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Developing the functionality of a mobile decision support system

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Observation of present-day decision-makers, increasingly seen among mobile workers, reveals what their role is essentially about as well as some of the emergent properties of their behaviors: the pursuit of rich face-to-face communication, the need to process a large variety of data feeds, the capability of operating under high-risk exposure and tough competition, innovativeness, the facility to form winning coalitions, and persistent concern for image and repute. While many mobile decision-makers make a substantial contribution to the development of an organizational information system, their ability to exploit the system may be compromised by a number of limitations relating to, for example, accessibility. This paper seeks to explore the evolution of modern technologies and IT solutions in the context of computer support for the mobile decision-maker.

Keywords: mobile decision support systems; mobile decision-maker; video decision support; group decision support; mobile support for decisions; continuity management; security in mobile decision support

1. Introduction

The authors of a seminal work edited by Bennet and focused on decision support system (DSS) design (Moore and Chang, 1983, p. 186) argue that 'the underlying decision context – problem definition, managerial preferences, decision making procedures – was treated as constantly evolving in a decision space', and, therefore, 'one of the designer's responsibilities is to continuously monitor the movement of the decision context as it migrates through the decision/design space'. Relevant research findings can help us understand issues relating to the decision context, including its migration. A number of scholars (Galbraith 1973; Leavitt, 1951) have found that either the amount or the nature of information processing is associated with task uncertainty. Weick contends that new data may not resolve anything when equivocality is high (Weick 1979). Daft and Lengel (1984) classify communication media along a continuum of 'richness', which is composed of (1) the availability of instant feedback, (2) the use of multiple cues (physical presence, voice inflection, body gestures, words, symbols), (3) the use of natural language, and (4) the personal focus of the medium; face-to-face communication is the richest medium, while written documents are the leanest (Daft & Lengel 1984, 1986). Communication can be enriched by combining diverse media, such as video, audio, or chat. The aspect of dynamics is brought up by the rapidly growing Computer-Mediated Communication specification (Giles et al., 2010). The Multicast

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Backbone (MBone) technology, developed by Deering (1990), has become the basis for videoconferencing (McCanne and Jacobson, 1995). The first experiments with mobile videoconferencing were conducted at the beginning of the twenty-first century (Brandt 2008; Pham et al., 2001). However, further technology research is definitely necessary.[1]

The fast advances in transaction systems have created both new needs and new potential in data analysis – e.g. the data soup concept (Thierauf 2001). The functionalities of data-oriented decision support systems can be performed by Business Intelligence (BI) systems (Gray 2003). Recent research (Pedro et al., 2003; Stanek et al., 2003) demonstrates that there is a challenge in introducing handheld devices: Navigation behavior is obviously different from that in a desktop environment. Leaders in the BI domain (SAP BusinessObjects Mobile, IBM Cognos Mobile) supply technologies where the same BI content that users work with every day on their desktops is automatically rendered and optimized for their compact mobile devices.

A vital change has affected the concept of the everlasting corporation, which no longer seems valid in the twenty-first century. Lasting through time involves adequate measures prescribed by continuity management, founded on integrative and interdisciplinary risk management coupled with a reliable information system. Although there is certainly room for mobile technologies in such systems, one should be aware that in crisis situations cell phones might stop responding – which is discussed by Baze (2012) in the context of the Personal Emergency Communications Plan. To pinpoint the critical importance of communication and the availability of alternatives in emergency contexts, the paper further offers a more extensive treatment of good practices tested in military training areas – the JAŚMIN system (Piotrowski et al., 2012). Under emergency, the use of military forces may be controlled by civilian state administration, which brings our attention to the need for developing options for contingent integration of existing systems. Singapore's experience of the 2003 severe acute respiratory syndrome (SARS) crisis is employed by Chee Bin and Whye Kee (2012) to illustrate how the Network Centric Warfare Framework can be leveraged in a non-military setting.

The above overview shows that there still are a host of issues in mobile decision support systems that call for further research. The following sections offer studies of a few relevant cases. The first two cases, recapitulating the authors' experiences with the development and implementation of mobile systems in businesses, are confronted with a third which highlights the progress in mobile technology linked to the introduction of the network-centric approach in military settings. In a manner of speaking, the cases anticipate the discussion of good practices proposed in Section 5.

