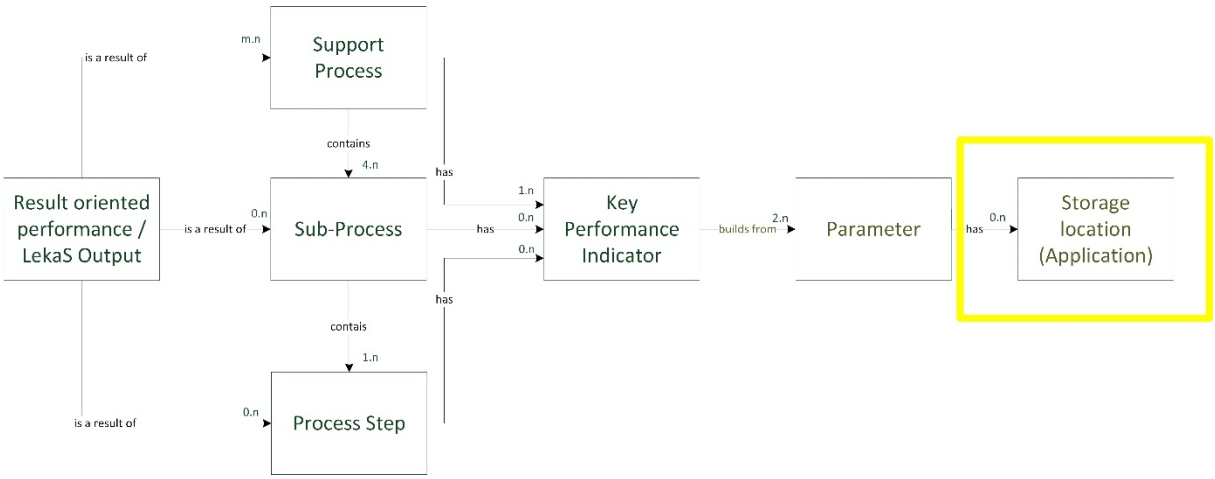
ApplikaS – Application catalogue for Non-medical Support Services in Hospitals

based on LekaS

Version 1.0 – based on German original



Authors:
Nicole Gerber
Wolfgang Perschel
Carina Tschümperlin
Dominik Wattenhofer
Prof. Dr. Susanne Hofer

Translation
Paul Schmitter
Carina Tschümperlin
John Bennett
Nicole Gerber

Published:
Zurich University of Applied Sciences (ZHAW)
Institute for Facility Management (IFM)
Wädenswil

November 2017

Project partners

conrealis

Deloitte.

Kantonsspital Aarau

Kantonsspital Graubünden

Universitätsspital Basel

UniversitätsSpital Zürich

SAP

Zürcher Hochschule für Angewandte Wissenschaften

zh aw Life Sciences und Facility Management

IFM Institut für Facility Management

Zürcher Hochschule für Angewandte Wissenschaften

zh aw School of Management and Law

Acknowledgements

Katharina Alföldi, Zurich University Hospital
Adrian Ammann, Cantonal Hospital Graubünden
Richard Birrer, University Hospital Basel
Reto Bucher, Cantonal Hospital Aarau
Prof. Dr. Alexandre de Spindler, ZHAW Institute of Business Information Technology
Annieck de Vocht, Deloitte AG
Ralph Dopp, Deloitte AG
Dr. René Fitterer, SAP (Switzerland) AG
José Juan, Cantonal Hospital Aarau
Dr. Helmut Kneer, Zurich University Hospital
Stefanie Lange, ZHAW Institute for Facility Management
Thomas Leiblein, ZHAW Institute for Facility Management
Christian Möller, Deloitte AG
Adrian Moser, ZHAW Institute of Business Information Technology
Wolfgang Perschel, conrealis ag
Michele Pizzolante, Cantonal Hospital Graubünden
Hansjörg Sager, University Hospital Basel
Ramona Schadegg, ZHAW Institute for Facility Management
Matthias Scherler, Deloitte AG

The foundations of this publication were made possible by the funding of the Swiss Commission for Technology and Innovation (CTI).

Abstract

In order to be able to handle the complexity of the various data with regard to more transparency – also in the non-medical support services in hospitals [FM in HC] – hospitals are dependent on suitable and usefully aligned software applications. Until recently, the integration and alignment of the non-medical applications was given scant attention both in theory as wall as in practice. The goal was therefore to gain an overview of the situation of the implemented applications by means of a survey and, on the basis of research, to determine which applications are available on the market and suitable to cover as many functionalities in the hospital operations as possible. These fundamentals should firstly shed light on the current situation and thus sensitize managers of FM in HC and as well as those in IT to the topic, and secondly, reveal the requirements for alignment within the FM area to the suppliers. The Application Catalogue ApplikaS, together with the Key Performance Indicator Catalogue KenkaS and the Process Model PromoS are part of the Reference Model for Non-Medical Support Services in Hospitals RemoS and the basis for the Guideline for applying SAP for the Facility Management in Healthcare in Healthcare LesapS and the IT-supported Assessment, Simulation and Benchmarking Tool for Facility Management in Healthcare. All topics mentioned are documented separately in detail and can, together via interlinks to other documents, be downloaded and thus implemented under www.zhaw.ch/ifm/fm-healthcare/remos/en.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

ApplikaS	Application Catalogue for Non-medical Support Services in Hospitals [German: Applikationskatalog für nicht-medizinische Supportleistungen in Hospitals]
CAFM	Computer Aided Facility Management
DRG	Diagnosis Related Group
ERP	Enterprise Resource Planning
FM in HC	Facility Management in Healthcare
FTE	Full Time Equivalent
IFM	Institut für Facility Management / Institute for Facility Management
IT	Information Technology
ITIL	Information Technology Infrastructure Library
KenkaS	Key Performance Catalogue for Non-medical Support Services in Hospitals [German: Kennzahlenkatalog für nicht-medizinische Supportleistungen in Hospitals]
HIS	Hospital Information System
KPI	Key Performance Indicator
LekaS	Service Catalogue for Non-medical Support Services in Hospitals [German: Leistungskatalog für nicht-medizinische Supportleitungen in Hospitals]
LemoS	Service Allocation Model for Non-medical Support Services in Hospitals [German: Leistungszuordnungsmodell für nicht-medizinische Supportleitungen in Hospitals]
LesapS	Guideline for applying SAP for the Facility Management in Healthcare [German: Leitfaden zum Einsatz von SAP für das Facility Management in Healthcare]
PromoS	Process Model for Non-medical Support Services in Hospitals [German: Prozessmodell für nicht-medizinische Supportleistungen in Hospitals]

RemoS	Reference Model for non-medical support services in Hospitals [German: Referenzmodell für nicht-medizinische Supportleistungen in Hospitals]
ZHAW	Zurich University of Applied Sciences [German: Zürcher Hochschule für Angewandte Wissenschaften]

1. Introduction

To start with, the project will be introduced: what was the starting position, the objective and the benefit promise of the project, what was the methodology, which topics were not covered and how is the document connected to other sub-projects.

1.1. Starting Position

As stated in KenkaS (Gerber et al., 2016c), the introduction of the case-based lump sum / SwissDRG in Swiss hospitals has led to more calls for data transparency in the non-medical sector. In order to handle the complexity of the various data, hospitals, like other sectors, are dependent on the use of appropriate and sensibly adapted software applications (Köbler et al., 2010; Rasche et al., 2010). Until now, the integration and coordination of non-medical applications has received little attention in theory as well as in practice (Gansert, 2009; Gräber et al., n. d.; Schlegel & Fischer, 2010; Seidel, 2010; Simoneit, 1998; Winter et al., 2006).

1.2. Objective

The aim was to gain an overview of the situation of the applied applications in the field of non-medical support services, and based on research, elicit which applications on the market, with regard to the most comprehensive coverage possible according to the service catalogue for non-medical support services in hospitals [LekaS] (Gerber & Läuppi, 2015), are available and suitable for hospital operations. These basic principles should highlight the initial situation and thus sensitize FM in HC- and also the responsible IT persons on the subject and also illustrate to suppliers the need for coordination within the FM area. The development of the application catalogue is an element which serves as a basis for the extensive project "*Development of an IT-based assessment tool and a corresponding introductory guide for relevant facility management process applications in hospitals, based on an adaptive reference model*". The aim of the entire project was to present the connections between non-medical (partial) processes, key indicators (parameters) and their storage applications and to define them in terms of a uniform standard for the Swiss health care system. In addition, a customer- and user-friendly solution in the form of an IT-supported assessment tool including an introduction manual should be developed on this basis, so that FM in HC can, tool supported, undergo a systematic analysis and so that courses of action for the removal of possible weaknesses can be identified and discussed.

1.3. Benefit / Application

Thanks to the foundations developed, it is now possible for all responsible persons of FM and IT in HC to analyze the situation in their context to use the framework to identify weaknesses and to systematically discuss further steps. Suppliers of corresponding software applications receive an overview of the scope and parameters of requirements for FM in HC and are able to decide to what extent they want / are able in the future to offer features for FM in HC which are lacking.

1.4. Methodology

The overview of the performance levels in the hospital in Figure 1 and the performance mapping model LemoS (Gerber, 2016) in Figure 2 served as a conceptual basis.

