Capabilities and Levels of Maturity in IT-based Case Management

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Abstract. We present the results of a case study where we compared the needs of case managers with the capabilities of *case management software systems* (CMS) in social work, health care, and the handling of complex claims in insurance. Building on existing maturity models, we relate capabilities with maturity levels and present the C3M maturity model for IT-based case management.

Whereas vendors of *business process management suites* (BPMS) argue that case management requires flexible process guidance and improved context-sensitive information handling, we identify case assessment and case similarity as key capabilities of future CMS. We show how these and other capabilities are implemented in CMS today and discuss future trends of how CMS capabilities will evolve further. Furthermore, we discuss the impact of CMS technology on the practice of case management in an organization.

Our results are beneficial for the evaluation of CMS. They support organizations in mastering levels of maturity when using CMS, help them exploiting their benefits and addressing associated risks. The results also help BPMS vendors in adding the 'right' case-management capabilities to their BPM software when addressing case-oriented work.

1   Introduction

Case management (or case handling) has become a popular term within the business process management community as well as among vendors of BPM suites. It is commonly used to emphasize that a business process management suite (BPMS) offers flexible process support, e.g., that users of BPMS can change process flows during execution, and that multiple information sources related to a case are handled by the BPMS in a uniform and context-sensitive manner.

In its original meaning, case management denotes a specific management approach for the coordinated handling of complex situations in social work, health care, and insurance and is supported by well-established case management software systems (CMS) today. Examples of CMS that are widely used in Switzerland are CaseNet (www.diartis.ch), a web-based solution, and e-Case (infogate.ch), a rich client. One may thus wonder how trends of flexibilizing BPMS relate to the capabilities of currently existing CMS. We therefore conducted a case study during which investigated the capabilities of CMS and their usage in more detail. We present the following contributions in this paper, derived from the results of our case study:

– Building on [3], we introduce a revised four-quadrants model based on the dimensions of knowledge complexity and relationship complexity to position and distinguish case management among different types of human work.
– We present a set of capabilities for CMS that is derived from case management work in its original domains.
– We relate these capabilities to different levels of maturity in using information technology in case management and present the C3M maturity model for IT-based case management.[3]
– We summarize current trends in IT-based case management and discuss their impact on the practice of case management in an institution.

Lucerne University of Applied Sciences and Arts has currently defined four interdisciplinary focus areas that bundle a wide area of research and education activities. One of these focus areas is devoted to the future of social security and the social insurance system.[4] Social security is not only an important factor guaranteeing the stability of a society by offering support in case of disease, accident, unemployment, or poverty. The social security system also constitutes an important economic factor, e.g., in Switzerland, more than 140 Billion swiss francs or one third of the GDP result from social transfer services. All social security systems face enormous challenges due to dramatically growing expenses, demographic changes, and the need to better coordinate and align existing services as well as to develop new service models. Solutions to these challenges comprise, among many others, legal and technological aspects. In particular, information technology is considered as an important source of potential solutions, think for example of the EU research initiatives on ambient assisted living to help an aging population.

In our research project, we are investigating case management practices and how IT solutions can help improving the intra- and inter-organizational coordination and alignment of services in the area of health care, e.g., related to diagnosis-related groups, personal health management, and prevention, e.g., child welfare and protection of minors. In a first phase, we explored current trends in using IT technology for case management in selected insurances and public organizations that are partners in the case management network of Switzerland, which joins over 100 private and public organizations (see http://www.netzwerk-cm.ch). Furthermore, we assessed the state of the art of IT-based case management solutions used by our partners and explored how existing IT solutions impact their practice of case management. We also talked to vendors of case management systems and IT providers of innovative solutions used in CMS.

In particular, we address the following questions:

– What capabilities provide current IT-based case management solutions and how are they used in an organization?

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[3] Note that we focus on the assessment of the maturity in using IT systems for case management, but do not assess the maturity of case management itself. The latter is completely out of our focus and would require a very different approach, see for example [10, 17]. However, to the best of our knowledge, no maturity models for case management exist in literature.

[4] See http://www.hslu.ch/hochschule-luzern/h-interdsiziplinaere-schwerpunkte.htm (in german only).

– How do these capabilities impact an organizations's practice of case management and what benefits and risks can be observed?
– Which IT capabilities require users and what future trends can be identified?

We conducted interviews with stakeholders in the field of case management, reviewed sources from the swiss case management network, and analyzed the currently available literature. We also compared the identified capabilities as seen by users and vendors of CMS with those capabilities offered or envisioned by BPM researchers and vendors. Although we cannot claim our analysis to be representative, in particular not at a global scale, we believe that our results make interesting contributions to the future of IT-based case management as well as BPM suites.

