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Inertia in Sociotechnical Systems

On IT-related Change Processes in Organisations

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ACTA
UNIVERSITATIS
UPSALIENSIS
UPPSALA
2017

ISSN 1651-6214
ISBN 978-91-513-0010-8
urn:nbn:se:uu:diva-326799

Dissertation presented at Uppsala University to be publicly examined in ITC 2446, Polacksbacken, hus 2, Lägerhyddsv. 2, Uppsala, Friday, 15 September 2017 at 13:15 for the degree of Doctor of Philosophy. The examination will be conducted in English. Faculty examiner: Professor Netta Iivari (University of Oulu, Faculty of Information Technology and Electrical Engineering, INTERACT Research Unit).

Abstract
Lind, T. 2017. Inertia in Sociotechnical Systems. On IT-related Change Processes in Organisations. *Digital Comprehensive Summaries of Uppsala Dissertations from the Faculty of Science and Technology* 1531. 86 pp. Uppsala: Acta Universitatis Upsaliensis. ISBN 978-91-513-0010-8.

The introduction of new information technology (IT) in an organisation is one way of changing the conditions for how tasks and work processes can be designed and performed, as well as how people in the organisation interact with each other. Today, many Swedish workers rely completely on IT to be able to perform their jobs, while experiencing a combination of continuous and intermittent IT-related changes that affect this ability.

The introduction of new or updated IT systems in an organisation is an example of what is referred to as an IT-related change process in this thesis. Because IT has become such an integral part of modern organisations, many change processes in organisations are simultaneously enabled and constrained by the IT systems involved in a change process. In this thesis, I introduce the concept of inertia in sociotechnical systems to analyse IT-related change processes in organisations, and how achieving the goals of these processes is complicated by organisational, social, and physical aspects in addition to technology.

The context of this thesis is the Swedish public sector domains of health-care and higher education, and the result of research studies and experiences from four action research projects in these settings. The contribution of this thesis adds to the contributions of the included papers through the definition of inertia in sociotechnical systems and its subsequent application. The thesis shows that the concept of inertia in sociotechnical systems can be used to understand IT-related change processes as changes to the characteristics of a sociotechnical system, and, in the context of organisations, how these processes affect and are affected by an organisation's characteristics. This is illustrated in the thesis through the application of the concept on examples of IT-related change processes from the included papers and research projects. In addition, the thesis shows that the use of vision seminar methods can benefit Swedish organisations, since new IT is often introduced without clearly defined, expressed, understood, and accepted goals.

Keywords: Human-Computer Interaction, User-Centred Design, Participatory Design, Organisational Change, IT-related Change Processes, Action Research, Inertia, Sociotechnical Systems, Vision Seminars

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ISSN 1651-6214
ISBN 978-91-513-0010-8
urn:nbn:se:uu:diva-326799 (http://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-326799)

Till Jonna och Svea

List of Papers

This thesis is based on the following papers, which are referred to in the text by their Roman numerals.

I Lind, T., Cajander, Å. (2013) Mind the Gap: Towards a Framework for Analysing the Deployment of IT Systems from a Sociotechnical Perspective. In *Past History and Future Challenges of Human Work Interaction Design. Workshop Proceedings of 14th IFIP TC13 INTERACT 2013*, South Africa: University of Cape Town. 28-33

II Janols, R., Lind, T., Göransson, B., Sandblad, B. (2014) Evaluation of User Adoption during Three Module Deployments of Region-wide Electronic Patient Record Systems. *International Journal of Medical Informatics*, 83(6): 438-449

III Scandurra, I., Holgersson, J., Lind, T., Myreteg, G. (2013). Development of Novel eHealth Services for Citizen Use: Current System Engineering vs. Best Practice in HCI. In *Human-Computer Interaction – INTERACT 2013: Part II*, Springer Berlin/Heidelberg. 372-379

IV Cajander, Å., Nauwerck, G., Lind, T. (2015) Things Take Time: Establishing Usability Work in a University Context. *EUNIS Journal of Higher Education IT*, 2(1)

V Nauwerck, G., Lind, T., Cajander, Å., Lárusdóttir, M. (2017) Swinging Machetes in the Jungle – Technological Frames, ICT Leaders and User Centred Perspectives. *Behaviour & Information Technology* [submitted]

VI Lind, T., Cajander, Å., Sandblad, B., Daniels, M., Lárusdóttir, M. et al. (2016) Students Envisioning the Future. In *Proc. 46th ASEE/IEEE Frontiers in Education Conference*. Piscataway, NJ: IEEE Press.

