

# Systems Development as Networking

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## Abstract

The notion of networking is used to conceptualize systems development as a series of activities aiming at consecutively allocating resources at interrelated places in order to promote the development and use of computer-based systems. Applying concepts and terminology of actor-network theory, circulating and black-boxing commitments of the actors involved are identified as recurrent activities essential to achieve progress in system development projects, i.e. to encourage actors to contribute required resources in due time and place. The argument is exemplified in a case study of the implementation of an information system supporting the examination administration of a large university. In general, the networking approach offers a number of potentials for reflecting and managing the phenomena related especially to distributed development environments.

## Introduction

Research in the fields of Information Systems, Systems Development, Organizational Informatics, or Participatory Design aim at reflecting the interrelation of complex social activities and implementation of information technology (IT) in organizations. The ongoing effort to provide sound theory explaining these interrelations is impeded not only by incompatibilities of approaches to scientifically frame the 'technical' and the 'social', but also by the rapid changes of the kind of new information technology and its dissemination:

1. *Drawing a line between systems development and systems use has become less adequate* to reflect on current practice. More and more, system development includes the customization, deployment, and use of standard products, and system use more and more requires situated design and creativity (adaptation, configuration, customizing, modeling, interface design etc.). Thus, the life cycle of a software product consist of consecutive development/use activities.

2. *System development and use are aiming at an infrastructure* serving organizational needs with both 'developers' and 'users' contributing to its growth. Organizational units concerned with systems development and use subsequently embark on joint efforts (instead of one unit delivering a ready-to-use product to some other unit(s)).

3. *As computer-based networks extend system boundaries for IT applications*, the various actors using

and cooperating via the system are often separated by organizational boundaries, linked rather by some cooperative arrangement than by effect of some hierarchical power structure. Instead of one social actor being able to execute power over all other actors, *development and use take place in distributed environments* which are not organized nor controllable as a whole, i.e. each organizational unit involved is capable of independent decision making. Thus, communication within the project and with users and/or other stakeholders, sharing views and perspectives, clarifying conflicts, achieving consensus, and adapting to an evolving correspondence between actors become more and more critical success factors.

In practice, much of the work in systems development is still organized in projects, but they find themselves in an unstable organizational environment for the time of project duration. New challenges for project management include to cope dynamically with questions such as: Who is to regard as project members? What are the project aims and tasks? Who and when to contract with, inside and outside the project, and what for? How to plan and evaluate progress?

Scientific observation and reflection also need a framing for the duration of inquiry. The question is how to analyze and interpret the development work of IT experts and other actors involved, how to reflect on project management under these new conditions, and what perspectives are useful to assist practitioners and/or to guide development and use of appropriate methods and tools.

In the following, it is argued for the need to reframe the system development process. Second, with the help of actor network theory, systems development is re-conceptualized as networking with blackboxed commitments. The approach introduced is applied to a case study of the implementation of computerized support for the examination administration of a large university. To sum up, this article points out the advantages of this approach for researchers and practitioners.

## Reframing the Systems Development Process

Describing and reflecting the process of system development in relation to its organizational context has led to different 'schools' and respective assumptions subscribing to a certain kind of "great divide" (Bowkers et al., 1997) between the social and the technical. Each are centered around a specific *key object* of interest:

– Development as establishing *socio-technical systems* relates humans and IT in one framework. Stable condi-

tions of work organization are assumed, at least for distinct states of the organization. Theories and development methods (e.g. Mumford, 1983; Checkland, 1981) draw a clear line between development and use (in general, systems theory approaches require boundaries). Key success factors are identifying system and subsystem boundaries, elements and relations, as well as providing a clear picture of 'what is' and 'what should be'.

– Systems development as *social activity* (Lyytinen, 1986; Andersen et al., 1990; Mathiassen, 1998) provides analytical concepts (such as role analysis, stage modeling, reflection-in-action), also aimed to assist practitioners in coping with the daily challenges of systems development. Here, systems development, as professional work of IT experts, is concerned with identifying and relating social and technical aspects within the boundaries of an identified socio-technical area of concern (including programming, system description, feasibility study, conversion, maintenance, and training of users as well as project planning, estimation and quality assurance). Humans and social actors are regarded as the driving forces with technology as 'tools in their hands'. Key success factors are understanding work practice, critical reflection and cooperation between the actors involved.