The paper is organized as follows: Section 2 reviews the origins of case management and explores case management work in more detail. It positions case management with respect to business process work, intelligent problem-solving, and social collaboration in a four-quadrants model and discusses the applicability of the case management metaphor to other types of knowledge-intensive work. Section 3 summarizes capabilities of IT-based case management solutions and relates them to maturity levels. The C3M maturity model for IT-based case management is proposed that relates key capabilities to benefits and risks at each level. Section 4 briefly summarizes trends of how IT-based CMS will evolve in the future. Section 5 reviews related work, whereas Section 6 concludes with a brief summary.

2 What constitutes Case Management in its original Meaning?

Case management practices have recently been very influential on discussions around the next evolutions of business process management. BPM authors often speak of adaptive case management [15] or case handling [1] and refer to a better support for weakly structured and knowledge-intensive processes. As the authors of [1] state, data and business goals play a much more prominent role than predefined workflows: "In case handling, the knowledge worker in charge of a particular case actively decides on how the goal of that case is reached, and the role of a case handling system is assisting rather than guiding her in doing so."

The original setting of case management as it was defined in the context of social work emphasizes additional aspects. For example, the definition of case management by the case management network of Switzerland[5] states that case management is

> . . . a specific approach for the coordinated handling of complex situations in social work, health care and insurance. A bundle of services is provided to a client based on her/his individual needs in a systematic and cooperative process in order to effectively achieve jointly defined objectives in high quality. Case management coordinates inter-professional and inter-institutional services and respects the autonomy of the clients while preserving resources in the client's and the supporting systems.

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[5] Netzwerk Case Management Schweiz, http://www.netzwerk-cm.ch

Case management defines how a complex situation is handled and how the services, which respond to the needs of the client, are determined and implemented. Five phases are commonly distinguished in the client-facing processes of case management:

1. **Clearing and Intake**: Is a client in a situation in which case management can and should be applied?
2. **Assessment**: What detailed situation is the client facing? How is the case structured? What services could be of help, reaching which possible objectives?
3. **Planning**: What objectives can be jointly agreed with the client? Which services are possible and can be bundled to achieve the objectives?
4. **Linking and Monitoring**: How are the services put in place and how is the partner network established? How effective are the services?
5. **Evaluation**: Which results and change are achieved in the client's situation before she/he exits the case-management process? Are the objectives met?

Phase 1 covers the entering of a client into the case-management process. Phases 2 to 4 are highly iterative. The assessment often happens in a continuous way leading to changes in the planning and linking of the services when necessary. Figure 1 summarizes the phases.
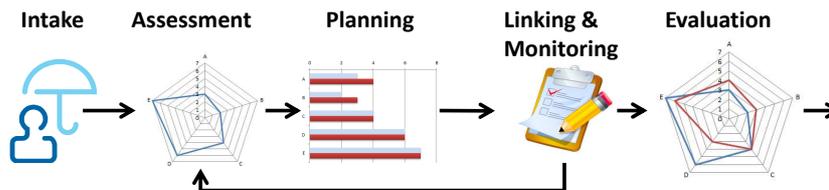
**Fig. 1.** The 5 phases of the case-management process.

Three characteristics stand out when comparing case management to business process management: (1) the setting of objectives jointly with the client, (2) a planning phase where the case manager selects possible services, but also needs the buy-in of the client that these services can be applied and constitute a solution to the complex problems faced by the client, (3) the controlling (and revision) of service execution towards achieving the objectives.

Historically, case management has emerged as a management discipline within social work to ensure the continuity of care in the United States in the 1970/1980 years where social work and health care were extended into a coordinated end-to-end process involving different institutions and professions. Elements of case management can be found much earlier in social work, but the management discipline was coined in this decade. A core metaphor of case management is to tailor the care-giving process to the needs of the individual, i.e., the creation of a personalized instance of this process. The tailoring itself is a qualified process conducted by the case manager who needs a variety of competences to succeed. Furthermore, transparency of the tailoring is required,

i.e., the result must logically follow from the assessment outcome and the defined objectives, which set the constraints for what is possible and meaningful for a client.

Case management is thus considered as a coordinated response to a differentiated landscape of offerings that can constitute a solution to a client's complex problem. It has the goal of empowering clients and also often initiates change in the resource system when necessary. Thus, in response to [15], one may argue whether a term such as *adaptive* case management is meaningful as case management is by definition a highly adaptive process.