VII Lind, T., Lárusdóttir, M., Cajander, Å (2017) What is the Use of Vision Seminars? – An Evaluation from the Perspective of Participants and Stakeholders. *Behaviour & Information Technology* [submitted]

Publications Not Included in this Thesis

Grünloh, C., Hallewell Haslwanter, J. D., Kane, B., Lee, E., Lind, T., Moll, J., Rexhepi, H., Scandurra, I. (2017). *Using Critical Incidents in Workshops to Inform eHealth Design*. In Proc. 16th IFIP TC.13 International Conference on Human-Computer Interaction, INTERACT 2017. Springer. (*forthcoming*)

Nauwerck, G., Cajander, Å., Lind, T. (2017). *Digital Transformation and the Changing Role of Student Administrators: A Case Study*. European Journal of Higher Education IT, 2(1).

Cajander, Å., Grünloh, C., Lind, T., Scandurra, I. (2016). *Designing eHealth Services for Patients and Relatives: Critical incidents and lessons to learn*. In Proc. 9th Nordic Conference on Human-Computer Interaction: Game-Changing Design. New York: ACM Press.

Lárusdóttir, M., Cajander, Å., Erlingsdottir, G., Lind, T., Gulliksen, J. (2016). *Challenges from integrating usability activities in Scrum: Why is Scrum so fashionable?* In Integrating User-Centred Design in Agile Development, Springer. 225-247.

Cajander, Å., Nauwerck, G., Lind, T., Lárusdóttir, M. (2015). *Challenges for action research on HWID in activity based workplaces*. In INTERACT 2015 Adjunct Proceedings, University of Bamberg Press. 161-170.

Cajander, Å., Sandblad, B., Lind, T., McDermott, R., Daniels, M. (2015). *Vision seminars and administration of university education: A case study*. In Proc. 1st Al Baha University and Uppsala University Symposium on Quality in Computing Education, 29-32.

Vieritz, H., Ullrich, C., Isaksson, E., Schmitz, H., von der Heiden, B., Borau, K., Shen, R., Palmér, M., Lind, T., Laaksoharju, M. (2015). *Case Study 1: Using widget bundles for formal learning in higher education*. In Responsive Open Learning Environments: Outcomes of Research from the ROLE Project, Springer. 79-113.

Lind, T., Cajander, Å. (2014). *Towards using the creation of a mosaic as a metaphor for change*. In Proc. 8th European Conference on IS Management and Evaluation (ECIME 2014). Reading, UK: Academic Conferences Publishing. 377-379.

Scandurra, I., Holgersson, J., Lind, T., Myreteg, G. (2013) *Development of patient access to electronic health records as a step towards ubiquitous public eHealth*. European Journal of ePractice, 20: 21-36.

Abbreviations

AR	Action Research
CSF	Critical Success Factor
DOME	Deployment of Online Medical Records and e-Health Services[1]
EHR	Electronic Health Record
EPR	Electronic Patient Record
HCI	Human-Computer Interaction
ICT	Information and Communication Technology
IS	Information System
IT	Information Technology
IVAN	IT i Vården, Användbarhet och Nytta[2]
KiA	Kvalitet i Användning[3]
LADOK	Lokalt ADB-baserat Dokumentationssystem[4]
PD	Participatory Design
SIS	Student Information System
SISU	Student Information System for Universities[5]
STS	Sociotechnical Systems
UCC	Uppsala County Council[6]
UCD	User-Centred Design
VSP	Vision Seminar Process

[1] Project name and name of the subsequent research consortium.
[2] Project name, 'IT in Health-care, Usability and Benefit'.
[3] Project name, 'Quality in Use'.
[4] Name of the consortium and student information system in the SISU project, 'Local Automated Data Processing-based Documentation System'.
[5] Project name.
[6] Since January 2017 known as Region Uppsala.

