Technological Changes in High Reliability Organization: Implementation of a Telematic Rescue Assistance System into German Emergency Medical Services

Marie-Thérèse Schneiders, Daniel Schilberg, Ingrid Isenhardt, Sabina Jeschke
Institute of Information Management in Mechanical Engineering (IMA)
RWTH Aachen University
Aachen, Germany

Email: {marie.schneiders, daniel.schilberg, ingrid.isenhardt, sabina.jeschke}@ima.rwth-aachen.de

Abstract- **The introduction of a Telematic Rescue Assistance System into the German Emergency Medical Services aims at the enhancement of treatment quality and efficiency of rescue operations. Rescue teams are supported on site by a specialized emergency physician in a remote Competence Centre. Using mobile radio networks the Telematic Rescue Assistance System enables real time transmission of voice communication, vital parameters, pictures and videos from any emergency site. The successful and sustainable operation of a Telematic Rescue Assistance System in German Emergency Medical Services organizations requires the elaboration of a context and object adjusted implementation strategy. Dealing with technology change in a so called High Reliability Organization, organizational culture and structure affect primarily the design of available implementation instruments. Further requirements to the arrangement of an implementation process result from the sociotechnical specificities of the Telematic Rescue Assistance System. The present work presents the methodology used within the research project to develop an adequate implementation strategy, pointing out the relevant requirements and the chosen instruments to implement the system within five different Emergency Medical Services departments in 2012.**

Keywords - Telematic Rescue Assistance System; German Emergency Medical Services; High Reliabilty Organizations; Technology Implementation; Implementation Management

I. INTRODUCTION

Within the German research project Med-on-@ix (2007-2010) engineers, researchers and physicians from Aachen developed a preliminary model of the *Telematic Rescue Assistance Systems* (TRAS) and evaluated the prototype for 10 months within a trial run in the *Emergency Medical Services* (EMS) of the city of Aachen. The evaluation of the system revealed the potential of telemedical support during EMS missions regarding high quality treatment of emergency patients and the enhancement of information and time management.

The TRAS allows the immediate support by EMS teams during an emergency operation by a tele-EMS physician in a remote *Competence Center* (CompC). Not only the real-time transmission of vital data and pictures from the emergency site but also the video footage out of the *Mobile Intensive Care Unit* (MICU) via 3G mobile radio networks, provide the necessary information basis for the qualified telemedical support. Via mobile communication the tele-EMS physician is connected with the team on site and provides the necessary medical know-how and decision authority in terms of adequate diagnosis and treatment. The CompC serves as an information crosspoint between prehospital, clinical and related health care facilities along the medical supply chain [1].

The project work pursued a joint organizational and technical development approach [2] to guarantee a user-centered requirement management and a continuous process improvement in line with the development. The constant involvement of EMS physicians and paramedics into the design and development process as well as trials at different levels of development (simulation studies in 2008 and 2009) and the final trial run in regular operations of the fire department in Aachen aimed at a wide scope of requirements regarding the implementation of the TRAS in German EMS organizations.

The follow-up project "TemRas – Telemedical Rescue Assistance System" started in 2010 faces the challenge to establish the TRAS at a broader level to be used in five different EMS departments in Western Germany. The research action is funded by the Ministry of Innovation, Science and Research of the state of North-Rhine Westphalia (MIWF) and the European Union for three years. At a technical level the roll-out of the TRAS requires the adaption of the software architecture to enable simultaneous support of multiple MICUs. The adapted software architecture overcomes the absence of standards for data exchange, integrates the existing devices used by MICUs and manages the communication for different applications [3]. The telematic network connects the MICU, the EMS team on site and the CompC. The long

 ISBN: 978-1-61208-179-3

distance communication is based on 3G mobile networks. Bluetooth and wireless transmission both enable the real time data transmission in the near area from the monitor/defibrillator unit, a Bluetooth stethoscope and a digital camera as well as a video life stream from a network camera in the MICU to the CompC (Figure 1.).