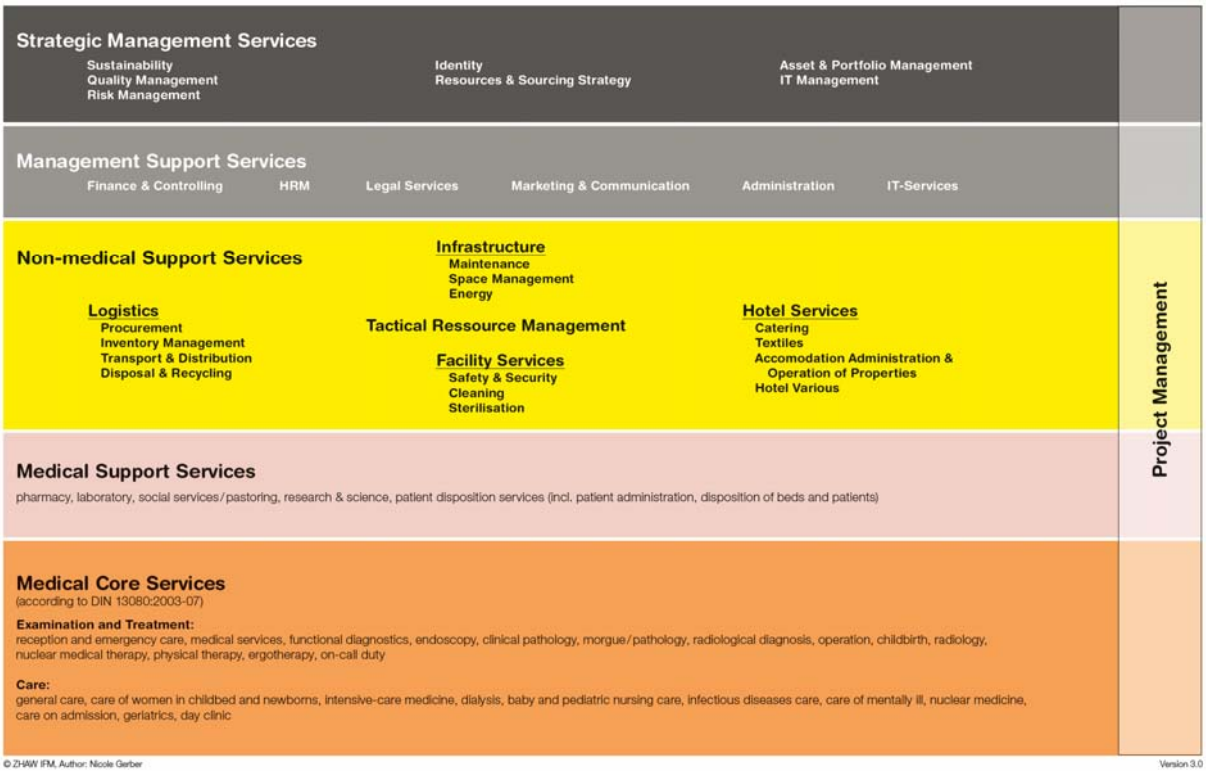


Figure 1: Overall Layout of Service Levels in Hospitals Version 3.0 (Gerber, 2016)

Figure 2: LemoS 3.0 (Gerber, 2016)

After detailed research of the literature, a survey of the use of non-medical software applications in seven hospitals was carried out for empirical data collection. In addition, systematic online searches were conducted.

1.5. Delimitation

For an initial evaluation, seven hospitals were interviewed. With the insights gained, tendencies can be identified. For a final assessment, the choice of hospitals should be more systematic and larger scale survey should be carried out.

The research of the software applications was limited to online research and consisted of data provided by the suppliers, which were not verified in technical detail.

The original objective of declaring the suitability of the various applications in the context of FM in HC could not be met – for a decision on the suitability of an application many individual contexts and constellations need to be considered, and it became evident that these cannot be generalized and therefore need to be clarified with specialists in each individual case.

1.6. Links / Connections with other topics

The application aspects presented are based on the results-oriented performance specifications in **LekaS, the Service Catalogue for Non-medical Support Services in Hospitals** (Gerber & Läuppi, 2015).

They also include the KPI parameters from **KenkaS - Key Performance Catalogue for Non-medical Support Services in Hospitals** (Gerber et al., 2016c) and the process definitions from **PromoS - Process Model for Non-medical Support Services in Hospitals** (Gerber et al., 2016b).

The explanations concerning the interrelationships of the mentioned subareas above are given in the **RemoS - Reference Model for non-medical support services in Hospitals** (Gerber & Hofer, 2016) and is shown in Figure 3.

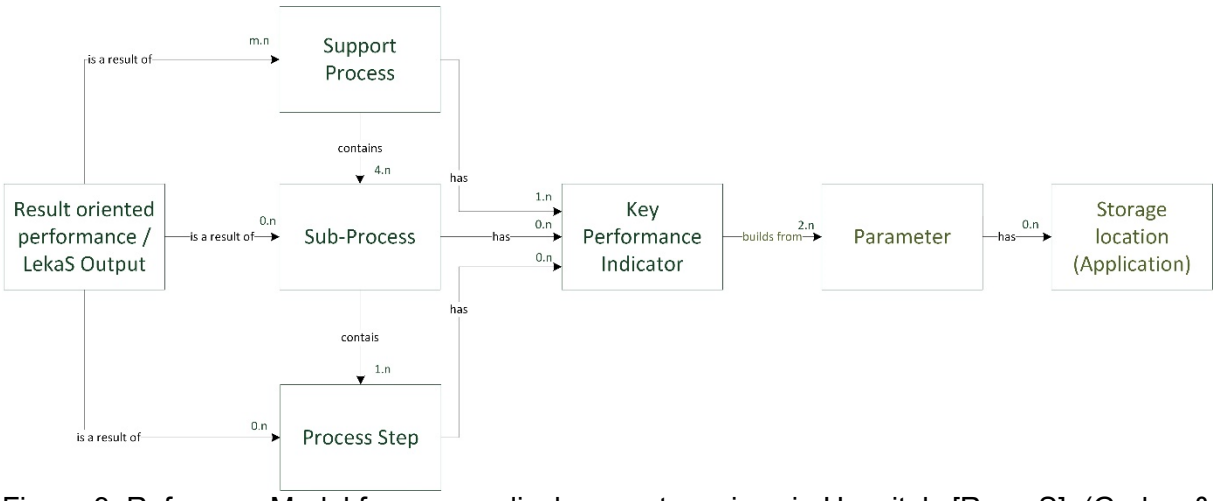


Figure 3: Reference Model for non-medical support services in Hospitals [RemoS] (Gerber & Hofer, 2016)

The possibility of recording the applications status quo and defining a possible target state with the corresponding implementation possibilities is presented in the **IT-supported Assessment, Simulation and Benchmarking Tool for Facility Management in Healthcare** (Möller et al., 2017).

The specific degree of coverage of the applications with regard to **LesapS - Guideline for applying SAP for the Facility Management in Healthcare** is shown (Weigele et al., 2017). All publications can be retrieved and downloaded at *www.zhaw.ch/ifm/fm-healthcare/remos*.

1.7. Outlook

The findings from the application catalogue are used as a basis for further projects relating to the coordination of non-medical support services software.

2. Theory in Relation to Application (Integration) in Hospitals

To ensure a common understanding, first of all the terms (software) applications and application management are defined. Subsequently, the context of the applications is explained and the topic Enterprise Application Integration is presented in summary.

2.1. Definition of (Software) Applications

The definition of application and software varies in the literature. In this context, the focus is on application software (see Kurbel 2014) and the definition of application according to Hanhart (2008, pp. 215 - 216, translated by the author) is adopted: An application is software that provides functions and data to support operational tasks. [...] An application can contain a service implementation. An application can use services. An application features functionality and data. [...] Several functions that operate on the same information objects are grouped into one application.

2.2. Definition of Application Management

ITIL defines application management as managing and supporting applications in daily operations across the entire application lifecycle. The goal is, among other things, that the applications are well thought-out, stable and economical (Ebel, 2015, p. 735 ff.).

2.3. Applications in Hospitals

According to Gerber et al. (2016d) hospital software applications can be divided into four different areas with regard to FM in HC:

1. Hospital Information System [HIS]
2. Enterprise Resource Planning [ERP]
3. Computer Aided Facility Management [CAFM]
4. Software Solutions

2.3.1. HIS

Clinical information systems serve the medical core business (cf. the orange area in Figure 1) and, according to Czap (2015), include patient administration, care and medical applications.

Due to the focus on non-medical support services, HIS is not a priority in this project. Nevertheless, it should be pointed out that some parameters, which were compiled in the key performance catalogue KenkaS (Gerber et al., 2016c), require information from HIS. These are in particular:

- Number of inpatient cases
- Number of outpatient cases
- Number of inpatient beds
- Number of care days
- Number of patients
- Number of inpatient discharges
- Average length of stay

2.3.2. ERP

Enterprise Resource Planning [ERP] includes, according to Gronau (2014) the following aspects:

Production:

- Inventory management
- Material requirements planning
- Procurement
- Production planning

Distribution:
- Incoming Orders
- Invoicing
- Sales analysis

Accounting:
- Assets and liabilities
- Bookkeeping / accounting
- Fixed asset accounting
- Budget planning and monitoring

Finance:
- Liquidation management
- Finance planning

Human Resources:
- Wage and payroll accounting
- Surcharges and bonuses

An ERP serves the needs of the 'Strategic Management Services' and their 'Management Support Services' (cp. gray area in Figure 1) in particular. The aspect of production is largely non-existent in the hospital, but rather covered by HIS.

