The Status Quo of Information Management in Hospitals - Results of an Online Survey

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Abstract: Context: Information Management (IM) departments in hospitals provide IT services supporting patient care and administrative hospital functions. Complexity and impacts of IT failures are continuously increasing. Therefore, professional IM departments are necessary, even though their importance is commonly underestimated. **Objective:** Little is known about the organization and variety of IM departments in German hospitals. Therefore, we want to characterize their capabilities. In this paper, we present a study that analyzes the current status of IM in German hospitals in the dimensions (i) organization of IM departments, (ii) educational degree of Chief Information Officers (CIOs), (iii) communication of the CIO with the hospital management, (iv) usage of IT-process- frameworks, and (v) application system categories used for IM-related tasks. **Method:** The evaluation is based on an online survey of 134 CIOs. The survey questions were developed according to domain-specific literature, the SNIK-ontology, and interviews with domain experts. The survey questions were improved by a pretest. **Results:** The survey indicates that most of the CIOs are graduates in informatics with 13 years of experience, who are responsible for one hospital without being member of the hospital management. CIOs communicate in weekly formal meetings with the hospital management where they discuss projects, finance, security, and critical IT- and hospital services. Most IM departments do not use IT-process frameworks, but nearly all of the IM departments use ticketing systems, network management systems, project management tools, collaboration tools, BI tools, and ERP systems. The results show, that IM departments are generally well organized with the potential for improvement in IT-process-frameworks and application systems for IM functions.

Keywords: information management, hospital, online survey, application systems, CIO, IT department, ITIL, management communication.

1 Introduction

Information management (IM) aims at the systematic management of information systems. An information system can be defined as the socio-technical subsystem of an enterprise comprising processes, information technology, and humans in their information processing roles. In hospitals, the permanent responsibility for life and death

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of patients and effectiveness rather than efficiency determine the activities of the medical professionals [LR13], [MC09]. Therefore, IM in hospitals has to consider organizational and legal requirements. However, information systems in health care are often said to lag behind information systems in industry by a decade. Several German studies support the existence of this felt gap. Two studies published in 2008 revealed the low maturity of applications in German hospitals and low IT budgets in comparison to industry [LKH08], [MSM08]. So far little attention has been paid to the internal structures, IM functions, and application systems used in IM departments (synonyms ICT or IT department). According to Winter et al. [Wi11], IM in hospitals has to differentiate between of strategic, tactical, and operational IM. Strategic IM plans, monitors, and directs the information system's long-term development. Tactical IM updates certain parts of the information system through projects. Operational management has to ensure the information system's daily operation. For all these IM tasks, called the IM functions, clear procedures, applications, competent staff, and a highly skilled manager in the form of a CIO is needed, who is responsible for the functioning of the IM department. Several studies indicate that business success is correlated with IT competencies or the adoption of standardized processes [MSM08], [PSBQ10], [MK11]. Therefore, professional IM departments are an important success factor for information systems.

The overall goal of this paper is to present a first descriptive evaluation to characterize the capabilities of IM departments in German hospitals. The goal is structured by the application of the Goal Question Metric (GQM) approach [Va02] by Basili et al. and is formulated as: *Determine* the capabilities of IM departments in German hospitals *with respect to* (D1) the CIO's position in the hospital management hierarchy, (D2) his/her educational background and experience, (D3) his/her communication habits with the hospital management, (D4) the use of IT-process-frameworks, and (D5) IM-specific applications used *for the purpose of* a professional and reliable strategic, tactical, and operational management *in the context of* IM divisions of German hospitals *from the viewpoint of* researchers and CIOs. We address the aforementioned goal by investigating 9 research questions (RQs), as documented in Table 1. The column *research question* shows the RQs, the column *dimension* shows the mapping of RQ to the dimensions D1-D5 in the goal. We expect the chosen RQs to be of high interest in the IM community.

