# Automated Guidance for Case Management: Science or Fiction?


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Humans dream about an intelligent computer assistant who would support them in critical situations thanks to its capacity to reason objectively, to take into account millions of factors and criteria and to value carefully thousands of alternatives prior to make a decision. HAL 9000, in Kubrick's 2001: A Space Odyssey (IMDB 1968), is probably the most famous incarnation of such assistant. Being a fictional character, it reflects a number of great ideas of scientists from the 20th century who believed that machines one day would be capable of doing any work a man can do. Though it was shown that such a vision of computer technology is too optimistic, scientists keep working on theories and prototypes that can support practitioners in agile decision-making and smart process management.

In this paper, we propose our vision of what academic research can do for such a pragmatic and experience-driven discipline as Adaptive Case Management and to discuss to what extent fiction may become reality in what we call *automated guidance for case management*?

## 1. What Makes the Perfect Case Manager?

To provide a common ground for our readers, we start with a definition of Case Management: OMG defines case management as "A coordinative and goal-oriented discipline, to handle cases from opening to closure, interactively between persons involved with the subject of the case and a case manager or case team". Case management processes have multiple applications, including "licensing and permitting in government, insurance application and claim processing in insurance, patient care and medical diagnosis in healthcare, mortgage processing in banking…" (OMG 2009). Navigating a spacecraft to a distant planet can make a perfect example of case management process too.

Efficient case management in industry is hampered by attempts to deal with case management process the same way as with regular business process. The main feature that distinguishes case management processes from traditional business processes is their unpredictability. Unlike a business process that, once designed successfully, can function for years following a predefined scenario, case management processes have to constantly adapt to various "unknowns". These "unknowns" may include client situation and needs, fashion, economical and technological trends, expert skills, available equipment, environmental conditions (temperature, humidity, pollution, radiation), etc. Here the term Adaptive Case Management (ACM) comes to play.

In the literature, Adaptive Case Management discipline is often compared to Business Process Management (BPM). From the theoretical standpoint, BPM and ACM demonstrate conceptually different views on the system design. Similarly to the "chicken or egg" dilemma, they try to resolve a question about what comes first: process or data? The view adapted by BPM is process-centered; it implies that data emerges and evolves within a process according to a predefined scenario, similarly to a product evolving on a conveyor belt. ACM view, in contrast, implies that process scenario evolves at run time in response to emerging circumstances or case-related data.

Dependence on changing data and other (possibly unknown) circumstances makes automated support for case management processes extremely challenging. Therefore, the features of a case management support system often include case artifacts organizer/repository, task scheduler/allocator, report generator, document sharing, business calculator based on business rules etc, while definition and assessment of alternative scenarios and decision making remains a responsibility of a human expert – a case manager. Let's look in detail at what makes a perfect case manager:

The first characteristic we derive based on our experience and discussions with professionals is *objective and well-argued reasoning.* A case manager has to be well informed about the case: he/she must take into account multiple variables in order to evaluate a situation and to decide on the further case handling scenario (e.g. an activity to perform, information to request, expertise to call for etc). He should also possess a vast experience in similar cases in order to predict possible alternative scenarios and estimate their likelihood. This resumes in the second characteristic: *capability to value alternatives under uncertainty.* And the last characteristic we add here is *capacity to learn fast turning both good and bad experience into expertise* that will eventually improve quality of manager's future decisions.

HAL 9000 could probably make a perfect automated case manager but this is still fiction; what about science?

## 2. FICTION OR SCIENCE?

We wish to assert from the beginning: no, we are NOT going to replace a case management expert by a program. However, we intend to push the limits of existing case management systems so that they could guide this expert and help him/her to learn quicker and to make better decisions faster.

Imagine an IT system that drives you and your team through a case like a GPS Navigator: it collects data from the different sources, identifies your current position (i.e. case status), anticipates traffic jams (i.e. resource deficiencies or other potential risks), calculates alternatives routes (i.e. case development scenarios), values them with respect to your current situation and objectives and proposes you options (i.e. set of activities) to help you in achieving your objectives with a maximum likelihood.

