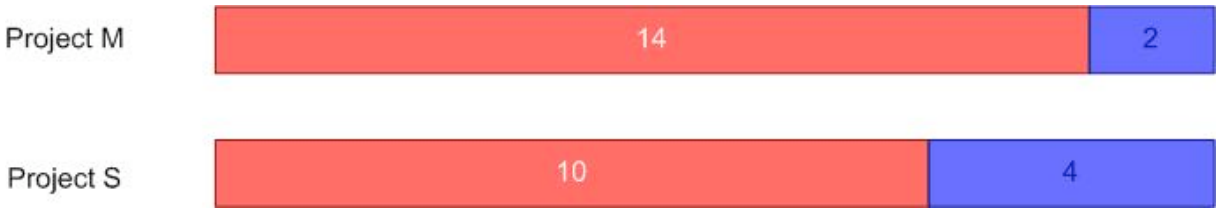

FIG. 1: Qualitative assessment of the amount of persuasion (red) and rejection (blue) on the two projects

In addition, the data show causal directions that indicate which phenomenon causes the others. It seems like initial resistance causes critical engagement with the Construction IT which leads to the realization that the technology does or does not offer benefits to improve individual work practices. This realization, then, in turn, leads to resistance in using the system or to a persuasion of using the technology. On the test case projects, the analysis of the responses that we summarize in Table 3 and 4 shows that both processes, in general, occur simultaneously. This can then explain why project team members are persuaded to implement parts of the proposed Construction IT and why they reject implementing other parts. A completely resistance pattern is illustrated by respondent 'B' who realizes that using the technology mainly results in benefits for the client. Consequently, she feels that in her company there is currently no drive to draw in 3D. FIG. 2 illustrates the two possible directions of how the phenomena influence each other.

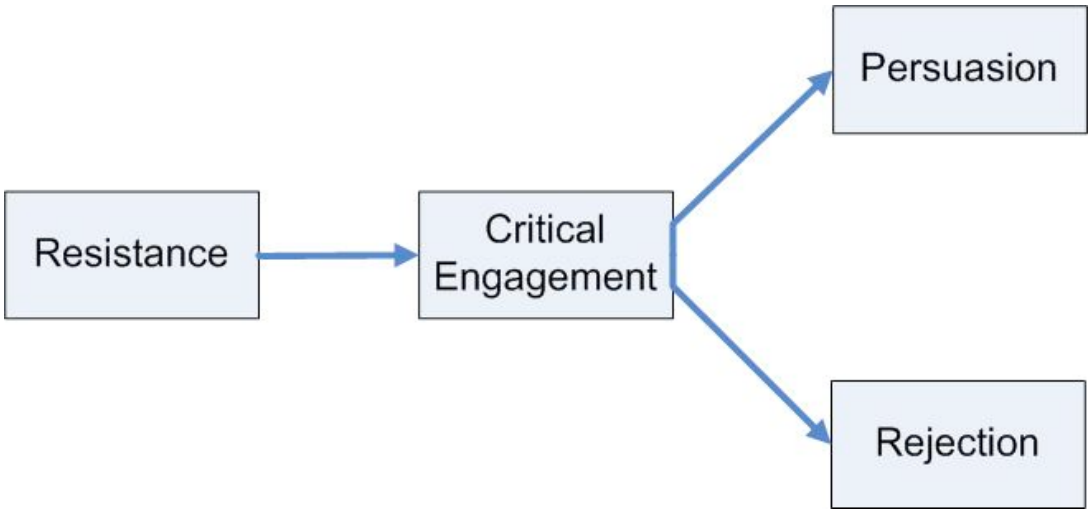

FIG. 2: Causal relationships between the phenomena

In summary, the analysis of the interviews concurs with the conceptualization of user resistance as a part of the change process. The data show that user resistance is an important concept that caused professionals on the projects to critically engage themselves with the Construction IT. In this way, the professionals were able to identify benefits and shortcomings of the technology which led to persuasion of the professionals or to resistance to use parts of the technology. It seems like the identification of benefits and shortcomings enabled the professionals to successfully implement the Construction IT on the two projects. Additionally, this identification of shortcomings enabled the professionals to actively search for solutions of how to circumvent shortcomings and to additionally improve the implementation beyond the initial intentions of the change agents. Further, the resistance of the professionals towards part of the technology helped to ensure that project teams used the MEP coordination tools meaningful within the local project context. Overall, the data show that user resistance was an essential factor that made the implementation of the Construction IT on the two projects successful. The next section critically evaluates common Construction IT implementation practice in light of these new findings.