This particular choice of case studies is supposed to substantiate the theoretical claims and propositions made in the introductory section as well as to accentuate their relevance to the mobile decision-maker. The first case presents an efficient solution addressing the need for improved communication in small- and medium-sized enterprises. From a technology perspective, successful support for ad hoc decisions entails the use of a dedicated video server, while from an organizational perspective, it involves the ability to innovate and to deliver high performance. The second case study demonstrates that, in banking and in trade finance sooner than in other economy sectors, a new era has begun as, with the use of mobile systems, support will be provided not only to operational staff. Finally, the third case proves that some military experience with decision support could be exploited in business settings, especially with mobile systems that require a high level of security.

2. Case Study One: The use of mobile conferencing for decision support

Statistics supplied by a Polish solution provider indicate that the number of organizations employing video communication and distance collaboration tools keeps growing steadily

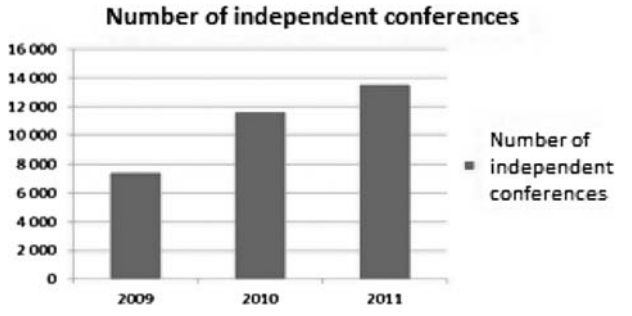

Figure 1. Increase in independent conferences between 2009 and 2011.

(Namysło, 2009). In Poland, the number of organizations using such tools increased by 42.5% between 2009 and 2011, whereas the number of independent conferences rose by 82% over the same period.

It should be emphasized that robust growth is observed not only in the number of customers seeking and using this kind of technology, but it can be seen in other metrics, too: in the number of conferences held, in the average number of session participants or, finally, in the average session duration. It can be concluded that more and more customers are aware of the advantages of videoconferencing and appreciate the safety and efficiency of professional videoconferencing tools. There is also a growing interest in the potential for increased mobility that can be gained through the use of mobile devices (Vidcom, 2012).

This section offers a discussion of two sample applications of mobile videoconferencing technology in specific business cases (Vidcom, 2012). The first is an implementation of a mobile help desk, and the second represents an example of support for typical management processes through a central multi-conferencing server interacting with a number of mobile devices.

2.1. Some technical aspects

A decade has elapsed since work on mobile videoconferencing was initiated. Nevertheless, a stable system that could be used for computerized decision support is yet to be developed, as there are still some substantial technology challenges. In particular, efficiency and compatibility issues arise in combining technologies across specific standards and implementations (e.g. PC communication, GSM (Global System for Mobile Communications) and VoIP (Voice over Internet Protocol)). Furthermore, even the current leading products are still unable to fully meet users' expectations. Increasingly more efficient data compression and transmission methods promise to transcend the existing limitations. Market demand grows exponentially as more and more new types and models of mobile devices become available (smartphones, tablets, netbooks).

It is therefore necessary to carry on with research and development of innovative Information and Communication Technologies (ICT) solutions with a view to creating fully integrated systems capable of efficiently handling multimedia data transfers regardless of the hardware and software platforms used. To satisfy their customers' soaring expectations, manufacturers and vendors are forced to keep delivering new solutions to the market. By way of example, for a multimedia server computer to be able to perform effectively, it should have the following features:

- an internal protocol to receive data streams;
- a modular architecture expandable by appending user-built modules through an API;

- a possibility to run custom TCP/IP- or UDP-based protocols;
- receiving data streams transmitted via the industry's most popular audio/video streaming protocols (e.g. RTMPE);
- an ability to send configuration/control data over a protocol;
- stream recording at the server level;
- an ability to record video and audio data separately;
- recording multiple streams into a single movie;
- stream publication/broadcasting (media content streaming);
- use of advanced compression techniques for stream transcoding;
- adjusting the stream quality to the parameters of each user's data link;
- monitoring the bandwidth available for data transfers toward clients;
- support for additional custom codecs and filters;
- support for virtual cameras capable of capturing video input from a variety of sources;
- the availability of, and conversion from/to, a basic set of codecs (On2 VP6, Sorenson Spark, H.264);
- an ability to allow multiple clients to simultaneously connect to an output device;
- support for diverse operating systems, e.g. Windows/Linux/Mac, including mobile systems;
- an option to set up a camera over the same API under any system;
- the availability of a number of configuration models (via sockets, a control panel, or code binding);
- adding (embedding or overlaying) an image into the source of another image (such as logos and commercials);
- captioning (inserting captions into) a source video stream (e.g. text scrolling or popping up at the top or bottom of the screen);
- an ability to dynamically switch to a different video source (during operation/transmission);
- a capability of combining multiple inputs into a single user-defined output image (a management API);
- adding new codecs via the API, as well as conversion between codecs and on-the-fly video content encoding;
- support for various processors and processor classes (64-bit, 32-bit, Intel/AMD/ARM/SPARC, etc.);
- a capacity to run Web-based applications as well as desktop applications programmed in different languages.