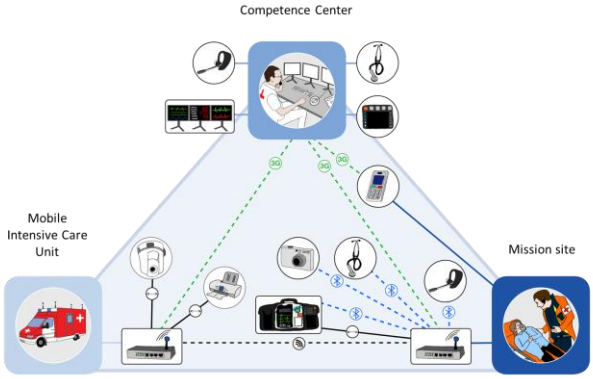

Figure 1. The optimised Telematic Rescue Assistance System

Besides the technical optimization of the TRAS, the main challenge is the implementation of the system in rural and urban areas with heterogeneous initial conditions in terms of resources, operating standards as well as user groups with different level of qualification and motivation.

The use of the TRAS implies a perceptible impact on communication structures and team processes [2]. Therefore the introduction into EMS organizations requires an implementation strategy considering system-related requirements as modified working processes, new working environments and new equipment. Furthermore organization-related requirements have to be considered to design the necessary actions. The implementation context is characterized by existing working conditions, cultural specification of the organization and structural conditions of the EMS department.

This paper offers an insight into the design of the implementation strategy pursued in the project TemRas. Starting with a literature review on the state of the art (section II), section III offers an insight into the characteristics of EMS as target organization of technology change. The methodology presented in section IV is partly borrowed from sociological and management theories. Whether sociological technology acceptance models underline the necessity of participatory implementation approaches, economical and marketing methods turn the gaze on the possibilities to bring about the organizational adoption and the long-term use of new technologies. Based on empirical values from the final evaluation results of the former project and scientific findings about EMS as a High Reliability Organization (HRO), an implementation strategy is developed relying on organization-related and object-related requirements (section V). The paper finally concludes with the idea how to learn from high reliability theory to design successful implementation processes.

II. STATE OF THE ART

To achieve the intended results by introducing new technologies a careful design of the implementation process is almost as relevant as the system design itself [4]. Since the decision to adopt a new technology does not online depend on the character of the product but goes in line with the first impression of its usefulness and the measures aiming at familiarizing the user with the changed working processes. The proper use of telemedical applications and the embedment into approved working routines affect the dissemination of the innovation through the healthcare sector. The aim of implementing telemedicine into healthcare organizations is to generate improved working processes with recourse to telemedical assistance. Care organizations develop routines around the use of new technologies and thereby create a selfreinforcing cycle of stability [4].

Following Gersick and Hackman routines are “functionally similar pattern of behavior in a given stimulus situation without explicitly selecting it over alternative ways of behaving” [5] . Current organizational routines can therefore be a source of organizational resistance against implementation of new technology combined with unknown working procedures.

Although past research has discovered that the decision to adopt a new technology does not guarantee its successful implementation [6] there has been only a few empirical studies on how to manage the group and interpersonal process to make implementation happen [7]. The organization’s willingness to adopt a new technology is a basic condition for successful implementation depending besides the user acceptance on the attitudes of managers towards technological change [8]. Research on technology acceptance revealed the necessity to consider not only the decision to adopt as a punctual event but to make a distinction between the classical terms of attitude, adoption or diffusion. Kollmann [9] recommends a gradual construct of acceptance considering user attitudes in a first phase, the willingness to try out a technology and in the end the long-term incorporation of a technology into organizational routines. Implementation measures aim at the creation of new organizational routines around the technology use, requiring a positive attitude and the readiness to try out something new. The success of the implementation process thus depends on the creating positive acceptance from the first user contact on. The closeness to the organizational environment encourages the consideration of cultural and structural particularities of the target organization.

