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Towards Enterprise Application Integration Principles for Facility Management Software in Hospitals

Nicole Gerber¹, Carina Tschümperlin², Dr. Nazali Mohd-Noor³, Prof. Dr. Susanne Hofer⁴

¹ Zurich University of Applied Sciences, Institute of Facility Management, Campus Grueental, P.O. Box, CH-8820 Waedenswil, Switzerland; PH +41 58 934 53 91; email: nicole.gerber@zhaw.ch

² Zurich University of Applied Sciences, Institute of Facility Management, Campus Grueental, P.O. Box, CH-8820 Waedenswil, Switzerland; PH +41 58 934 50 28; email: carina.tschuemperlin@zhaw.ch

³ Liverpool John Moores University, School of the Built Environment – LJMU – Byrom Street-L3 3AF, Liverpool, UK; PH +44 759 593 1983 email: M.N.Mohd-Noor@ljmu.ac.uk

⁴ Zurich University of Applied Sciences, Institute of Facility Management, Campus Grueental, P.O. Box, CH-8820 Waedenswil, Switzerland; PH +41 58 934 56 28; email: susanne.hofer@zhaw.ch

Abstract

Currently, hospitals have often installed up to 100 software applications within the non-medical support services (FM). The applications are mostly un-coordinated and only accessible for employees of certain sub-areas. Therefore, data is often stored redundantly, has to be transferred manually and some stakeholders are unaware of data locations and/or cannot access the data. In order to become more efficient, to save resources and to increase (data) quality, hospitals are now forced to find solutions in their processes and IT architecture - in the area of FM as well. Enterprise Application Integration (EAI) is an approach which has been applied to overcome this problem in other industries and partially also in the medical context in hospitals, but so far not including FM. During the latest research in non-medical support services in hospitals, connections and information needs between the different FM disciplines in hospitals became clearer. Extending these findings with the EAI principles in an explorative approach, the basis for future systematic integration of FM applications in hospitals is presented in this paper.

Keywords: Application Integration, EAI, FM in HC, Software Architecture

Starting Position And State Of The Art

In recent years, cost pressure has become an urgent topic in the healthcare [HC] sector, not only for the medical area, but also for the non-medical support services and thus Facility Management [FM] (Abel & Lennerts, 2006; Kriegel, 2012; Madritsch, 2009; Marsolek & Friesdorf, 2009; SwissDRG., n.d.; Thiex-Kreye, 2009). In order for Facility Management in Healthcare [FM in HC] to become more efficient and thus reduce cost without losing quality, it is necessary to gain transparency in the processes and their interrelations and the interfaces with the core business (Henke et al., 2011; Hess, 2014). Only then can the finances be differentiated systematically and put into key performance indicators [KPIs] for the purpose of controlling and benchmarking (Diez, 2009; Haux et al., 2010; Lennerts et al., 2003; Madritsch, 2009).

As in other sectors, FM in HC depends on software applications for efficiently computing reasonable and comparable KPIs on the one hand (Köbler et al., 2010; Rasche et al., 2010). On the other hand, it also depends on a well-defined software architecture. As Gerber and Perschel (2016) stated, Swiss hospitals currently have up to 100 mostly un-coordinated and sometimes only partially accessible applications in the area of non-medical services, thus producing redundant data. So far, the topic of integrating FM applications or Computer Aided Facility Management Systems [CAFM] in the software architecture together with Hospital Information Systems [HIS]

or Enterprise Resource Planning Systems [ERP] has been only partially dealt with. In hospitals the focus has been, if at all, set on the area of medical applications, only slightly touching non-medical aspects such as non-medical administration or maintenance (Gansert, 2009; Gräber et al., n.d.; Schlegel & Fischer, 2010; Seidel, 2010; Simoneit, 1998; Winter et al., 2006). In an FM specific manner, the topic of integration of applications has mostly been investigated in terms of Computer Aided Facility Management [CAFM] which so far has been tendentially defined in a general technical FM sense, not covering all the services mentioned in the holistic service catalogue for non-medical support services in hospitals [LekaS] by Gerber & Läubli (2015) and not including specific needs of FM in HC (Gerber & Perschel, 2016).

Research Objectives

The goal of this article is to present a clarification for a future systematic approach for further development in integrating non-medical or FM software applications in the HC context. The bases are findings from current FM in HC research projects and state of the art publications on Enterprise Application Integration [EAI] in general, EAI in the area of hospitals in particular and also in the CAFM context.

Methodology

During different current research projects conducted with the methodology of Design Science Research [DSR] according to Hevner et al. (2004), Hevner and Chatterjee (2010), Peffers et al. (2007) and Vaishnavi and Kuechler (2008), awareness of the necessity to extend the topics to the area of integration of applications arose. This occurrence is represented by the iteration arrow from “Conclusion” to “Awareness of Problem” in Figure 1. The current new iteration indicates that the methodology of this contribution complies with the DSR approach. In the current abductive phase, an explorative approach was chosen, using literature research and indications from expert interviews.