Contents

1 Introduction

The introduction of new information technology (IT) in an organisation is one way of changing the conditions for how tasks and work processes can be designed and performed, as well as how people interact with each other. Today, many Swedish workers rely completely on IT to be able to perform their jobs, while experiencing a combination of continuous and intermittent IT-related changes that affect this ability and that can potentially cause work environment problems. In a survey of the members of one of Sweden's largest public sector unions (Vision, 2014), 94 % of the respondents felt that their IT systems made work easier, while 38 % simultaneously felt that they lacked the knowledge necessary to use the systems efficiently. Another 38 % responded that the technical systems did not contribute to alleviating stress or preventing disturbances in their work. The approximately 1,400 respondents estimated that they spent on average 26 minutes per workday on dealing with disturbances caused by their IT systems. If extrapolated to all of the union's members (190,000 white-collar workers in the public sector), this equates to a yearly salary expenditure of roughly 260 million Euros (2.6 billion SEK) spent on these disturbances, which excludes any losses from the potential impacts of the disturbances on productivity and quality. To combat this trend and other negative effects identified in the survey, the union's first recommendation was to increase employee participation in the planning, development, and deployment of IT (Vision, 2014). Such involvement is far from the norm in Sweden today, with approximately 70 % of white-collar workers claiming that they had never been involved in the redesign of their work in conjunction with the introduction of new IT systems. To make matters worse, only 36 % felt that the introduction of new IT was implemented with clearly defined and expressed goals in mind (Unionen, 2015). The introduction of new or updated IT systems in an organisation is an example of what is referred to as an IT-related change process in this thesis. Because IT has become such an integral part of modern organisations, many change processes are simultaneously enabled and constrained by the IT systems involved in the process. In this thesis, I introduce the concept of inertia in sociotechnical systems to analyse IT-related change processes in organisations, and how achieving the goals of these processes is complicated by organisational, social, and physical aspects in addition to technology.

The context of this thesis is the Swedish public sector domains of healthcare and higher education, and the result of research studies and experiences from four action research projects in these settings. The contribution of this thesis adds to the contributions of the included papers through the definition of inertia in sociotechnical systems and its subsequent application. The thesis shows that the concept of inertia in sociotechnical systems can be used to understand IT-related change processes as changes to the characteristics of a sociotechnical system, and, in the context of organisations, how these processes affect and are affected by an organisation's characteristics. This is illustrated in the thesis through the application of the concept on examples of IT-related change processes from the included papers and research projects. In addition, the results of this thesis suggest that the use of vision seminar methods can lead to increased awareness of the goals of a change process and engagement in realising those goals. The use of vision seminar methods can therefore potentially benefit many Swedish organisations, where new IT is often introduced without clearly defined and expressed goals (Vision, 2014).

A sociotechnical system is a system that can be seen as a combination of two interdependent subsystems, one social and one technical (L. Klein, 2014). Society can be regarded as consisting of several interconnected sociotechnical systems of varying size and complexity. These systems range from large societal functions, such as energy distribution or public transportation, to small firms and businesses and even to individual users of IT. An organisation, as defined in the *Oxford English Dictionary*, is 'an organized body of people with a particular purpose, as a business, government department, charity, etc.' (OED Online, 2017). In everyday usage, inertia refers to a general tendency to remain unchanged or be difficult to change, and can, for example, be described as a characteristic of organisations and institutions (e.g., Alter, 2001; Besson & Rowe, 2012; Walker, 2000). As is shown in this thesis, understanding the reasons for inertia in sociotechnical systems and defining what inertia means in an organisational context can be used to understand and improve IT-related change processes.

1.1 Research Objectives and Purpose of this Thesis

The work presented in this thesis pursue the following research objectives:

1. To define the concept of inertia in sociotechnical systems.
2. To explore how the concept of inertia in sociotechnical systems can be used to explain effects observed in IT-related change processes.
3. To investigate whether vision seminars are a way to mitigate unwanted effects of inertia in sociotechnical systems on IT-related change processes.

