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Innovation of IT metasystems by means of event-driven paradigm using QDMS

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Globalisation of world economy brings new and more complex demands to business systems. In order to respond to these trends, business systems apply new paradigms that are inevitable reflecting on management metasystems – quality assurance (QA), as well as on information technology (IT) metasystems. Small and medium enterprises (in particular in food industry) do not have possibilities to access external resources to the extent that could provide adequate keeping up with these trends. That raises the question how to enhance synergetic effect of interaction between existing QA and IT metasystems in order to overcome resource gap and achieve set goals by internal resources. The focus of this article is to propose a methodology for utilisation of potential of quality assurance document management system (QDMS) as prototypical platform for initiating, developing, testing and improving new functionalities that are required by IT as support for buiness system management. In that way QDMS plays a role of catalyst that not only accelerates but could also enhance selectivity of the reactions of QA and IT metasystems and direct them on finding new functionalities based on event-driven paradigm. The article tries to show the process of modelling, development and implementation of a possible approach to this problem through conceptual survey and practical solution in the food industry.

Keywords: system management; quality; document management; QDMS; HACCP; SOA; event driven; BAM; CEP

1. Introduction

Companies today face a trend of accelerated changes in market conditions, requirements and activities at a global and local level Hoyle (2006). This requires new approaches to work organisation in order to provide maximum agility, reusability and flexibility in order to achieve optimum performance, cost, speed and quality of products and services. According to Zhuge (2002), this has resulted in a shift from primarily functional silo-based organisations (entities are the key business functions) to object-based process management (key entities are business processes as objects of business systems). As companies' business processes need to change and adapt with a frequency much greater than before (Lu, Sadiq, and Governatori 2009), and knowledge of business process management (BPM) becomes the most valuable commercial and academic resources

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(Moitra and Ganesh 2005), this implies that the processes of quality assurance (QA) and information technology (IT) (Zeng, Shi, and Lou 2007) (which is to provide information management support processes) have to adapt even faster.

There are two trends that the authors detected as a global company responds to rapid changes and demands in the market (Bernardo et al. 2009; Caswell, Bredahl, and Hooker 1998), which are:

(1) The implementation of the quality management system (QMS; QA metasystems; Trienekens and Zuurbier 2008) that can be divided into three categories (Anderson, Daly, and Johnson 1999):
   (a) Metasystems whose binding is regulated by the introduction of home country legislation (e.g.hazard analysis and critical control points (HACCP) (O'Neill and Sohal 1999);
   (b) Nested voluntary metasystems that companies implement in response to growing needs of competitiveness in the market (Karantininis, Sauer, and Furtan 2010);
   (c) Quasi-voluntary metasystems that companies implement as a de facto obligation to survive in the market in general (British Retail Consortium (BRC) – Global Standard – Food Packaging).

   (It should be noted that the ISO 9000 generic metasystem is applicable in any field of business and is the basis for other metasystems, while for example the HACCP and BRC metasystems are specific to the food industry.)
(2) The implementation of BPM/ERP (enterpise resource planning)/CRM (customer relation management)/BI (business intelligence) subsystems as building blocks for IT metasystems support of business management systems. And here it should be noted that the BPM is the infrastructure metasystem on which other IT metasystems are based.

Although in practice QA and IT metasystems are most often implemented as separate projects, they present the layers of the same business system. As business processes become the most valuable company corporate resources (Ilyukhin, Haley, and Singh 2001) all metasystems are aimed at agile modelling, management and optimisation of a systems business processes.

The food industry as a propulsive industry segment is particularly susceptible to constant change and demands for improvement from both the market (caused by sudden changes of demographic, economic and social maps of the world, which causes a change of lifestyle consumers) and business environment as required by state regulations. The primary focus of the food industry is the aspect of food safety for use, that is ways in which this can provide security in global terms.

This implies necessity that processes in critical points should be monitored with extra attention, to make them traceable (food traceability from field to plate) (Regattieri, Gamberi, and Manzini 2007) and capable for quick reaction to problem and return to stable phase (resilient) (Zhang and Van Luttervelt 2011; Carvalho and Cruz-Machado 2011). In addition, very important issue concerning food industry is environmental sustainability Gerbens-Leenes, Moll, and Uiterkamp (2003).

Trends that are observed in the food industry can be divided into the following groups:

(1) Changing the organisational structure in terms of the pursuit of vertical integration (Henningsson et al. 2006), especially for small and medium enterprises (SMEs) (sustainable value chains) in the form of:

- Ownership vertical integration
- Contractual vertical integration
- Vertical integration in the form of networks and associations.

(2) The development of a number of public and private standards for safety and quality in the process of obtaining the food chain (Trienekens and Zuurbier 2008) (HACCP, good agricultural practice (GAP), BRC, etc.) in response to global market demands of food products.

(3) Monitoring, acquisition and application of process automation by means of hardware and software sensors (Etzion and Niblett 2010; Eric et al. 2010; Lai and Liu 2009; Wang, Zhang, and Wang 2006).