– Systems development as part of *organizational change* emphasizes systems implementation as the range of activities within a given organization to integrate some new kind of IT artifacts in its chains of social action. In particular, required activities include "effective logical analysis, sound technical construction, effective design for users and successful change management during implementation" (Fisher, 1999, p. 294). In short, as humans deal with IT they are changing or reproducing their own organizational environment. Most of commercial and scientific interest concentrates on top-down approaches based on business process reengineering (e.g. Scheer, 1998). However, a growing body of research acknowledges that it requires complex organizational work to get information systems "up and running" (Kling and Lamb, 1999). Key success factors are understanding the organizational environment of IT use (including driving forces of organizational change), assessing the organizational impact of IT system and change management.

Explaining the dynamic aspects, research in this field concentrates either on "factors" explaining process variations by studying their associations with independent variables, or on "recipes" linking dependent with independent variables (Robey and Newman 1996). Process models attempt to relate subsequent events (e.g. "encounters" linked by three kind of "episodes;" Newman and Robey 1992) or to provide a rich picture of the process as a whole (typically stage models, e.g. Damsgaard and Scheepers 1999). With the conceptualization introduced here, it is intended (1) to bypass the "great divide" in a way that the relation of humans and IT may remain undefined and (2) to integrate the micro and the

macro level of reflecting systems development processes. The aim is to provide a new frame for conceptualizing and managing the phenomena related especially to distributed development environments.

## Creating Networks by Boxing and Circulating Commitments

Reconstructing the 'success' of science and technology as the extension of networks enrolling human and non-human resources, Latour (1987) suggests to "arrive before the facts and machines are blackboxed or [to] follow the controversies that reopen them" (first "rule of method", *ibid.*, p. 258). What is often called actor network theory (ANT) originates in social anthropology and the sociology of science, to "denote an emerging set of ideas about networks of association, in which groups of heterogeneous allies, by virtue of the strengths of their aligned interests, create those black-boxes that eventually come to be seen and accepted as the facts of everyday life" (McMaster et al., 1998).

During the last decade, ANT has inspired a number of researches to follow inscriptions and transformations in order to reflect project experiences and to conceptualize the interrelation of actors in the socio-technical contexts of systems development (e.g. Walsham, 1997; see McMaster et al., 1998, for discussion of earlier contributions). Walsham (1997) has pointed out the potentials for IS research, such as ANT provides concepts (theory) as ways of viewing elements and suggests to trace these elements in empirical work (methodology), and people and artifacts (e.g. organizational members and computer-based systems) may be analyzed with the same conceptual apparatus.

Inspired by the work of Latour (1987), the notion of networking is used here to conceptualize system development 'in-the-making'. The argument put forward here is that systems development

- aiming at *establishing a system based on computer networks*
- must also *establish a network of commitments* by all actors whose consent and effort are necessary to make use of the computer system's potentials *by putting these commitments in a '(black) box' and circulate them among those actors.*

To get practical with this approach, the key words need to be further explained within the SD context. Within ANT (cf. Law 1997) a **network** is much like a structure, except there is no assumption that specific links or nodes in the network are guaranteed. Actors may be both human and non-human, i.e. the various elements of the heterogeneous network are all equally able to act upon one another. To get a computer-based system in an organization "up and running" it needs subsequent promotion and support by a number of social actors. Each

commitment for promotion and support might be essential and a prerequisite for further steps in development and implementation. It might even require complex social activities to achieve a single commitment (including resolving conflicts). But as soon as it is 'there' the following activities just 'draw' on this commitment, i.e. further steps in development and implementation align all past commitments to establish the flow and allocation of resources in due time.