Studies on adoption of new technologies in healthcare organizations underpin that technology implementation is a process during which new beliefs, new skills, and new collaborative routines are simultaneously developed [7]. Edmonson et al. [7] found out that “organizational differences in size, resources, academic status, innovation history, and senior management support were not primarily associated with implementation success” but ascribe these results to the unusual degree of homogeneity

 ISBN: 978-1-61208-179-3

across the observed cardiac surgery departments, introducing minimal invasive cardiac surgery. The authors point out the importance of collective learning processes and the role of team leaders as innovation drivers. It is decisive to foster open communication and mutual trust within the teams, "reinforcing a particular technological frame, which affects how others think about a new technology and the nature of the challenge it presents" [7]. Edmonson et al. [7] suggest a four-step process to establish new working routines: enrollment, preparation, trials, and reflection. The process model that emerged from these data is mundane: (1) carefully select a team, (2) practice and communicate, (3) work to encourage communication while experimenting with new behaviors in trials, and (4) take time to reflect collectively on how trials are going so that appropriate changes can be made [7].

Similar studies and observations in EMS organizations have not yet been carried out. The remarks made so far show the necessity to take a closer look at the organizational culture to design an implementation strategy, along with stimulating of positive technology acceptance as a prerequisite for organizational adoption.

III. TECHNOLOGY CHANGE IN HIGH RELIABILITY ORGANIZATIONS

As EMS teams are able to balance effectiveness and safety despite the complexities of the environment regarding uncertainty of the situation, time pressure and restricted available resources, EMS organizations are considered High Reliability Organizations (HRO). Risky environment and the fact of facing partly insoluble tasks make human errors practically inevitable in these organizations; nevertheless fewer mistakes are made than expected, as problems are identified at an early stage. These organizations do this by consistently noticing the unexpected and reacting in a very flexible way.

Following the HRO model by Weick and Sutcliffe [10] these organizations have a collective state of *mindfulness* in common. Five principles of acting and organizing create a mindful way of behaving:

1. preoccupation with failures rather than successes,
2. reluctance to simplify interpretations,
3. sensitivity to operations,
4. commitment to resilience and
5. deference to expertise.

Members of mindful organizations pay attention to small deviations from regular operations and consider even small failures as a potential cause for bigger problems. They do not try to overlook mistakes to focus on successes but take failures as learning moments. HRO avoid the human tendency to oversimplify the world around us. In order to create more varied and differentiated expectations of what could happen HRO build diverse teams and welcome a wide variety of perspectives that challenge the conventional wisdom.

The concentration on things that disconfirm, are uncertain or implicit creates a so called "mindful culture" [11] that Weick describes as an informed culture creating and sustaining continuously intelligent wariness. A mindful organization culture provides a basic framework for the capability to discover and to manage unexpected events, to create high reliability.

Paulina and Callois [12] showed by analyzing reliability strategies in the military, space and semiconductor industries that HRO tend to limit their speed of technological innovation in order to preserve their level of reliability. LaPorte [13] explains this phenomena with the risky environment in which HRO operate "in wich any change in circumstances, internal processes or technical innovation is more likely to degrade than to improve existing operations". These assumptions have so far not been transferred to the analysis of EMS organizations; however no successfully realized widespread innovations in EMS are observable within the last decades.

IV. METHODOLOGY - DEVELOPMENT OF A IMPLEMENTATION CONCEPT

Contrary to the traditionally interpretation of the implementation as a closed stage of development within a engineering process, current approaches dealing most with strategy implementation processes foster a new point of view. Instead of splitting the development process into a planning, an implementation and an evaluation phase, implementation activities refer to change tasks realized at different stages of development. Daniel [14] defines implementation as all activities that ensure the future success of the application deployment object in the implementation context, regardless in which phase of the development the corresponding activities take place. Those activities target both person- and object-related objectives concerning then the two reference planes 'result-related objectives' and 'process objectives'. Figure 2. shows the defined objectives in line with the implementation of the TRAS.

	person-related objectives	object-related objectives		
	user-acceptance	quality	cost	time
result-oriented	high acceptance for the TRAS	compatibility between the TRAS and the EMS organization	low follow-up costs	early introduction
process-oriented	high acceptance for the implementation process of the TRAS	fault-free approach, little impairment of day-to-day business	Low implementation costs	short duration of implementation

Figure 2. Objectives of the implementation activities

Beside the positive user acceptance in view of an organizational adoption of the system, best quality of the TRAS and the implementation process as well as an early and brief introduction of the TRAS is intended.

