Network Information Management for Collaboration in Disaster Management: Concepts and Case Study

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Abstract Interorganizational information exchange has become crucial to increase resilience and agility in disaster management. New collaborations between organizations to exchange information through innovative technologies create challenges for information management. It implies different stakeholders, diversified policies, multiple interpretations of innovative technologies, restricted knowledge of each other's organizations and shared governance of processes of innovation, cooperation, design and decision making. We offer an approach for Network Information Management that allows for and takes advantage of these differences between stakeholders and their organizations. An approach in which innovation, cooperation, design and decision-making is shared among stakeholders. The approach is based on three basic components: process management, scenario based development and organizing vision. These components reinforce each other resulting in convergence of stakeholder's positions throughout the process. The approach has been applied and tested in an innovation project for disaster management in the Netherlands, which serves as a case study in this paper.

Keywords Scenario based development · Network information management · Innovation management

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1 Introduction

Hazard prediction, risk mitigation and crisis response increasingly ask for collaboration between different organizations, agencies or stakeholders and have become an issue of interorganizational information exchange. The recent fire disaster at Moerdijk, nearby Europe's largest harbor Rotterdam (The Netherlands) showed over again the need for information exchange between public and private organizations (Nationale Raad voor Veiligheid) to improve crisis response and to minimize economic damage [1]. Increasingly organizations create alliances to share information. This accounts for organizations involved in disaster management (the demand side) as well as for organizations providing the technology for disaster management (technology partners). On the demand side, private and public institutions need to cooperate to exchange information by applying new technologies. These technologies can support cooperation in existing business chains, but also enable new collaborations that were previously considered impossible. Technology partners on their side need to collaborate to develop an ecosystem of innovative technologies, simply because it is rarely one technology that provides the innovation. It is the 'new combination' of organizations and technologies that lead to innovation [2].

Information management is the primary discipline in organizations concerned with relating patterns of information exchange between organizations to innovative technological innovations supporting this exchange. Information management is defined as the integrative, balanced management of different domains related to information usage in and between organizations. It concerns strategic, structural and operational information-related issues, which relate information and communication processes in the organization to supporting ICT [3]. This view on information management is congruent with that of others in the field who put the usage of information in organizations central and not the technology [4–7].

Innovative collaborations between organizations to exchange information through innovative technologies create challenges for information management. Organizations wanting to innovate to increase collaboration and to reach common goals, face challenges of alignment, conflicting interests and trust [8]. Collaboration requires coordination on processes of information exchange, requirements determination, design and decision-making. Interorganizational collaboration implies different stakeholders, diversified policies, multiple interpretations of innovative technologies, restricted knowledge of each other's organizations and shared governance of processes of innovation and cooperation. Innovative interorganizational collaboration implies ambiguity. Nor the collaboration itself, nor the abilities to enable collaboration with technologies and how the ecosystem of technologies needs to be designed are known in advance. These need to be determined throughout the innovation process. Moreover innovation processes are not straightforward. They tend to be iterative and multi interpretable. Thus, interorganizational innovation breaks with organizational routines and is ambiguous, which ask for processes of sense making [9]. Therefore, information

management faces the challenge of networking and sense making, a process of getting to a collective vision on information exchange between organizations [10]. We call this Network Information Management (NIM).

In this paper we describe an approach for Network Information Management based on three basic components: process management, scenario based development and organizing vision. This approach is being applied and tested in an innovation project for disaster management in the Netherlands, which serves as a case study in this paper. The paper ends with discussion and conclusions. With our NIM approach we contribute to knowledge and practice in the field of information management for disaster management specifically and on knowledge on information management in networks of collaborating organizations in general.

2 A Network Information Management Approach

Network Information Management (NIM) is an approach in which process management, scenario based development and the development of an organizing vision is central. The three reinforce each other.

2.1 Process Management

The application of innovative technology to achieve new collaborations between organizations (eventually even between organizations that did not collaborate before) is not unambiguous. Involved stakeholders will have different views on how they might benefit from the collaboration and/or the technology. Furthermore, how the technology might enable collaborations needs to be proven. Besides this ambiguity, stakeholders' interest might differ or even conflict and involved parties might work together on other projects, which contradict with the current project. Therefore they interact in a network of mutual dependencies. Project management, although inextricably linked to the application of ICT, has its limitations in these situations. Such situations do not offer the opportunity to define an unambiguous project definition. Unambiguous commissioning is rarely the case and financial business cases are hard to determine. The application of innovative technologies for new collaborations requires freedom for experimentation and sense making. Moreover, interests in this project might contradict with interests of the stakeholders in other collaborations. Any new form of collaboration, eventually with new partners, requires discovery of each other's interests, positions and expectations. Process management is a more sensible approach in such situations [11].

