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THE USE OF AN EXTENDED DATA-DIALOG--MODELING PARADIGM IN THE PROCESS OF BUILDING DECISION SUPPORT SYSTEMS FOR END USERS – THE EXAMPLE OF COMARCH FACTORING FRAUD PREVENTION

Introduction

Almost thirty years ago, Sprague and Carlson described their data-dialog--modeling paradigm in a book titled *Building Effective Decision Support Systems*. It represented a pioneering attempt to offer a universal approach to deploying decision support in different environments [SpCa82]. The paradigm was a true milestone that has revolutionized the way decision support is addressed to different decision makers. Decision support system (DSS) architectures that have sprung up from that seminal concept provide a widely accepted reference framework for most contemporary DSS designers [TwSW11].

The Extended Sprague-Carlson paradigm

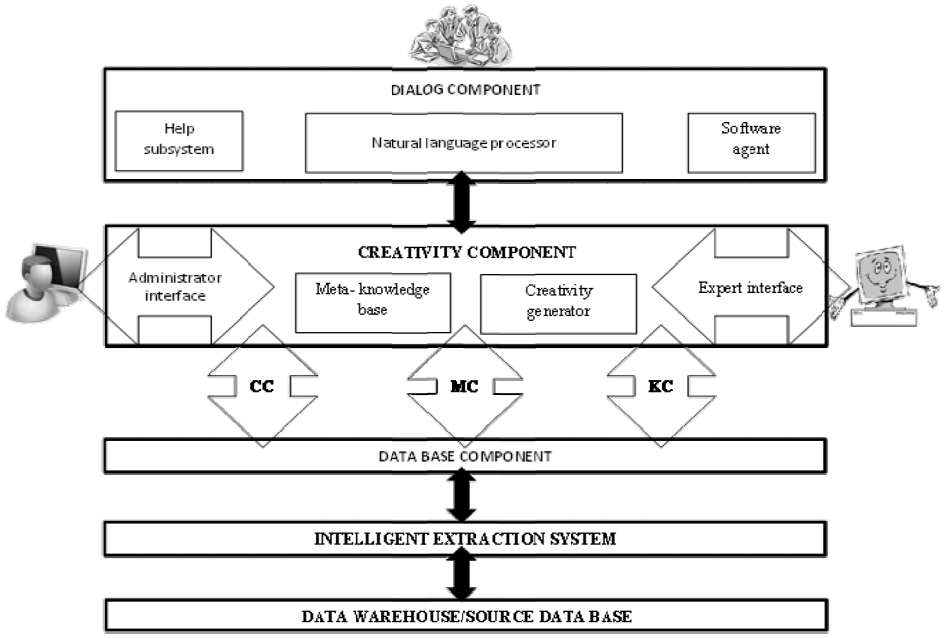
In 1999, a team headed by Prof. Stanisław Stanek proposed the inclusion of additional elements to the classical Sprague-Carlson paradigm. They chose to pursue three new strands of research [Stan99]:

- communication,
- knowledge,
- creativity.

The three new elements were appended in response to the rapid growth of new technologies used in decision support – the new information era seemed to call for modifications of the Sprague-Carlson triad to make it better suited to the evolving

needs of designers and their customers. These needs are broadly reflected in current DSS classifications, which differentiate between systems oriented on data, dialog, modeling, knowledge, communication or, just recently, creativity [StST06].

The complete paradigm in its extended form, including the new elements, is shown in Figure 1. The diagram visualizes the placement of the particular elements within the context of a sample decision support system.



Key:
CC – Communication Component,
MC – Modeling Component,
KC – Knowledge Component.

Fig. 1. The Creative Decision Support System architecture

Source: [Stan99].

Over the last few years, the software house CONSORG S.A. has successfully implemented several business intelligence systems whose architecture is aligned with this extended paradigm. The projects were conducted within the financial sector and involved strategic management of capital groups [TwSW11].

This paper also features a case study demonstrating how the extended Sprague-Carlson paradigm underpinned the development of an innovative decision support tool called Comarch Factoring Fraud Prevention. Within this system, support was deployed to the decision making process as well as to risk management and data monitoring, hence each of the components – data, dialog, modeling, communication, knowledge and creativity – was instrumental [WWW1].