To achieve the defined context- and object-objectives (Figure 2.) requirements towards a successful

 ISBN: 978-1-61208-179-3

implementation strategy were identified on both sides by referring scientific findings from the project itself and external theoretical and empirical research work.

Context-oriented implementation is focusing primarily on overcoming personnel and organizational barriers of implementation. Approved instruments originate from the categories information, qualification, motivation and organization [15]. Applied measures concerning these categories can have cross-sectional effects such as informational and qualifying measures can have motivational impact on the target group. The success of all implementation measures depends on the acceptance by the affected persons and their willingness to take part in the change process. In this regard information and communication actions have a direct link to technology acceptance.

As Chau and Hu [16] showed in their study upon telemedicine acceptance by physicians the main task of management in technology change process consists in demonstrating and communicating the technology's usefulness to the routine tasks and services [16]. To avoid the so called "Not invented here" syndrome [17] the design of the TRAS has to fully recognize the needs of the user groups. The early involvement of paramedics and physician into the development process had the most important impact on the user acceptance. The consequent dialog and the constructive way of dealing with feedbacks, fears and inhibitions paved the way to a user-centered technology creation.

Object-related requirements were derived from several evaluations of the previous project Med-on@ix. The use of the TRAS was evaluated during a one-year trail from different perspectives. Besides the quality of treatment, focusing on time management and the appropriateness of the treatment process, the user acceptance of the TRAS was evaluated to gather potential for improvement of the system. By analyzing the impact of the TRAS on working routines of EMS teams several requirements were identified aiming at the elaboration of working and communication rules to be considered in telemedically supported missions [18]. Change tasks where identified concerning the use of checklists to guarantee a necessary level of standardized working procedures and the training of users in using the TRAS properly.

Bergrath et al. [19] evaluated the technical and organizational feasibility of the pilot TRAS based on 157 EMS missions in the city of Aachen, concluding that the use of the TRAS is feasible even if technical reliability and availability has to be improved in the future. The authors reported technical problems caused by network disconnections especially inside buildings. Evaluation of organizational implementation revealed successful cooperation between the EMS team on site and the tele-EMS physician in terms of ECG interpretation, diagnosis and treatment decisions.

To achieve the implementation objectives (Figure 2.) context and technology related requirements are describe in the following section and the implementation strategy is drawn to meet cultural and structural particularities of the implementation project. The morphological box in Figure 3. modeled after Baumgartner and Schneeberger [20] offers an insight into the range of strategic design parameters.

dimensions of the implementation strategy			design options			
culture	behavioural style		top-down		bottom-up	
	managerial style		directive		participatory	
structure	object	Extent of implementation	Complete object		Gradual introduction of object modules	
		Stage of development	Ideal solution		Approximate solution with rework option	
	context	context definition	overall context		successive introduction into context areas	
		transition between context areas	coupled	overlapping	parallel	decoupled
	time	Point in time	Considering the relevant maturity level		Considering favorable opportunities	

Figure 3. Development of an implementation strategy

The implementation of the chosen strategy is finally realized through different implementation measures. As mentioned above implementation instruments belong to the categories information, qualification, motivation and organization.

V. RESULTS – THE IMPLEMENTATION STARTEGY

A. *Organization-related requirements*

The implementation of new technologies into German EMS organizations underlies the barriers of the federal healthcare system. State specific EMS legislations bring about different structures of service, working practices, level of qualification and various allocations of rights and duties. The introduction of technological assisted working procedures has therefore to meet shared needs of EMS organizations, avoiding conflicts with structural conditions by adapting the TRAS at the prevailing conditions. As for example the training of paramedics is integrated into weekly standard on-the-job training. For same reasons the application of the TRAS does not explicitly interfere in the handling of emergency calls and the working processes of the dispatch center for rescue services.

