CURING HEALTH CARE INFORMATION SYSTEMS WITH OPEN SOURCE SOFTWARE

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Abstract:

The purpose of this paper is to examine the current state of open source projects in health care environment and the level of collaboration in this field. We underpinned our discussion on the theoretical foundations of institutional theory, collaboration and virtual organisations. This article reports briefly the challenges of health care information systems and open source software as a possible solution alternative. The empirical part analyses an EU sponsored open source health care project, SPIRIT. We argue that both inter-organisational HCIS and OSS development projects face similar challenges in collaboration due to their organisational setting. To enhance future collaboration, we introduce a set of managerial solutions found in successful open source projects.

Keywords: health care, information systems, open source software, collaboration, institutional fields, virtual organisation

1 INTRODUCTION

The European Union has expressed in various statements strong support in favour of open source software (OSS), and recommendations concerning the use of open source software have already taken place in political circles within European Union and several national governments.(Working Group Libre Software 2000), (Information Society Technologies Advisory Group 1999). The EU has also expressed the need for research concerning the benefits of OSS and the barriers preventing the development and adoption of OSS. One such advocacy project was EU SPIRIT project, which objective was to foster the adaptation of open source in health care.

Health care information system (HCIS) are of particular interest since the costs have been constantly soaring since the 1990s and health care information systems have been seen as one remedy for rationalisation of health care (Raghupathi 1997), (Wang, Middleton et al. 2003). Health care organisations have implemented new information systems extensively during the past two decades. However, information systems in health care are highly fragmented and therefore fail to fulfil promises of rationalising health care. (see e.g. (Itkonen 1999))

Our premise is that currently health care information systems are too fragmented to work in most efficient manner. Firstly, maintenance of several different information systems is wasting scarce resources, and secondly, the quality of care for patient could increase, if the systems were better integrated and data could be shared and used more efficiently between different organisations.

In our opinion, health care organisations could benefit from open source concept. OSS promotes de-facto and de-jure standards (Working Group Libre Software 2000). Standards are one important precondition for efficient data sharing. In addition, development and use of OSS components as the backbone of information system would reduce development risks and allow each developing party to concentrate on their core competencies (McDonald, Schadow et al. 2003). Not forgetting the fact that it would create savings for exiguous HCIS budgets.

However, there are sizeable barriers for adaptation of OSS in health care, such as conservative attitudes towards new technologies and practises. Secondly, health care information systems often process critical information and there is no room for “beta-phase” solutions (McDonald, Schadow et al. 2003). Thirdly, open source projects often concentrate on developing small individual components rather than larger integrated solutions.

This paper reports a case study of open source advocacy project in health care. We analysed and evaluated the EU SPIRIT project aiming to foster the use of open source in health care. The empirical part of our study is based on the publications and material of the project. All the material is available in the Internet. We anchor our empirical discussion in organisational theories, especially in collaboration and virtual organisations paradigms.

The purpose of this paper is to provide an examination of the *status quo* of open source projects in health care and provide a basis for further discussion. Our research questions are:

1. What is the current state of open source projects in health care?
2. What is the level of collaboration within open source health care projects?

2 HEALTH CARE AND INFORMATION SYSTEMS FROM AN ORGANISATIONAL PERSPECTIVE

2.1 Institutional fields and collaboration

According to Hesselbein and Whitehead: "We live in a time when no organization can succeed on its own... As we look around us in a new century, we realize that businesses and non-profits in today's interconnected world will neither thrive nor survive with visions confined within the walls of their own organizations. They need to look beyond the walls and find partners who can help achieve greater results and build the vital communities to meet challenges ahead." (Hesselbein and Whitehead 2000)

Usually the success and failure of new technological innovations are explained by the functional and economic advantages that new technologies provide over traditional ways of doing things, whereas the cultural and behavioural aspects are left to little attention or ignored completely. (Phillips, Lawrence et al. 2000; Hargadon and Douglas 2001) However, *technology* and *organization* do not occupy separate spheres – or function according to separate logics, but they constitute an entity that should be dealt with as a whole rather than as a technical subpart and a social subpart. (Berg 1999)

One of the principal theoretical perspective of this study is that of institutional fields and especially inter-organizational collaboration. In our opinion, the theories suit very well in the research of health care information systems and of open source. Nevertheless, the theories are still relatively sparsely used in these research fields.

