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# Change Management in Information Technology - A Literature Review

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**Abstract.** The purpose of this paper is to present the state of the art of research in Information Technology (IT) in Change Management (CM). Initial studies indicate that investments into CM in IT often do not add the predictable value, neither to the CM division himself nor to the association supported by the CM section. A basis for further study into this complex and inter disciplinary area is therefore needed. This literature review will contribute to this basis. Based on a Systematic Literature Review (SLR) method, journal articles, with a focus on CM in IT were found. Relevant articles were organized in categories according to focus on Technology, IT layer, CM process and theory, research method applied and type of findings. Finally research gaps were identified. There seems to be a general belief in technology combinations as a way to speed up the rather slow IT diffusion process in CM. It is documented that current research into CM in IT has an unbalanced focus on few specific technologies, IT layers and CM processes, and that further research should focus more on the IT implementation process and use. Knowledge from application and use could be fed back into (and strengthen) conceptualization and progress, thereby adding more value to CM. Only the search engine Scopus is used. This is the first review paper focusing on CM in general in IT, giving an overview of the area and delivering a basis for further research.

## Introduction

This paper presents current research with focus on Information Technology in Change Management. Considerable resources are invested in implementing and using IT systems supporting CM work processes and activities. Initial studies indicate that these investments often do not add the expected value, neither to the CM department itself nor to the organization supported by the CM department. A basis for further research into this complex and inter-disciplinary area is therefore needed [12]. This literature review will contribute to this basis. The systematic literature review (SLR) method used in this article is explained in section 2 Method. In 3 Finding the Literature the criteria for finding the

literature and the approach using the search engine Scopus is explained. How data is extracted from the found literature is described in *4* Extracting data from the literature. Data analysis is placed in section 5 Analysis of current research on IT in CM

## Method

This systematic literature review (SLR) is based on principles in [7] complemented by rudiments in [10]. This SLR includes the following four stages with eight steps: Planning stage: Purpose and goal, Selection stage: Searching the literature + Practical screening, Extraction stage: Quality Appraisal + Data Extraction and Execution stage: Analysis and Findings + Writing the Review. This paper demonstrates the Protocol for this SLR, where only the writer of this paper has been elaborate. Based on a set of key words, recognized through an initial snowball sampling, a broader search was conducted to find journal articles, with a focus on IT in CM. Relevant articles were grouped into categories according to focus on 1. Technology, 2. IT layer, 3. CM process, 4. Theory and research method applied, and 5. Type of findings. The categories, which are based on an interpretation of the contented in the articles, were listed in tables, thereby creating a basis for a quantitative and systematic analysis approach to the data extracted from the literature. Finally study gaps were recognized [3].

## Finding the literature

### Search key words

To recognize pertinent IT related search key words, an initial search for articles published after 2006 within the area of CM in IT remained conducted in the CM journal "Change management", using the search engine Scopus. For each article found with a focus on IT in CM, the author key words were added to the search string [2]. This snowball sampling of search key words led to a search string, resulting in N=17 articles found. The search was done in title, author key words and indexed key words. The period chosen covering the last 6 years is found acceptable, taken the rapid development in IT into account.

Based on the above mentioned search string a final search was now done in all English journals, resulting in N=90 articles found. The search key words relating to CM were "Facilities Management" and "Change Management", the rest relate to IT. The search in "Facilities" N=15 and the search in all journals N=90 overlapped with N=5, thereby the total number of articles found was N=108. Data in Scopus about the articles were exported to an Excel spread sheet,

Where the screening and classification was complete.

## Criteria for including literature

Abstracts in all N=108 articles found were now screened based on the following criteria: 1. Level of focus on IT in CM, 2. written in English language and 3. Journal articles. The articles were placed in one of three groups, primarily depending on their level of focus on the topic of IT in the operation phase of the facilities lifecycle. Articles with a main focus on the topic (N=23) were put in the first group, but also articles, with a content assessed to be of main relevance for primarily focusing on the AEC phases were put in the second group. Finally articles with no focus on the topic (N=45) were placed in the third group. All N=23 articles in the first group are listed in Table 1, where technologies in focus in the articles are listed in columns, according to the technology area.

## Extracting data from the literature

Only articles with a high relevance, as described above, were included in the next steps of the review. Each of these articles where downloaded from e.g. the publisher's web page, and stored in the reference manager software tool Mendeley. While reading printed paper versions of the articles, information, such as which technology each paper was focusing on, was typed in the spread sheet mentioned above in predefined columns. The spread sheet was then used for categorizing, synthesizing and analyzing the extracted data in the next steps.

