How FM can enable the increasing need for process orientation in hospitals

Nicole Gerber, Christine Verhoeven, Susanne Hofer

Institute of Facility Management (IFM), Zurich University of Applied Sciences (ZHAW), Switzerland

Abstract

Hospitals are facing the challenge to operate in a more process-orientated manner in order to improve efficiency and transparency as well as to reduce costs. This also includes the area of Facility Management [FM]. This situation presents a great opportunity to look at the interfaces between the medical core business and the non-medical support services, and to establish FM as a holistic process supporter instead of a sole provider of single services. In order to handle the numerous interactions between the different professions and requirements within the complex hospital context, specific process visualization and simulation tools and methods will have to be developed. To achieve a characterization of different processes, a model for FM in Healthcare [HC] processes in the entire hospital process context is presented. Following the Design Science Research [DSR] principles, an iterative approach combining explorative elements with empirical qualitative expert-interviews was applied. The findings show that FM in HC needs to intensify the characterization of processes, the systematic collection of (process) data, the openness towards IT and the interdisciplinary dialogue between the medical, non-medical and strategic processes in hospitals in order to accommodate the increasing need for process orientation in hospitals.

Keywords: FM in Healthcare, (Sub-)Processes, Process Visualizations, Process Simulations

1. Starting Position and State Of The Art / Introduction

Hospitals are currently facing several challenges. One of the most important ones is cost pressure and consequently the need for more efficiency, transparency and interdisciplinary cooperation (Kriegel, 2012; Busse, 2009; Angerer et al., 2012). Other industries that faced similar challenges earlier, overcame the situation by applying business process engineering penetrating the whole business and thus using synergies. Hospitals have recognized the issue to some extent, but so far, the process engineering approach has not or only partially been applied in healthcare, mainly because of a lack of process culture in the past, historical dominance of medical aspects refusing to include the non-medical aspects, silo thinking mentality within the many disciplines, a lack of service orientation and a fear of losing status by making processes transparent (Angerer et al., 2012; Salfeld et al., 2009; Bornewasser, 2013; Kriegel, 2012; Fischlein & Pfänder, 2008).

Nevertheless, hospital process standardization and simulation has been done in several medical areas. One approach towards standardization and process-orientation in hospitals is the implementation of clinical pathways, a definition of procedures of treatments including resources and competencies (Schlieter, 2012; Richter, 2008; Salfeld et al., 2009). However, clinical pathways have so far not been applied by all medical staff; they only comprise medical procedures and are mostly not combined amongst each other (Gadatsch, 2013). In addition, it has not been reported that non-medical aspects as suggested by Gerber (2014) have been further considered so far. With regard to FM process modeling, several approaches have been published (e. g. Fleischmann, 2007; GEFMA 230:2008; Krämer et al., 2013; SN EN 15221-5:2011) but so far the specific context of Facility Management in Healthcare (FM in HC) has not yet been factored in. In terms of simulation, numerous projects for specific areas within a hospital like simulating physical patient flows (Kumar, 2011), patient scheduling (Herrler, 2007), simulation of specific patient processes like admission and discharge (Kim, 2013) or optimizing emergency care processes (Shim & Kumar, 2010) have been reported. However, the approaches were conducted in an isolated manner and for the most part, focusing on specific medical topics. Holistic process engineering or visualization comprising the hospital in its whole complexity of medical core processes and care, the strategic management and their support processes as well as the non-medical support processes (FM) and/or FM process modelling in the specific context of FM in HC have not yet been developed.

Other reasons in addition to the lack of process orientation in hospitals mentioned above

might be a) that the complexity of the whole context necessitates different approaches taking into consideration different working cultures and unifying them on common level and b) the dynamism of the only partially plannable patient processes occurring in the hospital context. In terms of changing the process culture in hospitals, Angerer et al (2012) suggest starting by specific projects visualizing selected processes before developing them further. This is what this article does in a systematic way.