(Barley and Tolbert 1997) contend that *institutional theory* highlights cultural influences on decision-making and formal structures, organizations and individuals rest on a net of values, norms, rules, beliefs and taken-for-granted assumptions. *Institutions* then can be defined as any social entity that exerts influence and regulation over other social entities as a persistent feature of social life (King, Gurbaxani et al. 1994).

(Lawrence, Hardy et al. 2002) define *collaboration* as cooperative, inter-organizational relationship that is negotiated in an ongoing communicative process and that relies on neither market nor hierarchical mechanisms of control. According to (Phillips, Lawrence et al. 2000) *collaboration* involves the negotiation of roles and responsibilities in a context where no legitimate authority sufficient to manage the situation is recognized. This is especially true in the modern health care where an increasing number of highly specialized health institutions are participating in the process of patient care and the responsibilities of individual organizations are blurring (Van der Haak, Wolff et al. 2003).

(Keselman, Patel et al. 2003) present a number of crucial factors in collaborative decision-making for effective team functioning. These include shared goals, clear role differentiation among participants, strong leadership that helps to maintain focus without being too restrictive, shared understanding of the process grounded in group and individual expertise, and effective communication. (see also (Patel, Kaufman et al. 1999))

According to (Gajda 2004) the definition of collaboration is somewhat elusive, inconsistent and theoretical. The term collaboration has been overused to signify just about any type of inter-organisational or inter-personal relationship, making it difficult to evaluate with certainty. Gadja introduces the Strategic Alliance Formative Assessment Rubric (SAFAR) in order to evaluate collaboration. We will use this tool later in the empirical part of this paper to evaluate the level of collaboration in our case project.

Level of Integration	Purpose	Strategies and Tasks	Leadership and Decision-Making	Interpersonal and Communication
Networking	Create a web of communication	Loose or no structure	Non-hierarchical	Very little interpersonal conflict
1	Identify and create a base of support	Flexible, roles not-defined	Flexible	Communication among all members infrequent or absent
	Explore interests	Few if any defined tasks	Minimal or no group decision making	
Cooperating	Work together to ensure tasks are done	Member links are advisory	Non-hierarchical, decisions tend to be low stakes	Some degree of personal commitment and investment
2	Leverage or raise money	Minimal structure	Facilitative leaders, usually voluntary	Minimal interpersonal conflict
	Identify mutual needs, but maintain separate identities	Some strategies and tasks identified	Several people form "go-to" hub	Communication among members clear, but may be informal
Partnering	Share resources to address common issues	Strategies and tasks are developed and maintained	Autonomous leadership	Some interpersonal conflict
3	Organizations remain autonomous but support something new	Central body of people	Alliance members share equally in the decision making	Communication system and formal information channels developed
	To reach mutual goals together	Central body of people have specific tasks	Decision making mechanism are in place	Evidence of problem solving and productivity
Merging	Merge resources to create or support something new	Formal structure to support strategies and tasks is apparent	Strong, visible leadership	High degree of commitment and investment
4	Extract money from existing systems/members	Specific and complex strategies and tasks identified	Sharing and delegation of roles and responsibilities	Possibility of interpersonal conflict high
	Commitment for a long period of time to achieve short and long-term outcomes	Committees and sub-committees formed High	Leadership capitalizes upon diversity and organizational strengths	Communication is clear, frequent and prioritized degree of problem solving and productivity
Unifying	Unification or acquisition to form a single structure	Highly formal, legally complex	Central, typically hierarchical leadership	Possibility of interpersonal conflict very high
5	Relinquishment of autonomy to support surviving organization	Permanent re-organization of strategies and tasks	Leadership capitalizes upon diversity and organizational strengths	Communication is clear, frequent, prioritized, formal and informal