## Analysis of current research on it in cm

### Technologies

Table 1 shows that respectively article, with one exception, has a focus on one or more specific information technologies [14], thereby placing each article in one or more technology areas (columns in Table 1). Fig. 1 is based on a simple count in the columns in Table 1 showing the number of articles with a focus within each of the technology areas. The area with most articles is Data Repositories N=19. Of these N=11 focus on BIM, making BIM the technology most often in focus in all the articles. The area with the next most articles is Sensor and Mobile N=13, and here the most common technologies are RFID tag systems N=4, followed by Augmented Reality and Virtuality N=3. The area with the third most articles is Interoperability N=9 with the BIM exchange standard IFC being the most common "technology" N=3, followed by exchange framework protocols N=3. Workflow Systems and Facilities Intelligence only receive attention in N=5 and N=5 articles.

Figure 1. Number of articles with a focus within each of the technology areas (An article can focus on more than one technology area)
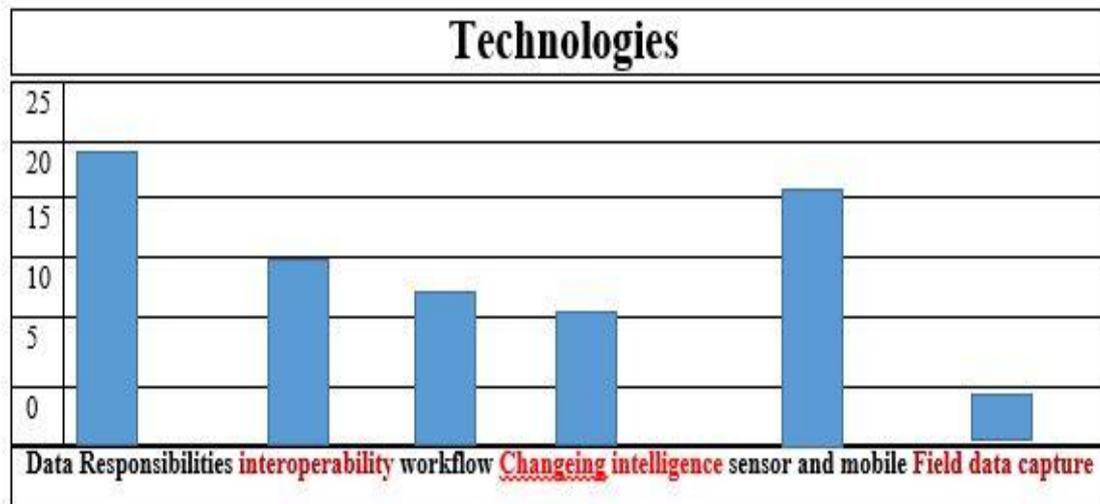


Figure: 1

Bar chart of technology management

## Findings in the literature

The findings in the articles indicate that IT in overall is in the initial stages of diffusion in CM administrations. CACM or more specifically CMMS seem to be the only technology in focus that actually is being used in CM organizations [6] and [5]. BIM is in the very early phases of application in CM, but obtaining the required data appears to be a major difficulty [1] & [9]. Application of RFID technology in CM is also only just in the early phase [8]. The many articles dealing with theoretical ideas often including combinations of technologies indicate a belief in technology combinations as a way to ease the IT diffusion process.

## IT layer framework

The IT layer framework introduced in Fig. 2 and used in the second column in Table 2 is inspired by [4] and should be unstated as follows: Articles fitting to the "Conceptualization" layer gives ideas of how the IT [11] in question will function. This transformation is in the research field of software engineering characterized as implementation. In this paper the word implementation is used in relation to implementation of the IT solution into practice. Articles in the "Implementation in practice" layer are consequently disturbed with the process of executing IT in organizations. Articles in the "Use in practice" layer focus on how IT is used in organizations. Knowledge from implementation and use could be fed back into (and strengthen) conceptualization and development.

Upcoming technology combinations, e.g. BIM used as a basis for AR, may need more conceptualization and before being introduced to the CM organizations.

Figure 2. The IT Layer Framework and the Number of articles with a focus within each of the IT Layers

(Each article is only placed in one layer)





Figure: 2 IT Layer Framework

**Theory and research methods**

Most of the findings presented have a prescriptive nature N=19. Typically a model or a method is proposed. The rest of the articles present descriptive findings N=5, diagnostic N=2, and prognostic N=2. See Table 2. A majority of the articles N=21 include theoretical solutions (e.g. methods) and often include empirical data from survey questionnaires N=8, case studies N=2 and test cases or scenarios N=8, see Table 2. Some of the conceptual solutions are not indication founded, but based on the authors own knowledge, experience and ideas. All studies including questionnaires and case

studies are cross-section [13]l. One exception is [5] who study CMMS data covering a 12 month period of maintenance in a Hotel. In general each article only uses one method for data collection and analysis, e.g. quantitative, qualitative (survey or case study) or conceptualization, but in some of the articles the choice of method is not clearly stated.