The basic characteristics of the Polish factoring market

Factoring is a rapidly growing class of products in the financial services market, perceived as an increasingly attractive alternative to traditional overdrafts. This financial tool can be seen as bridging the equity and the market information gaps and as an important financing instrument for operating activities. Thus, in many cases it can be essential to the survival of entities concerned. This characteristic accounts for the potential of the factoring market, which, even in developed economies such as Germany's, experiences dynamic growth at an annual rate of 30% (37% according to the Polish Factors' Association) [Bakk04]. Overall, since this service was first launched in Poland in 1995, the Polish factoring market has grown by more than 900%. Understandably, with entrepreneurs' increasing awareness of the opportunities offered by factoring, more and more companies are interested in using this instrument. Joachim Secker, a spokesman for the Board of Deutscher Factoring-Verband [Krec10], argues that the trend is sustainable largely due to the fact that customers who have benefited from factoring during the financial crisis will maintain a good opinion of this product and are likely to continue using it. This rising trend is evidenced in Figure 2. The data used in plotting it have been supplied by a scholar from the University of Warsaw and are based on annual reports by the Polish Factors' Association [Krec07].

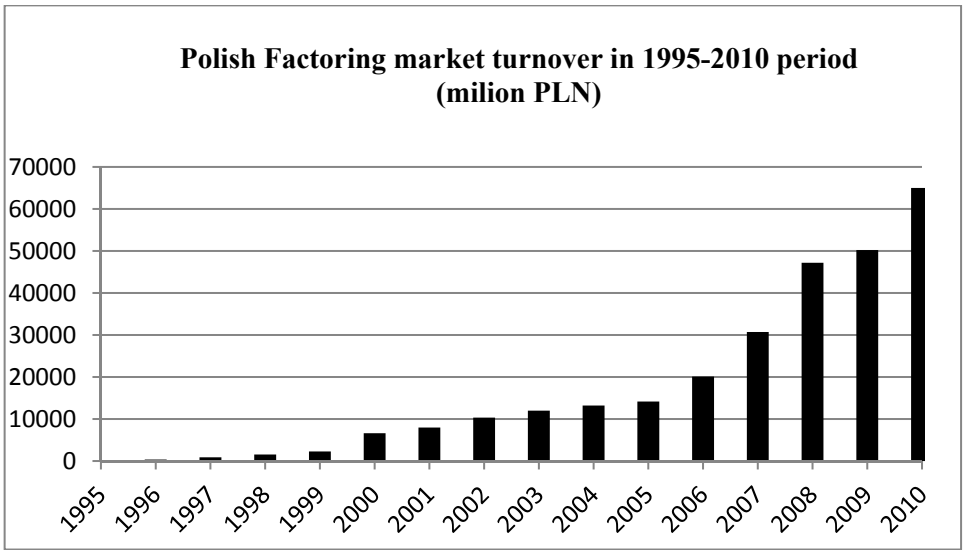


Fig. 2. Turnover in Poland's factoring market in 1995-2010

Source: [Krec07].

The Origins of Comarch Factoring Fraud Prevention

Responding to the market demand which has been indicated above, one of the largest Polish software companies COMARCH S.A. developed a support system solution for factoring transactions. While performing the first implementations throughout 2010, COMARCH engineers conceived a number of innovative enhancements to it. One of those was a solution addressing risk management in factoring transactions. As a result, tools were created that actually lie on the borderline between Business Intelligence and decision support systems and illustrate an interesting approach to support for factoring business processes*.

Risk management in factoring processes – problem definition

Like any other credit business, the factoring process is associated with the lender risk [Krec10]. However, in the factoring business most risks arise at the debtor's end or pertain to relations between the client and the debtor. This is a consequence of the very nature of factoring transactions, where the contractor is liable for the debt. It could be therefore stated that the credit risk allocation implies the risk of factoring [Krec07]:

1. Limited opportunity to examine the adequacy and reliability of the subsequent payer – at early stages of collaboration, the factor has to solely rely on documents supplied by the contractor-client.
2. The possibility of a contractual prohibition on receivables assignment to the factor; limitations of this sort have a similar effect as in 1 above – the need to trust the client's assertions and representations.
3. Risks associated with the assessment of a debtor's creditworthiness and credibility due to limited access to documents describing the debtor's standing or credit history.
4. Risks associated with companies that appear in different roles under various factoring contracts provided by the same factoring company or bank.