To make use of ANT we do not have to accept the full symmetry hypothesis of humans and nonhumans (cf. Walsham 1997). Here, the notion of **commitment** refers to an *agreement that something within an social actor's realm may be moved around, transformed, and allocated at some place for the purpose of system development and use*. "Something" could be physical or abstract objects (software, computer, financial asset), personal opinions now standing out in public (judgement, decision, consent), certain tasks to fulfill or activities to do in the future (work effort, availability), professional knowledge (e.g. about work processes), or anything else which might be a resource for effective system use. In this view, commitments are to channel and transform the *input*, i.e. the resources committed by a social actor, towards an *output*, i.e. the function of those resources required for effective use of the computer-based system (e.g. exploitable expertise, continuous service, process patterns, application procedures, work organization, system components).

Latour introduced the notion of **black box** in the beginning of his work (Latour, 1987, p. 2 f.): "The word black box is used by cyberneticians whenever a piece of machinery or set of commands is too complex. In its place they know nothing but its input and output." To work with commitments in the development process, they must be *boxed*, i.e. to draw a line around, to take them away from the actor who made the commitment, to circulate and make them a function or eventually brick in building the system. *Being boxed, commitments are mobile plans for allocating resources*.

In each situated development and implementation process, a unique framing of boxes of commitments is needed to create a network relating actor's resources to places and transforming those resources into a function for effective system use. In principal, those boxes could be anything as long as they are mobile and serve to circulate commitments on allocating resources – typical examples found in projects are actors' roles, public opinions and common beliefs, documents such as reports and contracts, budget, accepted work routines, a variety of technical devices. These boxes become *black* as soon as they are referred to only in their input and output, as they are part of other boxes, being transformed, without making visible the social process in which they have been established or which could lead to a withdrawal of the commitment.

According to ANT interpretations (Law 1997), networks may be imagined as scripts which means that one may read a script from, for instance, a machine which tells or prescribes the roles that it, the machine, expects other elements in the network to play. And, building and maintaining networks is an uphill battle, the links and nodes in the network do not last all by themselves but instead need constant maintenance work, the support of other links and nodes. Thus, networks are processes or achievements rather than given relations or structures.

The following case study tries to point out the role of commitments circulated, their 'acting upon' other elements in the network – how the machinery (software) calls for commitments, how the social actors call for commitments, how the social actors commit themselves (or not), how the existence (or lack) of commitments affects the development process and transforms the software system, etc.

### **Case Study: Computer Support for an Examination Administration**

A large German university is employer for 3.300 people (not included the university hospital), providing education for about 40.000 enrolled students (1998/99). The organization is structured into 19 more or less independent departments as well as some functional units (such as the central computing center). In 1996, the university established and institutionalized a task force for its own organizational development (Project University Development) with one focus on the examination administration. There, the need for a computer-based system was triggered by significantly increasing examination requirements due to modularization of study programs as well as the university management's interest to decentralize the examination administration (i.e. resolve central examination offices).

The author (*K.*) plays an active role in the reported case. Being teacher, researcher, and IS expert at the same time, there is not always a clear distinction between the roles of an IT user, scientific observer, and member of developing team. In the following, 'developing team' refers to the author and his colleague (*W.*) as well as three students who each assisted the work for limited time. So far, the engagement of the developing team has been based on three single contracts with *PUD* (each for six months at the most) with resources for only part-time work to advise and partly to manage/carry out the development and implementation under the formal guidance of *PUD*. Further technical development is carried out by the software producer and the university's central computing center.

To demonstrate the approach introduced, the 'story' of developing and implementing this system is presented by headlining some of the essential actor's commitments which have been in the focus and have been boxed and

subsequently circulated during the development process (a more comprehensive account will be given in Kliczewski 2000). For each commitment, the presentation includes one or two social events leading to the commitment, the kind of boxing as well as its subsequent circulation and transformation within the development process. The material presented is based on electronic and printed project documents collected from the very beginning, including meeting invitations, public opinion statements, official meeting notes as well as internal diary notes from project members. The story starts with the first circulation received by the developing team...

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*Circulation:* The manager **G.** of the *PUD*-subproject on examination administration has prepared and circulated a study on the history and past organizational development of the examination administration at this university.