**Journals and their research scope**

The papers are mostly within the study fields of Information Systems (IS), Computer Science, Management, Construction Engineering and Change Management. It is not surprising to find "IT in CM" articles in IS and Computer Science Journals, likewise it is not surprising to find them in Management and CM journals. In a lifecycle perspective CM can be regarded as carefully related to Construction Management, which can clarify why articles on CM in IT also are found in journals in the Construction research field [2].

## Conclusion

This evaluation demonstrations that 72% of the articles have an emphasis on conceptualization and growth while only 24% focus on implementation and use in organizations. Most of the results have a prescriptive nature. This specifies an instable study effort. Much new knowledge could be increased if emphasis removed towards CM organizations, where skills are being applied and used. Knowledge from application and use could be fed back into and fortify conceptualization and expansion, thereby adding more value to CM. Upcoming technology combinations, e.g. BIM used as a base for AR, may need additional conceptualization and growth before being introduced to the CM organizations. The technologies most in emphasis are BIM, followed by RFID. Most of the articles focus on combinations of different technologies, representative a general belief in technology mixtures as a means to haste up the rather slow IT dispersal process in CM. Additional technologies used in practice already, such as GIS, would probably get extra into attention, if more studies dedicated on operation and use in exercise.

## References

[1]    Becerik-gerber, B., Asce, A. M., Jazizadeh, F., Li, N., & Calis, G. (2012). Application Areas and Data Requirements for BIM-Enabled Change Management, (March), 431–443.

[2]    Chen, H.-M., Hou, C.-C., & Wang, Y.-H. (2013). A 3D visualized expert system for maintenance and management of existing building facilities using reliability-based method. *Expert Systems with Applications*, *40*(1), 287– 299.

[3]   Eadie, R., Browne, M., Odeyinka, H., McKeown, C., & McNiff, S. (2013). BIM implementation throughout the UK construction project lifecycle: An analysis. *Automation in Construction*, *36*(2013), 145–151.

[4]   Kim, M. J., Wang, X., Love, P., Li, H., & Kang, S. (2013). Virtual reality for the built environment : A critical review of recent advances, *18*(August), 279–305.

[5]   Lai, J. H., & Yik, F. W. (2011). A probe into the facilities maintenance data of a hotel. *Building Services Engineering Research and Technology*, *33*(2), 141–157.

[6]   Madritsch, T., & May, M. (2009). Successful IT implementation in Change  management. *Facilities*, *27*(11/12), 429– 444.

[7]   Okoli, C., & Schabram, K. (2010). *Working Papers on Information Systems A Guide to Conducting a Systematic Literature Review of Information Systems Research* (Vol. 10). Retrieved from http://sprouts.aisnet.org/10-26

[8]   Tulla, K., V äh ä, P., Matinmikko, T., Tolman, A., & M öt önen, V. (2009). RFID technology changes CM services deliveries. *Facilities*, *27*(11/12), 457–468.

[9]   Volk, R., Stengel, J., & Schultmann, F. (2014). Building Information Modeling (BIM) for existing buildings —

Literature review and future needs. *Automation in Construction*, *38*, 109–127.

[10]  Webster, J., & Watson, R. T. (2002). Analyzing the past to prepare for the future : Writing a review. *MIS Quaterly*, *26*(2), xxi–xxii.

[11]  Mahadi Hasan Miraz, Razamin Raml, Ku Ruhana Ku-Mahamud, Abu Raihan Bhuiyan Albarune & Foazul Islam.(2015). ICT Applications on Homestay Malaysia International Journal of Networking and Computer Application, July 15-16, 2015, IEEE, ISBN:9788193137314**.**

[12]  Saleheen, F., Miraz, M.H., Ramli, R. (2014). IT Operations in Retail Banking: A Case Study, Journal of Applied Management and Investments (Scoups) 2014, vol. 3, issue 4, pp. 245-250.

[13]  Saleheen, F., Miraz, M..H., Habib, Dr. Md. Mamun., Hanafi, Dr. Zurina. (2014). Challenges of Warehouse Operations: A Case Study in Retail Supermarket, International Journal of Supply Chain Management (IJSCM) (Scopus), 2014, vol.3, no.4, pp 63-67.

[14]   Miraz, M.H., Saleheen, F., Habib, Dr. Md. Mamun, Mahmuddin, M. & Nazri, E. (2015).
Mobile banking: challenges and opportunity, a case study in Bangladesh. Advanced Education
and Management (Scopus), Guilin, China, 2015