These trends lead to complexity of the business environment and the need to introduce integrated management systems. Accordingly, this leads to a set of new and more complex requirements for IT support management, which require change and the implementation of new paradigms. All these in case of SMEs indicate an imperative of reaching necessary competitiveness for existence on the market (sustainability, agility, traceability, resilience, control points monitoring, innovativeness), and thus it faces them with the problem of lack of additional, in most cases, external resources (particularly in the area of knowledge) that are unavailable (or insufficiently available) especially in food industry. Therefore, this article through the methodological and practical approach attempts to show the implementation of one of the possible solutions to overcome this, in our view, the key problem in SMEs operating in the current global conditions.

While previous research on event-driven (ED) paradigm is focused on technical and technological problems, our work presents original methodological approach how in real business environment of SMEs to carry out prototypical testing as well as efficient and sustainable implementation of this paradigm, relying, in the first place, on internal resources codified within the documentation of ISO 9000 metasystems.

The aim of this article is to show the potential synergetic interaction that comes from QA and IT metasystems in SMEs which do not have significant, primarily human resources such as large organisations, using methodological and practical application. The starting idea is to demonstrate the potential of a quality assurance document management system (QDMS) as a catalyst for process modelling and application of a new information paradigm.

The general idea is that quality system documentation could be a catalysts of ED paradigm in development of customised software solutions. On the other hand these software solutions with defined analysis of existing data could provide valuable feedback to management and QA procedures. The work is based on practical application in the food industry, in particular for the process of collecting, analysing and receipt of raw milk in a dairy.

In addition, the manuscript presents the case study of the application of this methodology in the food industry by means of originally developed software solution. The article provides significant experiences that might be helpful in future research and project implementation in this area.

2. Domain knowledge of real system

Metasystem is abstraction of other real systems in terms of describing, generalising, modelling or analysing the other systems. More formally (Gadomski 2004): 'if S is a system composed with objects O and given attributes A, and relations between its attributs consist an abstract systems called properties P, then the system composed with Pm $\subset$ P

and their interrelations, can be called metasystem of S. The system S is called reference system or domain system.'

In this article, the reference system is a business system of the organisation, while the metasystems, which are the subject of research are:

- QA metasystem – abstraction of the real system in terms of QA (the increase in demand for quality led to the introduction of QA metasystems especialy for food production and processing; Caswell, Bredahl, and Hooker 1998). Components of QA metasystem are ISO 9000 (generic QA metasystem), HACCP; OHSAS (Occupational Health Safety Advisory Services), etc.
- IT metasystem – abstraction of the real system in terms of information and communication technologies. Components of IT metasystem are BPMS (business process management system as generic IT metasystem), ERP (enterprise resource planning system), BI, BA (business applications), CRM (customer relationship management), DM (document management system), BAM/CEP (business activity monitoring with complex event processing), etc.

3. QDMS as a catalyst of the ED paradigm

Service-oriented architecture (SOA) is an effective technology for the integration of distributed information systems in complex enterprise environments. SOA is based on the technology of web services where the user request is forwarded to certain services, which provide a distributed service provider by the adjustment of the request/response mechanism, which after processing the request returns a response to the user. However, in business systems with a high level of distribution functions, these pulling services based on request/response mechanisms do not provide a sufficiently effective and flexible solution, because the business environment is changing rapidly in order to successfully respond to various environmental conditions. In particular for food industry there are also demands for critical control point (CCP) monitoring, process traceability and process ability to quickly respond to changes and return to stable phase. These are the reasons that impose the ED paradigm as an additional approach to complement the SOA paradigm, because it allows more natural application of distributed services through the publish/subscribe mechanism.

Event-driven architecture (EDA) already has a significant influence in the business environment, but the problem of identification and analysis of data of interest, in real time, prevents adequate agility and the ability of companies to make timely and accurate business decisions. It is therefore of vital importance that BPM/ERP/CRM solutions based on SOA architecture continuously and in real time monitor the flow of events (Liu and Lai 2011), make their processing (transformations, filtration and the events spotting patterns predefined occurrence scenarios of importance Menon et al. 2004), respond automatically and/or inform the system of business/management and thereby initiate the adjustment of business activities/processes triggering timely preventive/corrective actions. To ensure this, it is necessary to implement a BAM/CEP (Kong, Jung, and Park 2009) layer in the IT metasystem's organisation, which is based on the paradigm of the EDA.

The ED approach provides great flexibility and asynchronous functioning of software solutions, but in the application, as a new paradigm, it is facing a shortage of resources needed for actual implementation and enforcement.

The lack of resources in the ED approach in modelling are:

- The lack of standardised templates for certain model segments (vertical) and certain branches of business (horizontal).
- Lack of trained personnel for consulting when modelling an ED system.
- The inability of SMEs to engage consultants or train staff for the ED model, to deploy and implement the management system.

The aforementioned disadvantages initiate the problem of defining the initial settings of the ED starting model, which can be classified into:

- Detection of suitable candidates to be participants in the model and definition of their role (event producer, event consumer, event processing agent).
- Defining the type and means of the necessary event processing:
  - Processing events that are detected in the system
  - Detection of the scheme of events of interest (event patterns) for business and
  - Defining complex business events in response to changes in the system.