Table 1 Strategic Alliance Formative Assessment Rubric (SAFAR) (Gajda 2004)

2.2 Health care and information systems from an organizational perspective

Health care and HCIS are a fascinating field of research. The operating environment is highly fragmented and it differs in many ways from many other fields of 'business' (Berg 1999). Morris Collen (1995) has stated that developing a comprehensive medical information system appears a more complex task than putting a man on the moon had been.

Firstly, health care markets are heavily regulated by government. Yet, there are often several different authorities imposing divergent stipulations on health care actors. Furthermore, patients have different expectations and demands than customers in "regular" business; when a patient is involved in treatment it is usually more due to the circumstances rather than from his or her "free will".

Additionally, data security issues are pronounced in all medical treatment issues; lack of patients' trust in confidential treatment may hinder patients from obtaining medical treatment (Rindfleisch 1997). (Lorenzi and Riley 1995) Table 1 lists some of the basic differences between business and health care.

Business	***Health care***
Managed to create products/services that provide value to customers and profit to owners	Professions that are coordinated and administered to execute health policies that produce outcomes and strive to balance access, equity and quality against costs
Networking and collaboration accepted practices to access outside expertise	Technology being a tool developed by commercial enterprises. Reservations in becoming involved with industry for fear of loosing credibility in the eyes of peers
Prepared for change to continue to meet the needs of their customers	Resistance to management

Table 2. Differences in organisational cultures between business and health care (VTT 2003)

Actors in health care field posses such organizational features that research findings from other industrial or service sectors may not necessarily generalize to the health care sector. (Blair and Boal 1991) Fottler (1987, 369) illustrates eight features that distinguish health care organizations from other types of organizations (Fottler 1987):

1. Defining and measuring output is difficult.
2. The work involved is highly variable and complex, highly specialized and highly interdependent, requiring a high degree of coordination among diverse professional groups.
3. The work often involves emergency or non-deferrable activities, permits little tolerance for ambiguity or error, and uses professionals whose primary loyalty belongs to the profession rather than to the organization.
4. There exists little effective organizational or managerial control over physicians, the profession most responsible for generating work and expenditures.
5. In many health care organizations, there exist dual lines of authority that create role ambiguity, role conflict, and problems of coordination and accountability.
6. Most health organizations tend to be "loosely coupled" in the sense that organizational segments are only mildly responsive to one another and to the environment and organizational goals are vague.
7. The political, legal, and financial environments that confront health organizations are extremely complex and pluralistic requiring the development and maintenance of complicated intra- and inter-system linkages.
8. Because the preservation and enhancement of human life supercedes purely "rational" administrative concerns if or when the two conflict, services must be individualized to a greater extent than those of other human service organizations.

However, health care organisations are approaching "generic" business organisations in terms of management and organisation. Roles of managers in health care organisations are focusing on designing services, managing projects or implementing care delivery in new ways across the continuum of care. (Beyers 1995) refers to this change as shifting into virtual organisations. Virtual implying fewer boundaries, more interaction supported electronically and increasingly direct communication from one to another without the traditional or organisational structures.

In terms of health care information systems the situation is even more convoluted. In traditional business information technology can be seen as a strategic tool for change in staying competitive; streamlining functions; innovating new ways to do business; and creating novel business opportunities (Scott Morton

1990). In health care, the information systems have been traditionally seen as 'supportive' functions. An investigation establishes the tight financial situation in health care. The Finnish hospital districts use only 1,8 per cent of their budget into information systems development projects (Ruotsalainen 2003).