Compared to a GPS Navigator, the Case Navigation System (Figure 1) has to process parameters and events, whose sources can vary from customer calls, social media posts, stock market feeds and traffic reports to messages from RFID and other mobile sensors. Due to heterogeneity and complexity of processed information, this system has to come up with much more sophisticated navigation scenarios, too. Nevertheless such a vision is far from fiction: it is grounded on the intersection of mature scientific disciplines that we are going to examine below.

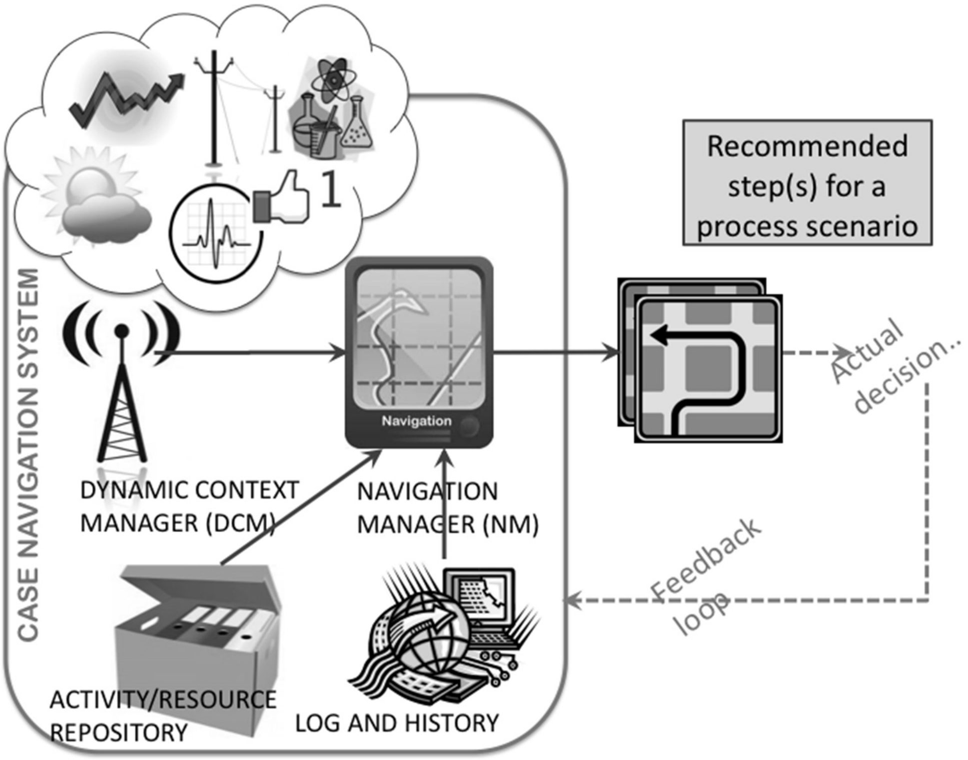



***Fig 1: Case Navigation System guides an expert providing him/her with a set of activities leading to a (current) objective with a maximum likelihood.***

Before discussing the scientific background, however, we take a closer look at the components of the Case Navigation System we propose. The logical architecture of our system follows the principles of Event-Driven Architecture (EDA), a successor of SOA. It is based on the capacity to sense the environment, produce, detect, process the events and react to these events.

***Dynamic Context Manager (DCM)***

Similar to a GPS Navigator, the Case Navigation System operates based on accurate definition of the current state (or position) of the case in its relevant coordinate system as well as its next state. Such state is defined by values of different case-related variables that can be of the two types: a) internal or controlled by the case (e.g. absolute coordinates, speed and direction of a car, generated report, calculated price, discount, offer) and b) contextual, or produced by the case environment (e.g. accidents, traffic jams, changing weather conditions, stock market fluctuation, new evidence, change of customer's situation).