R&D staff, and even more so programmers, are under much pressure to rise to these challenges (Vidcom, 2012). Indeed, suppliers who follow the market trends and are responsive to their customers' expectations make every effort to meet the above requirements.

2.2. e-VideoHelpDesk

e-VideoHelpDesk is a product dedicated chiefly to Internet-based expert sites, designed to extend the functionality of conventional help desks. Bundled with Web content management software come a number of access accounts for use by consultants, a comprehensive branding pack consistent with the Web site design, and a rich administrative panel for site management (Namysło, 2008, 2011; Vidcom 2012).

In the case being considered, the customer insisted on providing some consultants with devices that would enable them to render advice and support even when out of the office.

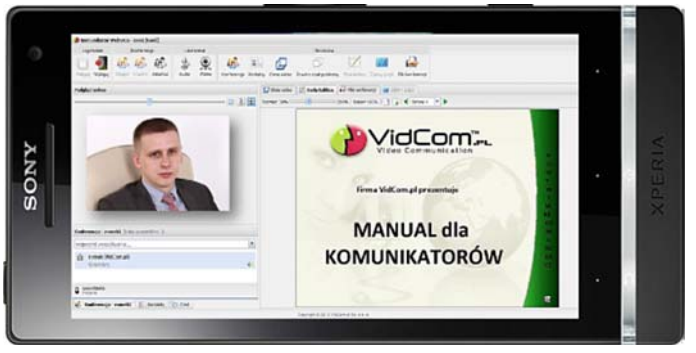

Figure 2. Video communication for Android (via smartphone browser).

The concern was that this highly specialized staff, spending much of their working time away on business, were frequently unavailable for many of their other clients.

In an effort to adjust the product to the customer's needs, a cloud-computing version of e-VideoHelpDesk was put together, with an addition of smartphones running Android-compatible communicator software.

(1) Type of business: Corporation
(2) Industry: Authorized industrial machine maintenance business
(3) Problem: Improve corporate logistics
(4) Solution: Implement e-VideoHelpDesk
(5) Benefits:

- Increased availability of technicians
- Cost of travel (attributable to on-site services) reduced by 25%.

2.3. e-VideoBiznes

e-VideoBiznes has been designed with efficient modern businesses in mind, in response to the perceived demand for fast and uninterrupted information interchange. The system makes it easy to hold videoconferences between a company's different branches, local (field) staff and the headquarters, national and international business partners, as well as virtually organize board meetings and shareholders' meetings – regardless of distance and without limits on the number of attendees. The e-VideoBiznes product comprises a videoconferencing software application and an agreed number of user accounts for virtual meeting participants. On request, a comprehensive branding pack is available, consistent with corporate visual identity, and an option to install system components on the customer's internal servers (Namysło , 2008, 2011; Vidcom 2012).

In the case under examination, the customer requested that some of the managers be provided with devices that would enable them to stay in touch (with their teams) even though they travel a lot on business. The customers stressed that executive managers should be able to react immediately in the event of an emergency, no matter how far away they might be from their offices.

To suit the customer's needs, a server version of e-VideoBiznes (all of the software running on the customer's hardware) was deployed, with an addition of smartphones running Android-compatible communicator software.

Figure 3. Video communication for Android (via a Web browser for smartphones).

The critical aspects of this case include (Vidcom 2012):

(1) Type of business: Joint Stock Corporation
(2) Industry: Investment
(3) Problem: Improve management
(4) Solution: Implement e-VideoBiznes
(5) Benefits: Effective and streamlined management processes.

