Towards a Comprehensive Key Performance Indicators Reference Model for non-medical Support Services / Facility Management in Hospitals

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Abstract

In healthcare, so far few data have been processed in terms of controlling and benchmarking of non-medical support services and their costs. With the introduction of case-based rate systems and increasing cost pressure situations in the healthcare sector, the need for cost allocation controlling, key performance indicators (KPI), benchmarking and a well-founded basis for strategic decisions has grown rapidly in Facility Management (FM) in healthcare. In order to provide a holistic and practically oriented solution, it was necessary to assess the requirements of the different KPI specifications of the various non-medical support services in hospitals. On the conceptual basis of the Service Catalogue for non-medical Support Services in Hospitals, the development of a KPI model was conducted in iterative interview sessions with different subject matter experts for FM in hospitals. The result is the setup of a systematic metamodel as the basis for a comprehensive KPI Reference Model for non-medical Support Services / FM in Hospitals providing the basis not only for controlling and benchmarking steps, but also for the development of corresponding adjustments of account plans and cost center accounting, as well as for aligning IT architectures.

Keywords: Controlling, Facility Management, Healthcare, Key Performance Indicators, KPI-Model

Starting Position and State Of The Art

The definition of non-medical support services in hospitals are defined in detail in the Service Catalogue for non-medical Support Services in Hospitals by Gerber and Läuppi (2015). Figure 1 depicts the overall content. This definition was chosen the conceptual basis for the further development of the Key Performance Indicators Reference Model presented for non-medical Support Services in Hospitals.

Figure 1: Service Allocation Model for non-medical Support Services in Hospitals (LemoS), visualizing the content of the Service Catalogue for non-medical Support Services (LekaS)
Source: Gerber and Läuppi (2015, p. 7)

Non-medical support services are of great value in a hospital not only because they facilitate the core processes, but also because they account for up to 30 – 40% of the total costs in a hospital (Abel, 2009; Abel & Lennerts, 2006). Since the introduction of the case based rates (Diagnosis Related Groups / DRGs) in 2012 in Switzerland, the goal of which is, amongst other things, to increase the efficiency, transparency and process orientation and thus to reduce costs by using resources more economically (SwissDRG, n. d.), the non-medical support services also have to comply with the new economical expectations, as do the medical services (Thiex-Kreye, 2009). An effective way of controlling the operation is to implement and monitor key performance indicators (KPIs) (Marr, 2012; Thiex-Kreye, 2009; GEFMA 2012; Kronz, 2005). KPIs have been specifically dealt with for many years in several FM related contexts; branch specifically for example for the construction industry (Kagioglou et al., 2001), for the hotel business (Harris & Mongiello, 2001) or the sourcing branch (Baldwin et al., 2000) to name a few. In terms of general facilities and buildings, and their maintenance, several measuring and benchmarking aspects have been explored, for example with respect to building operating management (Mignola & Tery, 2006) or technical building performance (Augenbroe & Park, 2005; Cohen et al., 2001; Pati, et al., 2009; Albert, 1998; Kutucuoglu et al., 2001; Weber & Thomas, 2005; Wireman, 2005). Looking at specific facilities, research results regarding performance measurement can be found for example for school facilities (Henry, 2001; Mei-yung et al., 2005) or for governmental buildings (Cable & Davis, 2004; Nicola, 2006). Looking at general FM KPIs, Kelly et al. (2005), Kincaid (1994), Kinnaman (2007), Lavy et al. (2010) or Shohet and Lavy-Leibovich (2010) can be

mentioned – they do not, however, include aspects of specific industries or country regulations. In the healthcare context, KPIs have so far mostly been assessed via governmental controlling reports, covering predominantly medical data like number of treatment days, number of beds, case-mix index or doctors per discharges (Statistisches Bundesamt, 2014; H+, n. d.; Eidgenössisches Departement des Innern, 2014). In terms of healthcare facility management, Shohet (2006) has developed KPIs for strategic healthcare FM and Shohet and Lavy (2004) set up an integrated healthcare facilities management model both of which, however, focus primarily on the technical aspects of FM in healthcare and do not include the whole range of FM services according to Gerber and Läuppi (2015) shown in Figure 1. The same can be said for the research results of FM in healthcare KPIs and/or benchmarking of Lavy and Shohet (2007), Liyanage and Egbu (2008), Shohet (2003), Shohet et al. (2003) and WGKT (2009).