As the impact of the TRAS is particularly connected to the performance of teams on site, the implementation efforts focused the operational capability. The TRAS has to be easily integrated as an add-on solution to regular operational processes. The evaluation of the Med-on-@ix System by paramedics showed the necessity to accompany the introduction of the TRAS by intensive training to generate qualified working routines in view of failure-free communication and teamwork processes. Users pointed out the importance of open communication and feedback possibilities. Regular debriefings and feedback between the users on site and the tele-EMS physicians constitute further important implementation measures.

 ISBN: 978-1-61208-179-3

Besides the importance of teamwork and open discussions for HRO [21][22], strong internal leadership is accounted within the implementation process by an elaborated role concept regarding both the operation of the TRAS during emergency missions and the implementation process itself realized by the project team. The implementation of the TRAS requires the support by authorities to foster the dissemination and consequent use of the new technology by the whole organization. Therefore the pre-information of authorities and the participatory design of the organizational implementation are decisive.

Research findings about HRO [23] bring about further requirements to be considered:

- well-defined project objectives
- target-orientation within the project
- team-orientation
- definition of roles

B. *Object-related requirements*

The development of the TRAS as a sociotechnical system faces beside technological challenges particularly many organizational challenges, critical in view of a successful implementation of the TRAS into daily work of EMS. The implementation builds on a joint technical and organizational development [2] aiming at an optimized user-centered design of the technical system as well as the organizational concept enabling the operation of the TRAS. The design of the TRAS requires the consequent adaption of the system upon the organizational conditions of use. The modular architecture of the system offers the possibility to implement different functionalities and various complexity levels, enabling an organization specific implementation effort.

The scope of the implementation constitutes a more challenging characteristique of the implementation object. On the one hand various divisions of the EMS department as well as the dispatch center, municipal administration and clinic workers are involved into the change project. On the other hand the involved paramedics and physicians have different needs, qualifications and levels of technical affinity.

The use of the TRAS implies beside specific organizational procedures, legal regulations concerning the delegation of medical treatment and technical complexity. In the consequence the implementation of the TRAS is confronted with a difficult communicability. In combination with the necessity of training mentioned above the implementation requires extensive measures of preparation.

Bergrath et al. [19] showed the failure-free use of the TRAS depends on the reliability of mobile radio networks. As these technologies remain instable inside buildings and in rural areas and as the context of use requires high reliability the implementation of such a system has to be realized as an add-on to traditional EMS working procedures.

C. *Implementation strategy*

Analyzing the described requirements success criteria for the adoption of a TRAS can be derived. Information and communication instruments avoid misunderstanding and miscommunication about the implementation project. It is therefore decisive to look for an early opportunity to inform the members of the organization. Starting with a roadshow in every EMS department with possibilities for an open discussion, regular meetings in line with training units and feedback meetings scheduled along with the TRAS operation.

By identifying promoters of the implementation project at various hierarchy levels and within the different involved divisions of the EMS organization the information flow and the diffusion of the TRAS within the implementation context is raised. To gather current moods or hidden rumors internal contact persons act as mediators and opinion-formers to intensify the harmonization between user needs and system design. Thereby the designated mediators play an important role in fostering positive user acceptance, reporting everyday experiences with the system to the system developers.

Referring to Figure 3. the main design elements of the developed implementation strategy are showed in Figure 4.

dimensions of the implementation strategy			design options			
culture	behavioural style		top-down ⟷		bottom-up	
	managerial style		directive ⟷		participatory	
structure	object	Extent of implementation	Complete object		Gradual introduction of object modules	
		Stage of development	Ideal solution		Approximate solution with rework option	
	context	context definition	overall context		successive introduction into context areas	
		transition between context areas	coupled	overlapping	parallel	decoupled
	time	Point in time	Considering the relevant maturity level		Considering favorable opportunities	

Figure 4. Implementation strategy for the introduction of a TRAS

The chosen strategy to implement a TRAS into a German EMS organization is characterized primarily on a cultural level by a top down strategy concerning the initialization of the implementation project. Authorities of the EMS department and municipal administration have to drive the adoption by legitimating the use of the TRAS in regular operations.