Following [3], we use a four-quadrants model to characterize human work along two dimensions: the complexity of knowledge (KC) required to successfully accomplish a work task and the complexity of the personal and business relationships (RC) required. Four quadrants can be distinguished, which allow us to differentiate and position modern IT solutions supporting human work, cf. Figure 2.
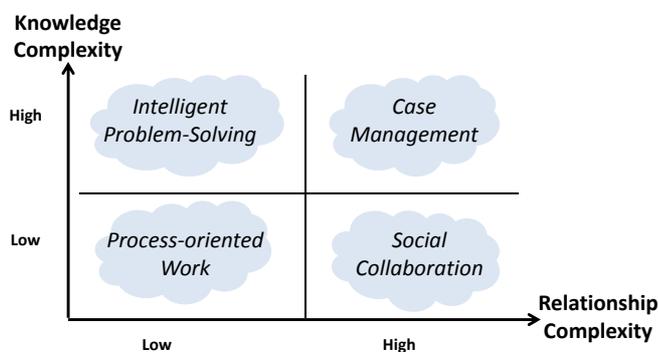
Fig. 2. Four quadrants of human work [3] (credits also to Pascal Sieber, Sieber & Partners).

- KC low/RC low: This quadrant comprises the domain of well-defined business processes that can be highly automated. It is the classical playground for BPM and workflow technology. The knowledge required can be clearly identified and captured in automated solutions. Relationships between human workers are well-defined and can be mapped to pre-defined roles that interact in a predefined workflow.
- KC high/RC low: This quadrant is the domain of creative and highly intelligent work, but also of intelligent systems that automate certain complex tasks within a well-defined scope. Examples are the detection of credit card fraud, complex event processing, document and internet search.
- KC low/RC high: In this quadrant, unstructured interactions between humans dominate and thus, social computing solutions prosper. Recent years have seen a tremendous development in the IT solutions that support and facilitate (but do not automate) these interactions. New trends such as *social business* emerge from the technology and show first impact on the business world by levering a thinking in terms of networks and platforms, cf. [9].

– KC high/RC high: The domain of highly qualified work combined with comprehensive collaboration needs. Workers use various IT systems, but are facing insufficient IT support today. Case management is only one metaphor to characterize this type of work. Other examples are research and development, business development and management, or project-oriented work to solve complex problems.

Following [12] and the feedback from our interview partners, we distinguish two types of how case management work is performed:

1. *Consumer-driven CM*: Case management is considered as a clearly distinguished and complex activity that is separated from other (more structured) business processes. It is strongly client-centered and purely driven by humans, i.e., the case managers. Phases of the case-management process are reflected in a CMS (or other tools) used by case managers, however, the CMS does not drive these phases nor trigger certain tasks autonomously. Case managers work fully self-dependent and maintain the responsibility over the process. Their work style is problem- and solution-oriented.

2. *System-driven CM*: Case management is part of a larger end-to-end business process, which comprises structured and unstructured activities. The unstructured activities require a complex coordination between different stakeholders in the process as well as deep knowledge/expertise either from stakeholders or sources that are external to the process. A typical example is the investigation of complex insurance claims under suspicion of a potential insurance fraud. In this example, system-driven case work is usually state-driven, i.e., state changes in the related information objects drive the progress of the handled case (an insurance claim may be *under investigation, under dispute, settled, rejected*). In system-driven CM, the CMS plays a more active role in driving and monitoring the case work and is often either an extension of the BPMS or integrated with it.

BPM suites are currently expanding from the lower left quadrant into all other quadrants by offering for example, business intelligence, collaboration features, and recently support for case management, the latter being mostly tackled by focusing on Type 2 of our classification, i.e., system-driven case management. Dedicated CMS used by case managers, however, focus more on Type 1, i.e., consumer-driven case management. Interestingly, we found that successful CMS rarely follow a paradigm of guiding case workers through a predefined set of activities triggered by events or states of the case. They rather focus on providing customizable forms and document templates, easy recording of assessments, objectives and plans, as well as on collaboration support. Their success lies in respecting the qualified nature of the case work, i.e., preserving the autonomy of the case workers in their decisions and work organization, as well as in facilitating the planning phase of the case-management process. They offer quite different features than BPMS, which we explore in more detail in this paper.

In our analysis, we found the following characteristics of case management work to be of central importance:

– Complex assessment instruments are used and a holistic view is applied to the case situation.

– Setting objectives is a collaborative process itself and central to the success of case management due to the motivation of the client.
– Case management work comprises complex coordination, controlling and monitoring as well as assessment activities.