For FM in HC, the ERP is an important reference for data sources. For the KPIs compiled in the key performance catalogue KenkaS (Gerber et al., 2016c), the following parameters in particular are essential:

Finance/Accounting
- Total costs
- Costs per subject area
- Specific costs (e.g. energy)
- Costs of external services
- Personnel costs

HR
- Number of FTEs (total or per subject area) or headcount
- Number of skilled personnel or assistants
- Absenteeism
- Hours of training

Procurement/Storage/Distribution
- Total value of goods
- Goods value (non-)medical procurement
- Number of input positions
- Number of output positions
- Material input costs
- Number of orders (per department)
- Number of items
- Number of orders executed
- Execution and processing time
- Deviation of quantity delivered
- Picks
- Inventory data

2.3.3. CAFM

Computer Aided Facility Management (CAFM) software

- is an integration-supporting, information technology tool
- supports specific FM needs throughout the facility's life cycle
- includes graphical and alphanumeric, as well as workflow management data

(Nävy, 2006;GEFMA400:2003)

According to May (2013) and GEFMA 400 (2013), CAFM includes:

- Inventory management
- Fleet management
- Maintenance management
- Service desk
- Help desk
- Energy control
- Security and operational safety
- Locking system management
- Environmental protection
- Space management
- Room booking
- Conference room management
- Cafeteria management
- Event management
- Cleaning management
- Letting management
- Visitor administration
- Relocation management
- Contract management
- Sustainability management
- Portfolio management
- Operating cost accounting
- Controlling

A detailed listing of the CAFM functionalities, described in the literature, are illustrated in Appendix 1.

2.3.4. Individual Solutions

This category comprises all application software applications, which serve individual topics or individual departments and are not integrated at a higher level into ERP or CAFM. With respect to FM in HC, the enumerated examples are given:

- Sterilisation application
- Textiles supply management
- Hospital-specific (FM) applications

2.4. Definition of Application Integrations / Enterprise Application Integration [EAI]

Enterprise Application Integration [EAI]

- is a process in which various independently developed and technically different applications are linked with one another with the aid of different tools, procedures and system architecture designs (Kalyani, 2012; Moturi et al., 2013; Themistocleous & Irani, 2006).
- aims to reduce the cost of application maintenance, to speed up adaptation, to ensure flexibility and fast responses, to secure information flows, to improve connectivity, to integrate data and processes, and to achieve interconnectivity and compatibility (Kalyani, 2012; Themistocleous & Irani, 2002).
- must take various aspects, such as integration layers, possible technologies, different architectures / topologies and integration methods into account (Fenner, n.d.,

Johannesson 2001, Kalyani, 2012, Marx Gomez & von Ossietzky, n. d., Siegenthaler & Schwinn, 2006, Soomro & Awan, 2012, Themistocleous & Irani, 2002, Wei, 2015).

2.4.1. Application Integration in Hospitals

In hospitals, application integration has been given little attention despite having recourse to the experience gained in other sectors (Mantzana & Themistocleous, 2006). Possible reasons therefore are

- Software providers cannot cover the different requirements
- Controllers, suppliers and supporters were not sufficiently convinced of the benefits of EAI

(Jobst, 2010; Mantzana & Themistocleous, 2004; Mantzana & Themistocleous, 2006).

Application integration in hospitals needs to be introduced for the following reasons:

- Hospital Information Systems [HIS] are often developed autonomously, very heterogeneously and in interdisciplinary fashion, and are therefore developed with different languages, platforms, hardware, data structures and types of formats (Khoumbati et al., 2005; Mantzana & Themistocleous, 2006).
- EAI can reduce medical errors, increase patient data protection and quality of care, support superior business decisions, reduce costs and enable data to be shared with external health stakeholders (Khoumbati et al., 2005, Khoumbati & Themistocleous, 2006, Mantzana & Themistocleous, 2004 & 2006).

Approaches for specific integrative approaches in the hospital context are presented in the form of a framework (Khoumbati and Themistocleous, 2006 & 2008; Khoumbati et al.,2006). However, the focus is on medical applications.

2.4.2. Application Integration in FM

Integration of applications in the context of FM has so far been particularly associated with CAFM-software or -systems (see section 2.3.3). However, it should be mentioned here that CAFM has so far tended to be understood as a technical FM tool and the holistic approach of LekaS (Gerber & Läuppi, 2015) has not been continuously incorporated. Nevertheless, there are already field reports in this area taking into account the special needs and conditions of FM in HC.

2.4.3. Application Integration of FM in HC

As Gerber et al. (2016d) state, there are currently no specific documented experience foundations concerning application integration from FM in HC. There are, however, basic principles of EAI in HC and EAI in FM which can be used and adapted to FM in HC. It will be necessary to define which aspects for FM in HC must be considered in the context of HIS, ERP, CAFM and customized software as well as the specific stakeholders IT in HC and software providers in HC.

3. ApplikaS – Application Catalogue for non-medical Support Services in Hospitals

First, the framework applied to explore FM applications is presented. Afterwards, the results from the survey and the research are explained and a subsequent conclusion is drawn.

3.1. Framework for the Determination of FM Applications in Hospitals

As a basis for the systematic determination of the situation of FM applications in hospitals, a corresponding survey framework was developed in advance. This includes all FM areas according to the service allocation model LemoS (Gerber, 2016) in Figure 2 and, if applicable, further sub-areas for the particular topic. The framework is illustrated in Appendix 2 and can be downloaded as an Excel file at */www.zhaw.ch/storage/lsfm/institute-zentren/ifm/healthcare/applikas-framework-eruierung-software.xlsx* for the operation of one's own business.

3.2. Scope of Service of Providers

A further aim was to provide an overview of which standard software applications cover parameters of non-medical subject areas. For this purpose online research was carried out on the basis of the framework mentioned above. In doing so, it was based solely on the statements made by the providers on their websites; customized solutions were not considered. The corresponding results are given in Appendix 3.

It is evident that some products are very specific to individual subtopics, while others have broad coverage of the subject areas. However, what cannot generally be judged is whether the individual functions can really supply the desired parameters and whether an integration would be possible.

3.3. Applied FM Applications in Hospitals - Current Situation

In accordance with the objective, the aim was to obtain an overview of which software applications are currently used by hospitals in the non-medical support area. For this, a survey in seven hospitals was conducted. With the framework mentioned above the applications mentioned were registered and consolidated. The results are summarized in Table 1.

Table 1: Information on non-medical applications

Number of software products per service group		Hospital A	Hospital B	Hospital C	Hospital D	Hospital E	Hospital F	Hospital G
Non-medical Support Services	Procurement	n/a	1	3	1	n/a	3	3
	Logistics	1	2	6	3	1	4	6
	Recyclable materials & Mediums	3	n/a	n/a	n/a	n/a	n/a	n/a
	Infrastructure	10	5	9	11	12	7	13
	Hygiene	1	n/a	2	1	1	2	2
	Safety & Security	2	1	3	3	n/a	3	5
	Hospitality	5	6	10	13	12	8	15
	Tactical resource management	n/a	n/a	1	n/a	n/a	n/a	n/a
Management Support Services	Finance & Controlling	1	1	5	4	4	4	5
	Personnel / HRM	2	5	10	7	10	4	9

	Law	n/a	1	n/a	n/a	n/a	n/a	n/a
	Marketing & Communications	1	3	5	4	n/a	5	9
	Administration	n/a	n/a	n/a	1	n/a	n/a	n/a
	IT	n/a	n/a	3	2	n/a	2	2
Strategic Management Services	Sustainability	1	n/a	n/a	1	n/a	n/a	n/a
	Quality management	n/a	2	3	1	n/a	1	1
	Risk management	n/a	n/a	1	n/a	n/a	n/a	n/a
	Identity	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Resource / sourcing strategy	n/a	1	n/a	n/a	n/a	n/a	n/a
	Asset / portfolio management	n/a	n/a	4	n/a	n/a	2	n/a
	IT-strategy	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Project Management	Project management	1	n/a	1	1	n/a	n/a	2

It becomes apparent that several applications are in use for quality management, asset/portfolio management and project management, personnel, finance/controlling and marketing/communication and for infrastructure, hospitality management, logistics and safety/security, however little or none are used for the other areas, whereby it should be noted that in almost 40% of the disciplines no clear statement was made as to whether an application is currently being used or not (cf. also Gerber & Perschel, 2016).

The detailed results of the survey can be found in Gerber & Perschel (2016).

3.4. Conclusion

On the basis of the research and the interviews carried out, the following conclusions can be drawn:

- Currently, a large number of different software applications are used in the area of non-medical support services, which are poorly or not at all matched with the IT architecture.
- With the present documentation (including the additional parts of KenkaS, Gerber et al., 2016c, PromoS, Gerber et al., 2016b, RemoS, Gerber & Hofer, 2016) and the framework which has been developed, a foundation has been established with which the connections within the non-medical support services in hospitals is made more visible and by reducing the complexity for the responsible people in FM and IT in HC, it becomes more manageable.
- Nevertheless, the market for software in HC is very broad and the hospital landscape is very heterogeneous. At present, no generalized statement can be made about the suitability of individual products. Instead, the combination of existing software architecture must be individually recorded and assessed per facility.
- The present results with regard to CAFM providers give clarity regarding the development of products according to the conceptual basis.
- Hospitals tend to use only a small portion of the range of services provided by the CAFM applications, so the degree of exploitation of the functions available is generally speaking rather small.
- It has become clear that the current situation concerning the software applications and the location in the hospital software architecture must be given more attention and dialogue with the stakeholders must be initiated.