In process management, the focus is on the quality of the decision making *process*, not on the content of decisions, or on reaching predefined goals with predefined means (cf. project management). Process management accommodates stakeholders to bring their interests, problems and visions to the front. The initiator

recognizes its interdependence from the other stakeholders fully and encourages them to take initiative themselves. This creates commitment and support. Problem definitions benefit from this approach as stakeholders bring in their perceptions, values and beliefs. Crucial in process management is the design of an open and socially safe environment in which the stakeholders are invited to co-create the agenda and decision-making process while they can protect their core values. Furthermore, it is important to stimulate progress in the process. In our NIM approach this is ensured by working with scenario based development.

2.2 Scenario Based Development

It is important to involve potential recipients of innovative technology as early as possible in the design and development process as their requirements are hard to articulate upfront. From the beginning on the different parties need to be involved in a process in which they discover the innovation potential of the technology for new practices of collaboration. Scenario-Based Development (SBD) is a method to bring technical and customer parties together around a specific problem taken from work practice. A scenario is a description of the dynamics in a work situation, in which actors, backgrounds and assumptions are included in more or less detail. Scenarios allow for interaction, for articulation of meaning. With SBD, commitment and imagination of users from different (public/private) parties, with their specific backgrounds, are encouraged. Mutual understanding and a common vocabulary are co-created [12]. The (future) information technology application and its innovative potential are being created in an interactive process. The outcome of SBD is a demonstrator in which the dynamics of the scenario can be shown, and possibly interacted with. By means of a demonstrator technical researchers can trigger potential customers to understand the added value of new technology for their working practice. This creates a cyclical process in with supply and demand parties interact and articulate user requirements and specifications. The goal of SBD is to show innovative potential of technology and to stimulate articulation of new ways of collaboration in the first place, not to prove technological feasibility or to develop a first version of a production system: a common goal of traditional prototyping.

2.3 Organizing Vision

During the different phases of the process that is being management by process management, different demonstrators are build based on mutually defined scenarios. Based on these scenarios stakeholders develop an organizational vision. An organizational vision (OV) is a focal community idea for the application of ICT in organizations. Organizational visions are collective sense making of the innovative

application of ICT for organizations or networks of organizations [13]. People recognize what the technology can mean for their organization and the collaboration with other organizations. As such an OV serves as a *memory of the future.* Developments in technology and changes in the organization are not only interpreted through this memory but also created according to this memory. The OV is formed through experiences with creating and interacting with the scenarios and demonstrators. As such the demonstrators serve as a *memory of the present* regarding what is currently possible. As several demonstrators are being developed and stakeholders have build trust in each other and the demonstrated technology, the OV tends to become more visionary, more futuristic. The OV goes beyond today's possibilities of demonstrators and becomes more directive for the articulation of (new) scenarios. The memory of the future begins to direct the creation of memories of the present. OV's leave room for interpretation so that sense making is not being blocked. OV's are plausible stories of the future of the organization in which agendas, policies and core values can be recognized and continued [14]. But at the same time OV's can be used to redirect agendas and policies in the direction of the OV. Demonstrators can be used to test the feasibility of these directions, thus decreasing ambiguity of the situation.

2.4 Reinforcement of the Three Basic Building Blocks in the NIM Approach

Process management, SBD and OVs reinforce each other by incrementally decreasing the ambiguity of the situation whilst undergoing the innovation process. Process management contributes by providing clarity about the decision making process and social safety throughout this process. Scenarios and resulting demonstrators provide stakeholders with the opportunity to bring in what they find important and to decrease ambiguity by showing the abilities of the technology. This provides a memory of the present and secures progress in the process, which is an essential requisite in process management to keep the process going and preventing stakeholders from leaving the process [11]. The OV that develops throughout the process further reduces ambiguity because it tends to become shared amongst stakeholders adding to trust and giving directions to scenario's and demonstrators. Every time demonstrators show the feasibility of the OV, trust in the collaboration and the technology is reinforced and ambiguity is decreased. As ambiguity decreases the OV becomes increasingly what it is meant for: a device for interpretation, mobilization (of people within organizations) and legitimization (of people's actions) [13]. The process management that started quite open closes step by step, eventually resulting in a situation where traditional project management can do the rest.