1. Theoretical Background

2. 2.1 Process visualization and process modeling

The importance of visualizing and modeling data and processes has been examined in different contexts (e.g. Eppler & Platts, 2009; Stachowiak, 1983). Sampson (2012) has shown that it is not only possible to model physical processes such as manufacturing, but also service processes. Different tools have been presented:

- *Flowcharting* tools like Event-driven Process Chains (EPCs), for interaction of entities and networks (Sampson, 2012)
- *Supply Chain diagrams*, linear process visualization for clarifying relationships between process stakeholders, but neglecting the inclusion of actions between the entities (Sampson, 2012)
- *Business Blueprints* for dynamic core and support processes, distinguishing between process steps that can be seen by the customer ("above the line of visibility") and those that are done behind the visibility of the customer (Shostack, 1984; Bitner et al, 2007; von Felten, D. et al. 2012)
- *Process Chain Network Diagram* (PCN), a further development differentiating between direct interaction, surrogate interaction and independent processing, and adding the nature of interaction, depicting all entities and allowing network representation (Sampson, 2012).

Within the hospital context, flowcharting and supply chain diagrams can, as in other industries, be used to depict and (re)engineer specific processes, but they are not made for investigating connections and synergies between different disciplines. Business Blueprinting and Process Chain Network Diagramming make it possible to show connections and to differentiate between different kinds of processes; they are, however, limited to a two-dimensional view, which do not comprehensibly illustrate the effect of simultaneous processes below the line of visibility of the patient – as it is mostly the case for Facility Management in Healthcare [FM in HC].

2.2 Process simulation

One possibility to investigate internal interactions and interdependencies of complex systems and sub-systems is computer-based simulation (Banks & Nelson, 2014; Perros, 2009). According to Banks and Nelson (2014) simulations offer the advantage that processes and procedures can be investigated without disturbing the operational processes and that the demonstration of scenarios help in visualizing and thus communicating between disciplines - both very crucial topics in the hospital context. On the other hand, it has to be taken into account, that it might be difficult to interpret simulation outputs and that simulation needs expert knowledge of different areas and can thus be time consuming and expensive (Banks & Nelson, 2014). It is therefore very important to formulate the problem well, to define the requirements of variables (exogenous, endogenous) and outputs (tables, graphics, movements) and to choose the appropriate conceptualization (static, dynamic, deterministic, stochastic) and depiction level of the model (Banks & Nelson, 2014; Perros, 2009; Herrler, 2007).

In the past, Sharma et al. (2007) presented a specific FM in HC simulation approach in the context for maintenance service management in hospitals in terms of resource allocation and impact measuring. Even though the authors had declared that the model could be applied in other areas, no continuation of the project was reported.

3. Research Objectives and Research Question(s)

In different research and development contexts of the authors, FM in HC experts had mentioned the need for different kinds of process visualizations or simulations in order to improve efficiency and reduce wastage of resources. For example:

- on an operational level, to reduce food waste and unnecessary overtime when preparing food, having real-time data about medical patient processes and scheduling
- on a tactical level, to visualize impacts and having managerial decision support upon deciding between different kinds of cost cutting measures (e.g. the trade-off between reducing staff or quality of service)
- on a strategic level, to have different scenarios of different investment and maintenance strategies with the according simulation of figures over the life cycle

The research objective of this paper is therefore to find existing or new possibilities as to how to distinguish between different categories of processes delivered in a hospital where FM takes part, to gain understanding of current interdependencies and to develop a basis for

further development improving process visualization and simulation. The explicit research question thus derived is: How can FM contribute to the increasing need for process orientation in hospitals?

4. Research Design

As the goal of this article is to set up a (reference) model as a visualization basis, the methodology of Design Science Research (DSR) according to Hevner et al. (2004), Hevner and Chatterjee (2014), Peffers et al. (2007) and Vaishnavi and Kuechler (2008) was applied. Based on the DSR principle illustrated in Figure 1, an iterative approach combining explorative elements and qualitative semi-standardized expert interviews was chosen.