The contextual variables can change spontaneously or due to external reasons; they can have mild or severe effect on the case and therefore need to be considered in order to define the case scenario. On the other hand, considering too many contextual parameters can make the case management unbearably tough. The idea is to select, measure and monitor "right" contextual variables at the "right" case states. This is the role of dynamic context manger (or DCM) component (Figure 1).

At a given time, the context variables processed by DCM plus the values of internal case variables are transmitted to the navigation manager (NM).

***Navigation Manager (NM)***

The Navigation Manager (Figure 1) makes navigation decisions and: it determines one (or several) plausible activity to execute with respect to the current objectives and navigation conditions[1]. Specifically, when such a decision is required, NM takes into account the current case state, the context of the case defined by the DCM, and the available activities (i.e. what can currently be done?). It runs a predictive algorithm and calculates different scenarios of case development and their possible outcomes. Eventually it selects those scenarios that will have a highest probability to result in the desired outcome. It suggests corresponding activities and their assignment to actors from the activity/resource repository (Figure 1).

As an expert uses his/her intuition or previous experience to make the right guess, the accuracy of scenario/outcome predictions of the NM can be improved by using previous experience in similar cases that is stored in the Log and history component (Figure 1).

***Log and History***

This component is the memory of the case manager: it contains descriptions of scenarios of previous cases (successful or not) and can be "mined" in order to answer the questions "was similar situation already happen?" and if yes, "what did we do?" and "what happened next?". Log/history mining techniques are a valuable toolkit for determining patterns in cases and predicting further development of the case under certain initial conditions. Therefore it is important to accurately record every event, decision made and activity that follows to this log at run time. This is depicted with a dashed line tagged "feedback loop" in Figure 1.

***Activity/Resource Repository***

This element represents a catalog of activities that can be performed during the case handling and resources that can be used (actors, equipment etc.). Each activity is characterized by:

- A set of conditions under which it can be performed (e.g. when a specific event happens, when a certain resource is available, when the value of x is greater than…etc); this set of conditions is typically called precondition.
- A set of conditions or outcomes that will be produced upon its termination; this is typically called postcondition.

NM uses preconditions and postconditions to determine the "right" activities to perform in the current case state.

Resources are also characterized by the conditions when they can be used. For example, actors (or human resources) are described by their skills: this enables a dynamic activity-actor assignment. Activity/resource repository can be extended any time by defining new activities and adding new resources.

***Algorithm***

Following the concept of Navigation System, we represent case management process as moving in a coordinate system where each coordinate takes values of some case-specific parameter (e.g. client income, inflation rate, time of the day, availability/amount of some resource etc.).

A single point or a group of points in this coordinate system corresponds to a case state (or status) at a given moment of time. We say that "the case develops" if its

[1] We consider that objectives of the case are not fixed and can change during the case handling.

state changes over time. There are three types of triggers that can lead to state change: case management activities, internal events and external (contextual) events. The examples of these triggers and their corresponding state transitions are shown in Table 1.

***Table 1: Examples of Triggers***

| **Trigger type** | **Trigger example and subsequent state transition** |
|---|---|
| External events | Applicant files complementary information about his income -> clerk processes the information -> the application gains "high income" status and "Priority processing" state of the case is triggered |
| | Temperature rises above critical -> "Emergency" state of the case is triggered |
| | Interest rate of the bank changes -> "Contract re-validation" state of the case is triggered |
| Internal activities | Manager invalidates the application -> "Demand refused" state is triggered |
| | Agent (or system) recalculates discounts -> "Contract re-validation" state of the case is triggered |
| | Team executes an emergency operation procedure and reduces the temperature -> "Normal operating" state is triggered. |
| Internal events | Contract validity date has expired -> "Contract re-validation" state is triggered |
| | "Out of stock" reminder is generated by the system -> value of the corresponding "resource amount" variable is changed to "0". |

The case management can be seen as navigating from one state to another, aiming to achieve some case objectives (a target state).