In addition to technical and fiscal reasons cultural reasons play often a significant role in the adoption of new technology. One frequently used phrase in health care against information systems is that the machines cannot substitute human interaction, which is naturally true, but at the same time it is often forgotten that new technology can actually give more time for the nursing staff to look-after patients.

The research field of health care information systems (i.e. Health Informatics) is very convoluted. Terms Health Informatics (e.g. (Nykänen 2000))and Medical Informatics (e.g. (Friedman and Abbas 2003)) are mostly used as synonyms. In this paper, the term Health Informatics is used in scientific domain and the term Health Care Information Systems (HCIS) when we are discoursing about the concrete systems.

Categories/ Characteristics	**Medical devices**	**Pharmaceuticals**	**Health informatics**	**Health & well-being, independent living & security**
(End) Users	Health care professionals	Patients	Health care professionals	Citizens
Decision makers in procurement	Management, administration and health care professionals of the organizations involved	Doctor (and patient)	Management, administration and health care professionals of the organizations involved	Customers
Payers	Owners of health care organizations	Insurance, out-of-pocket payment	Owners of health care organizations	Customers
Rule makers	EU-directives (GMP & quality), national legislation and policies on social affairs and health	EU-directives (GMP & quality), national legislation and policies on social affairs and health	National legislation and policies on social affairs and health and privacy	Consumer protection

Table 3. The focus of this study based on the market segments and characters for products in health and well-being (adapted from (VTT 2003)

3 OPEN SOURCE DEVELOPMENT PROJECTS FROM AN ORGANISATIONAL PERSPECTIVE

3.1 Virtual organisations

Virtual organisation (VO) is a new paradigm in organisation design (Khalil and Wang 2002). There has been a lot of debate about the essence of the virtual organisation, and different researchers have given their opinion about the definition of VO. Many have been using even a different term, such as network organisation (Ching, Holsapple et al. 1996), (Franke 1999), virtual corporation (Byrne 1993) or imaginary organisation (Hedberg 1997) – each emphasising a certain aspects of the organisation. Open source software is collaboratively developed in projects, which can be considered as specific types of virtual organisation. Therefore virtual organisation theory is often used to analyse open source development projects (e.g. (Ljungberg 2000), (Markus, Manville et al. 2000), (Crowston and Scozzi 2002)).

In this article we adopt the definition presented by (DeSanctis and Monge 1999), who in our opinion succeed in capturing the essential characteristics of a virtual organisation. DeSanctis and Monge define virtual organisation as a collection of geographically distributed, functionally and/or culturally diverse entities that

are linked by electronic forms of communication and rely on lateral, dynamic relationships for coordination. These attributes make possible for a VO to adapt highly dynamic processes, contractual relationships, edgeless, permeable boundaries and reconfigurable structures.

(Ahuju and Carley 1998) emphasise three main aspects in virtual organisations, namely the existence of a goal shared by all the members, geographical distribution and the use of ICT to communicate. Efficient management of these aspects leads to success.

(Markus, Manville et al. 2000) states that virtual organisations work if the organisation has:

- A powerful set of mutually reinforcing motivations, including a share in collective success
- Self-governance, including
  - membership management (the ability to ensure that there is a manageable number of high-quality contributors)
  - rules and institutions that members can adapt to their individual needs
  - the ability to monitor and sanction members' behaviour
  - reputation as a motivator and control mechanism and
  - shared culture, values and norms of behaviour
- Effective work structures and processes, such as task decomposition and project management in software-development work
- Technology for communication and coordination – and norms about how to use it.

Thus the key issue in success of VOs is management. (Khalil and Wang 2002) present IT enabled meta-management for virtual organisations. Compared to traditional management, meta-management has two major differences. Firstly, a VO must make goals explicit and tangible. Secondly, the central task is the maintenance of the temporary partnerships within a VO. Table 4 summarises the major unique characteristics of meta-management of VO and their alignment with managerial requirements.