The research studies include:

- Studies of the deployment of electronic patient records (Paper II) and e-health services (Paper III) in Swedish health-care,
- A study of organisational practices regarding change processes related to the development, procurement, deployment, and evaluation of IT (Papers IV and V), and
- Studies of the preparatory activities for a new student information system at a Swedish university, and the role of a vision seminar process in these preparations (Papers VI and VII).

An effort to understand IT-related change processes in organisations has been a common denominator of these studies, resulting in the parallel development and formulation of the concept of inertia in sociotechnical systems as presented in this thesis (with the first iteration of the concept presented in Paper I).

1.2 Disposition of the Thesis

This thesis is divided into chapters, sections, and subsections. Following this introductory chapter, chapter two introduces the research projects within which the studies were conducted and the insights and experiences informing this thesis were gained.

In chapter three, the seven research papers supporting this thesis are presented, including motivations for their respective inclusion as well as an overview of the papers with title, authors, publication status, abstract, and detailing my contribution to each paper.

In chapter four, the research background of this thesis is presented, including an outline of the history of the sociotechnical systems tradition and an interpretation of, and my position in, the field of Human-Computer Interaction.

Chapter five introduces action research as my research methodology and provides an outline of this tradition in relation to my research, as well as my multi-grounded theory approach (Goldkuhl & Cronholm, 2010) to theory building and choice of methods. In addition, subsection 5.2.1 provides a description of the research process regarding the development of my definition of inertia in sociotechnical systems in the iterations prior to the current definition presented in section 7.1.

Chapter six presents and exemplifies how inertia and related concepts have been used in previous research.

In chapter seven, I present the results of my research in relation to my research objectives. First, my definition of inertia in sociotechnical systems is presented in section 7.1, along with proposed handles for its application (research objective 1). Second, in section 7.2, the concept of inertia in soci-

otechnical systems, as defined in the previous section, is applied retrospectively to illustrate the presence and impact of inertia in the cases covered by the papers included in this thesis and using more general insights from my participation in the action research projects (research objective 2). This involves using the concept to perform meta-analyses of each of the analyses already performed in Papers II, V, and VI. The first meta-analysis is based on the factors identified as both potential barriers and enablers for IT-related change processes in health-care, presented in Paper II. The second is a meta-analysis of the identified technological frames (Orlikowski & Gash, 1994) of respondent groups in the KiA and SISU projects, presented in Papers V and VI. The two final subsections are devoted to a retrospective analysis of a change process in the DOME project (supported by Paper III), and a retrospective analysis of the KiA project itself (supported by Papers IV and V). Third, section 7.3 contains an analysis of how a vision seminar process was applied in the SISU project and how it supported the mitigation of inertia during the preparations for the New Ladok student information system and the envisioned future of study-administrative work (research objective 3).

In chapter eight, I discuss how the three research objectives have been addressed in this thesis, I discuss the impact and significance of the work, and, finally, I discuss my concept of inertia in sociotechnical systems in relation to other concepts of relevance.

In chapter nine, I present the conclusions that can be drawn as a result of this thesis.

In chapter ten, I present three possible venues for future work that could complement or extend upon the work of this thesis.

Finally, this comprehensive summary is concluded with acknowledgements, a summary in Swedish, and a list of the references used in this summary.

Appended after this comprehensive summary of my research, the seven research papers are presented in their published or submitted manuscript form.

2 The Research Projects

This chapter introduces the research projects within which the studies were conducted and the insights and experiences informing this thesis were gained.

2.1 IVAN

IVAN was a research project running between 2008 and 2012 in which researchers within human-computer interaction (HCI) at the Department of Information Technology, Uppsala University, collaborated with the Uppsala County Council. The project's name, IVAN, is a Swedish acronym that translates into 'IT in Health-care, Usability and Benefit' (originally 'IT i Vården, Användbarhet och Nytta'). The goal of the IVAN project was to create and disseminate knowledge, methods, and recommendations for how the deployment and use of information technology could be supported and evaluated. The study presented in Paper II was conducted as a part of this research project.