Table 3: Examples of coded statements for project M

	Resistance Indicator	Possible Potential	Critical Engagement
D	"I think at first there was a lot of skepticism with this new technology. Everybody was selling it as if it was the next big thing." "Yeah but at first there was definitely some skepticism, especially from the older people that have been in construction for 10-15 years and have never seen this technology."	"It was basically our structural engineer who did the model, and then they gave it to us as a background. I would say probably 60-70% was used in the 3D model. A lot of times you were coming back after all the MEP has done installed, all the little pieces of Miscellaneous steel had to go in."	"It would have been nice if it would have been 100% in the model, because there were a lot of times when you were coming back after all the MEP has done installed, all the little pieces of Miscellaneous steel had to go in."
E	"… and first I pushed of against it, I did not want to do it, all the old men a lot of us don't like changing."	" … and it got at least, let's say a couple of months for everybody to get used to the idea of how this works. But now everybody understands it and I think it works very good." "It made my work, let's say either, it made it better then let's say five or ten years ago. Now I spend all my time in the field trying to figure out and work with the subs of how all the stuff gets together below the ceiling. This program that we are using right now, the [Construction IT application]. It worked way better it made my life easier. I've been able to actually spend more time building the building then trying to put out fires."	
S	"I would have not thought that we will use it, but we used it way more." "It used to be pretty intimidating with what we used, but we used the [a Construction IT application], used various CAD programs for the different discipline adopt the 3D models, then they integrated everything together into the [a Construction IT application]."	"I was able to issue the rows go to the crate with the engineer that was dealing without and ask him to pull this conflict out. If there was a conflict that was called MEP, structure, skin, or in that nature, tie into the under slab. I was able to go to him and say what was that on your model, I want to see what was going on and he could inform me exactly as to the cause. Without any doubt where the problem was. So it, you know, certainly has helped in the resolution of conflicts out in the field."	

Table 4: Examples of coded statements for project S

	Resistance Indicator	Possible Potential	Critical Engagement
B	"But there was such a learning curve. Let's say if S. Electric has or uses 3D CAD in 3D [Clash Detection] for let's say two years where we are completely flawless you know understand all the ins and outs I would say yes it would make our job easier." "Productively drawing things in 3D CAD there isn't that drive right now. It would be good to get our CAD department to increase the attitude in drawing something in 3D."		"Correct right now it is more of a benefit for the client." "I think in the future it would be best to have a server a [Construction IT application] server that everybody could be dialing in and have the coordination meeting over the computer and have the pre-coordination meeting log in here almost like remote desktop where everybody can see what the other person is doing or looking at see the collision and find the solution." "… if [a Construction IT application] had the ability, like [an instant messenger], [an instant messanger], that type of thing where you can actually have an open communication with someone that works on the same project to be able to interact in the [a Construction IT application] model and move around and everyone has the same view and coordinate who is gonna fix what."
F	"It's like with all new technology, with all new technology you gotta go through your functions and you gotta get the niches out of it."	"It's gonna actually make my job easier. Because I gonna come in and my elevations and my routes are already gonna be set, so that's one thing I don't have to do. I can concentrate more on other activity. I can concentrate more on quality of work. A lot of the RFI will already be hashed out so that will take my time off, concentrate more on the project and the direction the project is going than on anything else. So it's gonna be an asset for me, it is gonna be a major asset for me."	"I think sequencing can be a key factor on using that program. Because everybody is coming in and we don't talk about sequencing, but I think sequencing is gonna be a major factor. That way it is not embezzlement."
L	"For the basement it was a learning curve, we were meeting every Wednesday and M. and me were meeting on Monday it was really a change for us to do the clash report."	"Yes, yes! I can see the openings for it to go, before that I had to try figuring it out from the utility drawing on paper where I adjusted color in some of the piping in some of the trades, I could put elevations. It's just quicker, it allows me to do my work quicker."	"The only thing I was hoping the first time I wasn't sure from the model if we can manipulate the product within the model. I guess hopefully in the future they might come up with something that you can change things in the model."

6. IMPLIMCATIONS FOR CONSTRUCTION IT IMPLEMENTATIONS

According to our paper's findings, we suggest that change agents account for user resistance as an essential function of a successful change process. Doing so, it is no longer possible to consider resistance as negative psychological human behaviour that needs to be managed out of change processes. Instead, technology managers need to work together with resistant recipients and even foster resistance. This, in turn, will require that Construction IT change agents improve their relationship with recipients.