Characteristics of virtual organisations	Characteristics of meta-management	Managerial requirements
Autonomic participants	Equality among participants	Coordination Virtual group management Group decision making
Cooperation is not Permanent in the nature	Maintenance of temporary partnerships	Policies Organisational redesign
Common interests	Explicit goals	Low costs Performance management
Sharing knowledge	Knowledge management beyond information/data management	Negotiation Mass customisation Organisational learning
Electronic communication	Global-orientation	Automatic workflows Ubiquitous information Capture New IT adoption

Table 4. Characteristics of meta-management and managerial requirements (Khalil and Wang 2002)

3.2 Open source development projects

Open source software, exactly defined, is software that follows the terms of distribution given in the Open Source Definition (OSD) and whose license is approved by the Open Source Initiative (OSI). The real essence of OSS is hence in the licensing terms and not just the accessible source code, which is part of the qualities the licensing terms generate. The licensing terms do more: they allow the free use, redistribution and modification of the software. The copyright owner holds the moral rights and some economic rights to

the software, but transfers many important rights to the users and developers of the software, in order to enable the development of the software and to increase its adoption.

Open source software development is literally software development that produces OSS. This development is done in the open source community, a virtual community that consists of individuals and organisations developing and using the software. However, it is common to use terms such as open source development to describe a development method introduced and used widely by the open source community; often called also the bazaar development method or the Linux development method (e.g. (Raymond 2001) (Ljungberg 2000). The methods and tools vary from project to project, but several characteristics are common to many OSS projects. The generic OSS development process (Feller and Fitzgerald 2002)

- is parallel, rather than linear
- involves large communities of globally distributed developers
- utilises truly independent peer review
- provides prompt feedback to user and developer contributors
- includes the participation of highly talented, highly motivated developers
- includes increased levels of user involvement
- makes use of extremely rapid release schedules

The open source development model can be seen as the opposite of traditional software development (or the cathedral development method). These are the extremes of the software development model continuum. (Fuggetta 2003) points out that most of these characteristics are in fact not unique to open source development, but are found also in traditional software development. However, it can be stated that open source software projects can use almost any model in that continuum, while proprietary software projects have great difficulties applying different models than the cathedral-like (Working Group of Libre Software 2000). It is important to notice that open source software can be developed with both approaches. Most of the qualities that are regarded as qualities of open source software are derived from the characteristics of the bazaar style development. Some OSS products have been developed with traditional means, and even licensed with proprietary licenses, and later licensed with open source licenses.

Open source software development is organised into projects that can consist of both individuals and organisations (enterprises or others). Typically, participating in these projects is fully voluntary, i.e. the participant is not legally bound to work for the project. Successful open source projects are shepherded by well-respected leaders or leadership teams (Lerner 2001). The coordination of OSS projects can be handled in three different ways (Ljungberg 2000):

- Single benevolent dictator, who is typically the owner or the founder of the project.
- Rotating dictatorship, where the top position changes from time to time.
- Voting committee, where the project is managed by a group of core developers.

Open source leadership must provide an initial vision, communicate clear procedures and be perceived as fair. If a member is not happy with the actions or behaviour of the project leader(s), he or she can challenge those actions by following a specific resolution process (Markus, Manville et al. 2000) or even fork the project, using the code base to clone the project.

The characteristics of open source software are therefore derived from the licensing terms and the freedoms they create. The fact that no one holds exclusive right on the code, several problems experienced with proprietary software can be solved: (Working Group of Libre Software 2000)

- There is no one with the power to restrict in a unilateral way how the software is used, even in retroactive way.
- There is no single entity on which the future of the software depends.
- No “black boxes” are possible.
- There is always the possibility of “forking”, or creating an alternative code base if the current one is wrongly managed.
- No per-copy fees can be asked for modified versions, and anyone can use the current code base to start new projects.

- There are fewer conflicting priorities due to marketing pressures.
- Open source creates a new forum for democratic action.