RQ.ID	Research Question	Dim
RQ.1	How is the CIO positioned in the hospital management hierarchy?	D1
RQ.2	Which educational background does the CIO have?	D2
RQ.3	Which work experience does the CIO have?	D2
RQ.4	How does the CIO communicate with the hospital management?	D3
RQ.5	How often does the CIO communicate with the hospital management?	D3
RQ.6	What are major issues in the communication with hospital management?	D3
RQ.7	Which IT-process-frameworks are used for strat/tact/operat.IM functions?	D4
RQ.8	What is the level of utilization for the ITIL-framework?	D4
RQ.9	Which IM-specific application systems are used to support IM functions?	D5

Tab. 1: Research questions and the dimensions (Dim.) of the goal

The position of the CIO in the management hierarchy is interesting since it shows the status of the CIO and his/her decision power (RQ.1). The educational background and the work experience (RQ.2) of CIOs influence the organization and standard-orientation of the IM department. The work experience (RQ.3) of CIOs does highly influence the organization of the IM department and decisions. Communication is a key management factor. Thus, we are interested in the CIO's communication habits (RQ.4). The form and frequency of communication (RQ.5) with the hospital management indicates the quality of relationship between these two. The issues the CIO discusses with the hospital management (RQ.6) are interesting since they show important aspects of a CIO's daily business. IT-process management frameworks (RQ.7), such as ITIL, COBIT, and PRINCE2, allow reliable and controlled operation processes to support IM functions. The level of utilization of IT process management frameworks (RQ.8) shows to which extent the IM departments act according to the frameworks. IM departments use a variety of application systems to support several IM functions. We want to understand which classes of application systems are used for which IM functions (RQ.9).

This paper is structured as follows: Section 2 explains the methodological background of the survey design and the development of the study questions. The evaluation of the online survey and the answers to the research questions are given in Section 3. Section 4 discusses the results and the insights gained in this study. Potential threats to validity are discussed in Section 5. The conclusion and ideas of future work is given in section 6.

2 Methodology

This section describes the study design process used to construct the online survey, and in brief the performed online survey.

2.1 Survey Design

In the development of the study, four roles were involved. First, the editor team consisted of two persons familiar with the hospital IM domain and basic questionnaire-design. Second, the survey team consisted of two persons who have significant experience with study- and questionnaire-design and are able to rate the defined questions from a survey point-of view. Third, the domain expert is a person, who is familiar with the hospital IM domain and all variations of different hospital IM departments. Fourth, the beta testers, a heterogeneous group of 10 persons who completed the questionnaire as CIO and gave detailed feedback. The survey team also contributed to the selection and review process.

Figure 1 shows the process of the survey design. In the selection process, the editor team formulated the goal and question proposals of the survey according to the GQM scheme, based on three sources. For the structuring of IM functions in hospitals, we adopted the strategic, tactical, and operational IM classification as proposed by Winter et al. [Wi11].

In order to extend the hospital-specific work of Winter et al., the domain-independent IM work of Heinrich/Stelzer [HRS14] has been used. For all topics that relate to tactical IM, i.e. project management, the work of Ammenwerth et al. [Am15] provided a good structure of tasks and best practices. These sources were used to create an ontology of IM in hospitals (SNIK- ontology) [Sc15] that contain IM-specific concepts. The SNIK ontology provided a glossary for the process of questionnaire construction and the formulation of the question and answer sets. The question proposals were refined, restructured, or rejected with the help of domain expert interviews. In the review process, the finalized set of questions was discussed with the survey team. Questions that did not match the survey criteria were redesigned or were refused. The survey criteria for valid questions are: (i) question must contribute to the goal of the survey (ii) question must be easily understandable (iii) question must be answerable by most of the hospitals and suit most of the IM settings (iv) evaluation must be reasonably practicable (i.e. limited number of free-text questions) (v) filter questions may be applicable to reduce the effort for participants. In the pretest phase, the survey team created a pretest version of the online survey based on the questions from step 2 in the tool Unipark[4]. This online survey was evaluated by the beta tester, domain experts, editor- and survey team. All involved roles gave sound feedback and proposed changes to the questions, which were incorporated in the next iteration of the selection and review process. The pretest was iterated twice. Finally, the online survey was executed in the phase online survey.