The research within the project focused on the regional health-care organisations' common electronic patient record (EPR) system and the usability issues related to this system, with the aim of identifying and recommending changes necessary to improve efficiency and effectiveness when working with the EPR system. Empirical data was collected through studies at the region's main health-care providers, including a university hospital, a smaller regional hospital, and several primary care facilities. Financial support for the research project was provided in part by the Uppsala County Council and in part by the Department of Information Technology.

The IVAN project involved one senior professor, two senior researchers, one PhD student and six Master's students. I was one of the students writing my Master's thesis based on a study in the project. After the project ended, I became a PhD student and co-authored Paper II, based on experiences from my Master's thesis project and a number of other studies within IVAN.

2.2 DOME

DOME is the selective acronym for 'Deployment of Online Medical Records and e-Health Services' and was the name of a collaborative project between Uppsala University, the University of Lund and the University of Skövde. The project was initially funded by the Swedish Governmental Agency for Innovation Systems, VINNOVA, between 2012 and 2014. Following the end of the initial project, DOME continued as a research consortium with funding from other sources. The overarching goal of the DOME project was to produce and disseminate knowledge about the adoption and use of medical records online and other e-Health services aimed at benefits for both patients and health-care. Paper I was authored in parallel with ongoing studies in both the DOME and KiA projects (described below). Paper III presents a study performed in the DOME project and my licentiate thesis (Lind, 2014) was primarily based on studies performed within the DOME project.

The research was conducted through studies in cooperation with different agents involved in the launch of services providing patients with access to their own health records over the Internet, and other e-Health services. Though the main focus of DOME was on the national deployment of e-Health services in Sweden, the original project also had international ties through collaborations with the EU project SUSTAINS, coordinated by the Uppsala County Council and comprising 16 parties in 11 countries.

The DOME project was originally comprised of 16 researchers from Uppsala University, the University of Lund, and the University of Skövde with backgrounds in many different fields, including health informatics, human-computer interaction, information systems, library and information science, and business studies. Since becoming a consortium, DOME has grown to include researchers from the Royal Institute of Technology (KTH), Örebro University, Karlstad University and Karolinska Institutet. The consortium's research is divided into three work packages, focusing on topics related to patients and relatives, professions and management, and development and implementation, respectively. My main involvement in DOME was through the work package focusing on development and implementation, on which my licentiate thesis was based (Lind, 2014).

2.3 KiA

At the start of my PhD studies I took part in the KiA project (Swedish acronym for 'Kvalitet i Användning', which translates as Quality in Use). It was a collaboration between the research group of which I was a member and the university administration's planning division at Uppsala University. Papers IV and V were based on the activities conducted within the KiA project.

The KiA project started in January 2012 and ran for two years. The long-term goal of the project was to contribute to improving the Uppsala University administration's processes for development, procurement, deployment, and evaluation of administrative information technology.

During the first year, the main activity for the project members was to educate almost 200 of the IT professionals working at the university on the topic of usability, as well as organising seminars and workshops on this topic. The second year the project did two studies on the work environment and usability issues of the people working with financial administration. Reports from these studies were well received within the organisation. The KiA project ended with the completion of these studies, though the collaboration between the researchers and the university administration continued in a new configuration as the SISU project.

2.4 SISU

When the KiA project ended, our collaboration with the university administration changed its focus to the deployment of 'New Ladok', the next major release of the Ladok national student information system. The series of Ladok systems have been developed and maintained through a national consortium with 37 members, primarily Swedish universities and a few government agencies. The Student Information System for Universities (SISU) project concerns the local effort at Uppsala University to prepare for the third major release in the Ladok series, planned to be introduced during the spring of 2018. Papers VI and VII were based on studies performed within the SISU project.

Each consortium member is responsible for the local deployment of the New Ladok system. Since the current version of Ladok is a locally hosted and maintained installation, most universities and colleges have assigned the responsibility for the deployment of the New Ladok system to its local unit in charge of managing and maintaining that installation. This is also the case at Uppsala University, and this unit is the one our collaboration with the administration continued through as the SISU project. This unit, the Student Records Office, employs approximately ten individuals. While these employees were in general very experienced professionals, they felt ill-equipped to manage the deployment of the New Ladok system.