It therefore becomes clear that concrete and comprehensive KPI models including KPIs of all non-medical support services / FM according to Gerber and Läuppi (2015) have not yet been established, nor has an adaptation of FM KPIs specific to the contexts of hospitals in Switzerland been undertaken. Currently, for those responsible for FM in healthcare, it is therefore neither possible to systematically and holistically monitor non-medical support services nor to benchmark performances between different hospitals. In order to empower the FM managers in hospitals, a systematic and applicable approach towards useful KPIs is necessary.

Research Objectives and Questions

For FM managers and boards in hospitals to be able to control the non-medical / FM services more efficiently in the future, a systematic and comprehensive set of KPIs relevant to hospital practice has to be developed, illustrating their interrelations and enabling prioritizations for manageability on board level (supplying Management Information Systems). For this purpose, a reference model has to be set up presenting a simplified view on the complex situation within the many (interrelated) non-medical support services. So that the model will be applicable in practice, it has to ensure that compliance with existing financial reporting structures will be possible, it has to be expandable and amendable in the future and it has be able to serve as a basis for a broad benchmarking initiative for FM in healthcare, as well as for the development of aligned software architectures for non-medical support services applications.

This article, however, focuses on two specific areas: Firstly, the process of the reference modelling including the metamodel ideas is presented. Secondly, the metamodel and the reference model are depicted, and their application is explained.

Methodology

Design Science Research

As discussed in the Starting Position and State Of The Art section above, the introduction of new regulations in Swiss healthcare caused the need for a more systematic approach with non-medical support service data, which had so far only been dealt with in an unstructured and incomplete manner. The complexity of the subject, the poor data, the low maturity level of the whole industry in regard to cost allocation transparency and the different needs and views of various stakeholders required an open research approach in order to find the relevant questions and aspects in the whole context, and to be able to approach the complexity. Therefore, an iterative and circular research approach was chosen, not only for the data collection, but also for modelling.

Hevner (2007) offers a Design Science Research Cycles approach suitable for setting up new and innovative models and allows the act of co-creation with the future users according to Lusch et al. (2007). The first cycle is called the Relevance Cycle, which iteratively deals with requirements and field testing. The cycle iterates between the "Environment" aspect including application domains (namely people, organizational and technical systems, problems and opportunities) and the "Design Science Research". The second cycle, the Design Cycle, is part of the "Design Science Research" which deals with building of designs, artefacts and processes as well as evaluation in an iterative manner. The third cycle is called the Rigor Cycle iteratively dealing with grounding and adding to the knowledge base. This third cycle iterates between the "Design Science Research" area and the "Knowledge Base", which includes the foundations of scientific theories and methods, experience and expertise and meta-artefacts like design products and design processes. This Three Cycle View represents the current research situation perfectly in firstly showing the interconnections between the environment, the research activities and the available knowledge base, and secondly by illustrating the constant and parallel iterative actions between the different aspects; and it offers a pragmatic approach.

Sampling and Data Collection

As a first step, a literature review was conducted to find existing approaches in FM, in other branches and/or in healthcare which could be consulted or integrated in the development of the KPI model for non-medical support services in hospitals.

To determine which of the non-medical support services had to be classified as relevant amongst the ~200 defined services by Gerber and Läuppi (2015) and thus be prioritized in the KPI model in order to reach manageability, the criteria for this definition were developed and ratings were conducted in iterative sessions by means of interview tables together with seven FM in healthcare subject matter experts. The results were reflected upon and further developed by a second, independent group of four subject matter experts, as well people responsible for FM in Swiss hospitals.

To set up the interrelations of the model, the conceptual basis of Gerber and Läuppi (2015) was combined with the previously defined classification factors presented in the section Prioritization and Simplification. Again, the clustering of the various services on different levels were set up and discussed in iterative expert discussion panels with eleven FM in hospital subject matter experts with the support of an additional financial expert in order to make allowances for the aspects of compliance with existing financial reporting structures.