The functionality of our Case Navigation System can be summarized in the following abstract algorithm:

1. Select the relevant case-specific parameters, observe and measure them and identify the current case state (DCM + NM);
2. Identify probable scenarios (sequences of states) taking into account, if possible, previous experience (NM + Log&History);
3. Exclude the scenarios that are forbidden or not feasible for the current case according to business rules, regulations, availability of resources etc. (NM);
4. Select the scenarios that can lead the case towards its target state with the highest probability (NM);
5. Identify one or several alternative activities that trigger such successful scenarios and recommend them to the case manager (NM + Repository);
6. Record the case manager's decision (Log&History).

The algorithm above should be repeated in a cycle, and can be triggered

- by a case manager requiring an assistance;
- by DCM, after registering some potentially important contextual or internal event.

## 3. SCIENTIFIC BACKGROUND

The idea of automated guidance for ACM is grounded on the intersection of several scientific disciplines. In particular, we propose to explore formal methods, formal concept analysis (FCA) and dynamic context modeling.

Table 2 shows the steps of the algorithm for the Case Navigation System presented above and indicates the research challenges and theoretical background for implementing these steps.

***Table 2: Theoretical Foundations required for Case Navigation System***

| Step | System Element | Scientific Objectives |
|---|---|---|
| Select the relevant case-specific parameters, measure them and identify the current case state | DCM + NM | *Research objectives:* Dynamic model of the context; Representation, capturing and processing of complex internal and contextual events; Rules for inclusion/exclusion context subjects/elements into consideration; Formal Specification of case coordinate system.<br>*Disciplines*: Dynamic context modeling; Complex Even Processing; Formal specification languages. |
| Identify probable scenarios (sequences of states) taking into account, if possible, previous experience | NM + Log&History | *Research objectives:* Rules for state transitions; Specification of case objectives, final states and case management scenarios; Discovery of the case abstract states and case management scenarios from the log and history.<br>*Disciplines*: Formal specification languages; Process mining; Formal Concept Analysis |
| Exclude those scenarios that are not feasible/forbidden for current case (i.e. business rules, regulations, availability of resources) | NM | *Research objectives:* Formal specification of business rules; simulation and validation the case scenarios against these rules;<br>Disciplines: Formal specification languages and model checking. |
| Select the scenarios that can lead the case towards its target state with maximum probability | NM | *Research challenges:* Identification of the best next state given the current state;<br>*Disciplines*: Graph analysis; Formal Concept Analysis |
| Identify one or several alternative activities that lead to such successful scenarios and recommend them to the case manager | NM + Repository | *Research objectives*: Specification of activities (preconditions + postconditions) and resources; Identification of the activities that lead to required state transition with the maximum likelihood;<br>*Disciplines*: Formal specification languages; Formal Concept Analysis |
| Record the case manager's decision | NM + Log&History | - |

***Formal Concept Analysis (FCA)***

Automated guidance for ACM proposed in this paper depends heavily on the systems capability to analyze, look for dependencies and classify vast amount of data considering the case, its context, states, log and history. Navigation system also has to efficiently predict the successful scenarios and recommend to a user some course of actions based on a certain criteria. Formal Concept Analysis discipline proposes a set of methods and tool for such data processing and **predictive analytics**.

FCA is a mathematical theory relying on the use of formal contexts and Galois lattices (Birkhoff 1940). The use of Galois lattices to describe a relation between two sets has led to various classification methods: a Galois lattice gathers elements, which have common properties in clusters, called formal concepts. A partial order exists among these concepts, which form a lattice with an upper and a lower bound. Since their creation, Galois lattices have been used in numerous contexts to extract hidden knowledge from data.

Formal concept analysis provides a universal tool for clustering the objects as well it can be used as underlying semantics for a recommenders system, providing a selected subset of elements that correspond to a certain criteria. Its joint use with formal methods and context modeling is very promising in the context of case management.