This resource gap and mentioned problems that arise from it can be overcome by using QDMS as a knowledge base of the organisation.

Application services, available from the provider, map the business process in a services' modelled business environment, which is described in detail by the documentation management system. In order to make the mapping efficient, it is necessary that the documentation credibly reflects the business system and all its changes, as well as that there is a mechanism of the prototype for the testing of change through records in the documentation system. This raises the quality documentation system to a level of mechanism for iterative improvement of the business performance systems.

All this implies a strong demand for the implementation of a QDMS, which is based on the process organisation. QDMSs are based on knowledge of staff (management) organisation as well as integrated management system standards.

A QDMS must traditionally provide management of:

- QMS documentations
- QMS records

But that is not enough to achieve the necessary competitiveness of the organisation, and in addition to the above requirements a QDMS must provide:

- Monitoring and analysis of knowledge flows at the individual and team level.
- A proactive QDMS in terms of assistance to automate and optimise the use of documentation in the execution of business activities (Wallace and Mortimore 2000; Luckham 2007).
- Application of text data mining content and metadata of documentations (Panisello and Quantick 2001).

This provides an opportunity to use the QDMS as a base of knowledge and a development platform for modelling ED subsystems in segments where the request–response paradigm is not applicable because of the necessity for large and complex re-engineering

and continuous adaptation of existing IT solutions that exceed the available resources, or futileness due to the nature of business processes.

4. HACCP AND ED/BAM/CEP principles

The practical part of this article focuses on examples from the food industry (industry of production and processing of milk and dairy products) in which the binding QA metasystem is HACCP (it is more appropriate to introduce it integrated with generic ISO 9000 QA metasystems as the base (Huaji, Huarui, and Xiang 2009), but it is logical to impose exactly the same paradigm with organisations from any other area of business.

The basic generic principles of QA metasystems are:

(1) Extended documentation business systems and business processes that make up that system ('write down what you do, and then do what you have written down').
(2) Implementation and approval of system.
(3) System of internal auditing (by internal auditors) and external (by an unbiased third part auditor).

The basic principles of HACCP metasystems are (Luckham 2004):

(1) Identifying human health hazards that may arise in food production, processing, or distribution.
(2) Establishing CCPs for each of these hazards.
(3) Instituting preventative measures to be taken at each CCP to keep hazards within critical limits.
(4) Establishing monitoring procedures and clear actions to be taken in the case of a violation of the critical limit at each CCP.
(5) Keeping records of all activities that influence the safety of the product.
(6) Continually updating and validating the HACCP system.

As a natural solution to the IT paradigm, which would successfully map the QA paradigm in the food industry (e.g. ISO 9000 + HACCP) the use of events managed architecture (BPM/SOA/BAM/CEP) (Voisard and Ziekow 2011) is imposed (Figure 1).

A good example of the application of BAM/CEP for HACCP implementation is a software solution for the Israeli dairy farm management company AfiFarm AfiMilk (V. Ammon, Silberbauer, and Wolff 2007). While not structured as SOA architecture, it creates a cloud of real-time events, compares it with historical data and based on the predefined scenarios, it makes the prediction of complex events (such as the occurrence of mastitis in cattle) and automatically makes a corrective action of the treatment of livestock and informs the farm managers.

The problems with the implementation of a BAM/CEP layer metasystem's HACCP environment that have been suggested by previous research (V. Ammon, Silberbauer, and Wolff 2007) refer to the technical aspects of issues such as the capacity that a CEP event system can handle, the number of lost events, and the system agility to changes in real time, system traceability, resilience and sustainability, facilities for processing and analysis of events, optimisation of processing events, etc.

This article attempts to provide a model for how to make (in a real business environment) efficient, effective and sustainable:

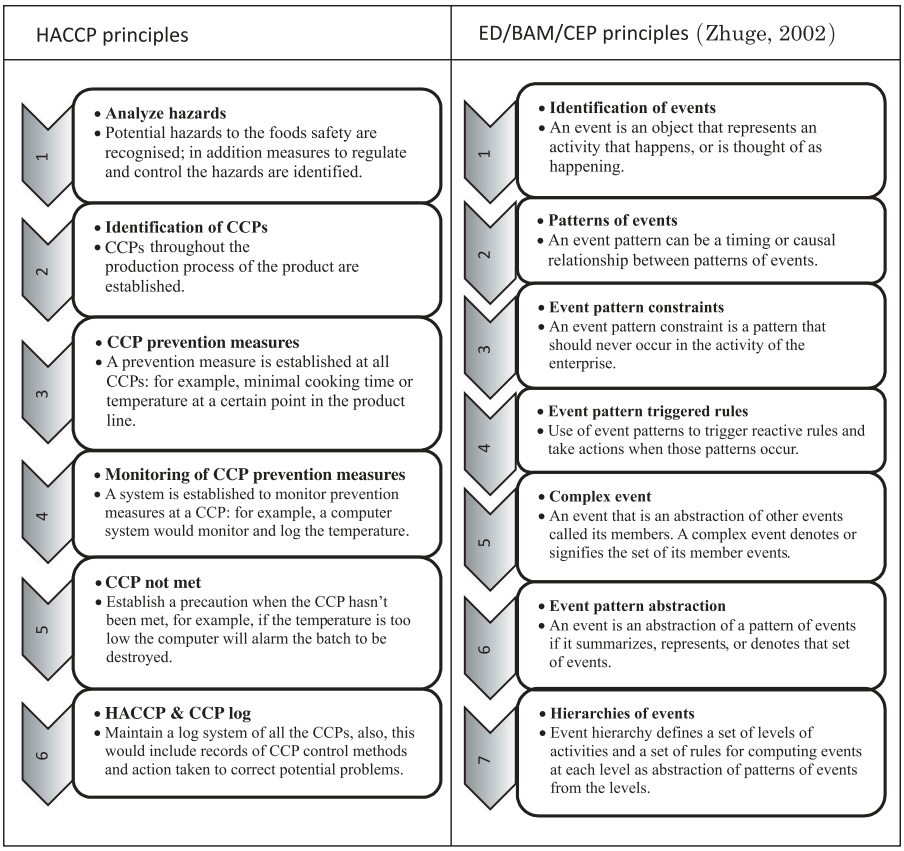

Figure 1. Mapping of HACCP and CEP principles.

- Implementation tools for training the management personnel to be involved as carriers of the redesign of business systems to the new SOA/BAM/CEP paradigm, and the benefits obtained through implementation of ISO 9000 + HACCP QA metasystems.
- Implementation of the logic of the new paradigm in the current business: IT solutions and its prototype testing by the staff and management, with the support of IT staff and consultants.
- Implementation and application of the new and altered IT solutions that are designed according to the new paradigm, but also logically tested through prototype implementation.

This would test the potential synergetic effect on the benefits obtained by the complementary application of QA and IT metasystems to the business systems by using QDMS as a process catalyst.

5. Approach to event-driven IT metasystems' remodelling

During the execution of business processes, organisations must adapt a continuous cycle system, which is formally defined through policy and quality objectives. Implementing

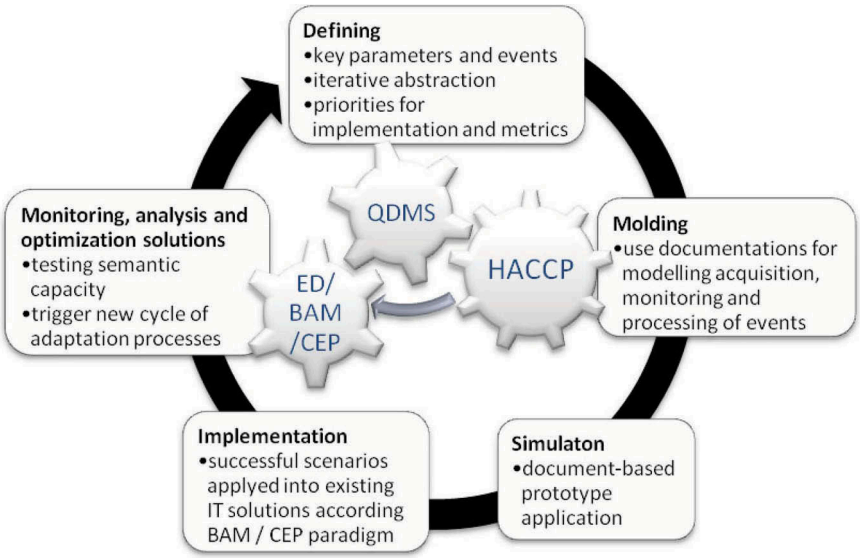

Figure 2. Remodelling cycle.

BAM/CEP/ED architecture must be seen as infrastructure improvement, not as the ultimate replacement of the existing IT metasystems.

The remodelling is done in cycles consisting of five phases and interaction of three metasystems (Figure 2). QDMS primarily serves as a catalyst of the process, but it is natural to achieve synergetic effect of all three metasystems.

5.1. Defining

Before one starts with the implementation into the existing IT metasystem, it is necessary to provide the procedures and tools to analyse existing data on the events, as valuable corporate resources from which, colloquially speaking, we read the history of the event.

There are three phases:

- Defining the key parameters of the process and subprocesses (extracting the significant minority of the insignificant majority – to overcome IT blindness) and their connection with events that are broadcast and events that consume them (the events in the processes and their interactions in the system).
- Iterative abstraction of low semantic events into high semantic events (data filtering, event detection scheme scenarios – paterns of events, as well as data derivation through iterative drill-down cycles that increase the capacity of abstraction and thus raise the semantic value of the complex events that are detected after each cycle) (Figure 3).
- Defining priorities for implementation and measurable performance parameters of the process according to set business objectives.