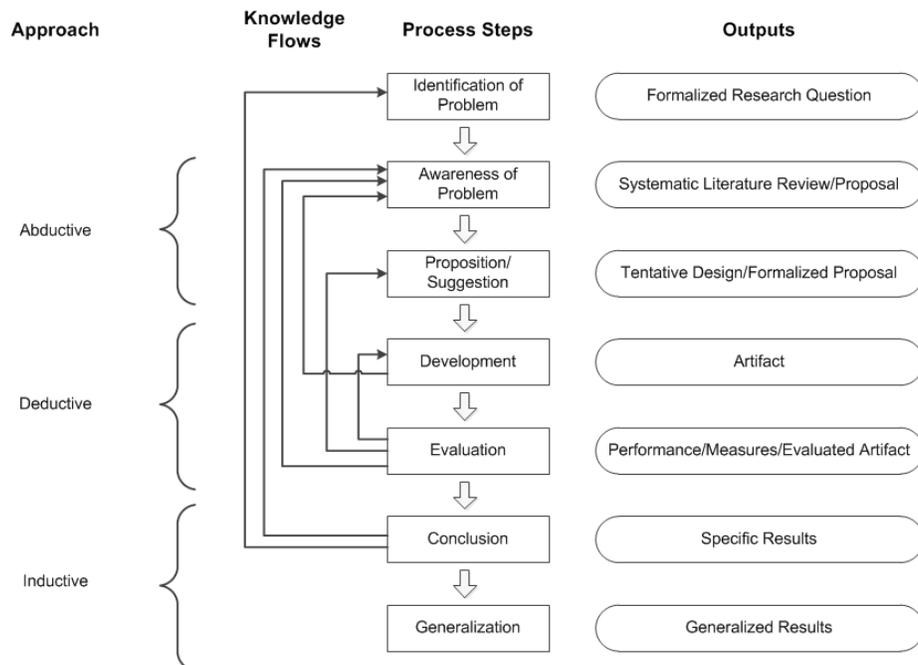


Figure 1: The general methodology of design science (based on Vaishnavi & Kuechler, 2008 and Dresch et al., 2015)

Integration of Applications

Enterprise Application Integration [EAI] is defined as a process of linking multiple applications which have been developed independently, which use different technologies or which are managed independently, using tools, technologies, approaches and principles of computer systems architecture design (Kalyani, 2012; Moturi et al., 2013; Themistocleous & Irani, 2006). The goals of EAI mainly are to reduce application maintenance cost, to be fast in adaptation, to maintain flexibility and manageability, to ensure quick response, to secure the information flow, to improve connectivity, to integrate data and processes, to be vendor independent and to achieve interconnectivity and compatibility (Kalyani, 2012; Khoumbati & Themistocleous, 2007; Klesse et al., 2005; Moturi et al., 2013; Siegenthaler & Schwinn, 2006; Themistocleous & Irani, 2002).

As indicated in the EAI definition, different aspects can and have to be considered when planning to apply EAI. One aspect is the choice of layer of integration like data level, application interface level, method level, user interface level (Themistocleous & Irani, 2002; Siegenthaler & Schwinn, 2006; Soomro & Awan, 2012). Another issue is the possible technologies to use, like database oriented middleware, message oriented technologies (e.g. message brokers), object oriented technologies, transaction based technologies (e.g. application servers), interface oriented technologies (e.g. application programming interfaces) (Themistocleous & Irani, 2002). The different architectures/topologies like Point-to-Point topology, Hub-Spoke topology, Bus Topology, middleware, message and process brokers are also aspects to consider (Soomro & Awan, 2012; Fenner, n.d.; Johannesson 2001; Kalyani, 2012) as well as integration methods like Service Oriented Architecture [SOA] or WebServices (Wei, 2015; Marx Gomez & von Ossietzky, n.d.).

Enterprise Application Integration in Hospitals

Healthcare Information Systems [HIS] are based on a heterogenous and autonomous development of interdisciplinary topics, areas and systems. This is why HIS have different computer languages, platforms, hardware, data structures and format types (Khoumbati et al., 2005; Mantzana & Themistocleous, 2006). Due to the autonomy, interconnectivity and interoperability of the applications in HC, the integration of Information Systems in HC is therefore one of the most urgent priorities (Khoumbati et al., 2005; Khoumbati & Themistocleous, 2006), particularly because of attempts to reduce medical errors, to secure confidential patient data, to improve care quality, to support clinical decisions within an increasingly complex area, to reduce paperwork processes, to reduce cost as well as to become ready to exchange data with external healthcare stakeholders (Khoumbati et al., 2005; Khoumbati & Themistocleous, 2006; Mantzana & Themistocleous, 2004 & 2006). According to Mantzana and Themistocleous (2006) HC underutilizes application integration approaches despite the learnings of EAI in other industries. According to Jobst (2010), one of the reasons for this is that software providers do not comply with the different requirements of the HC industry. Another reason is that the stakeholders and actors such as Controllers, Providers and Supporters were not sufficiently convinced about the benefits of EAI (Mantzana & Themistocleous, 2004; Mantzana & Themistocleous, 2006). To overcome the current situation, Khoumbati and Themistocleous (2006 & 2008) and Khoumbati et al. (2006) suggest the use of a framework containing the following factors specifically within the HC context: benefits, barriers, compatibility, size of organisation, physicians' and administrators'