These characteristics are also discussed in the literature, e.g., [8], and applied to characterize knowledge-intensive work in general. It seems that the above-mentioned characteristics are typical for many modern and highly-qualified work tasks, which explains why the case management metaphor has received such interest by the BPM community. The case-management community itself feels rather uneasy when the term case management is used outside their domain, because other types of case management seem to exhibit only some of the elements from the case management definition. For case management however to succeed in the context of social work, all elements must be applied successfully and the case-management process itself must be well implemented with all its phases.

We find two aspects of case management especially interesting when applied to other types of work such as for example complex research and development projects, crisis management, etc. First, there is the personalization of the solution for the client, which is a key challenge and trend in the service economy. Companies such as IBM for example have adopted their terminology and speak of *clients* instead of *customers*. Instead of selling goods to customer, they address the needs of their clients and help them to succeed.[6] Second, the role of the business professional increases in the service economy and *information* is the key resource, see also [5]. Similar to the case manager, who is instrumental in the case-management process and balances complex needs and resources in an information-heavy process, many business professionals face corresponding challenges.

One can also gain new insights by better understanding the different roles in which a case manager acts, see also [7]:

– *Advocacy*: The case manager takes the side of the client to obtain the services the client needs.
– *Broker*: The case manager acts as a neutral intermediary between the client and the resource system to determine the optimal service bundle achieving the objectives while saving resources.
– *Gate-keeper*: The case manager assigns the available and required services to the client balancing constraints and needs in a fair way.
– *Supportive companion*: The case manager supports a client in a severe crisis situation such that the client becomes able to accept help and supporting services.

In each role, a case manager develops different information needs and handles the case-management process in a different way. Roles may also change during case management phases. This type of adaptive behavior depending on the role played by a responsible stakeholder in a process is not yet well-reflected in today's BPMS. We also would like to point out that these roles are different from the organizational roles usually considered in the design of business processes. They relate to the individual tailoring

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[6] See for example, IBM client success stories at http://www.ibm.com/software/success.

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of a process and the personal positioning of a stakeholder with respect to the client, which may also vary depending on whether a stakeholder actively handles a case, assumes a management or supervising position, or acts on behalf of a regulatory authority. Summarizing, applying the case management metaphor to other areas of knowledge-intensive work seems to be well justified, nevertheless, it should be done with care and by acknowledging the many important aspects of case management.

3 Capabilities and Maturity in IT-based Case Management

The IT landscape of CMS is currently characterized by local providers and solutions. We could not identify global players with global, but customizable products in the case management IT market. The reason lies in the high tailoring of CMS to local law and national social systems.

We begin by listing a set of capabilities required by case workers, but also offered by the IT systems used in case management. We group these capabilities by functional areas that we identified as relevant for more than one phase of the case-management process: management of the information and data belonging to a case, tracking and obtaining insights into the case history, recording and managing case-related decisions, support for collaboration among case workers and organizations, support for administrative tasks such as benefits or work-time accounting.

Capability	Degree of IT usage		
	low	average	advanced
Information	spreaded/paper-dominated	coordinated	integrated & consistent
- visualization	genogram, ecomap (paper)	diagrams	task-specific
- forms	simple	templates	intelligent
- access	individualized	role-based	inter-organizational
- assessment	guided	unified	standardized
Case History	spreaded across documents	tracked	visualized
- management	difficult	available	advanced insights
- insights	descriptive	diagnostic	predictive
Decisions	individually taken	systematically recorded	best practices
- case groups	none	possible	case similarity
Collaboration	disintegrated	partially integrated	seamlessly integrated
- transfer	difficult	supported	inter-organizational
Administration	separated	embedded forms	partially automated

**Table 1.** Capabilities grouped by functional area and degree of IT usage.

Table 1 gives an overview over the capabilities as they take shape from lower to advanced usages of IT systems. We distinguish three levels of IT usage. "Low" means no dedicated CMS is used, but the IT support comes from other tools, e.g., office tools or database applications. "Average" stands for today's typical CMS capabilities. "Advanced" represents innovative CMS extensions implemented or envisioned by some

players in the case management market. At the end of this section, we refine the advanced level of IT usage further and arrive at five levels of maturity for IT-based case management.

Information-related Capabilities: Handling the data and information of a case is a key capability during case management. Case information is often unstructured. In particular in the context of social work, graphical representations such as genograms or ecomaps are used to capture the situation of a client. Notes taken by a case manager, emails, and interviews are predominant entities of information. When the usage of IT systems is low, many of these information entities are often recorded on paper. Others are spread across various IT tools. With the introduction of a CMS, paper-based documents are replaced by electronic solutions and information entities are better coordinated. For example, data and documents can be easily transfered between different tasks within the case-management process. Diagrams are increasingly used besides text to visualize case assessments for example. Still, duplicated information recording happens. With an advanced usage, duplicated information is eliminated and information entities are integrated and checked for consistency. Advanced visualizations are available, for example, combining case-specific data with geographic and socio-demographic information. Figure 3 shows an example of an advanced visualization that combines patient data with geo-spatial information used by an insurance company to understand how patients move between health care providers.