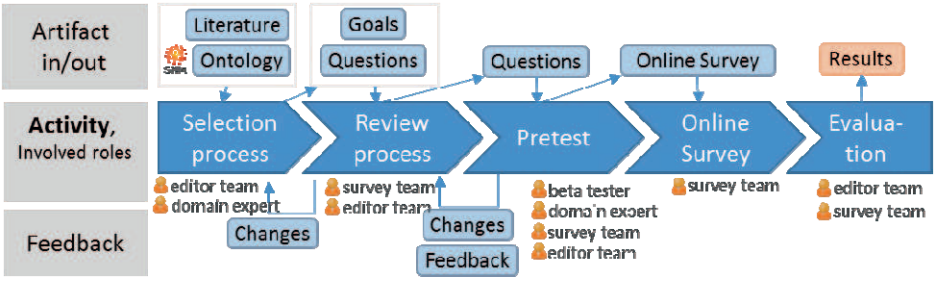


Fig. 1: The questionnaire development and study design process

2.2 Conducting the Online Survey

The study is designed as a cross-sectional study with possible repetitions. The online survey[5] comprises 59 questions and contains also questions for other goals, not focused in this article. There are approx. 1980 hospitals in Germany [St15], some of them belonging to a group of hospitals. Thus there is a lower number of CIOs. We contacted N=1284 CIOs via e-mail with an invitation to participate in the online survey. The CIO's E-Mail addresses were available to the survey team from previous surveys.

[4] http://www.unipark.com/de/
[5] The final online survey questions are available for download http://www.snik.eu/de/Ergebnisse/fragebogen2016.pdf, available in German only.

We collected the data from the online survey between February 12, 2016 and the beginning of April 2016. The survey resulted in 176 analyzable questionnaires, which are completed at least half. 134 of the 176 were completely filled. This results in a response rate of 13.7 %. From the participating hospitals were 11.8 % private hospitals, 37.2 % public hospitals, and 51.0 % in independent nonprofit organizations (n=176).

3 Status of Information Management in German Hospitals

This section describes the status of IM in German hospitals by investigating the research questions in Table 1. The number of answers considered is indicated as n and the standard deviation as σ for each evaluated question. The question number in the questionnaire is indicated by Q. We evaluated the stated questions, whereof the questions marked with */F* include the evaluation of free text fields.

3.1 Findings for RQ.1: The CIO's Position in Hospital Management Hierarchy

The position of the CIO in the hospital management hierarchy, as requested in RQ.1, depends on the CIO's inclusion into the hospital management, the job description, and the number of subordinated hospitals. Slightly more than half of the CIOs (54.9 %, n=95) are responsible for a single hospital (Q3, total n=173), whereas all others are responsible for more than one hospital (45.1 %, n=78). Those CIOs who are responsible for more than one hospital take care of 3.97 hospitals in average (σ = 6:394, n=78). Only a minority of 4.7 % (n=8) are female CIOs, whereas 95.3 % of the CIOs are male (Q5, total n=171). All participants were requested to name their job description (Q6/F, total n=170), which show a great variety. However, 82.9 % of the job descriptions indicate an executive status of the participant by containing the keywords leading, leader, manager, head of, etc. Interestingly, only in 3.5 % of the job descriptions, the term CIO is contained explicitly. The majority of 94.4 % (n=152) of the CIOs are not members of the management (Q18, total n=161). **Summarizing RQ.1**, we can state in most cases the CIO is male and not a member of the hospital management, but in the majority of the cases the job description reveals the CIO's executive status. Slightly more than half of the CIOs are responsible for one single hospital and in all other cases they are responsible for up to four hospitals.

3.2 Findings for RQ.2: The Educational Background of CIOs

Information about a professional training or graduate occupation, and certificates characterizes the educational background of CIOs (RQ.2).

More than half of the participants (52.5 %, n=94) hold a graduate degree from a university or a university of applied sciences. Nearly half of the participants (40.2 %, n=72) completed a professional training, six participants (3.4 %) hold a PhD, and seven

participants (3.9 %) have earned a GMDS medical informatics certificate (Q10/F, total n=179). Those participants that completed a professional training gave information about their specialization of education (Q11, total n=96). 23 participants (24 %) have a professional training in business administration, four participants completed a training in nursing or medical care (4.2 %), two participants finished a medical or therapeutic training (2.0 %) and the vast majority of 49 % (n=47) are qualified IT specialists. Other trainings were completed by 20 participants (20.8 %) in the areas of electronics, chemistry, and mechanical engineering.