3. Case Study Two: Comarch's Factoring Fraud Prevention as an example of mobile risk management support in trade financing transactions

The current global economic slowdown, which has been harnessing world economies for several years now, has not at all affected the area of trade finance which is referred to as factoring. This type of financial transaction, offered by specialized financial institutions or banks, has recently experienced dynamic growth, in Poland as well as throughout the world, spawning new approaches and varieties (Kreczmanska 2007). Like any modern financial transaction, factoring is supported by information technologies, many of which can effectively help expand the customer portfolio while ensuring increased security and successful finalization and settlement. However, it should be realized that software providers have so far focused predominantly on the development of support for transactions alone, giving much less attention to such business areas as risk management and customer relations, or to delivering mobile support to the factoring company's sales staff.

3.1. Application of mobile decision support in the factoring process

The factoring process involves a number of risks that have to be mitigated by factoring agents through risk management decisions. The fundamental dangers associated with factoring as a trade financing method are as follows (Kreczmanska 2007):

- when specifying the terms of transaction, the factor has to rely on incomplete debtor information fed by the client; therefore, at least initially, information on the behaviors of respective entities is lacking or insufficient;
- risk associated with a single entity simultaneously playing different roles – a business may be selling its financial assets (a client) while at the same time being a party to other factoring transactions as a debtor who may be subject to a debt recovery procedure;

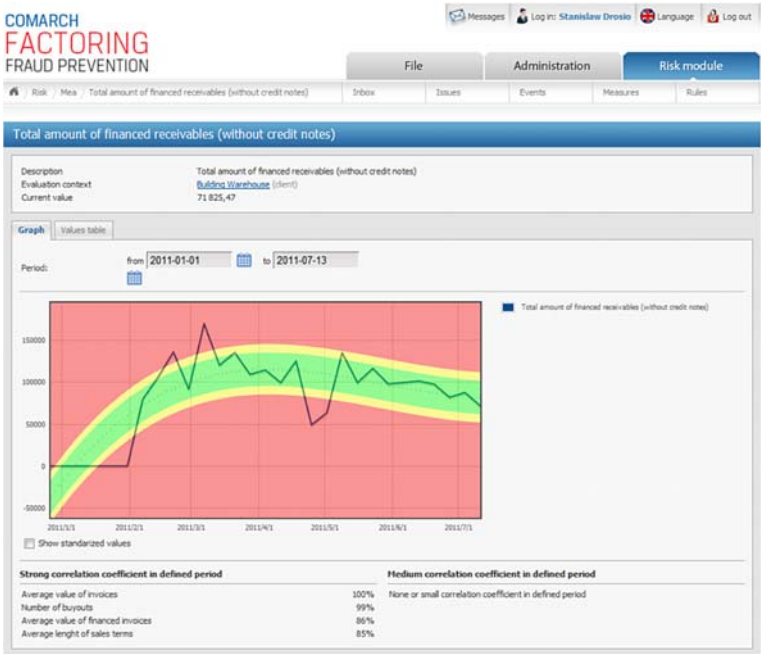

Figure 4. Visualization of total accounts receivable.

- the risk of undetected fraud attempts and/or and radical changes in the environment, e.g. in the behaviors of clients/sectors, that may affect debtors' solvency.

Scholars have already discovered that most factoring agents, whether financial institutions or banks, counteract these risks through active risk management involving such measures as (Kreczmańska 2007):

- risk identification,
- risk indicators,
- risk control,
- project risk assessment.

Two basic risk management contexts seem to emerge from this overview of dangers to the security of factoring transactions: (1) preventing and avoiding contracts with businesses whose risk of insolvency is high, and (2) continuous monitoring of transactions entering the transaction system which is used by the factoring company on an everyday basis (Binder 1997).

Responding to these needs, in 2010 Comarch S.A. launched a project aimed at *Implementing Innovation in Information Systems to Support the Factoring Process*, co-funded by the European Regional Development Fund under Measure 1.4–4.1 of the Operating Program 'Innovative Economy' (Comarch, 2012). The Comarch Factoring Fraud Prevention (CFFP) system originated as an outcome of the project. The system draws on behavioral analysis and, by choice and design, is supposed to operate as a mobile tool (running on any device with a Web browser installed) which supports mining through large thematic data collections.

The above can be illustrated with a visualization of the receivables index shown in Figure 4, where the underlying values, computed from historical data, have placed the indicator within a trend 'pocket'.