Support for these issues requires cooperation among factors in exchanging information about dishonest contractors or any incidents that may affect the competitive position of individual enterprises/banks performing factoring services. Factoring businesses should implement active risk management through [Krec07; Krec10]:

– risk identification,
– risk measurement,

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– risk control,
– project risk assessment.

The above analysis shows that, within the factoring process, factors must deal with two principal aspects of risk management:

1) no authorization to sign contracts that are too risky from the viewpoint of recovery,
2) ongoing monitoring of the entire portfolio of transactions passing through the transactional factoring system.

Given the wide range of transaction information to be handled, the portfolio should encompass the following [Bind97]:

– requesting the original copy of any invoice presented for purchase by the client,
– retrieving information from debtors on receivables assigned to other parties,
– notifying the debtor of any changes to the account number for receivable payments,
– document verification (including invoices),
– analysis of factoring contracts,
– building (a methodology of) indicators to track incidents that are likely to influence client behavior,
– adjusting the costs to purchase receivables and the cost of factoring fees to the level of risk exposure,
– offering different lines of factoring products, e.g. recourse factoring, non-recourse factoring, maturity factoring, etc.,
– providing additional protection for factoring transactions (e.g. a bill of exchange),
– establishing the right combination of different types of factoring limits,
– ensuring diversification of the clients and debtors portfolio,
– 24/7/365 monitoring of the parameters of factoring transactions.

IT vendors must confront the challenge of creating a tool that would be capable of performing such a broad range of functionalities and, at the same time, flexible enough to be able to interact with all major transactional solutions available in the trade finance market.

Comarch Factoring Fraud Prevention – system architecture

The preceding chapter has led to the question of what kind of information system could help simplify and automate these processes. Recently COMARCH S.A. undertook a project called *Implementing innovation in IT systems for factoring process management* [WWW1]. A considerable portion of the project was concerned with the design and development of Comarch Factoring Fraud Pre-

vention (CFFP) – a system which provides factors with assistance in analyzing large amounts of transactional data and satisfy the requirement of delivering *the right information to the right person in the right format, at the right time and the right place* [IaHe07]. This innovative solution has close affinities with two classes of information systems: decision support systems and Business Intelligence systems. Considering its key characteristics, it can be said to belong to both these classes [Stan99]:

1. It employs data mart technology, where the data mart is a standalone, independent system rather than part of another data warehouse.
2. It has a rich set of atomic indicators which can be easily aggregated to any level of detail.
3. The system is equipped with presentation tools to visualize indicators the same way that Management Information Systems typically do.

For the sake of clarity of presentation, the CFFP architecture and functionalities will be discussed in reference to the extended Sprague-Carlson paradigm which has been introduced in first part of this paper. This methodology permitted the developers to create a tool that would be flexible enough to support such complicated processes as risk management and fraud prevention in factoring.

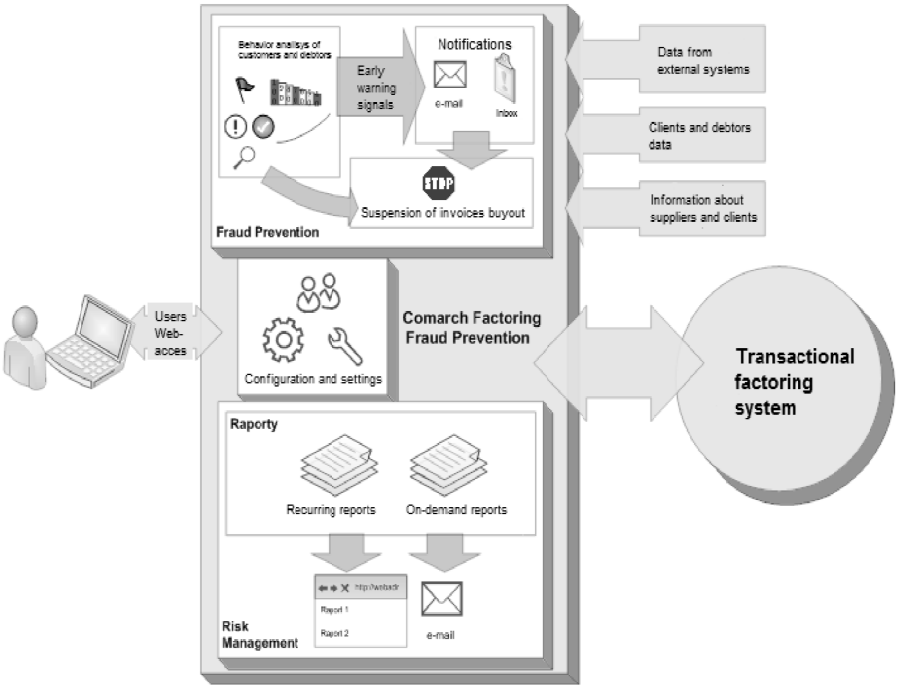

Fig. 3. The Comarch Factoring Fraud Prevention architecture

Source: COMARCH S.A.