In Figure 4 a schematic representation of the iterative process of abstraction of low semantic events into high semantic events is shown. In Table 1 a generalised and

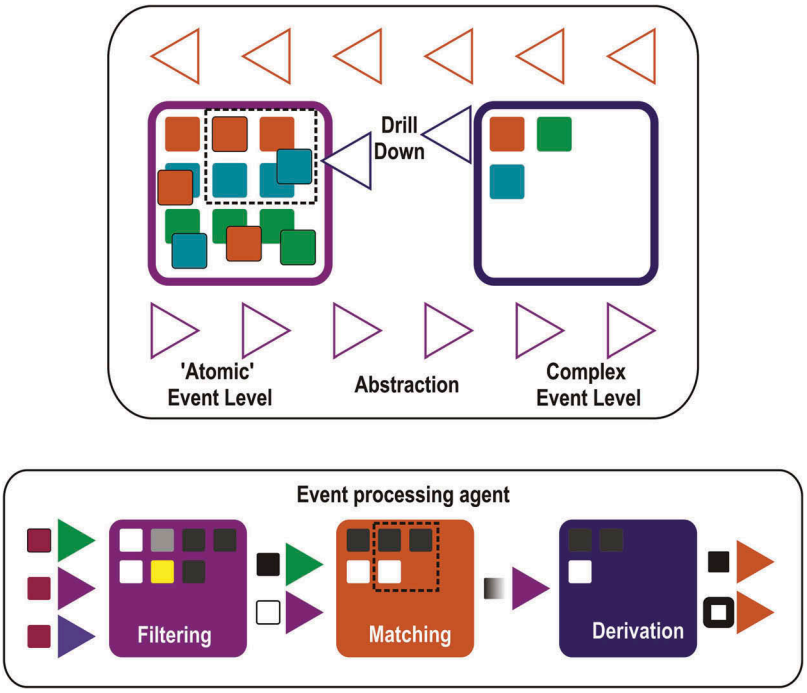

Figure 3. Event processing.

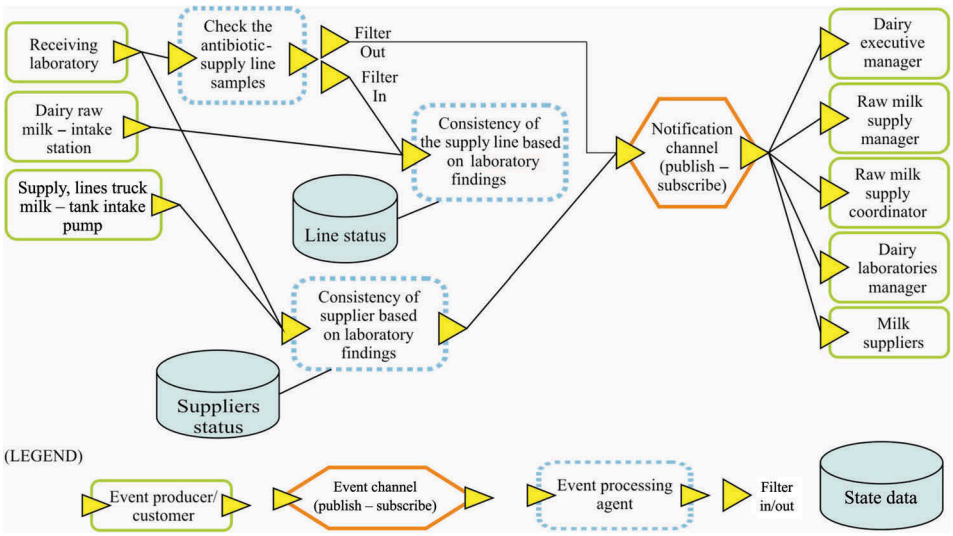

Figure 4. ED management system diagram – collection, analysis and reception of raw milk into dairy.

Table 1. Mathematical model.

$I_n = f_n\left(\sum_{x=1}^{x=n-1} D_x\right)$	1
$f_n = f_{nF} \cdot f_{nM} \cdot f_{nD}$	2
$I_n = D_{n+1}$	3
n	Level of abstraction (abstraction levels are not unambiguously determined, but depend on the availability and level of accuracy of data about events at a time and a given environment, i.e. the context of the events)
D_n	Information about the events of the n-th level of abstraction (no semantics at this level)
I_n	Information on the events of the n-th level of abstraction (with semantics at this level)
f_n	Aggregate data processing functions of the events
f_{nF}	Data filtering functions on the events of the n-th level of abstraction
f_{nM}	Patterns detect function of data on events in the n-th level of abstraction
f_{nD}	Derivation function of the new event based on information about events on the n-th level of abstraction

simplified mathematical model of the iterative process of abstraction of low semantic events into high semantic events is shown.

It is logical that priority is given to events directly defined by the HACCP metasystems as they are by nature of the metasystems' principles described in most detail from the point of introduction of the new paradigms and therefore carry the lowest risk of concept collapsing due to the lack of successful implementation.

5.2. Modelling

As the QA metasystem (here ISO9000 + HACCP) involves complete system documentations, implementation of modelling acquisition, monitoring and processing of events is recommended through (1) the DM process and (2) the records management process of the QA metasystem, adhering to all scheduled activities of these two processes. Table 2 shows the layers of the management documentation system and ED-based system that indicates a degree of parallelism and a recommendation for the documentation and mapping of ED-based applications in conceptual terms. (Another problem at this stage is the lack of standard definitions and holistic building blocks for the ED-based system).