Today, often, Construction ITs are managed focusing solely on the strategic long term benefits for an AEC project, an AEC company, or the AEC industry as a whole. Commonplace definitions clearly illustrate this focus. For example, Kunz and Fischer (2005), define Construction ITs as

- Engineering modelling methods to represent the product, organization and process;
- Model-based analysis methods to predict the project schedule, cost, effort, hidden work, organization, process and schedule risks;
- Visualization methods to present views of the product, organization and process in ways that are clear both for professionals in sub-disciplines and for interested non-engineering stakeholders;
- Business metrics and methods to manage projects using measured performance; and
- Economic Impact Analysis, i.e., quantitative models of both cost and value of capital investments

In another example, the vision of future digital models in the construction industry that the Stratcon consortium published predicts the business effects of Construction ITs as follows (Kazi et al. 2007; p.48):

- All systems in construction share common platform, network and protocols, with secure external connectivity via the internet enabling local, remote and mobile monitoring, diagnostics, reporting and operation.
- These systems provide optimised control and intelligent services to users and operators.
- The life cycle of construction products is supported by applications using semantically rich models that contain all relevant information without need for human interpretation.
- Digital models are accessible anywhere and anytime.
- Future digital models providing easy access.

We agree that this focus on long term strategic issues is important to secure research funding from companies and governmental sources, and to align upper management agents behind change efforts. However, we also believe that the sole focus on long term strategic goals also hinders an effective management of the change agent - change recipient relationship. In particular, such a focus does not allow recipients to reasonably involve themselves in the change process. They are often simply confronted with the need to implement the Construction IT as it is important to improve the overall performance of the project, the company, or the industry. In such a discourse, the gradient of the learning curve, the costs of using the VDC technology, and even whether the use of the Construction IT will improve the decision making of the change recipient at the operational level on projects is not important. From the viewpoint of the change recipient, a sensible and reasonable discourse about the Construction IT is, therefore, impossible.

This focus on strategic issues during the management of Construction IT and the corresponding inability to engage in an open discourse has two effects on the dynamic process of Construction IT implementations. First, Construction IT recipients cannot channel the resistance during an implementation into an active search for the possible benefits that the technology offers. Therefore, change recipients will not be able to find benefits of how the Construction IT can improve their day to day work processes. The second effect of the missing open discourse about the implementation is that the focus on strategic issues makes it hard for change recipients to take ownership of the implementation. Both of these reasons cause Construction IT recipients to avoid using the technology and, therefore, the expected strategic benefits can also not be realized.

7. A NEW IMPLEMENTATION STRATEGY: WORKING WITH RESISTANCE

To circumvent the above problems, we suggest that Construction IT change agents switch implementation strategies from a sole focus on strategic goals to a more pragmatic focus of how Construction IT can support the day to day work tasks of AEC professionals. Researchers have shown such benefits of Construction IT to improve the work processes of professionals. For example, MEP coordination applications are poised to help foremen to focus on immediate problems in the field, instead of spending endless hours working on change orders (Khanzode et al. 2006; Staub-French & Khanzode 2007). 4D applications can support engineers in creating better construction sequences faster and, additionally, help them with their tedious work to present sequences to other stakeholders (Hartmann et al. 2008; Hartmann 2007; Heesom & Mahdjoubi 2004). Estimators can automatically extract quantities from 3D models and thus save hours of tedious measuring of 2D construction drawings (Hartmann et al. 2008; Chen 2008; Staub-French et al. 2003; Akinci et al. 2002). All these examples show benefits that make the life of change recipients immediately better, without even addressing strategic issues, such as improved communication between all stakeholders of a project, or the possibility to streamline data flows between different stakeholders using centralized database systems.

To enable a more successful implementation of Construction IT we, therefore, suggest that change agents complement the open discussion about Construction IT towards the immediate benefits that these technologies offer. During these discussions we suggest that the change agents consider the raised issues of the potential users with respect to the Construction IT application not as resistance, but as suggestions of how to improve the Construction IT application itself. Change agents can then use these suggestions to inform the designers or developers of the application about possible or even necessary technical improvements. Ideally, we suggest that new Construction IT implementation efforts apply an ongoing ethnographic action-research effort to iteratively align new Construction ITs with organizations on construction projects (Hartmann et al. 2009). Hereby, we suggest that change agents not only focus on changing the potential users and their organizations, but also consider critically whether the proposed Construction IT application can provide immediate benefits to improve the existing work processes on the project.

In line with the above, we also suggest that change agents develop new metrics for Construction IT that stress such immediate benefits to support the direct work of AEC professionals. Such metrics should quantify the direct improvements in the work processes of practitioners. One way to derive such metrics, is from interviews like the ones we present above. Statements such as *"It made my work, let's say either, it made it better then let's say five or ten years ago. Now I spend all my time in the field trying to figure out and work with the subs of how all the stuff gets together below the ceiling."* offer starting points for measuring the direct usefulness of Construction IT for AEC professionals working at the operational level. Such metrics then allow change agents to benchmark improvements to actual design and construction management processes to quantify the immediate and meaningful benefits for construction professionals that decide on using Construction ITs. Change agents can then use these metrics and benchmarks to involve Construction IT users in the ongoing discussion about Construction IT, but also to iteratively improve the Construction IT applications itself. We hope that, in this way, it will be possible for change agents to establish a wide acceptance of Construction ITs among construction professionals working at the operational level. We expect that such a wide acceptance, in turn, will then enable the AEC industry as a whole to benefit from the strategic long term benefits that the above cited strategic position documents promise.