3.2. The characteristics of Comarch's Factoring Fraud Prevention (CFFP)

The real goal, then, is 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 to accept or decline a factoring contract, to alter contract terms, or to withdraw from an agreement due to excessive risk of financial loss as a result of fraudulent behavior (Bakker et al., 2004). The CFFP addresses these concerns in the following ways:

- 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 (Dudycz 2003).

However, from a factoring company's perspective, it is the CFFP's inherent mobility that makes the real difference (Sosnowska, 2005).

3.2.1. The technology architecture

The three-layer system 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 led to a possibility to apply service-oriented software development elements. In effect, users of the tool can customize its basic features to adapt it to their specific needs.

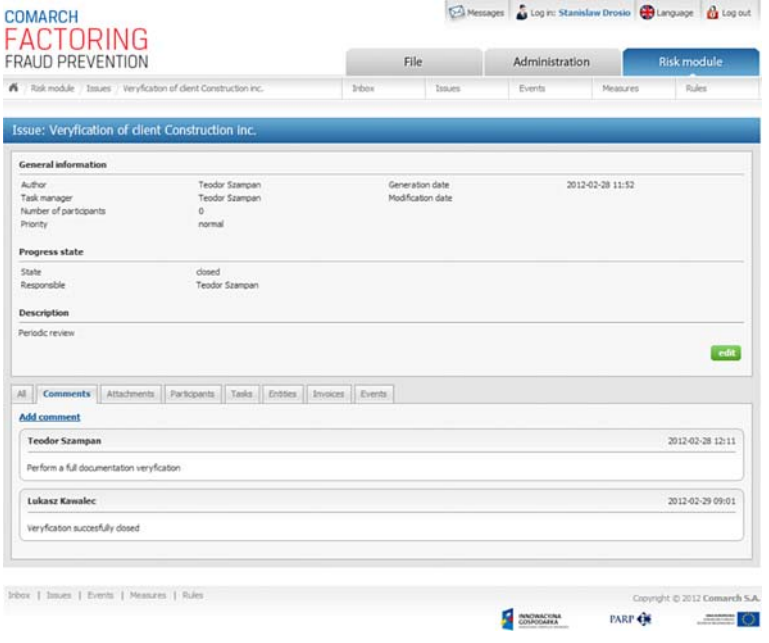

Figure 5. Web browser window with a form for issues management.

In the context of support for the risk management process, a degree of flexibility is crucial, making the tool capable of, for example, functioning under different measurement systems (setting decimal or thousands separators, date formats, etc.).

The latest mobile technologies can greatly facilitate work with reporting tools, too. In effect, the user does not need to generate complex, template-based on-demand reports, instead being able to export data from within the system into a flat file (.xls, .csv, .pdf) and then further edit and process the file using common, familiar spreadsheet applications.

This approach to system development also meant that it was possible to create a platform supporting key services for its users. Hence, new software application elements, following their intrinsic business logic, can be defined from the application layer, in a way that does not affect the system's data base. The mobile presentation layer, developed using Web-based technologies, provides access to user accounts from the corporate intranet as well as, once such rights are granted to an individual, from any device that can run a Web browser. In terms of specific functionalities, benefits derived from the technology used to develop Comarch Factoring Fraud Prevention are discussed in the subsequent parts of this chapter.

3.2.2. Mobile risk management in factoring transactions

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. As Web browsers are nowadays commonly found in mobile devices, the tool can be utilized to that effect across a number of domains (Ganesan, 2007). Comarch S.A. has designed the tool to apply mobile support primarily to 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 (Figure 5); 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 equipped 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).

3. Practical applications of the tool

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 also be 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 cooperation with customers.

4. Case Study Three: The mobile battlefield management system JAŚMIN

Uninterrupted operation and security are two other issues germane to mobile decision support systems. The solution described in this chapter is named JAŚMIN and has been tested on military missions and training sites (NATO's Combined Endeavor 2008, 2009, 2010, 2011; Poland's Aster 2008, 2009, 2010, 2011 and Borsuk 2010). JAŚMIN supports command, control and operations processes at all levels of the command structure, including the level of an individual soldier. Further, it contributes to building a tactical awareness among the military by integrating partial data into a complete picture of their combat position. Its ability to build mobile IP-based networks is a key feature of the system. Essentially, too, JAŚMIN constitutes a common framework for the transmission of voice, video and other data. A single container or a portable JAŚMIN set, which is how the system is shipped to the Polish Army, can be used to set up several separate telecommunications networks. These networks can work independently of one another, which means that it is possible to set up, for example, an open network alongside a closed one, or a national one alongside an allied one.