The main problem at this stage is inadequate defining of the required pattern of scenario events (definition phase) and is a key reason for the failure and slow implementation of the BAM/CEP solutions in practice. To avoid this scenario it is necessary to engage consultants or experts within the company and reference models from a similar

Table 2. Layers of the ED-based applications and documentation management system.

Layer	Event-driven system-based application	Management of system documents supported by QDMS
1	Language layer	Standard procedures operating layer
2	Execution layer	Specific work instructions layer
3	Communications layer	Controlled forms and flow chart layer
4	Capturing layer	Data recording layer (completed forms, drawing and database)

business environment (in our case from the food industry with a focus on the HACCP QA metasystem).

5.3. The simulation/prototype application

In this case instead of the term simulation it is more appropriate to use the term prototype model application because it represents a review of the model, but in the real environment. This is also a milestone for a further improvement cycle. The experience of the authors is that the prototype application of that BAM/CEP solutions should be granulated to the individual scenarios that are modeled, and on the basis of measurable results to proceed with successful scenarios into the further course of cycle improvements. This is the stage when the prototypical form of the logical level forms the main elements of the BAM/CEP architecture, but the application is supported only within a QDMS. In practice this means that the QDMS has a dedicated module for modelling and prototype implementation of the acquisition, monitoring and processing events in an unstructured form. Instead of relational database as the data carriers, non-structured documents (forms) are used, and relational databases contain only the metadata of the documents.

In this way the users themselves define, try, repeal or 'track tramp' the most acceptable ways for their business process activity, which are only being technologically cultivated during the implementation phase.

5.4. Implementation and enforcement

Since it is not realistic to expect a sudden shift of enterprise IT systems to BAM/CEP/SOA solutions, after the prototype testing, successful scenarios would be implemented into existing IT solutions (applications, modules), approaching the maximum (as it allows the adaptation of existing modules in the sense of purpose) BAM/CEP paradigm, including the information push approach where managers are interested in subscribing to information about the events that occur in a scenario interesting to them, and the system would send data when a given scenario happened (here the scenario is actually the prediction of a complex event).

Implementation of the BAM/CEP paradigm should be seen as a way to expand the scope of activities of existing applications in a flexible and non-invasive manner. Instead of comprehensive interventions on existing applications, we should seek the extension of functionality that allows broadcasting and consuming events. In this way, the intermediate layer of processing events can be set aside and thus a rapid adaptation of existing solutions to new business requirements of the system (a tendency that the users perform iterative adjustment applications in use) would be enabled.

5.5. Monitoring, analysis and optimisation solutions

During the ED module's operation it is necessary to enable continuous monitoring and analysis of the set of process parameters and thus monitor the effectiveness and appropriateness of implementation in practice. In accordance with the ED paradigm, process parameters are data about the events to which the different business functions are subscribed on the basis of which new business scenarios are changed, eliminated or defined.

This phase includes extensive use of predefined and ad hoc (custom) data analysis of events in the system. Based on this analysis, the semantic capacity is raised to the level required to start a new cycle of adaptation processes.

6. Industry application

The practical part of the work focuses on the example of the business process of collecting, analysing, and receipt of raw milk as one of the key processes/subprocesses of the production and processing of milk and dairy products. Dairy production belongs to the food industry where the trend of implementation of integrated management systems (e. g. ISO 9000 + HACCP), makes it a good candidate for ED IT metasystems' remodelling. Dairies that are included in the study had already implemented:

(1) Integrated quality management – QMS metasystem
(2) IT metasystem in the area of composite applications with low levels of interoperability and high levels of data redundancy:
   - Program for managing documents of QA metasystems – 'QDoc' that was implemented in parallel with integrated quality management metasystems or later in the course of the project developed an additional module in QDoc for defining and managing records QMS.
   - Data mining module to analyse existing data in the IT metasystems – module of program 'QProMng' adapted to the specific needs of dairies that participated in the project.
   - Program to manage the business process of collecting, analysing and receipt of raw milk – QLabMlek an ongoing project functionally extended to apply the ED/BAM/CEP paradigm.

The aforementioned programs are intended for the general support of consultants and employees in the implementation of the QMS, but were modified during the project based on analysis of user requirements.

In the first phase of defining the key parameters, management system documentation for the selected process (collection, analysis and reception of raw milk) is used as the initial resource. This documentation consists of:

- Procedure
- Quality plan
- HACCP plan of process
- Process list
- Following forms

As we have mentioned in this article, the HACCP requirements are naturally mapped to the ED paradigm, the documentation is used to reach the initial model of the event processing network. The model is adjusted and optimised through an iterative drill-down process using historical data of legacy IT metasystems (Figure 4). After defining the framework that the BAM/CEP paradigm model takes, the above two software tools (QDoc and QProMng) provided a prototype system that allowed employees of the organisation to the following:

- Tool for 'DRILL DOWN' data mining that is done in iterative abstraction of low semantic information about the events in highly semantic information. Users choose databases, combine them through queries and analyse data. Thus, detecting patterns of events of interest to system performance.
- Developing and proposing of draft forms that recognise employees as occasional recurring event scenarios relevant to business decisions.