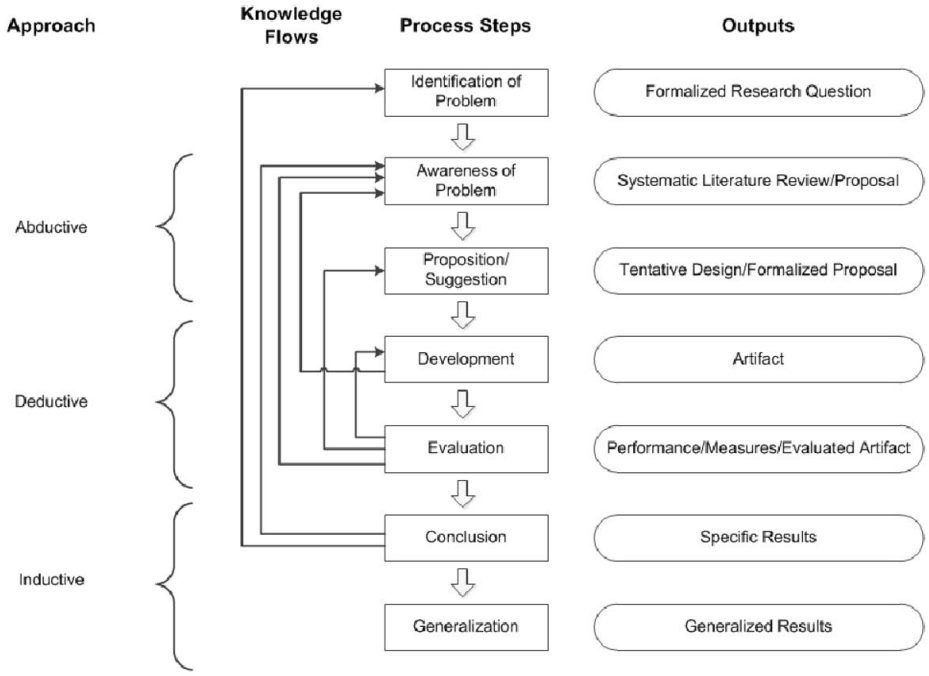

Figure 1: The general methodology of design science (based on Vaishnavi & Kuechler, 2008 and Dresch et al., 2015)

The *Identification of the Problem* and formulating the *Research Question* was derived from on-going research and development projects and previous publications. The *Awareness of the Problem* was underpinned by an extensive *Literature Review* on the subjects of process modelling and process simulation in general and in the (FM in) HC context. As a *Proposition*, modelling was suggested as a *Tentative Design.* In the *Development* phase, the model as an *Artifact* was developed in a concurrent exploratory nature combining design and empirical principles according to Huysmans & Verelst (2012) – to present the development and the model itself is the main goal of this article (compare Chapters 5 and 6). The continuation of the further development is two-fold: On the one hand, the model has to go through an

Evaluation by observations of the various FM processes, by investigating the connections amongst the different processes and their impacts with FM in HC and process specialists, and by consulting simulation experts to define the technical requirements before final *Conclusion* and *Generalization* can occur. On the other hand, the detection of different FM in HC process levels raised more specific *Awareness of more Problems* and will thus lead to more iterations (illustrated by the upward directed arrows in Figure 1).

1.1 5. Development of the Artifact

As mentioned above, in order to answer the research question, setting up a model as an artifact was chosen.

5.1 Conceptual Bases

The conceptual bases for developing the model is the Overall Layout of Service Levels in Hospitals shown in Figure 2, the Service Allocation Model for non-medical Support Services in Hospitals [LemoS] (Gerber, 2016) as depicted in Figure 3 and the Service Catalogue for non-medical Support Services in Hospitals [LekaS] (Gerber & Läuppi, 2015).

For setting up the model, the generally accepted modelling principles promoted by Schütte (1998) and Becker et al. (1998) were applied.