As the decision to adopt the technology is first of all taken on a team level several measures have to be taken to encourage the involvement of paramedics and physicians as primary user groups. The participatory approach is realized through feedback and communicative instruments. By the involvement of users into the development of technical and organizational system components user acceptance is achieved and a common goal comprehension is generated through consequent dialogue. The latter

 ISBN: 978-1-61208-179-3

fosters in combination with extensive training on the job the mindful culture needed to achieve high reliability.

The extent of implementation is defined by the modular character of the TRAS. The gradual introduction of system components reduces the complexity of the implementation. To foster the user involvement regarding the adjustment of the system the TRAS is initially operated within a small team of users or rather by running only one equipped MICU.

As the TRAS is used within a heterogenic flied of applications facing different infrastructural conditions the system is based on a modular architecture facilitating the implementation of approximate solution with rework options.

Furthermore the implementation is relieved by the stepwise extension of the user group. The involvement of selected EMS teams at a first level of the roll-out stimulates the organizational adoption.

The TRAS is implemented as an add-on solution for EMS missions. The parallel running of the traditional and the innovative way of treatment underpin the fall-back character of the tele-EMS physician. The implementation of the TRAS aims at reducing the time period when no EMS physician is available on site.

To reduce the procurement costs the implementation date is matched with the tendering of new MICU by the EMS departments. Considering these favorable opportunities the necessary conversion work is combined with the regular construction of the MICU.

VI. CONCLUSION AND OUTLOOK

The successful use of a TRAS in EMS missions requires an elaborated implementation approach starting already in the first development phase. Implementation research offers several starting point to successful technology introduction, lacking at the same time of practicable models to elaborate an implementation project.

The present paper suggests a methodology to design a context and object oriented implementation strategy. We pointed out the importance of user involvement within the design of organizational and technical aspects of the TRAS to gain the necessary acceptance and finally to reach the organizational adoption. Regarding the here considered use case, the characteristics of an EMS organization as a HRO play a significant role in the choice of implementation instruments. Learning from HRO theories we considered organizational conditions producing high reliability into the technology change strategy.

As information technology is more and more adopted within the healthcare sector research on best practice implementation projects are needed to foster the capacity for innovation also in prehospital healthcare organizations. Current research activities might take into account the importance of planned implementation to achieve marketable technical innovations. Furthermore the scientific discourse on learning from high reliability organizations to design efficient and well-accepted technology changes might radiate on various interdisciplinary research areas.

VII. ACKNOWLEDGMENT

This work was funded by the Ministry of Innovation, Science and Research of the state of North-Rhine Westphalia (NRW). The project TemRas is realized in cooperation with the University Hospital Aachen, Philips HealthCare, P3 communications GmbH, 3M GmbH.
All authors are members of the Institute of Information Management in Mechanical Engineering of RWTH Aachen University, Germany.

REFERENCES

[1] M. Protogerakis, A. Gramatke, and K. Henning, "A System Architecture for a Telematic Support System in Emergency Medical Services.", IEEE, Proceedings of The 3rd International Conference on Bioinformatics and Biomedical Engineering, 2009, pp. 1–4.

[2] M. Schneiders, D. Schilberg, and S. Jeschke, A Joint Organizational and Technical Development of a Telematic Rescue Assistance System for German Emergency Medical Services. In: Proceedings of eTELEMED 2011, The Third International Conference on eHealth, Telemedicine, and Social Medicine 2011/ DigitalWorld 2011. Hrsg. v. (c) IARIA: Gosier, Guadeloupe, France, 2011, pp. 150-155.

[3] S. Thelen, M. Schneiders, D. Schilberg, and S. Jeschke, "Modular Software Architecture Approach for a Telematic Rescue Assistance System". In: Proceedings of the IADIS International Conference E-Health 2011. Hrsg. v. Macedo, Mário: Rom, 2011, pp. 201-204.

[4] B. T. Karsh, „Beyond usability: designing effective technology implementation systems to promote patient safety", Quality and Safety in Health Care, vol. 13(5), 2004, pp. 388-94.