### *Signing up for system development*

July 1<sup>st</sup>, 1997: **G.** (not having any computing experience) shows up for a meeting at the department of informatics, authorized to offer financial resources within certain budget limits. One department member (**K.**) agrees to establish a small team to consult the in-house effort setting up a computerized system.

*Boxing:* Meeting notes, a role title, and later on a contract and budget capture the agreement of the consultant and his team to put in their professional expertise, to be available and to work for the project.

*Circulation:* All actors concerned are informed about the designated project members and their tasks.

*Transformation:* Due to a difficult decision making process contracting is delayed, and serious project activities do not start until nine months later. However, increasing personal involvement leads to continuing work even in times without contract.

### *Buy! Don't make!*

May 8<sup>th</sup>, 1998: A four hour "expert meeting" takes place at the department of informatics. Participants were invited because of their past activities and/or leading role within the examination administration either in one of the three central offices or in one of the departments. Facing the complexity of requirements and the critical example of an old system developed in-house, none of the experts or decision-makers argue for building a new system, but (at this time) they hesitate to proceed and do not decide for one of the available software packages.

*Box:* Personal opinions and consent within the members or the meeting have now become public opinion and common understanding (without any shared document).

*Circulation:* Despite his announcement, the meeting facilitator (the head of *PUD*) never sends around the full

account of the meeting's discussion. In the following, only two (out of nineteen) departments, showing significant interest as pilot user, are included in the discussion and further planning.

*Transformation:* The developers now seriously call for test versions, ask for tenders and argue for resources for a more thorough analysis, eventually leading to new development requirements.

### *Sharing work expertise*

November 25<sup>th</sup>, 1998: **K.** does the first of a series of interviews for work practice analysis, with audio recording, a student assistant taking notes, and based on an interview guide elaborated within the development team a few days before. Interview partner is the senior staff member of one examination office. During the 90 minutes, the atmosphere is relaxed, at some times the senior staff member asks to stop recording to share some information not for public use.

*Boxing:* All interview partners receive the written documentation of their interview to approve correctness of content. Access to professional expertise and the consent of the administration staff to share it enabled a comprehensive analysis report (including project glossary).

*Circulation:* All actors involved receive the report on the work practice analysis.

*Transformation:* To create openness during workplace analysis and to sustain the staff's commitment for cooperation, the developing team subscribes publicly to a work-oriented perspective.

### *Client-producer engagement*

February 2<sup>th</sup>, 1999: The head and an expert of *PUD*, travel with **W.** to meet a public producer (who provides software without charge) and to negotiate commitments towards the timing of the implementation process as well as a possible contract. There, the producer assures assistance to get the system running before 2000. The visiting university members gain trust in the producer's competence and performance potentials. However, the producer makes clear, that other clients have priority and that service commitments are not dependent on (additional) financial offers. Five month later both sides will sign a contract about customizing and cooperation in general, but not including terms of licensing, maintenance etc.

*Boxing:* The selection of a non-commercial producer results in an unusual form of minimal and preliminary contracting stating only a very few commitments. There is hardly more to put in a box but the oral consent of the decision-makers and the software itself.

*Circulation 5:* *PUD* informs the actors involved about the progress in software selection. The *PUD*-newsletter reports on the project (with partly incorrect information).

*Transformation:* In practice, the producer-client relation makes significant progress while, on both sides, leaving a considerable amount of uncertainty and hesitation towards further commitments.

### *Security as top priority*

February 22<sup>nd</sup>, 1999: Security experts from the central and the informatics computing center meet with **K.** and the data protection commissioner. The commissioner states his requirements with respect to risk analysis and measures to be taken. In the following discussion all participants agree to a procedure (general risk assessment, layout of network infrastructure, specific risk assessment, specific counter measures) as well as to cancel the web interface for students because of inassessable risks. Certain members of the meeting commit themselves to certain tasks and due dates within the agreed procedure.

*Boxing:* The professional expertise and the consent of the experts on the procedure manifest a shared opinion and a call for action.

*Circulation:* The commissioner circulates a written report restating his opinion and calling for action. Despite the commitments, carrying out of the tasks will be seriously delayed. One year later, the commissioner (nor any other actor) will still not have received a response.