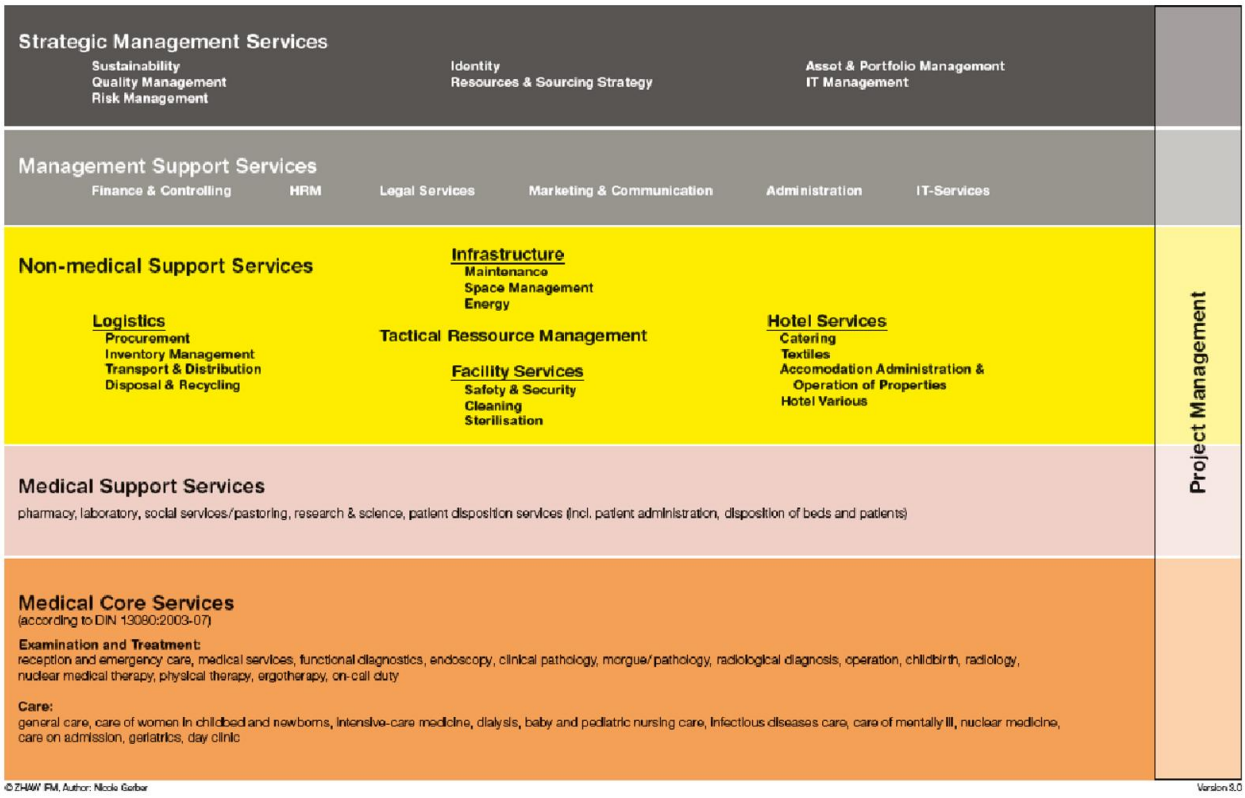

Figure 2: Overall Layout of Service Levels in Hospitals (Gerber, 2016)

Figure 3: Service Allocation Model [LemoS] (Gerber, 2016)

5.2 Categorization of processes

For the first step of process categorization, the distinction between the Medical Services (orange), the Non-medical Support Services (yellow) and the Strategic Management Services (grey) as depicted in Figure 2 were considered. Focusing on the FM processes and comparing those levels by Gerber (2016) with the level distinction of direct interaction, surrogate interaction and independent processing by Sampson (2012), the following parallels could be found:

- *Level of direct interaction* in the FM in HC context means FM *involvement in the medical process and/or FM processes with a direct contact with the patients* – here an allocation of request by a specific order placer or area is possible and thus an exact allocation of cost

- *Surrogate interaction* in the hospital context means FM *involvement in the operational and tactical hospital process overall* – here no single/specific allocation of request can be done; the processes are executed for the hospital as a whole and the cost can only be allocated by apportionment

- *Independent processing* in the FM in HC context means *strategic management processes* – here again, no single/specific allocation of request can be done therefore cost can only be allocated by apportionment

In a second step, all the services and their processes defined in LekaS (Gerber & Läuppi, 2015) could be assigned to the above mentioned levels depicted in Figure 4.