Finally, the creation of a metamodel and a reference model was undertaken on the basis of these findings, including reference modelling principles in line with generally accepted modelling principles by Schüttte (1998), Becker et al. (1998) and Becker et al. (1995).

When choosing the sample, specific focus was laid on including FM subject matter experts from different hospital categories and sizes in order to take into consideration the different needs of the whole industry.

Key Performance Indicators (KPIs)

KPIs are defined as measurements or indicators which deliver values according to specific definitions enabling managers to navigate and control their business (Marr, 2012; GEFMA, 2012; Kronz, 2005). For KPIs to have informative value, they have to be measurable, have to create an added value for the person monitoring the indicator, they have to be current, explicitly defined and complete (GEFMA, 2012; DIN 1996; WGKT, 2009). According to Johner (2009), KPIs are currently implemented for the operational control by many larger businesses in particular. DIN (1996) classifies KPIs by several aspects namely, their information basis, static form (absolute vs. relative numbers), target orientation (success vs. liquidity parts), object area and concrete action (normative vs. descriptive size). According to DIN (2000), the advantages of KPIs are the comparability and possibility of benchmarking between different entities, a better communication basis, better transparency and thus increased organizational learning processes and eligibility for certifications (e.g. ISO 9000). The challenges with KPIs are that it seems to be difficult for managers to identify the relevant indicators and to focus on the most relevant measures (Marr, 2012; Johner, 2009).

Model(ling)s

A model can be defined as a complexity reductive, graphical display, showing existing or desired parts of reality, designed with particular intentions of and for specific stakeholders, embodying the subjective perspective of the modeller(s) (Prilla, 2010; Frank et al., 2014; Delfmann, 2006).

Metamodels are descriptions of abstract systems and, as such, the theoretical basis defining the elements and their relationship within the modelling approach (DIN, 1996; Kruse, 1996).

A reference model can be defined as a special model within a specific area (Fettke & Loos, 2004).

The purpose of models can be manifold: for technical aspects like software design or enterprise resource planning (ERP), but also for organizational purposes or business process engineering (Fettke & Loos, 2003). The motivation for modelling is a discrepancy between the current situation and a desired status; the problem setting generates tasks which then can be transformed to a document or model with the help of drawing or modelling techniques (DIN, 2000). According to Gemino and Wand (2003), "the information represented is not necessarily information understood. Consequently, the usefulness of any technique should be evaluated based on its ability to represent, communicate and develop understanding of the domain." When choosing the modelling language, a distinction can be made between textual and graphical display (syntax), and between informal, semi-formal and formal modelling languages (Bartsch, 2010). The act of modelling is a constructivist procedure which can, according to Wilde and Hess (2006), be done inductively by observation or deductively out of theories.

In order to assess the quality of (reference) models, Schüttte (1998), Becker et al. (1998) and Becker et al. (1995) set up generally accepted modelling principles. They include the following aspects:

- Principle of correctness, ensuring that the content is represented correctly. This aspect cannot be proven per se, but has to be judged by experts
- Principle of relevance, making sure that only the data that is relevant for the defined goal is modelled

- Principle of economic efficiency, trying to balance the relationship between cost and benefit
- Principle of clarity, showing that a model is only valid if understood by its users
- Principle of comparability, trying to make sure that different models can be compared
- Principle of systematic structure, ensuring the inclusion of different views in order to reduce complexity

For the systematic development of the KPI Reference Model for non-medical Support Services in Hospitals, these principles were considered.

To find a meaningful set of KPIs, Johner (2009) suggests conducting four filtering steps with the relevant stakeholders: The first filtering step is to ask about the significance of the desired KPIs, followed by the question of the corresponding sensitivity in filtering step two. In filtering step three, comprehensibility and manageability of the indicators have to be set, completed by filtering step four, defining KPIs that can be collected with a reasonable effort and wherever possible automated by IT systems.

For the systematic development of the KPIs for non-medical Support Services in Hospitals, these criteria were considered, however not in a linear, but in an iterative manner.