***Dynamic context modeling***

The main characteristic that distinguishes Adaptive Case Management from Business Process Management is its dependency from the complex events and contextual parameters. The more complete information we have about the case context the more accurate the decision we can make about what to do next (Vanrompay 2011). However, too many contextual parameters can make the case management unbearably tough. Designing a context model that will adapt to the case needs by dynamically including new relevant parameters into the consideration and excluding the irrelevant ones – is an important endeavor for efficient Case Navigation System.

The process context information should be acquired, modeled and formally analyzed at run time in order to adapt case handling scenario and to ensure its flexibility (Bettini 2010). Most context models consider a subject or a number of subjects (e.g. a person, a physical or information object, a phenomenon etc.). Each subject can be associated with multiple context elements (location, status, etc.); for each context element, we observe values that can dynamically change and that can be described by meta-data. Both subject and context elements can be semantically described using ontologies.

The subjects/elements present in a current context model depend on the activity domain related to our case. An important advantage provided by dynamic context modeling is a possibility to add/remove subjects and elements to/from the context model at run time.

***Complex Event Processing (CEP)***

Capturing and processing complex events in business organizations have been recently addressed by Complex Event Processing (CEP) discipline (Luckham 2011) (Bates 2012). The goal of CEP is to handle the streams of information from different sources, to identify meaningful events and to respond to them as quickly as possible. Complex events can emerge at different layers of an organization and can combine various simpler events such as customer calls, messages, social media posts, stock market feeds, traffic reports, weather reports, etc. Integration of the CEP technology into BPM has a great potential (Janiesch 2011) as it can result in development of decision-support systems and other recommendation systems for efficient business process management.

*Detection-oriented CEP* is a class of CEP solutions focused on identification of *pattern situations* from combinations or sequences of events. Complemented by dynamic context modeling for run-time definition of complex contextual events and by FCA for identification and evaluation of case handling scenarios that can follow a detected pattern situation, detection-oriented CEP represent a valuable technology for automated ACM.

***Formal Methods***

Process modeling (graphical or formal) prior to its implementation is important since it helps to understand and communicate the meaning of the process. Formal modeling (or specification) is yet more beneficial: it allows a process designer to check if a given process meets specific conditions, respects (business) rules and if it can result in desired outcome.

*Formal specification of a case management process* assumes definition of the coordinate system, abstract states and conditions that trigger the state transitions during a case handling. This specification can be done using a formal specification language and further validated using formal methods.

In computer science, formal methods are a particular kind of mathematically based techniques for the specification, development and verification of software and hardware systems (Clarke 1996). The examples of formal methods include Z notation, B-method, Alloy specification language etc.

Formal methods can be used for step-wise system design: they provide a formal specification of the system to be developed at different levels of details and allow for accurate refinement (transition from one level to another). The resulting formal specification can be used to verify that the requirements for the system being developed have been completely and accurately specified. Along those lines, formal methods can be used to verify that the proposed case-handling scenario meets the objectives of the organization while respecting the contracts and regulations associated with it.

## 4. DISCUSSION

The vision presented above results from an academic research of our group and its implementation only begins. Our objective is to extend the capability of ACM supporting systems and to transform them from useful assistants to experienced guides and reliable advisors.

While trying to answer the question "what makes a perfect case manager?" we highlighted the following characteristics:

- objective and well-argued reasoning;
- capability to value alternatives under uncertainty;
- capacity to learn fast from the experience.

The Case Navigation System pictured above focuses on these characteristics: dynamic context manager supports objective and well-argued reasoning about the case; thanks to predictive scenario calculation and mining of previous scenarios, accurate predictions about case development can be made by NM; thanks to registered log and history, scenarios can be improved in the future.

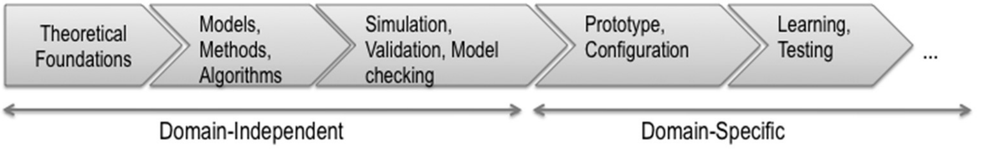
***So what?***

This is probably the main question that bothers a reader during the last couple of pages. Could these ideas, which look like a mixture between good imagination and scientific terminology, leave the research lab one day? We will try to answer this question.