Forms are used at all three levels, but with the introduction of a CMS, customizable templates improve electronic forms with pre-configured elements to initiate and manage services. Intelligent forms ease information recording and analysis at the advanced level. Access to a case remains with the individual case worker at the lowest level, whereas role-based access control is introduced with the usage of a CMS. At the advanced level, information can be exchanged and coordinated between organizations with security and privacy issues being resolved, e.g., by using an information broker that provides functionality far beyond the case folder introduced by some BPMS today.

A key capability is the correct assessment of the case. At the lowest level, the quality of the assessment depends on the qualification of the responsible case worker who follows organizational guidelines. With the introduction of a CMS, assessments are unified by templates and forms encoding guidelines. At the advanced level, sophisticated standardized assessments are introduced, which encode deep insights into a case management domain and enable the multi-faceted analysis of a case.
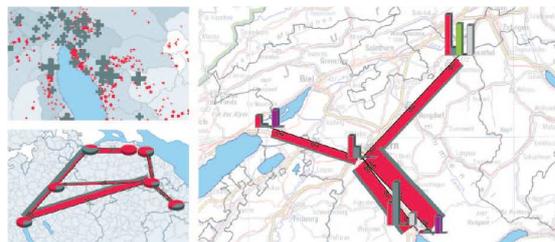
Fig. 3. Advanced case visualizations in D-Care, see www.lcc-consulting.ch.

History-related Capabilities: Tracking cases and obtaining aggregated information about a case or a case group is a major management need and often the reason why CMS are introduced into an organization. Understanding the history of a case, in particular, how effective the planning and linking worked, but also controlling and predicting its potential development, and recognizing complex cases early (including the detection of social trends), is a major challenge today. Data analysis techniques to visualize and understand the temporal progress of a case are requested by CMS users. The history of a case comprises the assessments and evaluation(s), the objectives agreed between case stakeholders, the benefits and services provided as well as their outcomes. At the lowest level, this information is spread across many documents and a unified view on the history of a case is very hard to obtain. With the introduction of a CMS, the information related to a case is managed in a more coordinated manner and the history is tracked, but problem-specific views on the history might not yet be available. Advanced levels integrate heterogeneous and unstructured information sources and provide sophisticated visualizations of the case history.

The main challenge for the case manager lies in arriving at an adequate assessment of a case and in keeping an overview of the big picture of the client situation and how it evolves. Case managers often face the problem that an improvement in one dimension causes a degradation in another. Deep human judgment is required to assess whether the overall situation has improved and which steps should be next. Sometimes, clients pose additional challenges by moving between service providers and trying to cut off a case history. For example, parents relocate to enter a challenged child into a new school, which cannot know about the history of the case due to data privacy issues.

Decision-related Capabilities: Knowledge of how a case is handled is often formulated as rules that guide or constrain the human decision maker. Some of these rules are made explicit in a case-management organization and are regulated by law, others remain implicit. Achieving and maintaining compliance of the case handling with legal regulations is a major challenge today as the complexity of cases as well as the regulation of case management is increasing. Furthermore, some, but not all of the knowledge about the case is available in the case-related documents. A significant source of knowledge also comes from observations made by the case manager and other case workers involved in a case. This knowledge is not always consistent and made explicit in the case-related documents, but plays an important role in the case-management process through the empathy and intuition applied when taking decisions. Effectiveness of decision-making is critical for the case-management process to succeed— an aspect where it often differs from business process management. Different case evolutions require different responses: different wrt. time to react, costs, coordination, benefits, experience, and qualification of the case manager. A better understanding of the state of the client, the events that happen as well as the case provider network helps in taking effective decisions.

At the lowest level, decision-making is not directly supported by the IT infrastructure. In a CMS, decisions are supported by an improved view on the case situation. With advanced usages of CMS, benefit/service usage patterns can be extracted from the case data and a specific case can be compared to a representative case group. A refined understanding of case groups can help in establishing best practices, but also risks that

a "one-size-fits-all" approach replaces the key paradigm of case management, namely that individualization is key to success, i.e., results do not improve, but cost savings are achievable by accepting less optimal solutions for clients.