Results

Prioritization and Simplification

Before conducting the prioritization, the necessary criteria had to be defined. The expert interviews showed that the following three aspects had to be assessed:

1. The main duty of a hospital is to provide medical services (WHO, n. d.). The primary mission for FM in healthcare as providing support for the core services therefore is to support all those medical activities; all other services provided tend to have a lower priority.
2. As the objective of the DRG system is to reduce cost, the financial perspective becomes essential. It makes no sense to monitor at the top level, costs resulting from services that are relatively insignificant in the whole context and/or that cannot be influenced within the FM field of activity.
3. Data that cannot be generated or maintained with the help of software applications will not provide the entirety of the necessary parameters and are very prone to errors due to incorrect manual input. In addition, it became clear that the necessity of additional administrative effort would tend to lower the acceptance of a new KPI model.

These findings led to the following classification factors:

1st priority: Importance of the service to the medical core processes
2nd priority: Financial importance and influence on the cost of this service
3rd priority: Availability of software application tools for this service

To generate a ranking by the subject matter experts, all the non-medical support services in hospitals according to Gerber and Läuppi (2015) were listed on a sheet. In three rows with the classification factors mentioned above, the experts had to fill in their estimation on how important these services are in relation to the assessment criteria from 1 (lowest priority) to 5 (highest priority). The entries from the different sheets were then consolidated into one table in a first step and the services of the same cluster with the same ranking were taken together in a second step (e.g. Electricity, Heat, Cooling and Water were clustered under Utilities). The service clusters were

then sorted by the priorities of the classification factors listed above. The result of the prioritized list of services and their ranking is shown in Table 1.

Table 1: Prioritized non-medical services

	relevance for core business	Influence on finances	IT support
Utilities: Electricity (1171.30), Heat (1171.10), Cooling (1171.20), Water (1172)	4-5	2-4	3-4
Procurement: Operational procurement of medical material and medicines (2551.11), Operational procurement of medical services (2551.12)Operational procurement of non-medical material (2551.21), Tactical procurement (2552)	3-5	3-4	3-4
Sterilization services: (1390.91)	5	3	2
Transport: Transport services (2443)	5	1-3	3
Maintenance of medical movables: Operation and preventative maintenance of medical movables (1990.10)	5	1-3	3
Operation of on-call rooms: (2290.4)	5	1	3
Catering: Patient and resident catering (2220.10)	4	4	4
Warehousing & Incoming goods inspection: Inspection of incoming goods (2490.10), Storage management of medical and non-medical material (2490.20)	4	4	4
Cleaning highly intensive areas: Cleaning of operating theaters (1390.03), Cleaning of therapeutic areas, admissions and emergency provision care (1390.05)	4	3	3
Cleaning wards: Cleaning of inpatient wards	4	3	3

Legend: 1 = low, 5 = high

For the further development of the reference model, those prioritized services were focused on. Nevertheless, the other services were also considered and the goal is to also apply the principle developed to all of the services defined by Gerber and Läuppi (2015) at a later stage (see section Outlook).

Metamodel and Reference Model

After the literature research and first subject matter expert interviews, the specific requirements for the reference model could be defined as: it has to

- simplify the complex context, but still be comprehensible and correct
- be able to ensure the possibility to include the aspects of compliance with existing financial reporting structures
- be expandable and amendable in the future
- serve as a basis for a future, all-inclusive benchmarking initiative for FM in healthcare
- fulfil the generally accepted modelling principles to ensure quality, acceptance in practice and dissemination

With these requirements, it became clear that the model would have to be divided into different independent levels so that the various expectations of aggregation and clustering levels could be incorporated; the different aggregated clusters then represent independent KPIs. Regarding the requirements for the clustering process, it was found that the clustered services have to have the same cost driver, otherwise an aggregation is not possible. A further requirement for a specific KPI cluster was that it has to be able to be implemented in practice and that necessity of an own

KPI cluster is given (e. g. by having the same process output). It has also emerged that the interrelations would have to be drawn from left to right, illustrated by arrows emphasizing this. With the requirements of prioritization within the complexity, highlighting was found to be the clearest way, and able to be applied on any level. As no formal language was necessary, an informal, graphical model design according to Bartsch (2010) was chosen. These metamodel ideas are depicted in Figure 2, showing the first row representing the ~200 services according to Gerber and Läuppi (2015) and with exemplified aggregations on the Aggregation Levels 1, 2 and 3, including an example of a prioritized KPI cluster highlighted on Aggregation Level 1.