Degree	University (%, n)		University of applied sciences (%, n)	
Diploma	32.7 %	34	36.5 %	38
B.Sc.	1.9 %	2	8.7 %	9
M.Sc.	5.8 %	6	6.7 %	7
State examination	3.8 %	4	2.9 %	3
Magister (M.A.)	1.0 %	1		

Tab. 2: Academic degrees.

Regarding the academic degree (Q12, total n=104), Table 3 shows that a Diploma is most common, nearly equally distributed between universities and universities of applied sciences. In contrast, B.Sc. and M.Sc. degrees are still very uncommon. These statements were not introduced until several years after the Bologna Process in 1999 in Germany has begun. Due to the work experience (see findings for RQ.3 in subsection 3.3), only a minority of graduates with M.Sc. and B.Sc. degrees already are in a CIO position. Other degrees are state examination (n=7) and Master of Arts (n=1) that are held by a minority of 7.7 %. The majority of CIOs has graduated from a university of applied sciences. The specialization in academic studies (Q13, total n=117) is in 30.8 % (n=36) informatics and business informatics, followed by 16.2 % (n=19) in business administration and 14.5 % (n=17) in engineering sciences. Only 12 participants (10.3 %) specialized in medical informatics. Medicine, natural sciences, and other specializations make up 28.3 % (n=33). Although medical informatics being a field of studies preparing for the job of hospital CIO, there are fewer graduates in medical informatics than in engineering. The subject of a PhD (Q14/F, total n=6) is in 2 out of 6 cases related to biology and in 1 out of 6 cases related to physics. One participant stated a topic related to computer tomography, which can be located in medical informatics or computer science. Two participants did not state their topic. **Summarizing RQ.2**, it can be said that slightly more than half of the CIOs have graduated with a diploma or a master's degree in a subject related to informatics or business administration, whereas a PhD is an exception. Less than half of the CIOs have completed a professional training.

3.3 Findings for RQ.3: The Work Experience of CIOs

The average work experience of a CIO in this position is 13.52 years, whereas the minimum was 0 and the maximum 35 years (Q7, n=170, $\sigma = 8$; 738). In average, a CIO is with his/her employer for 11.54 years (Q8, n=170, $\sigma = 8{:}093$). **Summarizing RQ.3**,

we can say that the typical CIO has more than 13 years of experience in his/her job, and stays more than 10 years with the same employer.

3.4 Findings for RQ.4: Communication of the CIOs with Hospital Management

The communication with the Hospital Management is supported by visual aids that contain or display information in the form of office documents, reports, or dashboards. Documents can be digital documents presented on displays or projectors, or they can be printouts of digital documents. Digital documents such as office documents and printouts are used frequently, as shown in Table 4a (Q22/F, total n=215). Information from reporting tools or dashboards is less frequently used. Interestingly, only a minority does not use visual aids at all. Other visual aids mentioned are flip-charts, whiteboards, and video conferencing systems. The most important contents of the visual aids (Q23, total n=149) are decision memos, recommendations, trends, and comparisons of departments or facilities, as depicted in Table 4b. Other contents mentioned were mind-maps, meeting minutes, or e-mails.

Visual aids	%	n
digital documents	62.6	134
printouts of documents	48.8	105
reporting tools, dashboards	23.7	51
no visual tools	3.7	8

(a) Visual aids for communication

Content	%	n
decision memos	85.2	127
recommendations	73.2	109
trends	72.0	108
comparisons of facilities	29.5	44
comparisons of departm.	22.1	33

(b) Content of visual aids.

Tab. 3: Visual aids and their content.

The contents of digital documents (Q24, total n=147) in the form of tables (17.4 %, n=115) and text (17.7 %, n=117) are considered to be more important than diagrams (13.9 %, n=92). The same applies to printouts of documents: tables (12.1 %, n=80) and text (14.2 %, n=94) are considered important, whereas diagrams (9.7 %, n=64) are less important. Interestingly and intelligibly is that diagrams (6.0 %, n=64) and tables (5.9 %, n=39) are more important when dashboards are used, compared to text (3.2 %, n=21). **Summarizing RQ.4**, it can be said that CIOs communicate with the hospital management by mostly using electronic documents with text and tables. The electronic documents contain decision memos, recommendations, and trends of the IM department. Dashboards focus on diagrams and tables, but are surprisingly less frequently used.