*Transformation:* The public commitment to highest security turns out to be a deadlock: without risk assessment, a final decision on product selection is not possible; the assessment does not proceed because responsibility for the infrastructure is unclear; this allocation is not decided because the product has not been selected yet... The developing team (without much security expertise) is restricted to facilitating the process and to resolving disagreements about the required security standards by canceling part of the system's functionality.

### *We run the system!*

April 28<sup>th</sup>, 1999: The software producer and the departmental computing center set up a test system at the informatics department – later this turns out to be the kernel for the productive system.

October 14<sup>th</sup>, 1999: The head of the university administration finally assigns the university's central computing service center to be (for the user organization as a whole) the center of the technical network as well as of the application system's technical management.

*Boxing:* The central computing centers is committed by assignment to put in professional expertise, work effort, devices etc. The informatics computing center provides a running system without being assigned.

*Circulation:* The university's top administration management circulates a number of oral and written statements assigning the central computing service center to be to be

in charge of the system's technical management. At the same time, the stand-alone installation is a black box of its own, calling for commitments.

*Transformation:* Despite its commitment the university's central computing center only very reluctantly allocates the necessary resources, e.g. establishing a virtual private network fails to meet the scheduled due dates. The preliminary stand-alone installation at the informatics department lacks organizational support, thus drawing the critical attention of works councils and data protection experts.

### *Participation is a must*

October, 14<sup>th</sup>, 1999: For the first time, the head of the university administration (the employer) officially meets with members of the two works councils as well as other actors involved. The participants agree – due to serious impacts on the work of employees – that the system's implementation needs a legitimate procedure and a regulation contract between employer and works council is prerequisite for the institutionalization of the system.

*Boxing:* Writing an official letter, one of the works councils agrees to start a pilot project in the departments of informatics and economics (the other council does not agree, but will take no further action to object). Work effort is put in to inform the works councils and to achieve a regulation for the system's use.

*Circulation:* The preliminary agreement of the works council is circulated among the departments involved. As the negotiations do not terminate, 'rumors' about the project are spread throughout the university.

*Transformation:* In the past, employer and works councils had reason to mistrust each other, now the works councils use the chance for getting 'a foot in the door' to raise general issues related to IT deployment within the university. In result, the contract on the system's use is significantly delayed.

### *Staff sets priorities on daily agenda*

November 18<sup>th</sup>, 1999: **W.** meet with the department's planner **S.** to agree on tasks, responsibilities and a schedule for the implementation procedure in the informatics department (a few days later a similar agreement will be achieved in the economics department). **S.** is competent and willing to embark on the project, but at the same time he is committed to a number of other pressing tasks.

*Boxing:* Based on professional knowledge, the developing team puts in significant work effort to elaborate project plans (stating roles, tasks, and schedules) for each organizational unit involved.

*Circulation:* Project plans are shared among departmental actors who have agreed to fulfill certain tasks.

*Transformation:* While the different organizational units and actors had basically agreed on cooperation, it needed continuous effort to motivate the actors involved to do the 'real work,' i.e. to concentrate on the project tasks despite their demanding commitments outside the project. In April 2000 *S.* quits his job at university to work on systems deployment in the private sector.

### *Let's get to work!*

March 2<sup>nd</sup>, 2000: For the first time, *W.* and a student team member train three members of the department administration using the system. Right away the new users start to enter results of the examinations which have taken place during the last weeks. As the first trained users start to work with the system, some procedures turn out to be complicated and requiring unacceptable effort.

*Boxing:* Work effort and professional knowledge is used to define new roles, tasks, schedules to manage the examination administration with the new system.

*Circulation:* New roles, tasks, schedules are shared within the department administration. The software producer sends a patch to ease the work-arounds. Rumors on the system's performance start spreading.

*Transformation:* The enthusiasm of the new users decreases as problems (and later even mistakes) arise. The lack of overall support (technical infrastructure, agreement with works councils, etc.) turns out to seriously impede the motivation of the administration staff.