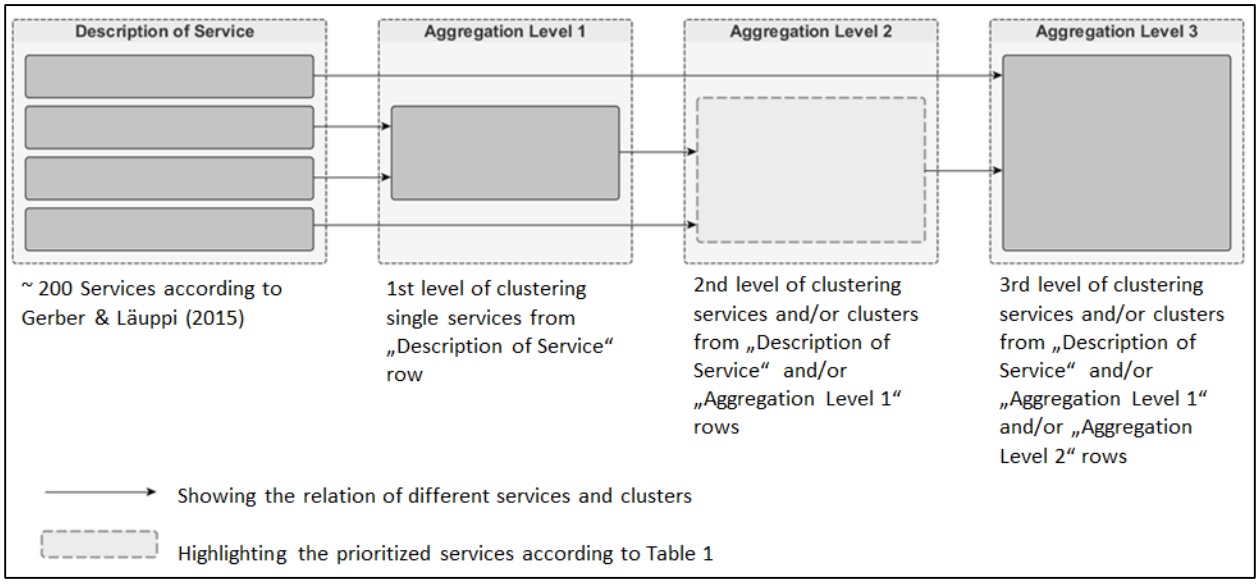

Figure 2: Metamodel of KPI Reference Model

Applying these principles to all the services according to Gerber and Läuppi (2015), taking into account the prioritization in Table 1, the model will present itself as drafted in Figure 3. As the goal of this article is not to explain all the different services and their clusters, but the principle of the reference and metamodel setup, only one area was selected to explain exemplarily: In the “Services” row, 18 services according to Gerber and Läuppi (2015) with all the specific numberings are listed. Under “Aggregation Level 1” eight clusters combining different services are shown, highlighting “Maintenance of medical movables” as one of the prioritized areas (see Table 1). “Aggregation Level 2” shows two further aggregations before the topic is merged into the “Aggregation Level 3” Maintenance.