Our group works in collaboration with other researchers in order to provide solid theoretical foundations, algorithms and working prototypes for the Case Navigation System depicted in this article. First, we are going to create models and algorithms for a *generic system*, which does not consider any concrete application domain. The next step is to create a prototype of the Navigation System for a concrete domain (e.g. banking, insurance, administration, legislative etc.).

The prospective prototype, however, cannot be considered a working system until it is *simulated, validated and tested* on multiple, first, toy and then, real life examples. Simulation and validation phase will be followed by the learning phase, where the algorithms will be tuned based on the existing cases. This will potentially improve their accuracy. These research and development activities are summarized in Figure 2.

***Figure 2: Research and development activities for the Case Navigation System***




### *Challenges*

The main challenges we have to face can be roughly divided in three categories:

- Theoretical challenges related to overall problem complexity and number of "unknowns" to manage.
- Technological challenges (e.g. scalability and robustness of algorithms, availability and quality of appropriate ICT technologies)
- Challenges related to adoption by the users (e.g. user perception of complexity versus utility, appreciation and willingness to adopt).

We give some examples related to our scientific objectives first:

In spite of their effectiveness, approaches based on a formal semantics, model checking and theorem proving are rarely used in practice due to their complexity and high implementation cost. Indeed, formal specification languages are typically based on first or higher order logic: reduction of a real life problem (i.e. a case and its handling) to a logical formula represents a complex task and requires specific skills from a designer. So far, formal methods have been successfully used in design and development of safety critical systems.

The main critique of the approaches based on Formal Concept Analysis is related to their scalability. Computation and update of Galois lattices are complex tasks, especially if the input data is large and evolves frequently. This can be seen as a serious drawback in development of automated guidance for ACM. To cope with this problem, several approaches based on filtering techniques have been proposed. Recent works demonstrate a possibility to generate Galois lattice from a data stream in real-time. In particular, some tools like FCA Stream Miner tool (Melo 2013), which implement this approach, have been successfully used for anomaly detection in telemetry data.

Scalability of context acquisition platforms can be pointed out as an issue for context-aware ACM. Indeed, the DCM component of the Case Navigation System described above needs to observe an important number of elements, identify and handle complex business events. This potentially involves connecting multiple distributed information sources. Recent solutions developed in the fields of pervasive systems and sensor networks demonstrate that it is possible to handle hundreds of sensors for observing context information.

Another critical challenge is related to the *heterogeneity* of contextual information: the DCM component has to deal with a multi-scale context, where information can range from simple coordinates coming from a GPS to complex client or market descriptions coming from cloud platforms, social networks, RFIDs and personal mobile devices. Such heterogeneous information has to be represented using multiple scales, demanding expressive models. This is an ongoing issue considered by numerous research teams. Complex Event Processing addresses the issues related to handling multiple heterogeneous information sources.

The problems described above mostly illustrate the theoretical challenges. Regarding the technological and adoption challenges we refer to Gartner's Hype cycle. Figure 3 illustrates the Hype cycle for emerging technologies for 2013[2] It evaluates the maturity, adoption and future direction for technologies and trends and helps us to illustrate some technological challenges. In particular, the Hype cycle from 2013 highlights the evolving relationships between humans and machines. According to this research, Predictive Analytics technologies already reached their plateau of productivity phase and are currently becoming the mainstream technology. Complex-Event Processing and Content Analytics technologies that also pave the road to context-aware ACM are currently on their peak of inflated expectations phase, meaning that the value of these technologies is not yet correctly estimated and their reputation is grounded on both success and failure stories. According to Gartner, both Content Analytics and CEP technologies will reach their maturity (the plateau) in 5 to 10 years (Figure 3).