3.5. Outlook

With regard to the use of FM in HC applications, the hospitals should now assess their current situation using the framework in Appendix 2, and determine gaps and/or uncertainties. After implementing the KPIs defined in KenkaS (Gerber et al., 2016c), it is recommended that in the appropriate (benchmarking) forums the suitability of the software products be discussed and together with the IT managers, the orchestration and integration possibilities should be addressed. Regarding to the approach to the integration of applications on the basis of existing procedure models in other industries and/or in the medical context, solutions are being developed in a separate project, which will likely be available to hospitals from 2018 onwards.

References

Czap, H. (2015). Krankenhausinformationssystem/Klinisches Arbeitsplatzsystem. from http://www.enzyklopaedie-der-wirtschaftsinformatik.de/lexikon/informationssysteme/Sektorspezifische-Anwendungssysteme/Gesundheitswesen--Anwendungssysteme-im/Krankenhausinformationssystem/index.html/?searchterm=HIS

Ebel, N. (2015). *Basiswissen ITIL 2011 Edition - Grundlagen und Know-how für das IT Service Management und die ITIL-Foundation-Prüfung*. Heidelberg: dpunkt.

Fenner, J. (kein Datum). Enterprise application integration techniques. Retrieved from: http://www-flare.cs.ucl.ac.uk/staff/W.Emmerich/lectures/3C05-02-03/aswe21-essay.pdf

Gansert, U. A. (2009). IT als Unterstützungsinstrument des Prozessmanagements in Krankenhäusern. In I. Behrendt, H.-J. König, & U. Krystek (Eds.), *Zukunftsorientierter Wandel im Krankenhausmanagement: Outsourcing, IT-Nutzenpotenziale, Kooperationsformen, Changemanagement* (pp. 233-265). Berlin, Heidelberg: Springer Berlin Heidelberg.

GEFMA 400. (2013). Computer Aided Facility Management CAFM - Begriffsbestimmungen, Leistungsmerkmale: GEFMA e.V. Deutscher Verband für Facility Management.

Gerber, N. (2016). LemoS 3.0 – Leistungszuordnungsmodell für nicht-medizinische Supportleistungen in Hospitals angepasst an neue Erkenntnisse. *Working Paper*. Retrieved from: https://www.zhaw.ch/storage/lsfm/forschung/ifm/09-working-paper-lemos-3.0-deutsch-geri.pdf

Gerber, N., & Läuppi, V. (2015). *Leistungskatalog für nicht-medizinische Supportleistungen in Hospitals LekaS - SN EN 15221-4 branchenspezifisch angepasst, erweitert und kommentiert* Retrieved from www.zhaw.ch/ifm/fm-healthcare/lekas

Gerber, N., & Hofer, S. (2016). *RemoS - Referenzmodell für nicht-medizinische Supportleistungen in Hospitals*. Wädenswil: ZHAW Institut für Facility Management.

Gerber, N., & Perschel, W. (2016). Aus neuen Erkenntnissen folgen neue Herausforderungen - Digital Support in nicht-medizinischen Bereichen im Hospital. *Clinicum, 3*(16), 98-99. Retrieved from: http://clinicum.ch/images/getFile?t=ausgabe_artikel&f=dokument&id=1311

Gerber, N., Tschümperlin, C., & Hofer, S. (2016b). *PromoS - Prozessmodell für nicht-medizinische Supportleistungen in Hospitals.* Wädenswil: ZHAW Institut für Facility Management.

Gerber, N., Tschümperlin, C., Mohd-Noor, N., & Hofer, S. (2016d). *Towards Enterprise Application Integration Principles for Facility Management Software in Hospitals.* Paper presented at the IFMA World Workplace, San Diego.

Gerber, N., Tschümperlin, C., Wattenhofer, D., & Hofer, S. (2016c). *KenkaS – Kennzahlenkatalog für nicht-medizinische Supportleistungen in Hospitals – inkl. KenmoS – Kennzahlenmodell für nicht-medizinische Supportleistungen in Hospitals*. Wädenswil: ZHAW Institut für Facility Management.

Gräber, S., Ammenwerth, E., Brigl, B., Grosse, A., Häber, A., Jostes, C. & Winter, A. (ohne Datum). *Rahmenkonzepte für das Informationsmanagement in Krankenhäusern: ein Leitfaden.* (kein Ort).

Gronau, N. (2014). *Enterprise Resource Planning - Architektur, Funktionen und Management von ERP-Systemen*. München: De Gruyter Oldenbourg.

Hanhart, D. (2008). *Mobile Computing und RFID im Facility Management - Anwendungen, Nutzen und serviceorientierter Architekturvorschlag*. Heidelberg: Springer.

Jobst, F. (2010). IT zur Prozessgestaltung im Krankenhaus – Wie bekommt man die optimale Kombination von IT-Anwendungen? In H. Schlegel (Ed.), *Steuerung der IT im Klinikmanagement: Methoden und Verfahren* (pp. 225-251). Wiesbaden: Vieweg+Teubner.

Johannesson, P., & Perjons, E. (2001). Design principles for process modelling in enterprise application integration. *Information Systems, 26*(3), 165-184. doi: http://dx.doi.org/10.1016/S0306-4379(01)00015-1

Kalyani, K. (2012). Recent trends and challenges in enterprise application integration. *International Journal of Application or Innovation in Engineering & Management, 1*(4), 62-71.

Khoumbati, K., & Themistocleous, M. (2006). Integrating the IT infrastructures in healthcare organisations: a proposition of influential factors. *The Electronic Journal of e-Government, 4*(1), 1-48.

Khoumbati, K., & Themistocleous, M. (2007). Application of fuzzy simulation for the evaluation of enterprise application integration in healthcare organisations. *Transforming Government: People, Process and Policy, 1*(3), 230-241. doi: doi:10.1108/17506160710778077

Khoumbati, K., Themistocleous, M., & Irani, Z. (2005). *Integration technology adoption in healthcare organisations: A case for enterprise application integration.* Paper presented at the 38th International Conference on Systems Sciences, Hawaii.

Khoumbati, K., Themistocleous, M., & Irani, Z. (2006). Evaluating the adoption of enterprise application integration in health-care organisations. *Journal of Management Information Systems, 22*(4), 69-108.

Khoumbati, K., Themistocleous, M., Irani, Z., & Mantzana, V. (2008). Information systems and healthcare XXIV: factors affecting the EAI adoption in the healthcare sector. *Communications of the Association for Information Systems, 22*(5).

Klesse, M., Wortmann, F., & Schelp, J. (2005). Success factors for application integration. *Wirtschaftsinformatik, 47*(4), 259-267. doi: 10.1007/bf03254913

Köbler, F., Fähling, J., Krcmar, H., & Leimeister, J. M. (2010). IT-Governance und IT-Entscheidertypen in deutschen Krankenhäusern. Eine empirische Untersuchung unter Krankenhaus IT-Leitern. *Wirtschaftsinformatik, 52*(6), 353-365. doi: 10.1007/s11576-010-0248-9

Kurbel, K. (2014). Software. *Enzyklopädie der Wirtschaftsinformatik*. Retrieved from: http://www.enzyklopaedie-der-wirtschaftsinformatik.de/lexikon/technologien-methoden/Software/software/?searchterm=software

Mantzana, V., & Themistocleous, M. (2004). Identifying and classifying benefits of integrated healthcare systems using an actor-oriented approach. *Journal of Computing and Information Technology, 12*(4), 265-278.

Mantzana, V., & Themistocleous, M. (2006). *Benefits and barriers related to EAI adoption: the case of a healthcare organisation.* Paper presented at the European Conference on Information Systems (ECIS), Regensburg.

Marx Gómez, J. C. (kein Datum). Serviceorientierte Architektur. *Enzyklopädie für Wirtschaftsinformatik*. Retrieved from: http://www.enzyklopaedie-der-wirtschaftsinformatik.de/wi-enzyklopaedie/lexikon/is-management/Systementwicklung/Softwarearchitektur/Architekturparadigmen/Service orientierte-Architektur/index.html/?searchterm=soa

May, M. (2013). *CAFM-Handbuch - IT im Facility Management erfolgreich einsetzen* (3., neu bearb. Aufl. ed.). Berlin: Springer Vieweg.

Möller, Ch., Moser, A. & Gerber, N. (2017*). Assessment-, Simulations- und Benchmarking-Tool für das Facility Management im Gesundheitswesen.* Wädenswil: ZHAW Institut für Facility Management [in Publikation].

Moturi, C. A., Kino, G. G., & Kahonge, A. M. (2013). Process model for enterprise application integration: case for a customs department. *International Journal of Applied Information Systems (IJAIS), 6*(2), 1-16.

Nävy, J. (2006). *Facility Management - Grundlagen Computerunterstützung Systemeinführung Anwendungsbeispiele* (4. aktualisierte und ergänzte Auflage ed.). Berlin: Springer.

Rasche, C., Margaria, T., & von Reinersdorff, A. B. (2010). Value delivery through IT-based healthcare architectures. In M. Stephan, W. Kerber, T. Kessler, & M. Lingenfelder (Eds.), *25 Jahre ressourcen- und kompetenzorientierte Forschung: Der kompetenzbasierte Ansatz auf dem Weg zum Schlüsselparadigma in der Managementforschung* (pp. 417-443). Wiesbaden: Gabler Verlag.