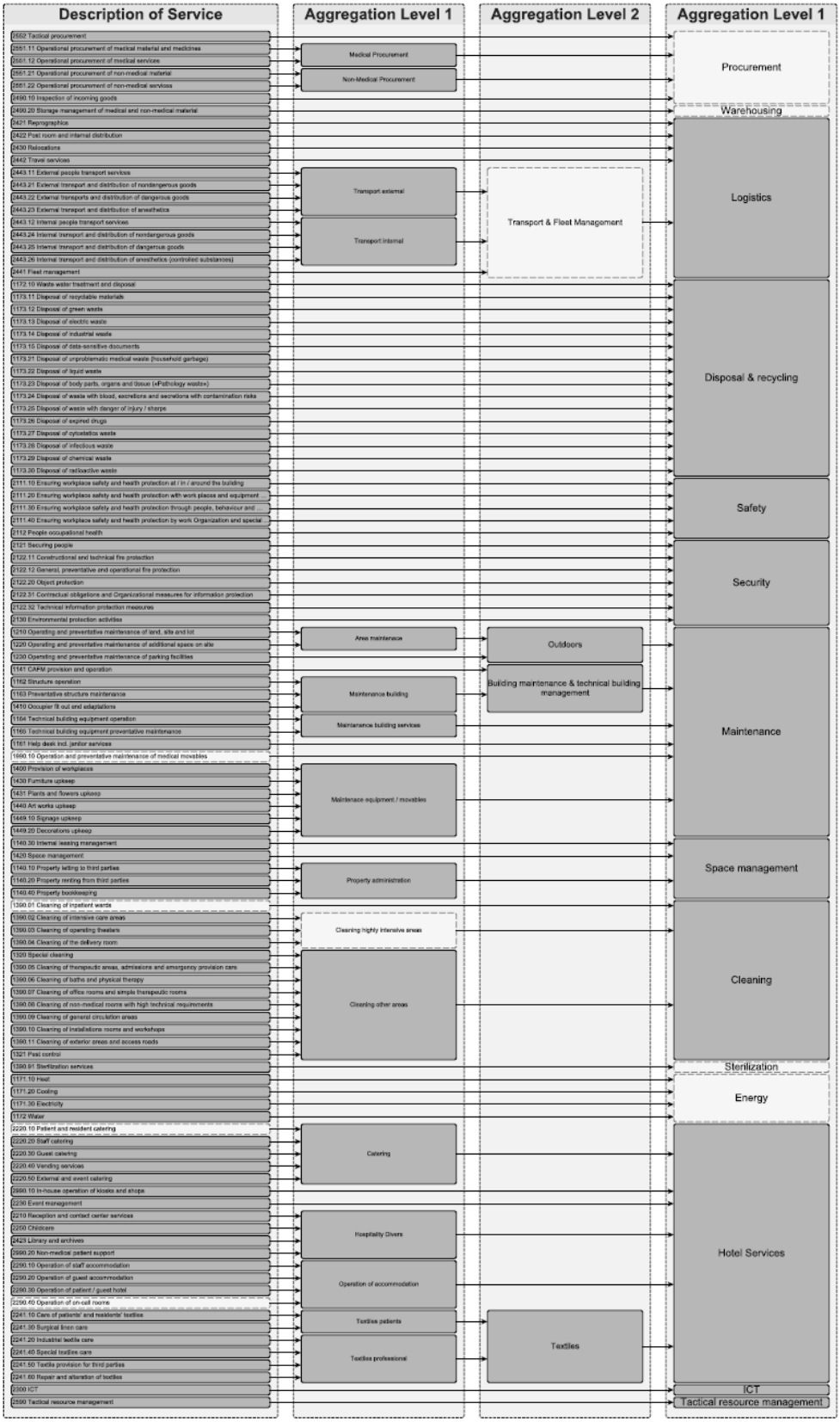

Figure 3: KPI Reference Model for non-medical Support Services in Hospitals

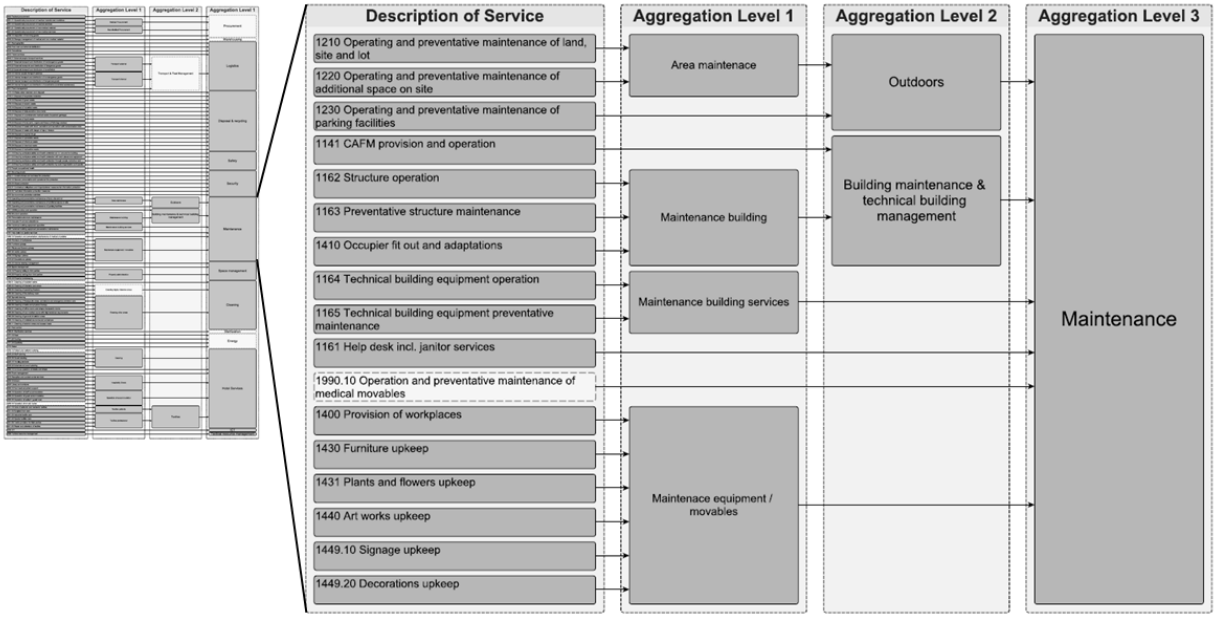

Figure 4: KPI Reference Model for non-medical Support Services in Hospitals explained by the example of the specific Main Services cluster "Maintenance"

Discussion and Reflection

The goal was to set up a KPI reference model for non-medical support services in hospitals and thus provide FM managers and boards in hospitals with a systematic and comprehensive basis to control the non-medical / FM services more efficiently in the future. The metamodel and reference model draft presented are the first steps towards a truly comprehensive KPI model for non-medical support services in hospitals and proved that the great complexity can be managed in a systematic way. The Design Science Research approach by Hevner (2007) turned out to support the process of modelling and simplifying in the complex situation well. By reducing complexity, setting up a clear structure and prioritizing the numerous services involved, the complex situation could be simplified, comprehensibility and manageability was ensured. The chosen modular approach of the metamodel offers the possibility of expansion and amendments (e.g. for further requirements due to financial aspects) and also facilitates manageability. Using the Service Catalogue for non-medical Support Services (Gerber & Läuppi, 2015) with its clear definitions as a conceptual basis, the prerequisites for future benchmarking possibilities are given. By including relevant and appropriate subject matter experts, the practical reference, the relevance of involved data, the approach toward correctness, clarity, sensitivity and significance was assured. The principle of comparability of the model seems to be of less importance, as the model is set up as a reference model for a specific industry