Figure 3 provides a high-level overview of the CFFP system architecture. The following system components can be distinguished, corresponding to the elements of the data-dialog-modeling-communication-creativity paradigm [Stan06].

The Data component. Unlike more traditional information and decision systems, the CFFP is built around a data mart that stores data from the transactional factoring system. It is not necessary to utilize a classical data warehouse, since all of the data are completely homogeneous (transaction parameters are loaded only). Moreover, it is possible to eliminate extraction, transformation and load (ETL) tools [Dudy03]. Within the CFFP, this role of an ETL tool is actually performed by the interface between the transactional data base and the data mart.

The Dialog and Communication component. Within this specific implementation of the proposed architecture, the Dialog component takes form of an executive dashboard or control panel. The system's main page presents all the essential information, divided into groups by priority:

1. Informative – reminding of routine tasks, notification of indicators returning to acceptable values.
2. Warning – informing of any parameter exceeding the first validation level (specified in the underlying risk model).
3. Alarm – which occurs when a ratio exceeds the threshold set by the factor as an alert area.

All of this information is role-sensitive, i.e. to targeted at specific roles defined in the CFFP's Creativity component. Another important element of the system architecture is the expert system, which performs three fundamental functions [KoST05]:

1. Diagnosis – using a set of observable symptoms to determine the current state of the clients and debtors portfolio (as well as identifying weak signals e.g. from the relations between clients and debtors).
2. Construction – creating detailed user reports based on the diagnoses performed. Importantly, the system allows the user to instantly export data from any table in the system. Owing to this functionality, users may choose to perform further operations on data in a more familiar environment, e.g. using a spreadsheet application.
3. Control – controlling the application by monitoring the user's activities and triggering appropriate actions depending on the current date or behavior of enterprises taking part in the factoring transactions.

The classical ad hoc drill-down search is supported by the system and allows the user to move toward required tables faster and more effectively. This means that the formulation of a drill-down query depends on the conclusion

produced by the system. The query result then fires another sequence of rules, which in turn triggers a further drill-down query. The process terminates in case the system is unable to generate a conclusion and, consequently, activate another query. The objective finding should take place through the discovery of the underlying cause-and-effect chains among the increasingly more detailed information sets delivered in the query reports.

The Modeling component. The modeling process aims to support the user (risk analytics) in detecting symptoms of potential frauds – like non-standard behaviors of clients and debtors during factoring transactions. The variables which the system tracks fall within the following main areas:

- monitoring of payments (looking out for direct payments, i.e. payments from unrecognized accounts; the average payment time),
- analysis of the claims indicator (e.g. the average worth of credit notes, the number of overdue invoices),
- monitoring of invoices in operational factoring data (e.g. the average amount of receivables purchases, the number of recourses),
- monitoring of credit exposure (e.g. the average worth of invoices purchased),
- overdue monitoring (i.e. the number of outstanding invoices and the number of days overdue),
- monitoring of capital-associated companies (i.e. the number and worth of transactions between certain companies),
- monitoring of clients' and debtors' behavior (i.e. the number of recourses over a period, the average [length of] trade credit period).

This approach substantially extends the area in which to search for component combinations most suited to addressing a specific problem, and brings one closer to the selection of the best solution. The author's experience has enabled him to tentatively validate the effectiveness of behavioral analysis in the process of fraud detection and risk management.