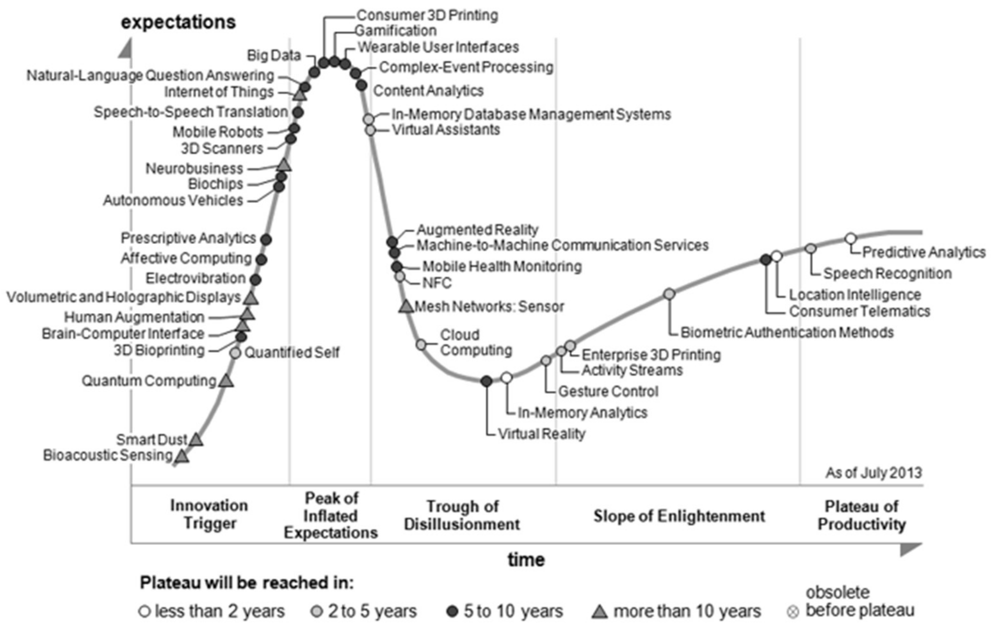



***Figure 3: Gartner's Hype Cycle for emerging technologies in 2013.***

The passage from the purely theoretical Case Navigation System described in this article to a concrete system that deals with a real life example presents a whole set of new challenges. We highlight just two of them:

- To **select the right level of granularity**, we have to identify relevant internal and contextual parameters that will affect the produced recommendations and determine case scenarios. This task is not easy even for a professional case manager with years of experience. The main risk is to

[2] (Source: Gartner, August 2013 http://www.gartner.com/newsroom/id/2575515).

get the system that is either too naïve (abstracts away too many parameters and produces only trivial recommendations) or too complex (produces scenarios and recommendations impossible to decipher or validate).

- To **specify and further improve the system logic**, we have to collect a substantial amount of data on case management history (past cases). Unfortunately, organizations often do not collect such history. Even if they do - very rarely they keep trace in a standard format that can be easily reused/understood.

In this paper, we presented the concept of Case Navigation System, which is grounded on academic research of our group. Our idea is to extend the capabilities of ACM supporting systems of today and to transform them from useful assistants to experienced guides and reliable advisors. Though a perspective of having fully automated case management sounds like science fiction and we are still far from inventing HAL 9000, some exciting functionalities such as context-aware scenario prediction and evaluation can be envisioned.

## 5. REFERENCES

(Bates 2012) Bates, J.: John Bates of Progress explains how complex event processing works and how it can simplify the use of algorithms for finding and capturing trading opportunities, Fix Global Trading, retrieved May 14, 2012

(Bettini 2010) Bettini, C., Brdiczka, O., Henricksen K., Indulska, J., Nicklas, D., Ranganathan, A., Riboni, D.: A survey of context modelling and reasoning techniques, Pervasive and Mobile Computing, vol. 6, issue 2, pp. 161-180 (2010)

(Birkhoff 1940) Birkhoff, G.: Lattice Theory, First Edition, Amer. Math. Soc. Pub. 25, Providence, R. I. (1940).