JAŚMIN has been designed and is supplied by Teldat[2], an ICT business founded in 1997 by Henryk Kruszyński and Marek Cichocki, its presidents and former military officers serving together in the signal corps. Determined to put their ideas into practice, they retired from the army to establish and lead their own company. Among the company's first successful products that put it on a fast growth track was a suite of networking devices known as the Integrated Telecommunications Centers KTSA, which were soon used to build MIL-WAN – the Ministry of Defense's information network, also catering to all organizational units of Poland's Armed Forces. The creation of JAŚMIN was inspired by the specific needs relating to the Polish Army's involvement in military expeditions. As Henryk Kruszyński recalls,

> The Army asked us to build a mobile version of the KTSA. We decided to, on the one hand, significantly reduce the size of its original release and, on the other, make it truly mobile while at the same time enlarging its potential. The name itself, Jaśmin, came later. We wanted something that would sound similar and mean the same in a number of languages. Besides, military tradition suggested it would best be the name of a flower.[3] [4]

JAŚMIN, like the US Army's Land Warrior, the French FELIN and the German IDZ, follows the recommendations laid down for the NATO Network Enabled Capability (NNEC). The network centric C4IS (Command Control Communications & Information Systems) framework prescribes that the system should consist of multilaterally communicating centers providing services under the SOA (Services Oriented Architecture) standard. For better interoperability, solutions such as the JC3IEDM data base model – adopted and ratified by the NATO as STANG 5525, specifying the requirements and the types of information needed in combat operations – have been implemented, alongside message (MIP MEM) and data exchange (MIP DEM) mechanisms using broadband data links and the TCP/IP protocols. Nonetheless, the greatest challenges in designing this kind of system are to ensure stable performance in spite of reliance on radio transmission characterized by low bandwidths and intrinsic instability, and to reduce vulnerability to difficult operating conditions found in battlefields.

4.1. Key technological aspects

Teldat engineers developed one of the most interesting workarounds to the instability of radio transmission within network centric command and control systems: the BRM (Battlefield Replication Mechanism) protocol based on the standardized transport layer protocol referred to as UDP (User Datagram Protocol), which has been modified to incorporate a guarantee that data have reached the intended recipient. The protocol handles data grouping, filtering and compression, while at the same time making sure that transmissions are kept to a reasonable minimum. The data are encrypted using a symmetric key algorithm where a unique key is generated for each session and transferred via a secure key transfer method. It is possible to exchange information for example between systems employing Windows Desktop and those based on Windows Mobile.

Teldat engineers were also able to resolve issues specific to the modern battlefield, such as stringent requirements concerning integration and resistance to electromagnetic or environmental impacts. Their Tactical Terminal Tablet T4 is a portable tablet computer furnished with a touchscreen, representing the ultimate in military computing technology. Its features include integrated support for an accelerometer and a magnetometer; it also has WiFi and Bluetooth transmission interfaces, a GSM/CDMA (Code Division Multiple Access) module, a GPS receiver and a video camera. It complies with Polish standards for 'military' computers, corresponding to the American MIL-STD. Notably, the T4 is one of two lines of European-made machines, besides the German Roda computers, that fulfill the Polish military defense standards NO-06-A101 and NO-06-A103 from the most demanding N.14 group. In fact, in some areas, the T4 considerably exceeds the N.14 standard. For example, it is not only waterproof but also capable of working underwater for about two hours.[5] In addition, being a Tempest-class product, it is shielded to guarantee emission security (i.e. reduce compromising emanations).

JAŚMIN comes in four versions:

- the container version, also known as the HMS (Headquarters Management System), designed to manage combat elements as well as to build IP-based ICT networks; its name has been inspired by the way hardware and software is relocated and used;
- the portable version, which has been designed for similar applications as the container version and is nearly identical with it, except that there are no containers to carry about but the hardware and the software are packed in crates and adapted for use in buildings as well as in tents;
- the mobile version, known as the BMS (Battlefield Management System), designed to manage combat forces at the tactical level, liaise with HMSs and build on-board command and communication systems for combat vehicles and other ground vehicles as well as for some types of air vehicles;
- the Dismounted Soldier System version, designed to control a dismounted soldier operating within a team; it can be also used to liaise with the BMS and, when necessary, with the HMS.