- Over the draft to the draft form is further optimised through team work (thus providing a channel through which to promote the exchange of flows of knowledge of employees).
- Acceptance of the document draft as a system document, its application for approval of the authorised functions and collaboration on the application form in practice.
- Defining the chronology and functions involved in the application form with different roles in a scenario in which the application form takes place (the launch, the recruitment, approval, distribution, use, taking action, etc.).
- Implementation in practice through the acquisition, monitoring and processing of generated events that initiate pre-defined triggers for starting the business decision records' application form as a prototypical model of the ED system.

In the implementation phase, ED scenarios that are successfully tested through QDMS are introduced. ED scenarios implementation refers to the infrastructure solution (Figure 5):

- Event register with the service parameters for publishing information about events.
- Mechanism for the subscription business functions to select data on the events at a given scenario (pattern-in) for the problems in receiving raw milk in the dairy
- Defining the trigger event in response to the appearance of the given scenario (a pattern).

Technologically, the solution is implemented using Visual Basic for Applications (VBA)/ Microsoft Jet Database Engine (JetDBE)/Simple Mail Transfer Protocol (SMTP) protocols (VBA/JetDBE/SMTP). This is not a scalable technology but has proven to be very applicable in this case with 20-less concurrent users.

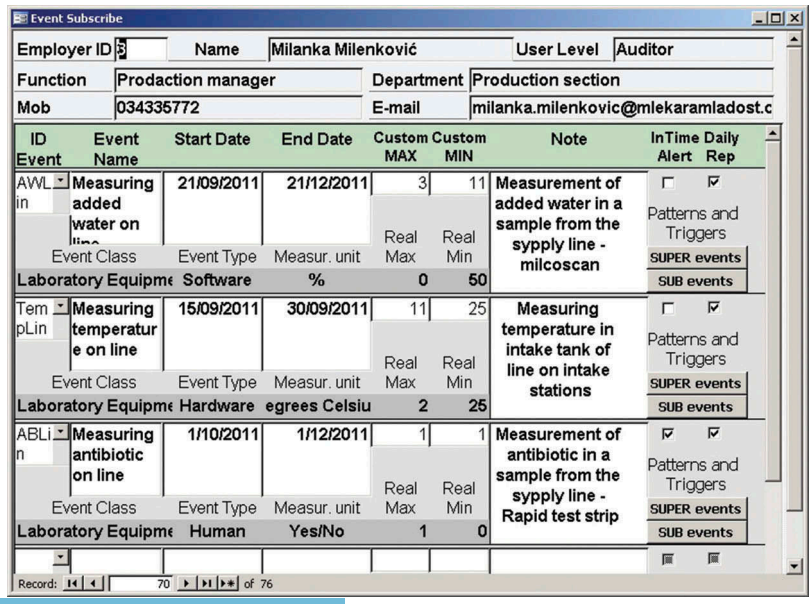

Figure 5. Event subscribe form.

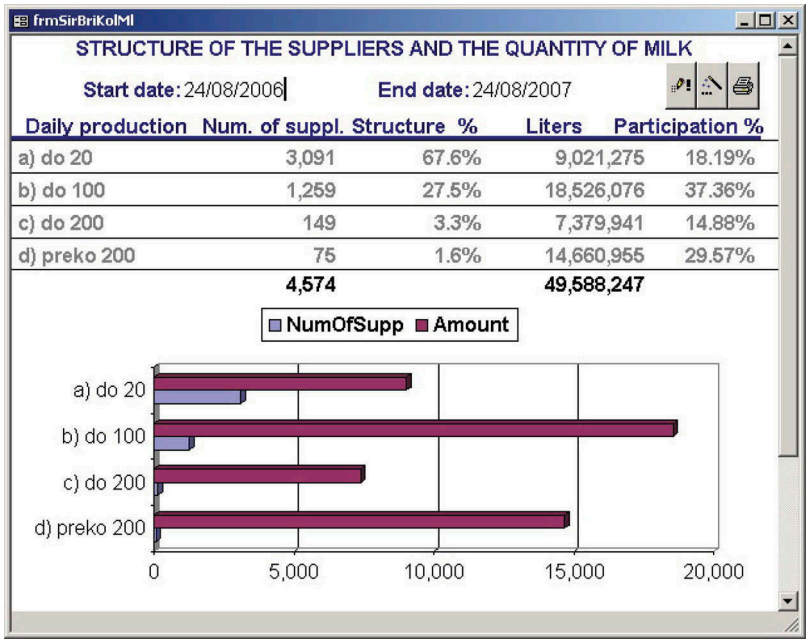

Figure 6. Milk producers – the structure of the average daily volume.

The monitoring, analysis and optimisation solution are realised through the tools of predefined data analysis, specialised for the reception of raw milk. The tools are implemented as a module within the QProMng and are flexible enough to allow the linking of different existing legacy databases of the dairies that participated in the project (Figures 6 and 7).