relationship, cost, patient satisfaction, telemedicine, IT infrastructure, IT sophistication, IT support EAI evaluation frameworks, support, compatibility, internal pressures, external pressures.

Integration Aspects of CAFM

The definition of the Computer Aided Facility Management [CAFM] scope can be seen in Figure 2. It becomes clear that on the one hand the compilation of areas within one software provides a good basis as an example of integration discussion. On the other hand, May (2013) shows that CAFM in itself is confronted with the integration topics of interfaces, web applications, mobile solutions or integrations platforms via middleware, web-services, workflow management, the use of SOA, the combining of different modules to form a system and in general the integrability in an existing IT environment. In terms of integration into Enterprise Resource Planning (ERP) software, procedures have been developed and used either by applying the extensions of business functions in technical oriented CAFM or by addition of FM functionalities in ERP software (May, 2013; Nävy, 2006).

Conclusions, Limitations and Outlook

In terms of EAI, literature shows that

- there are different documented possibilities on how to integrate applications in the HC industry
- frameworks and lessons learned considering EAI aspects in HC are available
- the currently presented solutions are not specifically considering the non-medical area within the whole context and do not focus on the integration of FM applications in the HC environment

In terms of CAFM

- learnings from CAFM integrations within the FM industry are available
- the documented solutions do not specifically cover the HC context

What now has to be investigated empirically is

- Which aspects proposed by literature for EAI in HC in general also apply for the non-medical / FM area?
- Which aspects have to be emphasized in this context?
- Are there additional topics to be considered when intending to integrate data from HIS, ERP, CAFM and additional single FM solutions as depicted in Figure 2?

In terms of stakeholders,

- the hospital IT departments have to be persuaded to tackle the task of integrating FM in HC applications systematically and
- CAFM software providers should also be involved to evaluate possibilities for enlarging CAFM functionalities towards a holistic software to support all FM areas.

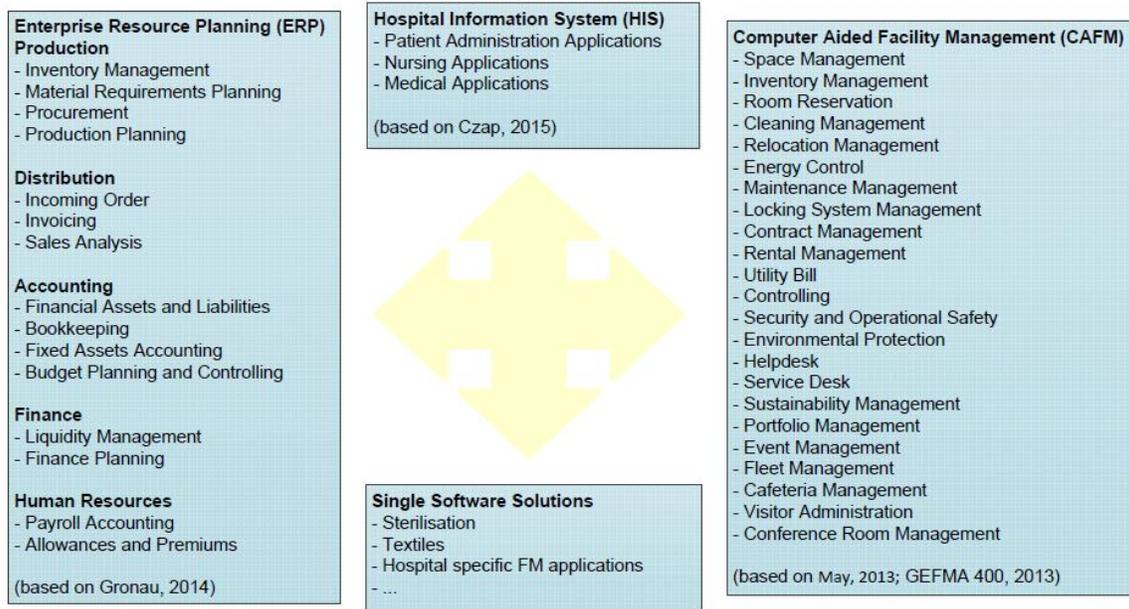


Figure 2: Software applications in HC to be integrated

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