Schlegel, H. & Fischer, M. (2010). Einführender Überblick. In H. Schlege (Eds.). *Steuerung der IT im Klinikmanagement Methoden und Verfahren.* Wiesbaden: Vieweg + Teubner.

Seidel, C. (2010). Strategisches Informationsmanagement. In H. Schlegel (Ed.), *Steuerung der IT im Klinikmanagement Methoden und Verfahren*. Wiesbaden: Vieweg + Teubner.

Siegenthaler, A., & Schwinn, A. (2006). Modellierung von Integrationsaspekten in Applikationslandschaften. In J. Schelp & R. Winter (Eds.), *Integrations-management: Planung, Bewertung und Steuerung von Applikationslandschaften* (pp. 203-230). Berlin, Heidelberg: Springer Berlin Heidelberg.

Simoneit, M. (1998). *Informationsmanagement in Universitätsklinika. Konzeption und Implementierung eines objektorientierten Referenzmodells*. Wiesbaden: Springer Fachmedien.

Soomro, T. R., & Awan, A. H. (2012). Challenges and Future of Enterprise Application Integration. *International Journal of Computer Applications, 42*(7), 42-45.

Themistocleous, M., & Irani, Z. (2002). *Towards a novel framework for the assessment of enterprise application integration packages.* Paper presented at the 36th Hawaii International Conference on System Sciences, Hawaii.

Themistocleous, M., & Irani, Z. (2006). *Towards a methodology for the development of integrated IT infrastructures.* Paper presented at the 39th Hawaii International Conference on System Sciences, Hawaii.

Vaishnavi, V. K., & Kuechler, W. (2008). *Design science research methods and patterns - innovating information and communication technology*. Boca Raton, Fla.: Auerbach Publications c/o Taylor and Francis.

Wei, N. (2015). Research on an information application integration platform based on SOA and web service. *International Journal of Multimedia and Ubiquitous Engineering, 10*(12), 165-174.

Winter, A., Ammenwerth, E., Brigl, B., & Haux, R. (2006). Grundlagen von Informations- und Kommunikationstechnologien im Krankenhaus. In B. Herbig & E. Ammenwerth (Eds.), *Informations- und Kommunikationstechnologien im Krankenhaus - Grundlage, Umsetzung, Chancen und Risiken*. Stuttgart: Schattauer.

Weigele, Ch., Imark, P., Fitterer & Gerber, N. (2017). *LesapS - Leitfaden zum Einsatz von SAP für das Facility Management in Healthcare*. Wädenswil: ZHAW Institut für Facility Management [in Publikation].

Appendix 1 – CAFM Functionalities according to GEFMA400-2013-03 and May (2013)

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Space management	(1) Documentation and updating of the space data (2) Needs assessment and qualification of the demand for space (3) Creation and updating of occupancy situations (4) Planning and organisation of the realisation of occupancy and furnishing concepts GEFMA, 2013, p. 3 (1) Space structure analysis (2) Space analysis (space, time and space) (3) Space planning (size, geometry, arrangement) (4) Space utilisation analysis (5) Space utilisation optimisation (variant formation -rating) (6) Internal space cost allocation (7) Rental space management (tenants, leases, incidental costs by rental space) (8) Determination of specific space requirements *translated from May, 2013, p. 48*	(1) Graphical and / or alphanumeric administration of space data (2) Identification of unoccupied space (3) Graphical navigation in floor plans *GEFMA, 2013, p. 3* There is great potential in CAFM for the rapid and user-specific evaluations of the data in the form of graphical and alphanumeric screen representations and formatted reports, in particular by the linking of database and ground plans with graphically oriented systems. *translated from May, 2013, p. 48*	(1) Collection and storage of object data and object description data: (1.1) Basic data (location, property, building, floor, room, room zone and its dependencies and assignments like properties at the location, room to the floor) (1.2) Predefined attributes to the basic data, such as the space type and usage (1.3) Additional user-specific attributes and criteria such as office materials, IT equipment, workstations in rooms or room zones (2) Assignment of space data to data from other modules of the CAFM software (2.1) Employees as users of workspaces to rooms, room zones or workplaces (2.2) Organisation units for rooms, room zones or workplaces (2.3) Cost centres for rooms or room zones, provided that allocation is not made via the assigned employees or the assigned organisational units (2.4) Inventory of rooms, room zones or equipment (2.5) Services on spaces *translated from May, 2013, p. 48*	(1) Overview of vacant spaces (2) Space evaluation according to DIN 277 (3) Space distributors of the users (4) etc. (5) Space allocation according to user-specific criteria (6) Space-related cost allocations by organisational unit (7) Development of space-related tender documents For the support of real estate portfolio management, property bonds with a linkage of key figures are also important for the monitoring of global portfolios. *translated from GEFMA, 2013, p. 4*	(1) CAD software (2) GIS software (3) Internet applications for navigation (4) Software for real estate valuation (5) Software for property, asset and portfolio management *translated from GEMFA, 2013, p. 4*

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Inventory management	(1) Determination of requirements for inventory objects (2) Procurement and inventory management (3) Movement of inventory objects (4) Documentation of the stock *translated from GEFMA, 2013, p. 4*	(1) Set up inventory objects with specific attributes (2) Allocation of inventory to cost centres, organisational units, rooms (3) Debiting / reversal of inventory objects (4) Link to inquiries and orders (5) Unambiguous labelling and identification of inventory (6) Carrying out inventory with barcode / RFID technology *translated from GEFMA, 2013, p. 4*	(1) Inventory number (2) Inventory type (3) Manufacturer (4) etc. *translated from GEFMA, 2013, p. 4*	(1) Inventory list with target / actual adjustment (2) etc. *translated from GEFMA, 2013, p. 4*	(1) Software for asset accounting makes sense for system integration. *translated from GEFMA, 2013, p. 4*

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Room reservation	(1) Reservation and booking of meeting / conference / meeting areas (2) Provision of additional services, e.g. catering and media technology (3) Provision of spaces and additional services *translated from GEFMA, 2013, p. 4*	(1) Search and reservation of rooms according to different criteria (2) Reservation of rooms with certain parameters (3) Reservation of rooms for periodically recurring periods (4) Retrieving room descriptions (5) Selection of additional services and link to the booking (6) Figure of cancellations (7) Settlement of user charges *translated from GEFMA, 2013, p. 4*	(1) Size of the spaces (2) Type of seating (3) Bookable media technology (4) Equipment features of the spaces (5) Goods baskets *translated from GEFMA, 2013, p. 4*	(1) List of vacant spaces for the period requested (2) Reservation confirmation (3) Utilisation of bookable space *translated from GEFMA, 2013, p. 4/5*	(1) Calendar software (2) Software of catering (3) Event software (4) etc. *translated from GEFMA, 2013, p. 5*

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Cleaning management	(1) Needs assessment, tendering, contracting, execution and billing of cleaning services (2) Quality assurance of cleaning services *translated from GEFMA, 2013, p. 5* (1) Invitation to tender for continuous cleaning services (2) Invitation to tender for special contracts (3) Accurate, exact settlement of the cleaning services (4) Adaptation of the cleaning concepts via the planning games (5) Planning of material and personnel use (6) Performance of quality management, cleaning control *translated from May, 2013, p. 51*	(1) Different intervals and quality standards must be assigned to the spaces (2) For the spaces, different activity categories must be defined (3) Linking with the order processing of planned and unplanned activities must be possible (4) Summary of cleaning space for lots and positions for tenders (5) Evaluation of finished work (6) Quality monitoring by the figure of application procedures *translated from GEFMA, 2013, p. 5*	(1) Cleaning class / categories (2) Unit prices (3) Course positions (4) etc. *translated from GEFMA, 2013, p. 5* Based on the (1) Space data (2) Object-describing features of the rooms or room zones (3) Window and glass surfaces belonging to the room (4) Link between space and space-related service level (type and times, cycle) the actual cleaning services in quality and quantity can be shown. *translated from May, 2013, p. 51*	(1) Quantity framework for invitations to tender (2) Request form (3) Cleaning plans, district plans (4) Space overview by priorities (5) Cleaning evidence *translated from GEFMA, 2013, p. 5* After matching the recorded data with the CAFM system, the corresponding reporting is generated there. *translated from May, 2013, p. 52*	(1) AVA software (2) Quality assurance software *translated from GEFMA, 2013, p. 5*