8. SUGGESTIONS FOR FUTURE RESEARCH

This paper aims to re-conceptualize user resistance as an essential and necessary function of every change process. In this way, we hope to diversify the discussion among AEC researchers and practitioners that mainly consider user resistance as a negative, dysfunctional characteristic of change recipients during the implementation of Construction IT. We based the re-conceptualization on our practical experiences with VDC implementations on construction projects and illustrate the concepts using an in depth analysis of interviews with construction professionals on two projects. We are aware that the presented data can only provide limited evidence for the generality of our claims. Future quantitative and qualitative research with AEC practitioners needs to provide more evidence. Nevertheless, we hope that the paper can motivate researchers to conduct more in depth research that shows that user resistance is an inherent part of the change process during the implementation of any Construction IT.

Furthermore, future research can explore the applicability of social psychological research that suggests a number of concepts that influence the amount of persuasion and rejection during change processes for Construction IT implementations. For example, social-psychologists have shown that thoughtfulness is an

important mediator of rejection and persuasion. This research provides evidence that thoughtful change recipients are less affected by the strength of messages from change agents (Wegener et al. 2004). In this way, thoughtfulness can be a safeguard against, so called 'fashion setters' (Abrahamson 1996) that try to diffuse Construction IT independent of the value of the technology for the target organization. Additionally, researchers have found that thoughtful resistance during critical phases of a change project has helped to keep conversations about the change alive which has, in turn, helped to make the change successful (Barrett et al. 1995).

Another interesting concept that future AEC research can closely examine is the concept of message strength itself. Latest social psychology research has contested the widely agreed upon opinion that the stronger a message is that argues for the change, the more change recipients will be persuaded by the change. Researchers have, for example, shown that students at a college in the United States were more in favour for random drug testing during classes if the message for the necessity of the drug tests was formulated as "You probably will not like this proposition, but it could be very good for the university", instead of "You probably will not like this proposition, but it is absolutely necessary for the good of the university" (Fuegen & Brehm 2004). Similarly, it would be interesting to research the reaction of AEC professionals during the implementation of Construction IT on messages such as "It will cost you some additional effort to implement the technology, but it is absolutely necessary for the good of the AEC industry" and "It will cost you some additional effort to implement the technology, but it will help your project".

9. CONCLUSIONS

In this paper we shed light on the concept of user resistance as a part of the change process during Construction IT implementations. Traditionally, AEC researchers and, in particular, Construction IT change agents have depicted the concept as a dysfunctional, negative characteristic of change recipients and as one of the major barrier to a widespread diffusion of Construction IT. Contrary to this negative conceptualization, managerial change theory sees user resistance as a necessary and important function of every change process. According to this literature, the paper suggests to re-conceptualize user resistance from an attribute of change recipients to an important and necessary attribute of every Construction IT implementation process.

The paper provides evidence that the re-conceptualization works and provides benefits for managing Construction IT implementation processes using data from ethnographic interviews with construction professionals. In detail, the paper shows that resistance was an essential part during the successful implementation of Construction IT on two AEC projects. Therefore, the findings from the interviews also show that user resistance is not overtly a negative concept. Moreover, the interviews show how resistance enabled the users of the Construction IT to critically engage with the technology. In this way, the data provide evidence that user resistance was actually helpful for the successful implementation of the Construction IT on the two AEC projects.

Based on these findings the paper suggests that Construction IT change agents restructure their change management efforts. In particular, the paper recommends that change agents try to involve Construction IT recipients in an open discourse about the technologies to channel their feelings of resistance into efforts to critically engage with the technology. We suggest that Construction IT change agents need to refocus their attention from the prevailing strategic management focus more on the immediate benefits that Construction IT technologies offer AEC professionals.

We hope that this paper offers fresh insights on Construction IT implementations and opens up new allies for critical thought about current top-down Construction IT implementation strategies. In particular, we hope that change agents use the management recommendations of the paper and start working closely with AEC professionals at the operational level. We believe that only through such an involvement of end-users during Construction IT developments and implementations can the struggles of the industry to diffuse Construction ITs be overcome (Hartmann et al. 2009; Hartmann 2008). This, in turn, will, hopefully, enable the AEC industry as a whole to finally realize the benefits that Construction ITs promise and that AEC researchers have identified in the last 20 years.

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