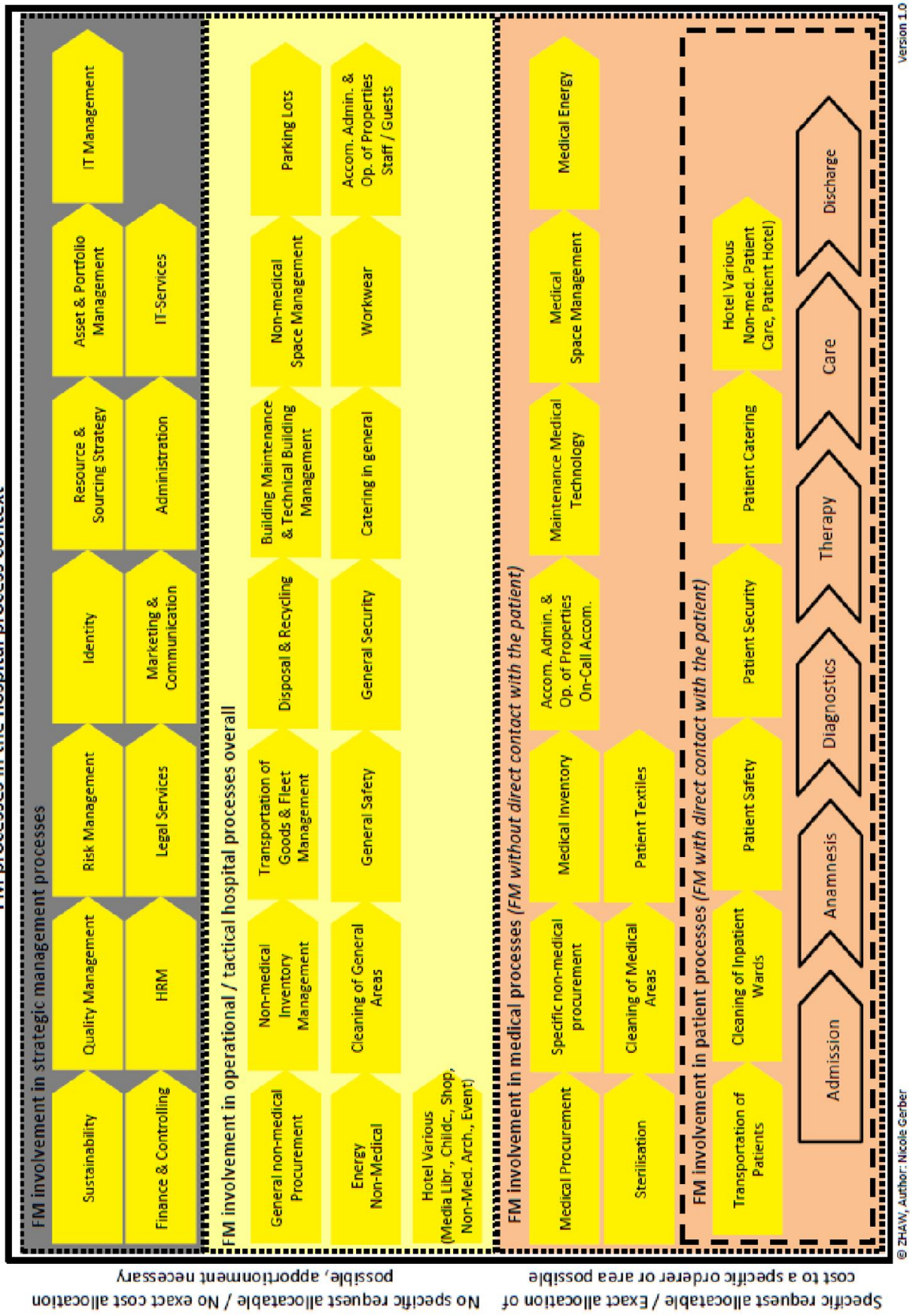

Figure 4: FM in HC processes in the entire hospital process context

What became clear in doing so was that it had not yet been investigated which stakeholder connections within the different levels influence the service execution of FM in HC, specifically which FM processes actually have direct patient contact and how they thus differentiate themselves from FM processes beyond the line of visibility and those of FM users who are not patients. This is why to gain greater understanding of this specific topic of interaction between FM and patients in hospitals and as an example for further investigations in the other areas, a first empirical study was conducted to specify the model.

5.3 Investigation of FM involvement in patient processes

5.3.1 Sampling and Data Collection

The data was collected in fives diverse hospitals with a range of 117 to 809 beds, applying the diverse-case method according to Gerring & Seawright (2007) with the goal to encompass the range values on relevant dimensions. Five FM in HC experts were interviewed in semi-structured qualitative interviews on the 15 Non-medical Support Service processes depicted in Figure 3.

5.3.2 Results

With the help of a systematically coded interview analysis, several tendencies could be derived: Out of the 15 Non-medical Support Service processes illustrated in Figure 3, Inventory Management, Sterilization and Space Management seem to not have any patient contact, whereas all the other processes have direct contact with the patient at some point. Processes which tend to involve short contact with patients (< 1 minute) are Textiles, Security and Energy, processes which tend to involve more than 5 minutes of patient contact are Procurement and Transportation Services & Provision. For the other processes, the different hospitals seem to handle the FM processes with very different emphasis in terms of patient contact intensity. When there is contact, it seems to be mostly verbally with physical presence; less common are signalization with a bell or communication by questionnaire. However, there are very different ways of interaction combinations within the execution of FM processes above the line of visibility with the patient.

6. Conclusions

The conclusions in terms of how FM can enable the increasing need for process orientation in hospitals out of the presented findings are manifold:

- With respect to the definition of FM in HC processes, it becomes clear that the processes have to be characterized on an empirical basis in order to be able to specifically proceed in the suitable process visualization. This is why FM in HC needs to intensify the systematic collection of FM (process) data in order to become ready for systematic, relevant and comprehensive process visualizations and simulations.
- In terms of visualization and simulation, the appropriate techniques within the specific contexts and the different process characters will then have to be defined and developed in the HC context. In the FM processes with medical connections, the basis of clinical pathways could be extended, for operational FM processes, real-time simulations or calculations based on production industries could be applied and for strategic processes, long-term scenario simulations could be developed. This implies that FM (in HC) first needs to become more open to IT and its technologies and procedures because it is only with IT-supported simulation tools and their principles that it will be possible to optimize the very complex processes in hospitals in a holistic approach in the future. Secondly, FM in HC should use the knowledge gained about the value of patient contact in order to strengthen its position towards the core business.
- In terms of interdisciplinary dialogue between the medical, non-medical and strategic processes in hospitals and in order to reach a more intense cooperation between FM and the core business in the future, FM in HC should take the initiative using its already interdisciplinary orientation and develop systematic approaches bringing the different disciplines together, using visualizations in order to promote common understanding including knowledge about managing internal and external Service Level Agreements.

The model “FM in HC processes in the entire hospital process context” offers an essential basis for theses further developments.

7. Limitations and Outlook

As explained in Chapter 4, the model “FM in HC processes in the entire hospital process context” is currently in the development phase and has to undergo Evaluation. The planned empirical in-depth investigation into FM in HC processes with patient contact by means of observations will contribute to the evaluation and also to the development of further investigations about process interconnections and the definition about appropriate visualization and simulation needs and tools. Now process visualization and simulation experts have to be consulted to determine the technical requirements of further developments. It is expected that several iterations illustrated by the arrows in Figure 1 will be necessary in order to specify the

different process characters in the complex and interlinked HC context.