3.5 Findings for RQ.5: Frequency of Communication with the Hospital Management

CIOs communicate with the hospital management in 42.3% (n=91) once a week. A minority of 16.7 % (n=36) of the participants communicate monthly. Only 10.7 % (n=23) communicate daily and only 1.4 % (n=3) communicate less frequently than yearly (Q19, total n=154). Formal meetings are used in 54.9 % (n=85) of the cases to

communicate with the hospital management. In 45.1 % (n=70) of the cases, CIOs rarely have a formal meeting (Q20, total n=155). Informal meetings with the hospital management (Q21, total n=155) are used rarely in 66.5 % (n=103), whereas in 33.5 % (n=52) of the cases they were used frequently. Therefore H.6 is true. **Summarizing RQ.5**, it can be said that most of the CIOs communicate weekly in a formal meeting. Informal meetings are used only rarely.

3.6 Findings for RQ.6: Major Communication Issues with the Hospital Management

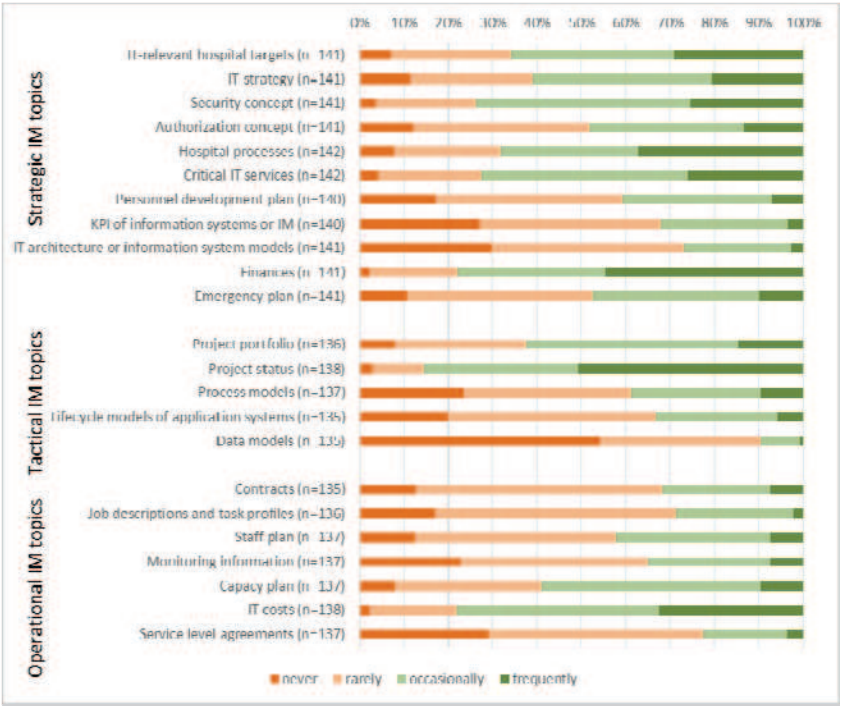


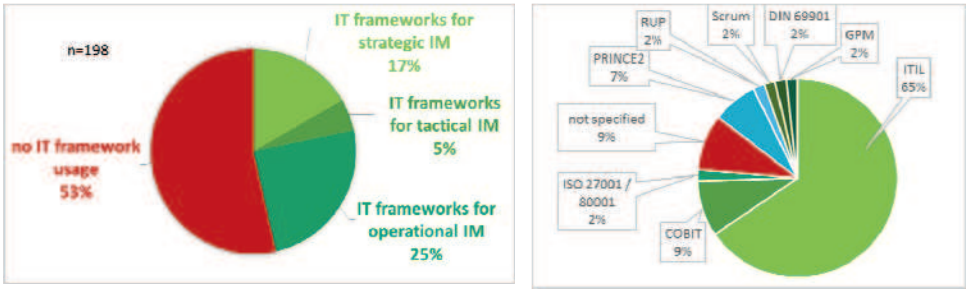
Fig. 2: Observed frequency of used strategic, tactical, and operational information