[5] C. J. G. Gersick and J. R. Hackman, „Habitual routines in task-performing groups* 1", Organizational behavior and human decision processes, vol. 47(1), 1990, pp. 65-97.

[6] W. J. Orlikowski, „Using technology and constituting structures: A practice lens for studying technology in organizations", Resources, Co-Evolution and Artifacts, 2008, pp. 255-305.

[7] A. C. Edmondson, R. M. Bohmer, and G. P. Pisano, „Disrupted routines: Team learning and new technology implementation in hospitals", Administrative Science Quarterly, 2001, pp. 685-716.

[8] D. Leonard-Barton and I. Deschamps, „Managerial influence in the implementation of new technology", Management Science, 1988, pp. 1252-1265.

[9] T. Kollmann, „Attitude, adoption or acceptance? Measuring the market success of telecommunication and multimedia technology", International Journal of Business Performance Management, vol. 6(2), 2004, pp. 133-152.

[10] K. E. Weick and K. M. Sutcliffe, Managing the unexpected: Assuring high performance in an age of complexity. Jossey-Bass, 2001.

[11] K. E. Weick and T. Putnam, „Organizing for mindfulness", Journal of Management Inquiry, vol. 15(3), 2006, pp. 275-287.

[12] V. D. S. Paulino and M. Callois, „Innovation and reliability strategies in the military, space and semiconductor industries: a comparative analysis". International Journal of Innovation Management (ijim), World Scientific Publishing Co. Pte. Ltd., vol. 14(05), 2010, pp. 795-821.

[13] T. R. La Porte, „High reliability organizations: unlikely, demanding and at risk", Journal of Contingencies and Crisis Management, vol. 4(2), 1996, pp. 60-71.

[14] A. Daniel, „Implementierungsmanagement", Ein anwendungs-orienterter Gestaltungsansatz, Wiesbaden, 2001.

[15] U. Zeyer, Implementierungsmanagement: ein konzeptioneller Ansatz am Beispiel der Implementierung von Lean Management. Hampp, 1996.

[16] P. Y. K. Chau and P. J. H. Hu, „Investigating healthcare professionals' decisions to accept telemedicine technology: an empirical test of competing theories", Information & management, vol 39(4), 2002, pp. 297-311.

[17] R. Katz and T. J. Allen, „Investigating the Not Invented Here (NIH) syndrome: A look at the performance, tenure, and communication patterns of 50 R & D Project Groups", R&D Management, vol. 12(1), 1982, pp. 7-20.

[18] M. Schneiders, M. Protogerakis, and I. Isenhardt, „User acceptance as a key to success for the implementation of a Telematic Support System in German Emergency Medical Services", Automation, Communication and Cybernetics in Science and Engineering 2009/2010, 2011, pp. 563-568.

[19] S. Bergrath, D. Rörtgen, R. Rossaint, S. Beckers, H. Fischermann, J. Brokmann, M. Czaplik, M. Felzen, M. Schneiders, and M. Skorning, „Technical and organisational feasibility of a multifunctional telemedicine system in an emergency medical service – an observational study ", Journal of Telemedicine and Telecare, 2011, in press.

[20] R. Baumgartner and T. Schneeberger, „Generic Management: Unternehmensführung in einem komplexen und dynamischen Umfeld", Duv, 2006.

[21] D. P. Baker, R. Day, and E. Salas, „Teamwork as an Essential Component of High Reliability Organizations", Health Services Research, vol. 41(4) , 2006, pp. 1576-1598.

[22] A. S. Frankel, M. W. Leonard, and C. R. Denham, „Fair and just culture, team behavior, and leadership engagement: the tools to achieve high reliability", Health Services Research, vol. 41(4), 2006, pp. 1690-1709.

[23] Shortell, S. M, J. Schmittdiel, M. C Wang, R. Li, R. R Gillies, and L. P Casalino „An empirical assessment of high-performing medical groups: results from a national study", Medical care research and Review, vol. 62(4), 2005, pp. 407.

 ISBN: 978-1-61208-179-3