References

Angerer, A., Auerbach, H., Früh, M. (2012): *SpitalPuls 2012 Prozess- und Changemanagement in Schweizer Spitälern.* Vom Symptom zur Diagnose. Crossing Borders. Winterthur: ZHAW SML, Abteilung General Management.

Banks, J., Carson, J.S., Nelson B.L. & Nicol D.M. (2014): *Discrete-Event System Simulation.* Essex: Pearson Education Limited.

Becker, J., Ehlers, L., and Schütte, R. (1998): Grundsätze ordnungsmäßiger Modellierung. Projektträger des BMBF beim DLR (Eds.). *Tagungsband zur Statustagung des BMBF Softwaretechnologie*. Bonn.

Bitner, M.J., Ostrom, A.L., Morgan, F.N. (2007): *Service Blueprinting: A Practical Tool for Service Innovation.*

Bornewasser, M. (2013): Prozessreorganisation im Krankenhaus: Lassen sich auch logistische Konzepte der Industrie im Krankenhaus umsetzen? In: Bouncken, R., Pfannstiel, M. & Reuschl, A. (Eds.). *Dienstleistungsmanagement im Krankenhaus I - Prozesse, Produktivität und Diversität*. Wiesbaden: Springer Gabler.

Busse, R., Tiemann, O. & Wörz, M. (2009): Veränderungen des Krankenhausmanagements im Kontext des Wandels internationaler Gesundheitssysteme. In: Behrendt Ingo, König Hans-Joachim, Krystek Ulrich. *Zukunftsorientierter Wandel im Krankenhausmanagement. Outsourcing, IT-Nutzenpotenziale, Kooperationsformen, Changemanagement.* Berlin Heidelberg: Springer.

Dresch, A., Lacerda, D. P., Valle A. & José, A. (2015): *Design Science Research - A Method for Science and Technology Advancement.* Cham et al.: Springer.

Eppler, M. J. & Platts, K. W. (2009): Visual Strategizing - The Systematic Use of Visualization in the Strategic-Planning Process. *Long Range Planning*. 42, pp. 42 – 74.

Fischlein, J. & Pfänder, T. (2008): *Industrielles Klinikmanagement.* München: FinanzBuch Verlag.

Fleischmann, G.F. (2007): *Referenzprozesse im Bereich von Facility Management*. Dissertation. Technische Universität Wien: Fakultät für Bauingenieurwesen.

Gadatsch, A. (2013): *IT-gestütztes Prozessmanagement im Gesundheitswesen - Methoden und Werkzeuge für Studierende und Praktiker.* Wiesbaden: Springer Vieweg.

GEFMA 230:2008. *Prozesskostenrechnung im FM - Grundlagen, Anwendung, Vorteile*

Gerber, N. (2014). Transferring Industry Approaches to Resource Management for FM in Hospitals - A Theoretical Reflection. *International Journal of Facility Management*. 5(2). URL: http://www.ijfm.net/index.php/ijfm/article/view/120/123 [12.6.2016]

Gerber, N., & Läuppi, V. (2015): *Service Catalogue for non-medical support services in hospitals - SN EN 15221-4 adapted, expanded and commented branchspecifically.*

Wädenswil: ZHAW Institut für Facility Management. URL: www.zhaw.ch/ifm/fm-healthcare/lekas-e [22.6.2016]

Gerber, N. (2016): *LemoS 3.0 – Leistungszuordnungsmodell für nicht-medizinische Supportleistungen in Spitälern angepasst an neue Erkenntnisse.* In: Working Paper. Wädenswil: Institut für Facility Management.

Gerring, J. & Seawright, J. (2007): Techniques for choosing cases. Gerring, J. (Ed.). *Case study research: Principles and Practices.* Cambridge University Press.

Herrler, R. (2007): *Agentenbasierte Simulation zur Ablaufoptimierung in Krankenhäusern und anderen verteilten, dynamischen Umgebungen.* Dissertation. Julius-Maximilians-Universität Würzburg.