However, there are also problems with open source software: (Working Group of Libre Software 2000)

- There is no guarantee that development will happen
- There may be significant problems connected to intellectual property, namely with software and algorithm patents.
- It is sometimes difficult to know that a project exists, and its current status.

4 EVALUATION AND ASSESSMENT OF THE SPIRIT PROJECT

The primary purpose of this research was to investigate the current state of open source software projects in health care. The empirical part of our study consists of research and analysis of a European open source health care project SPIRIT. The project was conducted by:

- Minoru Development SARL (France) as the project co-ordinator. Minoru is an open source health care company. Minoru's role on the project included actions to build the community, index ongoing projects, create content, and disseminate results. Minoru managed the community tools on an ongoing basis after the end of the project period.
- Conecta SRL (Italy) as the primary developer of the code for the SPIRIT site. Conecta is one of the major Internet Service Providers (ISP) in northern Italy. Conecta provides the internet connectivity and hosts the SPIRIT sites on an ongoing basis.
- Sistema Information Systems (Italy) is a small consulting company active in the creation of open source systems for veterinary and epidimiological applications. Sistema has created content and actions to build the community of open source health care. (The Spirit Project 2004)

According to its net site, SPIRIT is a pioneering project partially funded by the European Commission Fifth Framework Programme to hasten the uptake of free and open source information resources in health care in Europe. The purpose of SPIRIT is to distribute freely software and medical information to facilitate the implementation of economically viable and effective regional health care solutions. The SPIRIT project identified and classified best practice open source software applications and components from earlier, ongoing, and intended projects world-wide.(The Spirit Project 2004)

The open source approach to management and development of software is based on open teams collaborating over the Internet. Teams consist of key members that control the changes to the source code, a broader group of contributors that suggest improvements, and a large group of early adopters that test and evaluate the software during its construction in various real environments, and additional commercial and volunteer groups that package and distribute the software in suitable forms. (The Spirit Project 2004)

According to SPIRIT group this approach suits well with the accepted approach to the application and advancement of medical knowledge itself. Medical research is based on comprehensive evaluation of latent improvements, widespread publication of the results, and peer review. Similarities and differences between the processes affect the reasons to use open source and how open source should be applied in healthcare. The lack of trade secrets provides additional momentum to open source application to health care beyond the benefits enjoyed in other sectors. (The Spirit Project 2004)

The SPIRIT team set its own objectives and measured the achievements of the project. We used the SPIRIT material available in the Internet and made our own analysis of collaboration based on the (Gajda 2004) SAFAR model.

Table 5 summarises the project objectives and achievements set by the project partners.

Objective	Achievement	Our analysis
An increase in the size and activity of the community of collaborative developers, users, and policy makers.	A. The openhealth ™ list grew from 220 members in December 2000 to 273 in December 2002, an increase of 24%. The number of different people posting on the mailing lists of the indexed projects has increased 22% on an annual basis. The activity on these lists also increased as measured by the volume of messages and the number of topics discussed. B. In order to estimate the size and activity of the user community, we surveyed the awareness and usage of specific software resources in two comparative surveys. There were three open source products with statistically significant changes in awareness, two with increases and one (dormant) project with a decrease. There were five open source products with a statistically significant increase in usage between the two surveys. Only one proprietary product studied had a change in usage between the two surveys and none had a significant change in awareness. C. Policy makers in healthcare IT from most European countries were approached on an individual basis or in particular conferences and meetings. There were policy statements and support activity in several countries during the project period, often at a governmental wide level that would affect health care IT. Contact with the Spirit team had an impact on policy formation in the UK.	• It is arguable whether the increase of 24 per cent (or 53 members) in two years is a significant impact to make a difference in open source HCIS development. • In comparison, a well-known open source project host SourceForge.net has more than 30,000 projects and over 300,000 members. • We approve that the first objective was fulfilled and the web of communication in SAFAR model was created
Additional seed projects and software.	• The number of health care specific projects in the Spirit project index increased 38 to 118 (211%) in the two year period from March 2001 to March 2003. Three projects were initiated immediately after site visits by the Spirit team.	• In our opinion, the achievement of second objective is decent. Yet, the sheer number of projects does not necessarily have an affect on the level of collaboration, which was the focus of this research
Creation of a virtual meeting place.	• The Spirit portal and SpiritForge were the virtual meeting place created by the project. Some indicators of its success are listed above.	• The team created a base of support in form of virtual project hosting site
Increased commercial exploitation of selected open source resources.	• The Spirit partners have benefited from participation in the Spirit project through participation in other projects. The business plan created as part of Spirit has been well received. One of the partners was featured in promotional material on business planning. Major vendors, such as IBM and HP, are now active participants in the open source health care community.	• It remains unclear what was the SPIRIT's collaborative contribution to the fact that major vendors are after the project active participants in the open source health care community, and how the activeness is measured.