Nearly all information shown in Figure 2 with its frequency is used in the communication with the hospital management. When considering occasional and frequently used information together, the information most commonly used is project status, financial issues, IT costs, security concepts, critical IT services, hospital processes, and IT-relevant hospital targets. Other strategic information subject for communication (Q40/F, total n=141) that was stated by participants is: daily business, IT incidents, Hospital information systems, interoperability to medical technology, IT requirements from other departments, responsibilities. Other tactical information (Q49/F) is information supplied by users, cost plans, and time schedules.

Summarizing RQ.6, it can be said that major communication issues are related to projects, finance, security, critical IT- and hospital-services, and IT-relevant hospital targets. Monitoring information (status of helpdesk, system workload) is rarely issues.

3.7 Findings for RQ.7: IT-Process-Framework Usage

The survey reveals the IM categories, in which IT frameworks are used, as shown in Figure 3a, (Q16, n=198). A majority of 53 % does not use a framework at all. For operational IM functions, 25 % adopt an IT framework, followed by 17 % for strategic IM functions. For tactical IM functions, only a minority of 5 % adopt an IT framework.



(a) usage of IT frameworks in categories of IM (b) IT frameworks frequency

Fig. 3: IT framework usage

The most frequently used IT framework (Q37/F, Q45/F) is ITIL (65 %), followed by COBIT (9 %), and PRINCE2 (7 %), as depicted in Figure 3b. Other IT frameworks such as ISO 27001/80001, RUP, Scrum, DIN 69901, and GPM (all 2 %) were mentioned each by one participant only, and therefore do not play a significant role. Interestingly, CMMI and PMBOK are not used at all. ITIL can be viewed as both, operational and strategic IM. The IT-governance framework COBIT covers strategic, tactical, and operational IM aspects. As a project management framework, PRINCE2 is a tactical IM framework. **Summarizing RQ.7**, it can be said that for strategic IM ITIL and COBIT are used, for tactical IM PRINCE2 is used and for operational IM ITIL and COBIT are used.

3.8 Findings for RQ.8: The Level of Utilization of the ITIL-Framework

ITIL Process	not adopted		ad. planned		partially ad.		fully ad.	
Service strategy	34.8 %	16	19.6 %	9	43.5 %	20	2.2 %	1
Service design	28.3 %	13	28.3 %	13	39.1 %	18	4.3 %	2
Service transition	29.8 %	14	21.3 %	10	42.6 %	20	6.4 %	3
Service operation	10.6 %	5	14.9 %	7	53.2 %	25	21.3 %	10
Cont. Service improvement	32.6 %	15	32.6 %	15	26.1 %	12	8.7 %	4

Tab. 4: Degree of ITIL process adoption (ad.) for operational IM (rows present % and n).

Table 5 shows the degree of ITIL process adoption (Q57, n=47), whereas 36 participants adopt at least one of the ITIL processes partially or fully. Service operation is adopted by 35 participants partially or fully. Interestingly, more than 70 % use ITIL and most of the participants adopted it partially. It is surprising that strategy, design, and transition are adopted partially by many participants (43.5 %, resp. 39.1 %, resp. 42.6 %). **Summarizing RQ.8**, it can be said that ITIL service operation has the highest level of utilization, followed by service transition and service strategy.