Because information conveyed through JAŚMIN is likely to be critically important to forces engaged in combat, the system itself as well as any information stored or transmitted within it must be protected against a wide range of hazards. The manufacturer has provided administrators with a rich variety of protections suited to different requirements and different settings in which the system might have to operate. The network can be protected against unauthorized access by introducing port access control using the EAP (Extensible Authentication Pro-

Table 1. Good practices suggested by the case studies presented in the paper.

No.	Area	Explanation/Recommendations
1.	Developing an organization's situational awareness	Through combining snapshots and partial views from the operational level, the so called 'organizational situation awareness' is shaped. Aggregated data are delivered to their destinations at the relevant management (command) level. The use of analytical tools, geographic information systems (GIS) and simulators helps develop an awareness of the decision-making context, of the risks involved, and of the available options.
2.	Heterogeneous environment and network-centered framework (architecture)	Diverse system components (people, satellites, vehicles, sensors, etc.) are integrated into a scalable network-centered structure. Stability is warranted by the presence of redundant links. Rich, bi-directional communication is focused on dispersed individuals' natural behavior.
3.	Continuity in emergency/crisis situations	Continuity management must be based on organizational culture and continuity/contingency plans. With an mDSS, special attention must be given to the availability of alternative (redundant) communication methods: GSM, radio transmission (a variety of solutions), a wireless mesh networking. In addition, military experiences indicate that technical improvements should be aligned, and introduced parallel, with relevant training and staff development.
4.	Multi-functionality, durability, and ergonomics of the interface	The development of interfaces exhibiting specific properties is a consequence of the difficult operating conditions often found at conferences or in military training areas (extensive travel, movement across climates and time zones, uncomfortable postures and poor light). Although a number of relevant standards have already been incorporated in Teldat's system, all the parties concerned intend to carry on with improvements.
5.	Confidentiality and 'wartime' security	Perceiving correspondences between business activity and the military profession, one could conclude that to understand war, you need to understand the rules of business, and vice versa – if you choose to become a businessman, you have to learn about the art of war. Civilian solutions that have been studied lack advanced filters to control the flow of information between systems with different levels of security clearance, and have no shielded portable containers or sophisticated encryption methods.
6.	Use of highly resistant technology in environments exposed to interference	Successful business applications can usually be traced back to the perfect alignment of technology with a given problem and implementation context. In the cases under examination, the following central elements can be distinguished: a dedicated videoconferencing server (in the first case), a data mart technology, a Services Oriented Architecture (SOA), and a customized client-server model (in the second case), and a state-of-the-art patented radio transmission technology (the third case).

tocol). The protocol supports an array of authentication methods that can be implemented in the same way on any communication hardware used. The protocol architecture is based on the client/server model where the main server becomes the authentication server and any client becomes a supplicant. Importantly enough, all user Ethernet ports are ready to implement the EAP. User authentication is handled by a RADIUS (Remote Authentication Dial-In User Service) server providing a remote user authentication service. The way the service works is that, on any access attempt the remote access server issues, via the user's terminal, a request is made for the user's ID and password. As the requested information is entered, the input is encrypted and transmitted to the RADIUS server, which compares the data against respective entries in its data base and either grants or refuses access, in the former case also assigning appropriate rights to the user.

The system utilizes electronic cards to permit access to active network devices, computers and applications. Without the right kind of card, one cannot access any or some of the system resources. Further, cards can be used to assign specific access rights to different individuals using the same terminal. Data privacy is safeguarded owing to the use of SSL (Secure Socket Layer) sessions and the IPSec protocol for transmission. SSL is a client/server type of protocol handling secure connections and using certificates for authentication purposes. Albeit focused on server authentication, it can also be utilized to authenticate a client. The IPSec protocol, in turn, executes data encryption and verifies data integrity as well as authenticity; it identifies users based on certificates containing RSA public keys (one of the first and most common public-key asymmetric cryptography algorithms). The keys are authenticated and stored in the system-wide Authentication Center. The IPSec-based encryption, authentication and data integrity check mechanism is present in all hardware devices throughout the JAŚMIN system.