From the above table we can see that the project fulfilled all goals set to it. However, the final report of the project seems to make rather strong conclusions based on quite weak analyses. Therefore, the analysis of the state of collaboration was occasionally difficult. However, the purpose of this study was not to evaluate HCIS, but collaboration in open source HCIS. Though, the field of HCIS evaluation is an interesting field of research and there are quite a few previously published studies concerning the evaluation of information technology in health care (van der Loo, van Gennip et al. 1995; Ammenwertha, Gräber et al. 2003)

5 CONCLUSION

The purpose of this paper was to examine the current state of open source projects in health care environment and the level of collaboration in this field. We underpinned our discussion on the theoretical foundations of institutional theory, collaboration and virtual organisations.

Early systems in health care information systems focused on supporting existing organisational structures and to automation of manual processes. However, in our opinion health care organisations could benefit significantly of using open source software in their information systems. Not only could they benefit of the independency of OSS, but the OSS could save the scarce resources of HCIS development projects and promote data exchange.

We argue that one of the main obstacles in HCIS development is the rigid organisation structures and cultures in the health care field. Enhancing management and development of collaboration between health care organisations could provide significant benefits in terms of better and more cost effective health care.

Both inter-organisational HCIS and OSS development projects face similar challenges in collaboration due to their organisational setting. To enhance future collaboration, we introduce a set of managerial solutions found in successful open source projects. These congruities and solutions are summarised in table 6.

Common characteristic	Challenges in development	Possible solution
Diverse participating entities	Different motivations and cultural backgrounds – and therefore varying goals and difficulties in collaboration. Heterogeneous demands.	The project leader must form a common vision based on shared goals/norms – and establish clear procedures for action
Complex financial, legal and political environment	Complicated intra- and inter-organisational linkages, parallel and conflicting interests	A set of common practices, based on a agreement (e.g. OSS definition, GNU GPL)
Participants loosely attached in terms of organisation	Vague responsibilities, limited inter-organisational managerial control, ambiguous relationships and interdependence	Well defined and respected decision-making body
Traditional management difficult	Resistance to management	Meta-management approach; active use of reputation as impetus
Participants geographically distributed	Project requires work role differentiation and communication between developers is challenging	High modularity and use of ICT in communication

Table 6 The common characteristics, challenges and possible solutions of inter-organisational HCIS and OSS development projects.

OSS is built by communities of its users. Larger communities can build more successful software which in turn attracts even more participants. These so called network effects are subject to “critical mass”. Someone has to start the community and raise it to the point where it is self sustaining. OSS could be the solution if it only can fulfil the promises of widely accepted standards and information system de-fragmentation.

The SPIRIT project focused on fostering the adaptation of open source software in regional health care networks. The concrete goals of the project were to increase the open source HCIS community size and

activity. These goals were fulfilled, but the level of collaboration, as described in the SAFAR evaluation tool, remained on the lowest level of integration. The project was a good start for open source HCIS collaboration, but much more future work is needed to achieve the critical mass.

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