3.9 Findings for RQ.9: Application System Categories for IM Functions

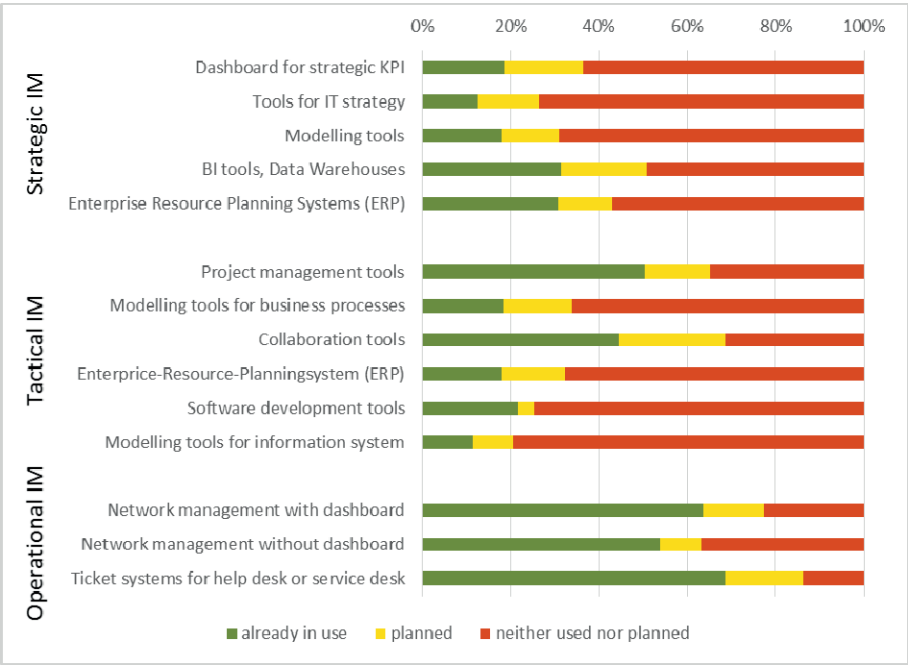


Fig. 4: Application systems used for IM functions

IM departments apply several tools in the form of application systems for IM functions (RQ.9). Since there is a great variety of different tools from different vendors, we examine the categories of application systems. For instance the category of *project management* application systems comprise the products Microsoft Project, inloox, FreeProject, and ProjectLibre. Figure 4 shows the distribution of application systems categories used for strategic, tactical, and operational IM (Q38, Q47, Q53). Interestingly, the vast majority of IM departments does not use application systems for various IM functions except for project management (n=68, total n=138), collaboration (n=61, total n=138), network management (n=79, total n=138), and ticketing (n=94, total n=138). In consequence, these IM functions seem to be important and complex and therefore

require tool usage. For strategic IM functions, mainly BI tools and Data Warehouses and ERP systems are used by 31 % of the IM departments. Only 30 % of IM departments use ERP systems for strategic IM. Project management tools and collaboration tools (SharePoint, Wikis etc.) have a high popularity for tactical IM functions. Network management systems with dashboards and ticketing systems for help- or service-desks have an extensive use of 57 % resp. 68 % in operational IM functions. Participants have additionally mentioned (Q39/F, Q48/F, Q54/F) that they use documentation tools and knowledge management tools (wikis and mind maps) for tactical and operational IM functions, as well as server-/client-management systems and software distribution systems for operational IM functions. **Summarizing RQ.9**, it can be said that most of the IM departments do not use application systems for strategic and tactical IM functions, but do almost always use application systems for operational IM functions. When application systems are used for IM functions, they are (in order of frequency) ticketing systems, network management systems, project management tools, collaboration tools, BI tools, Data Warehouses, and ERP Systems.

4 Discussion

In the following, we relate our study results to former studies on CIOs and IM in hospitals. Whereas our study aimed at the analysis of internal functions, application systems, certification, and staff-related issues of IM departments in hospitals, the study by Leimeister et al. [LKH08] from 2008 focused on strategic IT goals, IT cost, and the functionalities and user satisfaction in the context of hospital information systems. In our study, we could confirm some characteristics of hospital CIOs that did not change in the past 8 years. Regarding RQ.1, the CIO's position, there is still only a very small number of „real" CIOs who are officially named „chief information officer". The results of the survey indicate that the hospital management knows about the importance of the IM department, although they do not organize the IM department as an inherent part of the hospital management. Regarding RQ.2, the educational background, the number of CIOs holding an academic degree (52.5 %) was comparable to the corresponding value in [BMB06] (59.5 %). Interestingly, only few CIOs have graduated in medical informatics, although they are supposed to be domain experts. There might be two reasons: first, there are only few graduates or second, the position of a CIO combines management functions with domain knowledge acquired on the job. The work experience of CIOs of 13 years with the same employer for 11 years as investigated by RQ.3 indicates a strong relationship between hospital management and the CIO. The observed steadiness is of high importance for continuous and reliable management, and the strategic alignment of IM departments. Concerning the communication between the CIOs and the hospital board (RQ.4 and RQ.5), Burke et al. [BMB06] associated CIOs reporting to the CFO (Chief Financial Officer), the CEO (Chief Executive Officer), or the COO (Chief Operations Officer) and the revenues of the hospital. They found out that reporting to the CFO correlated with higher revenues in American hospitals. Our focus on the frequency of contact and the topics which are relevant in the communication between the CIO and