and not intended to be directly applicable in other industries or sectors; however, the reference model offers a possibility for comparability between the different hospitals once implemented consistently. The principle of economic efficiency of the modelling itself is very difficult to assess, yet the end result will clearly contribute to a more efficient benchmarking process - assuming consistent implementation. It has become clear that the set requirements could be met, but that certain aspects of the generally accepted modelling principles according to Schüttte (1998), Becker et al. (1998) and Becker et al. (1995) will have to be proven by further validation (see Outlook).

Limitations and Outlook

At this stage, the alignment of the KPIs with all the applicable accounting principles could not yet be validated and will have to be done iteratively with further FM in healthcare finance experts throughout the next financial year.

As outlined, the focus on prioritized service clusters augments the probability of inclusion in Management Information Systems in hospitals and also helped in the development phase. In order to have a truly holistic reference model, all the non-medical support services according to Geber and Läuppi (2015) will nevertheless have to be developed so that all the modelling principles according to Schüttte (1998), Becker et al. (1998) and Becker et al. (1995) can be validated qualitatively as well as quantitatively.

As soon as these aspects are included, it will be possible to make suggestions for adjustments of account plans and cost centre accounting in hospitals – a further step towards more sophisticated benchmarking. In addition, the final KPI Reference Model for non-medical Support Services in Hospitals will be the basis for the further development in aligning the non-medical software architecture.

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