The Creativity component. Within the proposed approach, this component is closely linked to visualization and comparison between different values and measures produced by the system. It is creativity that accounts for the possibility to apply user-defined parameters in performing a particular instance of behavioral analysis. Rules can be enforced in two basic ways:

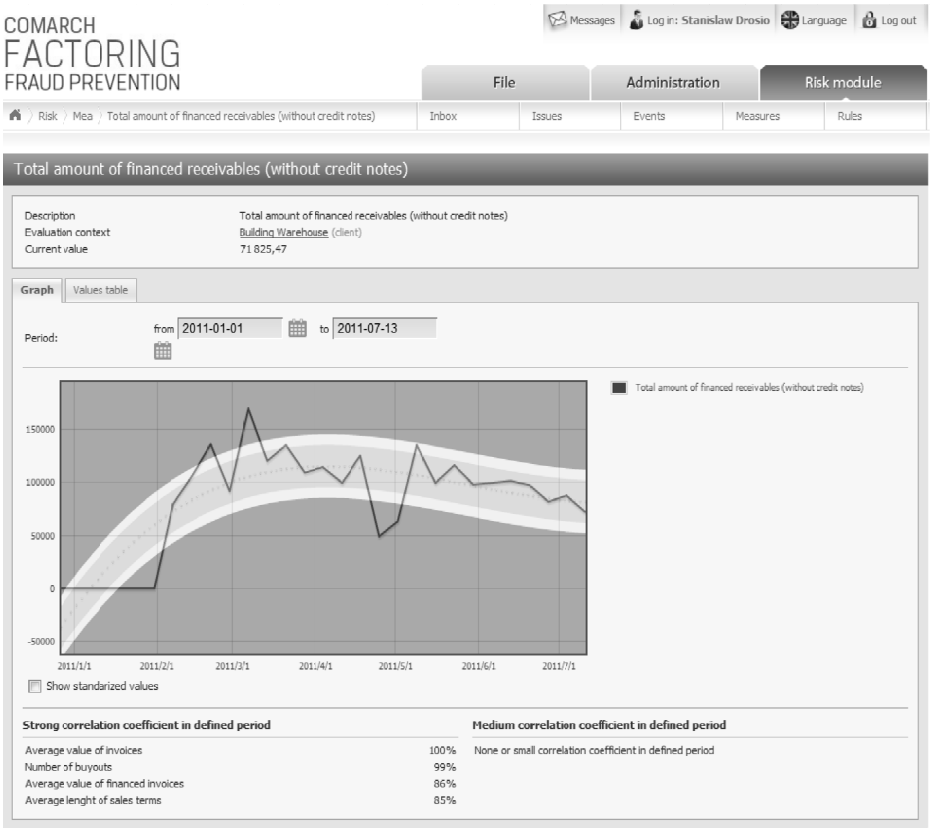

Fig. 4. Visualization of total receivables

Source: COMARCH S.A.

1. By comparison to the fixed thresholds used in analyzing debtor concentration. This is done by computing a value for the relationship between the client and the debtor.
2. Using a percent deviation from the trend line, which makes it possible to take advantage of the self-learning elements within the system (cf. Figure 4). By linking the trend line based on data mart data to the parameters of the risk module, the system will be able to advise the user of sudden changes in values.

Support tools have been implemented, too, such as simulation models, sensitivity analysis and business simulators, and/or strategic decision making games [StDr12], constituting a complementary knowledge resource for use in creative solution finding for future diagnostic problems.

Within the system being discussed, the software architecture also includes creativity elements. The three-layer architecture is made up of the following:

– the data base layer (a data mart), which can be implemented using any viable data base technology, although Comarch does recommend Oracle products,
– the application layer based on Java technology,
– the presentation layer developed using Apache Wicket.

This approach made it possible to apply service-oriented software development elements. As a result, users can customize the tool's basic features to adapt it to their specific needs. In the context of support for the risk management process, a degree of flexibility is crucial, making the tool capable of e.g. functioning under different measurement systems (setting decimal or thousands separators, date formats, etc.).

A business solution and use case

To achieve the system's primary goal and enable it to provide support to end-users, as described below, the operators have to determine the basic configuration of risk models. The process of model definition is based on the parameterization of percentage or linear thresholds. If the parameters of a transaction are outside the allowed range, the system will generate a warning message for the user.

The real goal is then to not only support data analysis by risk management teams, but also to propagate the findings to everyone involved in the process of making decisions as to whether to accept or decline a factoring contract, alter the contract terms, or withdraw from an agreement due to excessive risk of financial loss as a result of fraudulent behavior [Bakk04]. The CFFP addresses these concerns as follows:
– a three-layer system architecture was applied where the presentation layer is placed in the most intuitive environment that today's users can think of – an Internet browser,
– a data mart was employed instead of a full-fledged, complex data warehouse, which was possible owing to the easy-to-establish focus of the data being processed [Dudy03].