the hospital board add another, more qualitative view on the relationship between the CIO and the hospital board. The communication in weekly, formal meetings indicates an appropriate and purposeful cooperation of IM department and hospital management. Regarding RQ.6, the observed issues in communication were expected, especially finance and security topics. Interestingly, helpdesk and system workload rarely are issues. The adoption of ITIL in hospitals (RQ.7) of five European regions was analyzed by Hoerbst et al. [Ho11] in interviews conducted in 2008. At that time, only 5 out of 75 participating hospitals in Austria, Bavaria, Slovakia, South Tyrol, and Switzerland had already implemented parts of ITIL processes. Now we can see that the adoption of ITIL has increased over the past few years. However, 53 % of the hospitals still do not use a framework at all. In these cases the management of various IM functions has the opportunity to improve. The level of ITIL process utilization (RQ.8) shows the operational importance of the ITIL framework. However, it also shows the strategic utilization, which is surprising for us. Regarding RQ.9, the evaluation of the categories of application systems used in IM departments shows a clear deployment of tools for operational IM functions. Obviously, there is a lack of usage for strategic and tactical IM functions. Application systems for those IM tasks might just not be necessary or there might be a high potential for customized tools that support efficient IM functions.

5 Threats to Validity

The threats to validity of this study are structured according to Wohlin et al. [WHH03]. **Construct validity** considers whether the study measures what it claims [WHH03]. This study is a cross-sectional study that evaluates the capabilities of IM departments in German hospitals. Survey questions were designed by the use of literature and were subject of a review process and a pretest. Nevertheless, IM departments are different. Therefore, the questions allow to capture a wide range of possibilities. By comments in free text fields, we enabled the participants to submit additional information. Questions might be misunderstood or some participants might not be familiar with the IM classification. Therefore, we performed a review process and a pretest. We also gave examples and explanations in the questions that help to understand terms and grouping. **Internal validity** determines the extent of conclusions that can be drawn from a study, in particular by eliminating the bias of the study [WHH03]. Participants might bias this study, since only interested persons contribute to the survey. Therefore, the set-up of non-participating IM departments remains unknown. This problem is mitigated by motivating the participants with an incentive[6], an invitation sent by a professor of medical informatics, and the collaboration with the health IT report [Hü14] research group. Another threat to validity is that non-CIOs could also have conducted the survey. We mitigated this by addressing the invitation to CIOs only, which is evident by the job descriptions in RQ.1. There were no non-CIO-like job descriptions given. **External Validity** describes the possible generalization or transfer of the study results to other

[6] Participants could win a license for the enterprise modeling tool 3LGM2 , http://www.3lgm2.de/

situations [WHH03]. This study targets German hospitals and might not be transferable to other countries. As the focus is strictly on IM in hospitals, the results cannot be transferred to IM departments of other domains. The small number of 176 participants is mitigated by repeating the survey after one year.

6 Conclusions and Future Work

This article has investigated the status quo of IM in German hospitals in five dimensions. It shows that IM departments have a reliable foundation but have potential for improvement in IT-process-framework usage and a better utilization of application systems for IM functions. Future works include the analysis of more dimensions that characterize IM in a further study. Also the IM department's professionalism correlated to its outcome and success needs to be evaluated in a further study based on existing data. The IM department's success comprises support for processes, satisfaction of users and hospital management, and IT costs. In a combination with the health IT report, the success factors and dimensions D1-D5, which characterize the IM department, could be linked with each other. We also need to understand, how the IM changes over time and which future challenges in IM can emerge.

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