3 Case Study Slim Verbinden

Slim Verbinden (SV) (Connecting Smartly) is an innovative 2-year research program (2011–2013), which has been established by the Dutch Ministry of Economic Affairs. The program focuses on the use of innovative technology for achieving greater safety for workers and citizens during disasters and crises by providing relevant information from multiple sources. A great number of reputable technology parties are involved (from industry and academia), as well as a number of private and public organizations in different security regions in the Netherlands. Within the program, an ecosystem of various innovative technologies is developed and tested, including multi-agent technology for distributed sensing and multi-sensor data collection, multi-agent middleware software for secure data sharing enabling information providers to control who can access their information, crowdsourcing and self organization, context awareness technology, geographic information visualization and artificial intelligence explanation [15]. Studio Veiligheid, a Dutch foundation stimulating innovation in the field of safety, transport, traffic management and law enforcement, manages the SV program. Our approach for Network Information Management is being applied and tested in this program.

Process Management

At the start of the program it was unclear for the involved parties what the common end result would be. Each participating organization had its own interests. On the demand side, several private and public parties have their own role and responsibility in crisis management. On the technology supply side various parties offer specific innovative technologies and have their own market interest. Types of future collaborations and how technology could enable it were ambiguous and so was the innovation process to arrive at it.

We created an open and secure process leaving room for participative agenda setting, discovery of each other's interests and protection of core values. At the same time we offered enough structure to get to decision-making.

We encouraged the technology partners to bring to the front the innovative potential of an ecosystem of their technologies for disaster management, helping them to discover their mutual strengths and benefits of cooperation. We involved demand side parties in the process to bring in real life disaster management scenarios to stimulate these parties to envision future collaboration opportunities based on new technologies. The technology parties developed demonstrators based on these scenarios to show potential. These demonstrators made it easier for the demand side parties to imagine potential applications. Throughout the process, the interests and viewpoints of the participants converged and demand and technology supply parties began to understand their mutual dependence. Doing so we close the gap between science and practice and pave the way towards working solutions.

Scenario Based Development

One of the scenarios that have been developed during the Slim Verbinden program is the Tata Steel scenario. In collaboration with Tata Steel in IJmuiden,

the safety region Kennemerland municipality Velsen and several international logistic partners a scenario is developed around an imaginary 'toxic cloud' incident. This scenario encourages parties to think over their future cooperation and information exchange in crisis management in relation to the innovative Slim Verbinden technology. In this way these parties intensified cooperation in their disaster management, including official communications with citizens.

Another scenario has been developed in cooperation with the Municipality of The Hague, a private security organization and the Police Haaglanden (The Hague and surroundings). At Parkpop, a major pop music event in the city, innovative technology was used to locate and position emergency workers and security guards to route them quickly and effectively to a diverse set of incidents. New ideas emerged on interorganizational cooperation at festivals and created enthusiasm amongst different administrative levels at the participating organizations. Furthermore the users, offering technology partners advantages to bring their technology to market, playfully brought in rather detailed specifications for the technology.

Organizing Vision

At another Slim Verbinden project 'Raebell' a feasibility study of the application possibilities of low airspace radar technology was conducted. Based on scenarios and demonstrators an 'organizing vision' emerged. Initially, scenarios focused on "Prinsjesdag", a major yearly event in which the Dutch Queen rides in her nineteenth century golden carriage through The Hague to the Houses of Parliament to present the Government's plan to Parliament. At first scenarios were focused to protect the Queen, Parliament and the public against low-flying objects. However the scenario and the demonstrations provided parties the opportunity to think further and to express views on future scenarios, which are currently hard to imagine, such as increase in mobile air traffic equipment in lower airspace (like drones or even flying cars). Such a future situation requires new and different ways of coordination and information exchange as well as a different usage of radar technology, eventually in combination with innovative imaging and sensor technology. Throughout the process a memory of the future emerged from the demonstrators, the memories of the present.

4 Conclusion

The case study demonstrated that the combination of process management, scenario-based development and organizing vision is a powerful approach to improve the quality and effectiveness of an innovation process in networks of organizations involved with disaster management. Our approach for Network Information Management is also suitable for other situations where new or changing forms of cooperation need to become envisioned by existing or new participants and in which new technologies are being developed to support this new collaboration. Essentially, NIM designs a process in which cooperation (and

accompanying vision) develops *in* a process where parties test their cooperation through concrete scenarios in which innovative technology is being applied. We are convinced that using our approach as a base structure in the innovation process will not only lead to a better fit between developed solution and business process but also lead to a better return on innovation funding.

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