JAŚMIN devices run software that uses internal memory to record any unauthorized attempts to take off the protective cover and remove any of the installed components – any such intervention in the system will trigger an alarm in a local management station. The system also features a visualization tool displaying the network structure, and a failure reporting facility that enables technical personnel to instantly diagnose and fix problems. A detailed network usage log is maintained, helping enhance efficiency and identify critical elements and congestions. If necessary, the software can build up and deliver complete network management documentation. The network management subsystem is secured with electronic cards. Data from the main server are continuously backed up to any number (conditional on a particular setup) of networked servers to prevent accidental loss. Each device within the system can be remotely configured using the management software. Remote connections are, too, protected through the use of SSL sessions and RSA key certificates.

The container version of JAŚMIN has been examined and approved for use by the Polish Military Counter-intelligence Service. The container case is shielded against electromagnetic emissions, which makes it possible to work with classified and top secret documents inside it. Its physical protections are compliant with the SA4 standard, including sensors, alarms, anti-burglary monitoring, and access control. The door has a built-in combination lock, while an outside camera enables the crew to spot anyone intending to enter the container. Inside the container, there is a safe box for classified documents. All of JAŚMIN hardware devices can operate in extreme temperatures and difficult weather conditions, including excessive dust, humidity or frost. Its components are linked to a high-performance power generator that makes JAŚMIN independent of external electricity supply. Additionally, the hardware produces very little noise, allowing camouflage.

5. Good practices from the case studies

The case studies reported in the three preceding chapters can suggest some good practices for mobile DSS (Table 1). These days, especially in sectors like banking and finance, experience with continuity management derived from systems like the one described in the first case study should be widely utilized. Military systems can afford an opportunity to move on to a new level of data security, adding value to products like the CFFP, since it is vital within systems of this kind to prevent unauthorized access to sensitive data, such as a client's or debtor's financial information (sales volume, income, earnings, etc.). It should be underscored that efficient continuity management will also reduce the level of risks relating to the use of transactional software in factoring companies.

The characteristics of the JAŚMIN system, delineated above, and the built-in information security solutions clearly demonstrate the role that security plays in military settings. Protection against eavesdropping is of key importance to the success of military missions and operations, and modern information and communication technologies prove as useful in army networks as they are in civilian organizations. It should be realized that military experiences in security and continuity management can be exploited to improve security in other settings, too, especially with mobile systems, which are intrinsically exposed to issues with unauthorized access. A solution of this sort is described in Section 4 above.

6. Conclusions

In the modern information society a new, still poorly recognized area of decision support for users of mobile devices is emerging. Whether we want to improve the management of a company or bank, to enhance communication within research projects, or to support any activities of a military nature, we find more and more opportunities to utilize mobile devices. Thus developers will increasingly often encounter the same opportunities and strive with the same challenges and restrictions in solving similar problems. On the one hand, one can take advantage of the increasing capabilities of smartphones, and on the other, further pioneering technologies are expected to be launched soon.

Past experience attests to the unique character of support for mobile decision-makers, which results not only from purely technical constraints but also from the distinct needs of decision-makers operating in their work-specific circumstances: at different locations, in a rush, and very often at short time intervals. Context-aware software can significantly improve the decision-maker's working conditions.

The case studies discussed in this paper seek to stimulate debate over the solutions and the constraints of rich and dynamic communication, security, reliability, usability and experiences acquired in various areas of application. It seems that these cases indicate that most immediate efforts should be directed at dealing with: (1) continuity management (mobile video) allowing decision-makers to retain control over their areas of responsibility even if the only working device is a smartphone, (2) an increased level of security comparable to that of military systems (JAŚMIN, CFFP), and (3) enlargement of user groups due to the omnipresence of mobile devices and wireless Internet access, bringing new opportunities and dangers to mobile Decision Support Systems.

Notes

1. www.mhimss.org/sites/default/files/resource-media/pdf/Standards_Designed_to_Make_Mobile_Video_Clearer_-_IEEE_-_The_Institute_pdf(accessed on 2 August 2012).
2. http://teldat.pl/eng/index.html

3. *Nowa Technika Wojskowa*, No. 4, April 2012, available at: http://teldat.pl/download/czasopisma/NTW_04–2012.pdf (in Polish) (accessed on 2 August 2012).
4. The English equivalent of the Polish word 'jaśmin' is 'jasmine' – the name of any of numerous shrubs or vines belonging to the genus *Jasminum*, valued for their fragrant flowers that are used in perfumes and teas.
5. See http://teldat.pl/images/Komputerowy_Terminal_Taktyczny_pl.pdf.

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