Collaboration-related Capabilities: The longer a case lasts, the more stakeholders get involved and the more information needs to be coordinated between stakeholders. Low IT system usage hinders effective collaboration as information is scattered, must be manually transfered, and easily gets out of sync. With the introduction of a CMS, role-based access control is established, documents can be transfered using small workflows, and document exchange with office tools is made easy. Advanced solutions require to address in particular inter-organizational issues, which are mostly unresolved today. Each stakeholder of a case acts within his own law-regulated space and is not or only partially aware of the spaces of other stakeholders. Coordination and opportunity finding is therefore difficult. Furthermore, coordination needs vary for each case, which is a challenge for advanced CMS implementations.

Administration-related Capabilities: Accounting of benefits and tracking work efforts put into a case by stakeholders requires calculating forms and templates. With low IT usage, these forms exist either on paper or in separated IT systems. CMS embed and facilitate accounting. Advanced levels partially automate these tasks.

We are now ready to present our proposed C3M maturity model for IT-based case management. The model distinguishes a *pre-CMS level* and a *CMS level*, where a CMS is introduced into an organization. It refines the advanced usage of CMS into three *post-CMS levels*. In our investigations, we found that many organizations still work at the pre-CMS or CMS level. Some organizations, in particular larger insurance companies, begin to evolve their CMS systems and enter the post-CMS area. For each level, the model shows the main capability that we consider as characteristic for this level and combines this capability with two other aspects, namely the main benefit an organization can gain and the main risk it has to address.

At the *individualistic* level, the individualization paradigm on the side of the client as well as the case workers dominates. Documents are personally organized with the help of various IT systems. The main benefit is the high personal identification of the case manager with a case. The main risk lies in the lack of traceability. At the *supported* level, a CMS is used to better organize documents and provide templates that facilitate the case work. Productivity increases, but an organization might face acceptance problems of the CMS as well as lack of management support in particular in the initial phase of technology adoption. At the *managed* level, the organization exploits the data aggregation and analytics features of the CMS as a basis for management decisions at the level of higher management, but also for the handling of the individual case. Data of one case can be compared with data of other cases. Management transparency is the main benefit, but the risk is a cost thinking that overdominates other aspects. At the *standardized* level, a unified assessment methodology is implemented in the CMS and standardized assessments are introduced. Similar assessment outcomes lead to similar objectives and measures in the subsequent phases, helping to improve the effectiveness of the case-management phases as the main benefit. Visualizations of the case state, its objectives and history are provided by the CMS and exploited during decision making. As the main risk, changing assessments and their implications becomes more costly as

Individualistic	Supported	Managed	Standardized	Transformative
Cases handled in non-CM software (e.g. Office tools)	Cases handled in dedicated software (CMS introduced)	CMS data analyzed for management decisions	Case assessment standardized and visualized	Case histories analyzed & compared Best practices
Main Capability				
Documents personally organized using (non-CMS) standard software	Documents organized in case folders with role-based access Templates facilitate administrative work	Data aggregated over case groups Inter-case aspects included in planning phase	Assessments guided by software Case state, objectives and history visualized	Similar cases & best practices identified Intra- and inter-case data visualized
Main Benefit				
High Personal Identification	Increased Productivity	Management Transparency	Improved CM Phases	Increased Effectiveness
Main Risk				
Lack of Traceability	Inacceptance of CMS	Cost thinking dominates	Costs of Change increase	Loss of Individualization

Pre-CMS   CMS   Post-CMS

Fig. 4. The C3M maturity model for IT-based case management.

with any work approach that is implemented in a software system. At the *transformative* level, similarity of cases is defined including data from the case history, which enables an organization to extract best practices and feed them back into case management. This can help the organization as a whole to improve the effectiveness of its case management, but also bears the risk that the tailoring of a solution to the individual needs of a client is lost as cases are managed based on the most similar case group.

A refinement of the levels with the characteristic instances of all capabilities and a more detailed map of risks and benefits is possible, but goes far beyond the scope of this paper. We believe that this model is not only beneficial for maturity assessment, but also for IT governance purposes as it addresses the impact of IT innovations on a case-management organization. A systematic refinement of the model enables us to consider benefits and risks for all aspects of a business system. Organizations need to respond to IT developments. Their response decides whether they can built new business models upon an IT innovation and manage the associated risks in order to keep up with the competition or whether they will disappear from the market.