(Clarke 1996) Clarke, Edmund M., and Jeannette M. Wing. "Formal methods: State of the art and future directions." ACM Computing Surveys (CSUR) 28.4 (1996): 626-643.(Luckham 2012) Luckham, D. C. Event Processing for Business: Organizing the Real-Time Enterprise. Hoboken, New Jersey: John Wiley & Sons, Inc.,. (2012). p. 3. ISBN 978-0-470-53485-4.

(IMDB 1968) 2001: A Space Odyssey (1968), directed by Stanley Kubrick. IMDB: http://www.imdb.com/title/tt0062622/?ref_=fn_al_tt_1

(Janiesch 2011) C. Janiesch, M. Matzner and O. Müller: A Blueprint for Event-Driven Business Activity Management, Lecture Notes in Computer Science, 2011, Volume 6896/2011, 17-28, doi:10.1007/978-3-642-23059-2_4

(Luckham 2011) Luckham, David C. Event processing for business: organizing the real-time enterprise. Wiley. com, 2011.

(Melo 2013) Melo, C.A., Le-Grand, B., Aufaure, M. (2013) Browsing Large Concept Lattices through Tree Extraction and Reduction Methods, in International Journal of Intelligent Information Technologies (IJIIT).

(OMG 2009) Object Management Group, Case Management Process Modeling (CMPM) Re-quest For Proposal: Bmi/2009-09-23

(Vanrompay 2011) Vanrompay, Y. & Berbers, Y. Efficient Context Prediction for Decision Making in Pervasive Health Care Environments: A Case Study, In: Supporting Real Time Decision-Making, Annals of Information Systems, vol. 13, 2011, Springer, 303-317

## 6. OTHER RESOURCES:

(Arcangeli 2012) Arcangeli, J.-P.; Bouzeghoub, A.; Camps, V.; Canut, M.-F.; Chabridon, S.; Conan, D.; Desprats, T.; Laborde, R.; Lavinal, E.; Leriche, S.; Maurel, H.; Péninou, A.; Taconet, C. & Zaraté, P. "INCOME – Multi-scale Context Management for the Internet of Things". In: Paternò, F.; Ruyter, B.; Markopoulos, P.; Santoro, C.; Loenen, E. & Luyten, K. (Eds.), Ambient Intelligence, Lecture Notes in Computer Science, vol. 7683, 2012, Springer, 338-347

(Bider 2013) Bider, I., Johannesson, P., Perjons, E.: Do workflow-based systems satisfy the demands of the agile enterprise of the future? In: Rosa, M.L., Soffer, P. (eds.), Business Process Management Workshops (BPM 2012), Lecture Notes in Business Information Processing, vol. 132, pp.59-64,., Springer (2013)

(Kirsch-Pinhero 2013) Kirsch-Pinheiro, M., Rychkova, I. (2013). Dynamic Context Modeling for Agile Case Management 2nd International Workshop on Adaptive Case Management and other non-workflow approaches to BPM (AdaptiveCM 2013), OnTheMove Federated Workshops, Graz, Austria, 9-13 September 2013, to appear.

(Rychkova 2013a) Rychkova, I., Kirsch-Pinheiro, M., & Le Grand, B. (2013). Context-Aware Agile Business Process Engine: Foundations and Architecture. In Enterprise, Business-Process and Information Systems Modeling (pp. 32-47). Springer Berlin Heidelberg.

(Rychkova 2013b) Rychkova, I.: Exploring the Alloy Operational Semantics for Case Management Process Modeling. In proceedings of IEEE 7th International Conference on Research Challenges in Information Science (RCIS'13) ISBN ISBN #978-1-4673-2914-9

(Swenson 2010) Keith D. Swenson. Mastering The Unpredictable: How Adaptive Case Management Will Revolutionize The Way that Knowledge Workers Get Things Done. Meghan-Kiffer Press, 2010.