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**Note:** This is an ongoing project, so is the networking, there is no end to this story yet. Important next steps are evaluating use experience at the pilot sites, specifying and calling for additional customizing, setting up a use group, getting other departments involved, establishing an institutionalized network for supporting system use within the university (including putting the current developing team out of work).

Altogether, this is not a happy story. Some of the essential commitments have been achieved easily, but many others needed long time and hard work, or have not been achieved at all. Also, the notes on circulation here represent a rather positive view – the story could be told by unfolding the expectations of the various social actors and relating them to the project's shortcomings to circulate boxed commitments in due time.

At the time of writing, it is uncertain whether the project will ever turn out to be a success. Nonetheless, the experience of the 'missing links' to draw on necessary resources enabled the research to focus on the role of commitments in a development process largely affected by the absence of executable power structures.

## Development as Networking – a Portfolio

According to Latour (1997), the main contribution of ANT is "that by following circulations we can get more than by defining entities, essences or provinces". The idea put forward is: systems development forms a network-of-association aligning heterogeneous resources concentrated in a few places (e.g. computing center, departmental administration, software producer) which are connected with one another by (black-)boxed commitments. Intending to reframe the development process, systems development as networking serves a number of interests of researchers and practitioners:

1. Since ANT does not imply any distinction between humans and non-humans a priori, the observer is free to relate any kind of resource (objects, immaterial goods, opinions, intentions, capacities, etc.) on the same level of analysis. There is no 'ontological' divide between technical and social aspects of systems development, except that only social actors can make commitments.

2. The whole process may be structured on the micro level by identifying subsequent social events (meetings, activities) leading to one or more commitments. The link between these events are the boxed and circulated commitments as preconditions (required for the success of the event) and as postconditions (as a basis for future social events), forming a network of commitments as the development proceeds. The level of granularity for analysis is flexible, events come into focus according to the observer's subjective judgement of the commitment's importance for the development progress.

3. The accumulation of commitments represents the project history. It may be described by identifying the increasing number and complexity of boxes which become more or less "black" in the sense that the project budget and time constraints usually do not allow to unravel the boxes as the development moves on. On top of this, macro level models of the development process can be constructed by grouping several (kinds of) commitments whereas each group represents a stage of the process as a whole. The networking approach allows for an evolutionary perspective, i.e. framing the process is possible while the process is still going on.

4. Certain (groups of) commitments may be interpreted as milestones which enables to plan and carry out project management: What kinds of commitments do we need to set up this system in this organizational context? Who can/must commit required resources? What kind of process and what kind of preconditions do we need to achieve this? It is a requirement driven approach bringing into focus social actors, resources, and environmental conditions as the development moves on.

5. With boxing and circulating commitments as recurrent activities, the agenda for systems development (and implementation and use) may be rearranged,

especially in distributed project environments where commitments cannot be achieved by executing hierarchical power: (1) to achieve stability for the process by getting commitments and putting them in a sustainable and visible form (e.g. regulation contract with the works councils) so other actors are encouraged to take the next step; (2) to enable transformation by allowing actors to work with past commitments as resources (e.g. workplace analysis), to facilitate transformation of commitments (e.g. to ease security requirements by canceling system's functionality), and to call on new commitments to support allocation of resources wherever needed (e.g. to motivate actors to change priorities on the daily agenda).

6. Based on reflection of project experience (evaluating the project at stake, or learning from other cases), the social actors can decide on associating with such network by selecting and committing (their) resources – or not to enroll by opposing support and withdrawing resources. For training purposes, project cases or even systems can be studied as scripts calling for commitments.

7. The networking approach opens up a passage for a new generation of methods and tools. Given a number of empirical studies, it could be worth rethinking the issue of computer supported process modeling based on events and commitments, possibly leading to new ways of supporting systems development and project management.

To sum up, systems development as networking brings into focus the developers' work to subsequently reach for commitments, thus aligning social actors and their resources in a network. This approach offers a number of potentials for reflecting and managing the phenomena related especially to distributed development environments. Future research applying this approach should provide empirical studies as a sound basis for developing new methods and tools for systems development.

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