However, from a factoring company's perspective, it is the CFFP's inherent mobility that makes the real difference [Sosn05]. In business practice, the tool is deployed in the following four steps:
– launching a server computer to host the application,
– synchronizing data derived from the factor's transaction system,
– configuring the indicators and threshold values for the automated behavioral analysis of debtors in the factoring agent's portfolio,

– the system's automatic operation, resulting in warning signals to get users' attention, triggered on detection of specific behaviors inferable from factoring transaction data.

As a practical outcome, through implementing the tool a factoring broker will be, in the first place, able to diversify sources of data on a factoring transaction and on parties involved. Diversification can be also perceived in the context of the work of specialized risk assessment staff as the mobile application enables them to delegate powers and exploit other personnel's knowledge – for an even smoother factoring process – by involving them in direct interaction with customers.

On an everyday basis, factoring risk managers have to follow and analyze enormous amounts of data on factoring transactions from all parties involved in the factoring business. Comarch Factoring Fraud Prevention addresses their needs by deploying a considerable degree of automation to these processes. Owing to the tool, basic data analysis proceeds automatically, and the system can detect a number of major threats, e.g.:

– split (splitting high value invoices into smaller ones to avoid inspection from the factor),
– detection of incoming transfers from unidentified outside accounts (factors might make out fictitious invoices and pay those themselves in order to boost their financial liquidity),
– unexpected extensions of trade credit periods granted to debtors (it is known to often precede a company's ultimate collapse),
– growing concentration on a single debtor (this may be indicative of collusion between the customer and the debtor).

An automated tool facilitates the observation of such behaviors without engaging the attention of the factoring company's staff. Alongside process automation, staff concerned with risk identification and management is offered neatly organized data on factoring transactions. This obviously accounts for early and more effective fraud detection.

Conclusion

The technologies described above make Comarch's Factoring Fraud Prevention capable of serving all of the factor's personnel who might need data on risk assessments elaborated by specialized departments of banks or financial institutions. Comarch S.A. has designed the tool to deploy mobile support primarily in two areas:

- continuous analysis and delivery of data alongside their visualization in the form of graphs and tables,
- involving more of the factoring agent's staff via the issue processing facility; by delegating the requisite rights and powers to those users who interact with customers, data mentioned at the outset of this section can be instantly verified and updated.

On the other hand, the system has been furnished with high-level overview templates that come in handy in performing such simple procedures as routine customer relations while, owing to its mobility, all that one requires to launch the tool is a login, a password, and a device capable of running an Internet browser (e.g. a smartphone, a tablet, or a conventional laptop computer) [StND13].

In undertaking the research on the data-dialog-modeling-communication--creativity architecture the author and his teammates hoped to devise a useful framework within which to develop decision support systems that could truly rise to today's challenges, needs and expectations in such a difficult business as factoring is. This paper delivers an outline of the author's implementation work done within COMARCH's recent project [WWW1] in an effort to verify the applicability of the proposed architecture, seeking to contribute to the progress of decision support theory and methodology.

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ZASTOSOWANIE ROZSZERZONEGO PARADYGMATU DANE-DIALOG-MODELOWANIE W PROCESIE BUDOWY SYSTEMU WSPOMAGANIA DECYZJI UŻYTKOWNIKA – PRZYKŁAD SYSTEMU COMARCH FACTORING FRAUD PREVENTION

Streszczenie

Niniejszy artykuł prezentuje praktyczne zastosowanie innowacyjnego podejścia do procesu budowy komputerowych systemów wspomagania decyzji (SWD). Podejście to opiera się na przedstawionym w 1999 roku rozszerzeniu klasycznego paradygmatu Spraqea-Carlsona dane-dialog-modelowanie służącego do budowy systemów wspomagania organizacji. Stanisław Stanek w swojej książce zaproponował dodanie do powyższego narzędzia elementów komunikacji, wiedzy oraz kreatywności. W niniejszym artykule zaprezentowano praktyczne wykorzystanie rozszerzonego paradygmatu w procesie budowy narzędzia Comarch Factoring Fraud Prevention, które wspiera podejmowanie decyzji przez użytkowników końcowych w zarządzaniu ryzykiem na potrzeby realizacji transakcji faktoringowych.