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Relocation management	(1) Determination of available open spaces (2) Creation of furniture and relocation variants The relocation itself includes the preparation and implementation as well as documentation of changes in the respective location of (3) Selected single inventory (4) Individual or multiple workstations and their equipment, as well as entire organisational units, e.g. departments *translated from GEFMA, 2013, p. 5*	(1) Creation of furniture and relocation variants (2) Takeover of a target plan variant as an actual value (3) Creation of labels for the identification of the relocation equipment (4) Incoming / outgoing goods booking (also for scrapping) *translated from GEFMA, 2013, p. 5* The relocation planning can take place either graphically via a CAD editor, or by moving objects or object groups in the alphanumeric display. Modern CAFM software also has the possibility to map different planning variants in parallel and to contribute significantly to the optimal decision-making. The graphic support, possibly even with 3D representation, can considerably increase the acceptance of relocations among the employees and decision-makers involved. *translated from May, 2013, p. 52*	(1) Movement from - to (2) Inventory number, inventory type, number (3) Estimated costs (4) Necessary partial services (5) etc. *translated from GEFMA, 2013, p. 5* With the inclusion of the inventory data, the essential prerequisites for the use of CAFM for internal and external relocations are given. *translated from May, 2013, p. 52*	(1) Relocation lists for haulers (2) Door signs (3) Label that indicates the destination to identify the moving inventory (4) Updated floor plan and establishment plans (target state as the new actual state) (5) Work contracts (external / internal) to develop the technical infrastructure (6) Cost allocations (7) List expressions for the adjustment of the access rights *translated from GEFMA, 2013, p. 5* The following information is required for relocation: (1) Label indicating the place of destination for the identification of the inventory (2) Updated ground plan layout plans (target state as new actual state) (3) List expressions for forwarding agents (4) Lists or work plans for the development of the technical infrastructure (5) Prints for door signs (6) Printed key lists *translated from May, 2013, p. 53*	(1) Mobile applications for inventory *translated from GEFMA, 2013, p. 5*

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Energy controlling / energy management	(1) Recording and monitoring of media consumption (2) Optimisation of media consumption by optimizing the system and / or influencing user behaviour (3) Optimisation of the supply contracts *translated from GEFMA, 2013, p. 6*	(1) Figure of counter structures including counter change (2) Meter Reading (3) Allocation of consumers to meters (4) Weather adjustment of consumption values (degree day numbers) (5) Warning in case of irregularities in the supply of media (6) Description of consumption (7) Formation of key figures (8) Linkage of consumptions with unit rates and costs *translated from GEFMA, 2013, p. 6* The goal is the maximum transparency regarding consumption and costs. This is ensured by manual or automatic recording. *translated from May, 2013, p. 54*	(1) Meter number, meter type (2) Medium, consumption per unit (3) Calibration period (4) etc. *translated from GEFMA, 2013, p. 6* The following tasks are relevant in the area of recording and analysis: (1) Detection of all available counters (2) Administration & compliance of calibration periods (3) Meter reading and plausibility check (4) Deposit of calculation structures for the allocation of consumption (5) Deposit of weather data to the weather adjustment (6) Periodic comparison of consumption for the detection of technical irregularities *translated from May, 2013, p. 54*	(1) Time-based consumption overview (2) Consumption diagrams with set point and actual value curves (3) Emission overview (CO2) (4) Presentation of key figures *translated from GEFMA, 2013, p. 6* General evaluations refer to the development of consumption, in particular with the aim of the timely detection of irregularities. The data serves as both the basis for code calculations and for benchmarking by means of the space reference within a CAFM software and the associated possibility of assignment to users or user groups. *translated from May, 2013, p. 55*	(1) Detection systems for the mass import of meter readings (2) GLT systems and remote reading technologies (cam, radio, voice) and transmission via import interfaces (3) Power management software for the creation of energy concepts, energy balances, energy credentials, energy flow diagrams (Sankey diagrams), design, simulation and optimisation calculations, benchmarking, measurement of physical variables, utilisation analyses, energy flow diagrams. *translated from GEFMA, 2013, p. 6*

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Maintenance management	(1) Def. & consideration of the maintenance strategy. (2) Needs assessment, planning, procurement, implementation, control, documentation and billing of maintenance measures. (3) Receipt of disruptions and qualification by means of a concrete assignment of the structural or technical aspects concerned. (4) Monitoring of the fault rectification, taking into account defined priorities. (5) Preparation of planned / unplanned work orders and tracking of realisation with deadline and cost control as well as reminder function. (6) Autom. generation of work orders from reported faults and cycl. (e.g. regular maintenance) and reconciliation with existing service contracts *translated from GEFMA, 2013, p. 6* (1) Central detection of faults by a concrete assignment of the affected plant to be maintained. (2) Visual. processing requests, reported inquiries and their billing. (3) Personnel work lists and tasks. (4) Illustration of cyclic measures and their assignment to persons or companies in a user interface *translated from May, 2013, p. 56*	(1) Assignment of technical facilities to constructional objects, spaces, trades, contracts (2) Figure of hierarchical levels of the plant components (3) Definition of availability categories (4) Storage of maintenance plans with prioritisation of tasks and assignment to internal / external persons (5) Deposit of work instructions (6) Generation of customer-specific work orders (7) Status tracking of tasks and orders (8) Tracking of deadlines (warranty, maintenance, work orders) (9) Figure of the maintenance strategy (10) Resource planning of internal / external employees *translated from GEFMA, 2013, p. 6*	(1) Type of activity, interval, start, end (2) Responsible employee / role (3) Order number, status (4) Estimation costs (5) Activity catalogues by import of standards and directives (6) Performance lists (7) Priority determinations and standard intervals for planned measures (8) Criteria for the evaluation of planned and non-scheduled work (9) Objects of the inventory documentation (structural and technical equipment, inventory) (10) Company catalogues with manufacturers, suppliers and service companies (11) Cost centre to be charged *translated from GEFMA, 2013, p. 7* (1) Maintenance facilities (2) Work divided into main tasks and subordinate tasks (3) Personal data and company data of agents or suppliers (4) Action plans (5) Contract formalities (6) Logistics spaces for materials and tools (7) Time recording *translated from May, 2013, p. 56*	(1) Maintenance and test reports with status (2) List of safety-related and testable installations (3) Cost overview for a period and investment (4) Retrieval system data sheets (5) Plant history (6) Pending and completed work orders for work preparation and controlling (7) Monitoring of costs related to the investment (8) Statistical evaluations according to user-specific benchmarking (9) Availability of facilities, statistics on incidents and downtime, including the cost impact (10) Utilisation of the equipment with space statistics or operating hours among other things *translated from GEFMA, 2013, p. 7*	(1) ERP systems (2) Testing equipment (3) AVA software *translated from GEFMA, 2013, p. 7*

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Contract management	(1) Digital archiving of contracts (2) Monitoring of contract periods (3) Termination, cancellation, extension of contracts *translated from GEFMA, 2013, p. 8*	(1) Create master data for contracts (2) Linking to scanned contracts (3) Deposit of reminder functions at time limits (4) Linking contracts with investments, objects, cost centres (5) Filing of accounting rules (6) Figure of Service Level Agreements *translated from GEFMA, 2013, p. 8*	(1) Contract number, contract type (2) Beginning and end of term, cancellation period (3) etc. *translated from* GEFMA, 2013, p. 8 In the CAFM important key data of the concluded contracts such as (1) Performance (2) Term of the Agreement (3) Termination dates and renewal options (4) Addresses of contract partners (5) Location and distributor of the contract and ensures the observance of deadlines by means of automatic reminder and information functions. *translated from May, 2013, p. 50*	(1) Overview of contract periods (2) Overview of obligations under contracts (3) etc. *translated from GEFMA, 2013, p. 8*	(1) Document management systems *translated from GEFMA, 2013, p. 8*

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Rent management /Letting	(1) Rental and letting of spaces (2) Letting of spaces including sub-letting *translated from GEFMA, 2013, p. 8*	(1) Creation of lease agreements including conditions (2) Assignment of leases to rental units and lettings (3) Filing of adjustment procedures (4) Deposit of option rates (5) Calculation of the provision of rental and ancillary costs (6) Tracking of deadlines with reminder function *translated from GEFMA, 2013, p. 8* In addition to the alphanumeric data, the graphical ones are also useful here, such as floor plans with room stamps, the location of the spaces in the building or also picture material for the overall object and the interior spaces. *translated from May, 2013, p. 58*	(1) Types of contracts (2) Contract data (3) Accounting rules *translated from GEFMA, 2013, p. 8* (1) General information about the tenant (2) Term of the contract, notice periods, options (3) The exact allocation of rooms and open spaces (4) Access information (5) The storage of the contract history (6) The contract document in digital form *translated from May, 2013, p. 59*	(1) Contracts with status (2) Obtaining rental space according to specific criteria (3) Overview of the leasing status of a building / storey (4) Overview and forecast of revenues from a lease (5) Forms such as e.g. letter of dismissal (6) Rental invoice *translated from GEFMA, 2013, p. 8* The space data required for leasing can be determined from the space management. These data need not necessarily coincide with those from land management because they depend on the agreements in the lease agreements. *translated from May, 2013, p. 58*	(1) ERP system of bookkeeping (transfer debit position for prepayment of rental and incidental costs) *translated from GEFMA, 2013, p. 8*

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Utility billing / operating cost management	(1) Recording the actual costs (2) Allocation of costs (3) Charging of cost centres or debtors *translated from GEFMA, 2013, p. 9*	(1) Transfer of the actual costs (2) Distribution of the actual costs according to the deposit key stored on cost centres / accounts receivable (3) Calculation of the difference to advance payments (4) Creation of internal activity allocation or annual settlement *translated from GEFMA, 2013, p. 9*	(1) Cost categories, costs (2) Allocation formula (3) Cost centres, accounts receivable (4) etc. *translated from GEFMA, 2013, p. 9*	(1) Annual statement *translated from GEFMA, 2013, p. 9* In addition to predefined evaluations, e.g. (1) Annual or monthly detailed operating cost accounting per user or tenant (2) Building accounting with representation of non-convertible shares (3) Annual balance sheet for an entire property individual searches of a wide variety of kinds must be possible, which aim at the tracking of irregularities and the initiation of corresponding management measures within the scope of the created cost transparency. *translated from May, 2013, p. 59*	(1) ERP system of bookkeeping (transfer of actual costs and transfer of debit position for annual accounts) *translated from GEFMA, 2013, p. 9*