Huysmans, Ph. & Verelst, J. (2012): Towards a Normalized Systems Analysis Method: A Design Science Project Incorporating Empirical Research Methodologies. Helfert, M. & Donnellan, B. (Eds.). Design Science: Perspectives from Europe. *European Design Science Symposium*. Revised Selected Papers. Cham et al.: Springer.

Hevner, A., March, S. T., & Park, J. & Ram, S. (2004): Design Science in Information Systems Research. *MIS Quarterly*, March, 28(1), pp. 75 – 104.

Hevner, A. & Chatterjee, S. (2010): *Design Research in Information Systems - Theory and Practice*. New York et al.: Springer.

Kim, E. S. (2013): *Using Computer Simulation to Study Hospital - Admission and Discharge Processes*. Master Thesis. University of Massachusetts – Amherst.

Krämer, M., Görze, R. & Hinke, R. (2013): *Geschäftsprozesse im Facility Management.* May, M. (Ed.). CAFM-Handbuch - IT im Facility Management erfolgreich einsetzen. 3. neu bearbeitete Auflage. Berlin, Heidelberg: Springer-Verlag.

Kriegel, J. (2012): *Krankenhauslogistik - Innovative Strategien für die Ressourcenbereitstellung und Prozessoptimierung im Krankenhauswesen*. Wiesbaden: Springer Gabler.

Kumar S. (2011): Modeling hospital surgical delivery process design using system simulation: optimizing patient flow and bed capacity as an illustration. *Technol Health Care,* 19(1), pp. 1-20.

Peffers, K., Tuunanen, T., Rothenberger, M. A. & Chatterjee, S. (2007): A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems,* 24(3), pp. 45 – 78.

Perros, Harry (2009): *Computer Simulation Techniques: The definitive introduction!* Computer Science Department NC State University Raleigh, NC.

Richter, Frank (2008): *Entwicklung eines validierten Prozessreferenzmodells zur effizienten Modellierung und Simulation klinischer Prozesse.* Ilmenau: Technische Universität, Fakultät für Informatik und Automatisierung.

Salfeld R., Hehner S., Wichels, R. (2009): *Modernes Krankenhausmanagement - Konzepte und Lösungen.* Zweite, aktualisierte und erweiterte Auflage. Berlin, Heidelberg: Springer.

Sampson, Scott E. (2012): Visualizing Service Operations. *Journal of Service Research*. 15(2), pp. 182 - 198.

Schlieter, Hannes (2012): *Ableitung von Klinischen Pfaden aus Medizinischen Leitlinien - Ein modellbasierter Ansatz*. Dissertation. Fakultät für Wirtschaftswissenschaften der Technischen Universität Dresden.

Sharma, V.; Abel, J.; Al-Hussein, M.; Lennerts, K. & Pfründer, U. (2007): Simulation application for resource allocation in facility management processes in hospitals. *Facilities*. 25(13/14), pp. 493 - 506.

Shostack, L. (1984): Designing Services That Deliver. *Harvard Business Review*, Vol. 62, January-February.

Schütte, R. (1998): *Grundsätze ordnungsmäßiger Referenzmodellierung. Konstruktion konfigurations- und anpassungsfähiger Modelle.* Wiesbaden: Deutscher Universitätsverlag.

SN EN 15221-5:2011. *Facility Management Teil 5: Leitfaden für Facility Management Prozesse.*

Stachowiak, H. (1983): Konstruierte Wirklichkeit. Stachowiak, H. (Ed.) *Modelle - Konstruktion der Wirklichkeit*. München: Wilhelm Fink.

Shim, S. J & Kumar, A. (2010): Simulation for emergency care process reengineering in hospitals. *Business Process Management Journal*, 16(5), pp.795 – 805.

Vaishnavi,V. K. & Kuechler, W. Jr. (2008): *Design Science Research Methods and Patterns - Innovating Information and Communication Technology*. Boca Raton: Auerbach.

von Felten, D, Coenen, Ch. & Schmid M. (2012): *FM-Blueprinting: Schaffung von interdisziplinärer Transparenz für die Kern- und Unterstützungsprozesse*. Wädenswil: IFM Institut für Facility Management.