The main purpose of this module is that management based on information about events to which is subscribed to be initiated to start the analysis and early response to this potential problem. (Catch small problems before they become big problems.)

7. Conclusion

The article showed a methodological frame for modelling, prototypical testing and implementation of ED layer in existing IT environment. This methodology was also implemented in practice. The final outcomes and practical contributions of implemented methodology are:

- Additional module of existing QDMS software that serves as prototypical platform for initiation, modelling and application of acquisition, monitoring and processing of potentialy significant business events and scenarios with respect to ED paradigm and which is availabe to all users.
- Additional functional ED layer as an expanded range of action of existing BA that is able to process successfully tested events and scenarios from prototypical phase. Instead of overall intervention on existing BAs, a module is added that allows emission and consumption of events, as well as analysis of the data about events in the system. Based on these analyses management raised its semantic capacity to a level that is required for making business decisions.

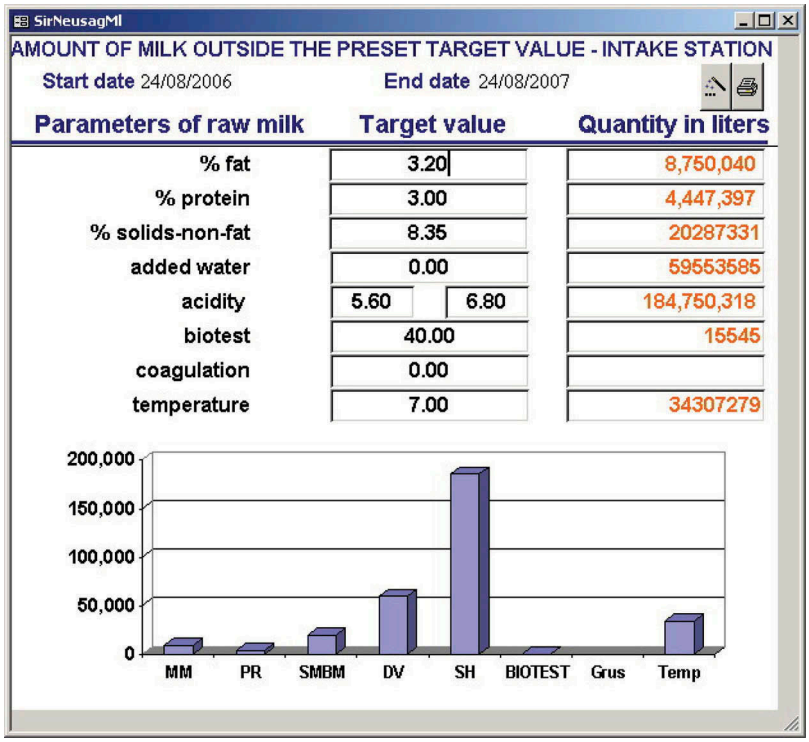

Figure 7. Conflicting milk – the structure according to chemical–physical parameters.

The article tried to show a way to encourage and take advantage of the potential synergetic effect of QA and IT metasystems of a business system in SMEs. It points to the possibility that the DM system of quality, with partial modification of the QDMS, can form a prototype platform for testing the potential of improving business systems using the BAM/CEP/ED paradigm and its implementation within the existing IT solutions. The article did not deal with the technological side of the applied solutions, but the possible application of the concept is shown. Therefore, the performance and scalability of the applied technologies are not relevant in the work, although it can be noted that the generic web services as SOA technology are in accordance with this model.

For a concrete example of the selected application in the food industry due to the authors, there is a natural mapping of HACCP and BAM/CEP/ED principles and the concept is shown as more clearly perceived, which in any case does not limit its application to other business sectors. From the standpoint of the business system concept, it provides a gradual, noninvasive way to enhance your existing IT metasystems relying on their own resources. As a result of applying the concept of the redesign program modules, in the long term, we can detect these indirect benefits from the project:

(1) Sustainable form of development and the further improvement of IT metasystems given to the concept of relying on dairy internal resources.
(2) Raising the organisational culture of middle management to understand:
   - The need and the connection (in practice they are most often implemented as separate projects) of QA (e.g. ISO 9000 + HACCP) and IT metasystems as layers of the same business system.

- Business processes as the most valuable corporate good of a company and their need for agile modelling, control and optimisation of these business system processes.
- Purposes of applying the SOA and EDA paradigms in a complementary relation in order to achieve agility, visibility and effectiveness of the business system as a whole.

(3) Exchange of good business practices that is created by working on a similar issue in a number of organisations from the same branch, and its propagation both vertically and horizontally.

Realistically measurable results will be visible after one cycle of the application modules for it because it will take a one-time dairy cycle of monitoring data (seasonal trends have a significant impact on the dairy and the best results are obtained only in comparison with data from the same period).

Finally, we could draw the following general conclusion: all metasystems that are implemented must be voluntary – metasystems as catalysts that companies implement in response to growing needs of competitiveness in the market, not as barriers imposed by formal legislation; and all metasystems present the layers of the same business system and make sense only if they contribute to the positive synergies of the business system.

Conflict of interest disclosure statement

No potential conflict of interest was reported by the author(s).

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