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Controlling	(1) Budget planning (2) Cost control (target-actual, forecasts) (3) Derivation and initiation of control measures *translated from GEFMA, 2013, p. 9*	(1) Create budget types and partial budgets (2) Deposit of individual measures with estimated costs (3) Allocation of the actual costs to the budgets (4) Comparison of actual and target values (5) Figure of forecasts (6) Formation of key figures (7) Preparation of reports *translated from GEFMA, 2013, p. 9* Such a business warehouse system or MIS (Management Information System) is able to visualize predefined management numbers at the push of a button. *translated from May, 2013, p. 62/63*	(1) Budget type, budget number, period (2) Estimated costs, target values, actual costs (3) Cost categories, cost centres (4) etc. *translated from GEFMA, 2013, p. 9*	(1) Management cockpit, dashboard (2) Target-actual match with forecast (3) Cost over several years (4) Space key figures (5) Cost key figures (6) Complaint frequency *translated from GEFMA, 2013, p. 9* The focus here is on target-actual comparisons, which enable the controls to be controlled in all essential service spaces by continuously analysing the development progress. *translated from May, 2013, p. 60* In the end, the controlling has to provide statements on the following aspects: (1) Implementation of strategic company objectives in relation to the resource real estate, (2) Cost structure and development caused by the property (3) Provision of the quality of service necessary for the fulfilment of the core business. *translated from May, 2013, p. 61*	(1) ERP system of accounting (transfer of planned values from the budget planning of the CAFM software to the ERP database and transfer of actual costs to the CAFM database) *translated from GEFMA, 2013, p. 9* Software-integrated systems for dynamic data analysis are useful here. The data are obtained, inter alia, from commercial IT systems (ERP), customer relationship systems (CRM) and other management systems. *translated from May, 2013, p. 62*

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Security and occupational safety	(1) Preparation of hazard assessments (2) Execution of instructions and training *translated from GEFMA, 2013, p. 9*	(1) Registration and identification of safety-relevant objects (2) Allocation of hazard groups (3) Leadership of digital federation and instructional books (4) Assignment of protective measures to objects (5) Filing of risk assessments (6) Figure of specific processes of safety and occupational safety *translated from GEFMA, 2013, p. 9/10*	(1) Employees, proficiency of the employee (2) Installations / spaces and category hazard assessment *translated from GEFMA, 2013, p. 10*	(1) Fire fighting plan and rescue route plans (2) Rescue route description (3) Overview of compliance with legal requirements (4) Risk matrix *translated from GEFMA, 2013, p. 10*	

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Environmental protection	(1) Collection and monitoring of waste quantities and emissions (2) Reduction of waste and CO2 emissions *translated from GEFMA, 2013, p. 10*	(1) Recording of emission values (2) Detection of type and quantity of waste generated (3) Collection of discharges into water bodies *translated from GEFMA, 2013, p.10*	(1) Type, quantity (2) Reference period (3) etc. *translated from GEFMA, 2013, p. 10*	(1) Evidence of the disposed waste according to the Waste Control Ordinance (2) Preparation accompanying materials for the material declaration for disposal (3) Generation of environmental key figures and comparison of different objects (4) Waste balance (5) Generation of waste key figures *translated from GEFMA, 2013, p. 10*	(1) Central waste management software from authorities *translated from GEFMA, 2013, p. 10*

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Help desk	The recording and reporting of faults can be carried out by means of a screen mask in the company's intranet or via the Internet. This makes it possible for the notifying person to monitor the work situation without additional telephone or verbal questions. *translated from May, 2013, p. 63*	In escalation scenarios, messages can be forwarded automatically to the responsible persons via email or SMS. *translated from May, 2013, p. 63* If necessary, the IT-based helpdesk can have a billing component. Which user should use which type of helpdesk should be pre-configurable via the user management of the CAFM software. *translated from May, 2013, p. 64*			In large or technically sophisticated buildings, a connection to building automation systems makes sense. *translated from May, 2013, p. 63*

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Sustainability management		(1) Energy control (1.1) Meter Reading (1.2) Figure of complex counter structures (1.3) Assignment of meters to consumers (1.4) Presentation of time-based consumption overviews (2) Safety and health and safety at work (2.1) Capture of safety-relevant objects (2.2) Assignment of protective measures to objects (2.3) Presentation of potential hazards at workplaces (2.4) Issue of rescue plans and signs (3) Environmental management (3.1) Recording of emission values (3.2) Evidence of waste disposal (3.3) Formation of environmental key figures *translated from May, 2013, p. 65/66*		FM sustainability key figures Fig. 4.13 *translated from May, 2013, p. 66* CAFM mainly supplies documents for the sustainability management of buildings and facilities at no additional costs, provided that regular maintenance of its master data is ensured. *translated from May, 2013, p. 67*	

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Further applications	(1) Event, canteen and fleet management (2) Visitor management (3) Conference room management (4) Service desk (5) Portfolio management *translated from May, 2013, p. 67/68*				

Field	Supported sub-processes / process steps	Functionalities	Data and catalogues	Reports / evaluation	Interfaces
Service matrix of CAFM systems	Process support (1) Tenant ability (2) Figure (3) Active support (4) Compl. integration (5) Ext. service provider *translated from Der Facility Manager (Eds.), 2016, p. 19*	Visualisation: (1) Alphanumeric (2) Grid graphics (3) Import (4) Referencing (5) Own module (6) Program access (7) Database *translated from Der Facility Manager (Eds.), 2016, p. 19* Licenses (1) User-bound (2) Not user bound (3) Spaces / object (4) Hardware (5) Companies (6) "Light version" available (7) Free demo available *translated from Der Facility Manager (Eds.), 2016, p. 19*	General information (1) Technical (1.1) Communication, power supply, (1.2) Pipe systems / cables, (1.3) Energy, (1.4) Maintenance, (1.5) Operational documentation, (1.6) Storage management, (1.7) Deficiencies/history, (1.8) Warranty, (1.9) Monitoring, (1.10) provision of installations (2) Infrastructural (2.1) Space analysis, (2.2) Occupancy planning, (2.3) Cleaning spaces, (2.4) Maintenance / glass cleaning, (2.5) Winter services, (2.6) Disposal, (2.7) locking administration, (2.8) Object protection, (2.9) Escape routes, (2.10) Fire protection, (2.11) Reception service, (2.12) Parking space, (2.13) Room reservation, (2.14) Post office and logistics (3) Commercial (3.1) Property, (3.2) Property valuation, (3.3) Property management, (3.4) Property management, (3.5) Operating expenses, (3.6) Financial accounting, (3.7) Personnel accounting, (3.8) Fixed asset accounting (4) Superordinate (4.1) Project management, (4.2) Task management, (4.3) Budget management, (4.4) Document management, (4.5) AVA support, (4.6) Contract management, (4.7) Quality assurance, (4.8) Benchmarking, (4.9) Quality assurance, (4.8) Mobile computing, (4.10) Stock data collection *translated from Der Facility Manager (Eds.), 2016, p.18*	(1) Stand reports (2) Reports editable (3) Report generator (4) Historisation (5) Dashboards *translated from Der Facility Manager (Eds.), 2016, p.19*	

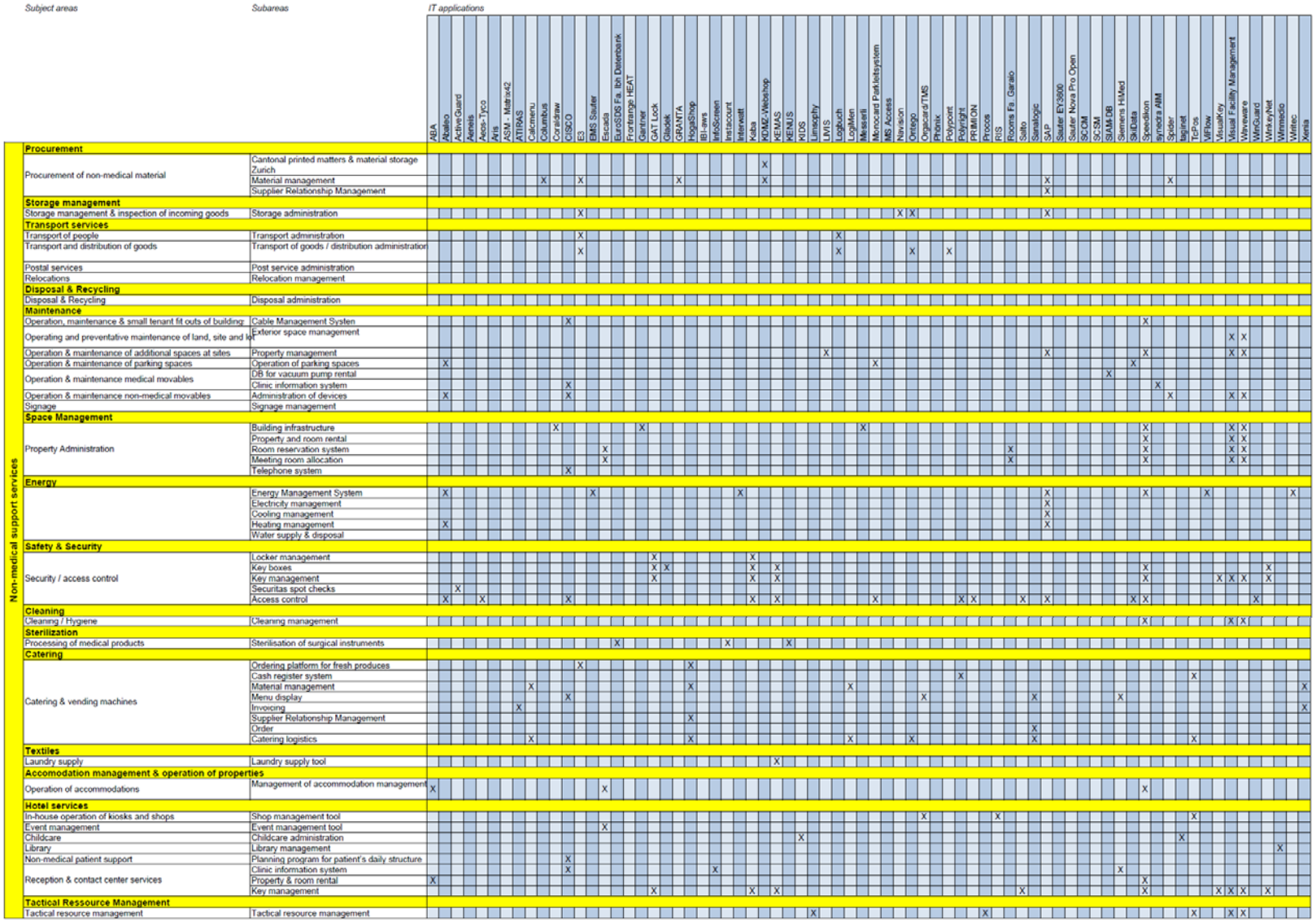
Appendix 2 – Framework for determination of the current situation concerning applications for FM in HC