The impact of IT on case management is also reflected in the four-quadrants model of human work. For example, we saw tendencies that the further division of labor within case management moves some activities from the upper right quadrant into the lower left, i.e., many administrative tasks within case management receive better IT support, get partially automated and thus, become structured business processes. A combination of intelligent and social computing technologies leads to novel IT capabilities provided by CMS. For example, information visualization changes the way how case managers can look at case-relevant data. Intelligent decision support exploits insights based on case similarity and leads to decisions with more effective outcomes. We briefly discuss some of these trends in the next section.

4 Trends in IT-based Case Management

Several trends and emerging needs have also been identified in our interviews that we briefly summarize in the following:

Adoption of Mobile Technologies: The trend to replace paper-based work and isolated legacy solutions with integrated CMS continues. Organizations still using proprietary extensions of legacy systems such as MS Access or Filemaker feel an increasing pressure to replace and modernize their IT environments. Mobile clients are clearly a need that help case managers work in different locations. Furthermore, web services or apps that extend mobile clients with specific context- or location-specific capabilities such as data access have been mentioned. Security needs increase as typical case workers are not really IT savvy, but information must be increasingly shared, including the access of clients to their personal data stored in a CMS. Furthermore, the intelligent linking of different information sources to enable the effective management of a case also leads to unresolved data privacy issues.

Improved Collaboration: The management and hosting of sensitive data is an unsolved issue, in particular when shared between different organizations. Complex cases require the delegation of tasks among case workers including a transfer of access to sensitive documents. The increased need for interdisciplinary cooperation and inter-organizational coordination requires effective solutions. In particular, the information need of involved stakeholders that join or take over a case management situation should be met with low effort and low cost, but effectively. Three major groups of users adopting different views and understandings must be addressed: the case workers, their management, and regulatory authorities. Collaboration solutions must also be seamlessly integrated with the default communication systems, which also evolve at a high pace.
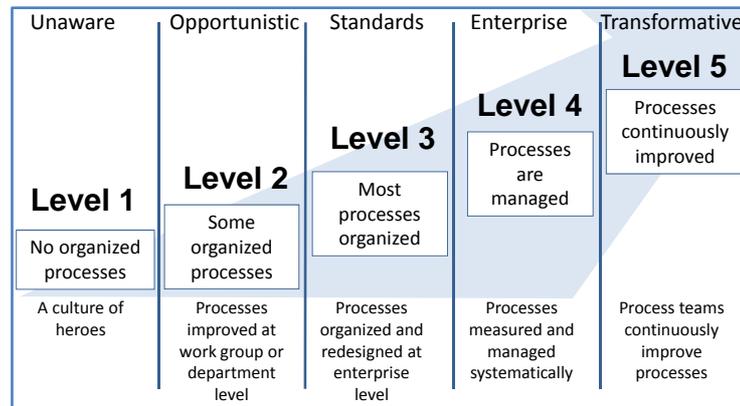
Applied Business Intelligence: The visualization of case-related data will gain further importance. On the one hand, case-related data will be presented more often in graphical form than text-based. On the other hand, different data sources will be presented in an integrated way and trends in the evolution of a single case or a group of cases will be displayed graphically. There is a clear desire to obtain insights into hidden patterns and states of cases. Furthermore, CMS will help case managers to learn from previous decision histories and also illustrate potential decision options. Decision support using aggregated and extended data, for example using external sources such as household statistics, is currently built into CMS. The early recognition of cases will be partially automated and thus improve the intake phase. There is a general need to integrate analysis tools and operative process support. Standardized assessments seem to gain further importance requiring deeper skills and involving more stakeholders. Cases that require cross-organizational collaboration undergo a detailed assessment, e.g., clarifying insurance conditions, during which it is determined which organization takes the lead in handling the case. Case similarity becomes a key concept at the advanced level, but effective criteria on which to measure the similarity of cases are an unresolved research problem in most domains. "Case intelligence/insight" in general is a promising future research area to achieve better decisions. Instead of descriptively recording in a CMS what is happening, decisions should be based on understanding why it did happen and finally move to prescriptive decisions that can actively influence what will happen.

Measuring and Scheduling: In particular larger organizations have an increased need to improve the scheduling of the case management work force. Furthermore, work-time reporting (and the related billing, benefits accounting, and cost transfer) should be further automated and simplified. In general, the desire increases to better measure the costs and quality of service benefits and their effectiveness for a case. An improved root cause analysis over a group of cases has also been mentioned. Questions such as why do cases increase? in which areas? are asked more often and cannot easily be answered with today's CMS. Recurring routine activities, for example those required to administer a case, should be easy to automate.