Non-medical support services	
Subject area	*subarea*
Procurement / Storage management / Transport services & provision (logistics)	
Procurement of non-medical material	Cantonal printed matters & material storage Zurich
	Material management
	Supplier Relationship Management
Storage management & inspection of incoming goods	Storage administration
Transport of people	Transport administration
Transport and distribution of goods	Transport of goods / distribution administration
Postal services	Post service administration
Relocations	Relocation management
Disposal & Recycling	Disposal administration
Maintenance	
Operation, maintenance & small tenant fit outs of buildings & installations	Cable Management System
Operating and preventative maintenance of land, site and lot	Exterior space management
Operation & maintenance of additional spaces at sites	Property management
Operation & maintenance of parking spaces	Operation of parking spaces
Operation & maintenance medical movables	DB for vacuum pump rental
	Clinic information system
Operation & maintenance non-medical movables	Administration of devices
Signage	Signage management
Space Management	
Property Administration	Building infrastructure
	Property and room rental
	Room reservation system
	Meeting room allocation
	Telephone system
Energy	
	Energy Management System
	Electricity management
	Cooling management
	Heating management
	Water supply & disposal
Safety & security	
Security / access control	Locker management
	Key boxes
	Key management
	Securitas spot checks

	Access control
Cleaning	
Cleaning / Hygiene	Cleaning management
Sterilisation	
Processing of medical products	Sterilisation of surgical instruments
Hotel services (catering / textiles / accommodation management & operation of properties / hotel services div.)	
Catering & vending machines	Ordering platform for fresh produces
	Cash register system
	Material management
	Menu display
	Invoicing
	Supplier Relationship Management
	Order
	Catering logistics
Laundry supply	Laundry supply tool
Operation of accommodations	Management of accommodation management
In-house operation of kiosks and shops	Shop management tool
Event management	Event management tool
Childcare	Childcare administration
Library	Library management
Non-medical patient support	Planning program for patient's daily structure
Reception & contact center services	Clinic information system
	Property & room rental
	Key management
Tactical resource management	
Tactical resource management	Tactical resource management
Management support services	
Finance & controlling	
Finance & controlling	Settlement for letting and cash payments
	Construction system project
	Deposit for keys etc.
	Cash register system
Personnel / HRM	
Human Resource Management (HRM)	Active Directory
	eLearning platform
	Health management of employees
	Course management system
	Service recording / cost unit accounting
	Personnel deployment planning
	Key management & loan item system
	Time recording for doctors
Legal	
Legal counsel and contracts	Legal service tool

Marketing & communication	
Marketing & Communication	Chat & VOIP
	Intranet
	Email
	Medical exchange of information
	Menu display, room reservation overview, dashboards
	Online notification tool
	Telephone system
	VOIP
	Queue management like at Swiss post offices
Administraion	
Administration	Administration Services
ICT	
IT Hardware	System center: Service manager
IT Software	System center: Configuration manager
Strategic management services	
Sustainability	
Life cycle planning / life cycle engineering	Life cycle planning tool
Environmental protection	Environmental protection management
Energy management	Energy management tool
Quality management	
Definitions of norms & guidelines	Norm & guideline management
Process management	Process documentation
Risk management	
Definition of risk strategy	Risk management
Identity	
Innovation promotion	Innovation management
Resource /sourcing strategy	
Definition resource / sourcing strategy	Resource management
Asset-/portfolio management	
Investment, portfolio & multiproject management	Investment management
	Portfolio management
	Multi project management
Financing management	Financing management tool
IT Strategy	
Definition of IT strategy	IT strategy development tool
Project management	
Construction projects	Construction project system
Project management general	Project system

Appendix 3 – Listing research application supplier in the context of FM in HC-Frameworks based on LekaS



IT applications

	Subject areas	*subareas*	ABA	Adeon	Aeneis	Aris	ASM - Matrix42	BusPro	Casewise	Coraldraw	CISCO	EasyLearn	easySoft SMSpro	ELO	EMS Sauter	Escada	Frontrange HEAT	GAT Lock	GRANTA	Guidelines.ch	Health-Engine	IBI-aws	IBI-care	IBO	ID-Expert	InfoScreen	Interwatt	isHospital	KEMAS	KG-Archiv	KISIM	KMS	LIVIS	Messerli	Moodle	MS Access	MS AD	MS Project Server	Navision	Orbis	Outlook	Phönix	Polypoint	Polyright	PRIMION	Procos	Protel	PROVIS	QuadrixShare	Qmatic	Rehatis/Softsolution	Salto	SAP	Sauter Nova Pro Open	SCCM	SCSM	Siemens HiMed	Speedikon	Spider	Syrona	Tacs	tagInet	TcPos	UKA AMF	Vectorworks	ViFlow	WinGuard	WinkeyNet	Wintec	Xbound
Management support services	**Finance & controlling**																																																																					
	Finance & controlling	Settlement for letting and cash payments	X																																																																			
		Construction system project																																																							X												
		Deposit for keys etc.															X																																																	X		
		Cash register system																																									X																		X							
	Personnel / HRM																																																																					
	Human Resource Management (HRM)	Active Directory					X																												X						X																											
		eLearning platform									X																						X																																			
		Health management of employees																																																									X										
		Course management system										X																																																									
		Service recording / cost unit accounting																			X	X								X																			X									X									
		Personnel deployment planning																					X																X			X		X																X	X		X						
		Key management & loan item system															X										X																						X																		
		Time recording for doctors																												X									X			X																	X										
	Legal																																																																					
	Legal counsel and contracts	Legal service tool											X				X																																																			
	Marketing & communication																																																																					
	Marketing & Communication	Chat & VOIP								X																X																												X													
		Intranet								X																																																											
		Email								X																														X																X													
		Medical exchange of information								X														X																														X													
		Menu display, room reservation overview, dashboards								X														X																														X													
		Online notification tool																							X																														X													
		Telephone system								X																X																												X													
		VOIP								X																																													X													
		Queue management like at Swiss post offices								X																																						X																				
	Administration																																																																					
	Administration	Administration Services		X				X			X			X		X					X				X					X		X		X													X		X																					
	ICT																																																																					
	IT Hardware	System center: Service manager					X																																																X														
	IT Software	System center: Configuration manager				X	X				X						X					X											X	X		X						X													X															
Strategic management services	**Sustainability**																																																																					
	Life cycle planning / life cycle engineering	Life cycle planning tool																																																				X				X												
	Environmental protection	Environmental protection management																																																																				
	Energy management	Energy management tool													X												X																											X				X								X			X		
	Quality management																																																																					
	Definitions of norms & guidelines	Norm & guideline management																		X																																						X								X				
	Process management	Process documentation			X	X			X					X										X				X			X																						X													X				X
	Risk management																																																																					
	Definition of risk strategy	Risk management																																														X																		X	X			
	Identity																																																																					
	Innovation promotion	Innovation management																																																															X					
	Ressource / sourcing strategy																																																																					
	Definition resource / sourcing strategy	Resource management																																				X		X										X									X											
	Asset- / portfoliomanagement																																																																					
	Investment, portfolio & multiproject management	Investment management																																																																				
		Portfolio management																																				X																				X												
		Multi project management																						X																																														
	Financing management	Financing management tool																																																																				
	IT Strategy																																																																					
	Definition of IT strategy	IT strategy development tool																						X																						X							X						X								X				
PM	**Project management**																																																																					
	Construction projects	Construction project system								X																																														X												
	Project management general	Project system																																				X	X							X		X					X																	