5 Related Work

Humphrey's seminal maturity model for the software process with its five maturity levels *initial, repeatable, defined, managed, optimizing* has inspired maturity models in various areas. Its original focus, as also carried on in the famous CMMI (Capability Maturity Model Integration) is on process improvement, i.e., it provides organizations with the essential elements of effective processes, which will improve their performance. It is thus very natural that maturity levels have been defined for business processes by the BPM community as well. We build on these models as we could not find in the literature any maturity models or capabilities sets defined for case management.

One of the first BPM maturity models is defined by Fischer in 2004 [4] who considers the dimensions (levers of change) *strategy*, *controls* (governance), *process*, *people*, and *technology* and defined the following five maturity levels based on capabilities reached along each dimension: *siloed*, *tactically integrated*, *process driven*, *optimized enterprise*, *intelligent operating network*. De Bruin and Rosemann present an improved model in 2005 [2] that replaces the process dimension (which is in fact the one to be defined and should thus not be part of the input) by the dimensions of *methods* and *culture*. The five maturity levels are preserved and follow more closely the original CMMI levels: *initial*, *defined*, *repeated*, *managed*, *optimized*. In 2006, Wolf and Harmon [16] present a maturity model with slightly changed levels focusing on the degree of process organization: *unaware* (no organized processes), *opportunistic* (some processes organized), *standards* (most processes organized), *enterprise* (processes are managed), *transformative* (processes are continuously improved). Also in 2006, Gartner [11] presents a maturity model distinguishing 6 phases, which refines the standards level into two levels of intra-process and inter-process automation and control. In 2007, Hammer [6] introduces the PEMM (Process and Enterprise Maturity Model) that distinguishes four levels of process maturity based on enablers such as *design*, *performers*, *owner*, *infrastructure*, and *metrics* and combines them with four levels of enterprise-wide capabilities based on *leadership*, *culture*, *expertise*, and *governance*. PEMM does not aggregate the two groups into overall maturity levels. Its focus is more on analyzing and guiding transformation processes than on a general assessment of maturity. Finally, the OMG publishes a BPM maturity model specification in 2008 [13] with the five levels *initial*, *managed*, *standardized*, *predictable*, *innovating* and defines detailed process areas. Despite minor differences in naming or emphasis on certain aspects, all models essential share similar levels of maturity.

Unaware	Opportunistic	Standards	Enterprise	Transformative
				Level 5
				Processes continuously improved
			Level 4	
			Processes are managed	
		Level 3		
		Most processes organized		
Level 1	**Level 2**			
No organized processes	Some organized processes			
A culture of heroes	Processes improved at work group or department level	Processes organized and redesigned at enterprise level	Processes measured and managed systematically	Process teams continuously improve processes

Fig. 5. The Wolf and Harmon BPM maturity model as presented in [14].

Usually, the models focus on the maturity levels, and less on the capability levels, which play a much more prominent role in CMMI. Capability levels apply to individual process areas and enable a continuous and incremental evolution of processes, whereas maturity levels address entire process areas and allow an organization to advance in stages. In our work, we focus on capabilities and their support by IT. Thus in contrast to BPM and other maturity models, we focus on the degree of technology adoption by an organization. It is important to acknowledge that higher maturity levels not necessarily mean better case-management processes. Each organization must decide which maturity level in using IT leads to the best support of case-management work. Our highest maturity level corresponds to the most comprehensive and sophisticated usage of IT technology, but this is not identical with the best case-management practices. As De Bruin and Rosemann pointed out [2], "it is a case-by-case challenge to identify the most appropriate (BPM) maturity level based on context, underlying objectives, related constraints, possible business cases, etc."

Recent years seem to have seen less interest in maturity models. Measuring and comparing processes and capabilities is interesting, but not necessarily useful unless it can help guiding improvements and transformations of a business. Our maturity model thus focuses less on measurement, but more on the identification of capabilities, for example as a foundation for a detailed requirements analysis. Furthermore, we link capabilities to benefits and risks to help governing case-management-related IT decisions and manage their impact. This helps organizations assessing whether a specific capability is needed and identifying its associated benefits and risks. The model thus supports organizations in evaluating software products and it simplifies purchasing decisions. Software vendors can position their product roadmaps with respect to the model. Furthermore, the model makes explicit the impact of technology on the business.

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6 Conclusion

We present a detailed characterization of case management and contrast it with the ongoing discussion of case management within the BPM community. We position case management in a four-quadrants model of human work and compare it with process-oriented work, social collaboration, and intelligent problem-solving. We derive a set of capabilities required by case workers and show how these capabilities are supported at the low, average, and advanced levels of using IT-based case management systems. We propose the C3M maturity model for IT-based case management consisting of five levels where we relate the characteristic capability of each level with the main benefit and risk of technology adoption.

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