With my assistance and that of two colleagues, the SISU project was initiated as an action research project to support the local project group at the Student Record Office through deployment. The goal of the project was to create the best possible conditions for future changes that enabled Uppsala University to exploit the potential for improvements and to prevent problems related to the introduction of New Ladok.

The first major activity within SISU, and the focus of the collaboration since, has been the application of a vision seminar process (Hardenborg, 2007) to produce a vision of the future work related to student record administration for four major user groups: study-administrators, teachers, students, and a mixed group with senior staff with experience as, for example, head of study, programme coordinator, or student advisor. We also supported the local project through regular meetings, approximately every third week with the project manager, assistant project manager, the communications officer, and a coordinator of support and user-training activities. These meetings primarily revolved around practicalities surrounding the vision seminar process and the organisation of activities following this process. They also provided a recurring opportunity for the project members and researchers to discuss recent developments (e.g., news on the status of the New Ladok development project) and the challenges facing the university and local deployment project.

3 The Research Papers

This thesis is supported by seven research papers that have been subjected to peer-review and published or are in the process of being reviewed for publication. In this chapter, the seven papers are presented, including motivations for their respective inclusion as well as an overview of the papers with title, authors, publication status, abstract, and detailing my contribution to each paper. The papers are referred to in the chapters and sections of this thesis by their Roman numerals.

The research studies comprise several components: studies of the deployment of electronic patient records (Paper II) and e-health services (Paper III) in Swedish health-care, as well as a study of organisational practices regarding change processes related to the development, procurement, deployment, and evaluation of information technologies (Papers IV and V). Ultimately, this thesis studies preparatory activities for a new student information system at a Swedish university, and the role of a vision seminar process in these preparations (Papers VI and VII). In parallel with these studies, an effort to understand IT-related change processes in organisations has continued and resulted in the formulation of the concept of inertia in sociotechnical systems as presented in this thesis (with the first iteration of the concept presented in Paper I).

In Table 2, an overview of the papers is provided detailing the research project each paper is associated with as well as what research objective(-s) each paper supports. The research objectives are numbered in the order they are presented in the introductory chapter: (#1) to define the concept of inertia in sociotechnical systems; (#2) to explore how the concept of inertia in sociotechnical systems can be used to explain effects observed in IT-related change processes; and (#3) to investigate whether vision seminars are a way to mitigate unwanted effects of inertia in sociotechnical systems on IT-related change processes. The motivation for including these papers in this thesis is as follows:

Paper I includes the first iteration of my work on defining inertia in sociotechnical systems. As such, Paper I is included in this thesis as it is the first step towards research objective #1. Combined with the definition presented in section 7.1, Paper I helps illustrate how I have developed the concept of inertia in sociotechnical systems from an abstract idea to a usable concept. The second iteration is a part of my Licentiate thesis (Lind, 2014), the third

was included in an earlier version of Paper VII (summarised in section 5.3), and the fourth is defined and applied within the Results chapter of this thesis (chapter seven).

Papers II, III, IV, V, VI, and VII constitute investigations into the overarching research area (IT-related change processes in organisations) within the IVAN, DOME, KiA, and SISU projects. Out of these, papers III and IV are case studies that provide additional context for the KiA and DOME projects, respectively. Papers II and V concern IT-related change processes in the IVAN and KiA projects respectively, and papers VI and VII concern IT-related change processes in the SISU project. These papers are included in the thesis for their role in enabling my pursuit of research objective #2.

Papers VI and VII include the application and evaluation of a vision seminar process within the SISU project and are included in this thesis to support the pursuit of research objectives #2 and #3.

Table 1. *Overview of the papers with associated research project and research objectives.*

Paper	Title	Project	Research Objective(s)
I	Mind the Gap – Towards a Framework for Analysing the Deployment of IT Systems from a Sociotechnical Perspective	Independent	#1
II	Evaluation of User Adoption during Three Module Deployments of Region-wide Electronic Patient Record Systems	IVAN	#2
III	Development of Novel eHealth Services for Citizen Use: Current System Engineering vs. Best Practice in HCI	DOME	#2
IV	Things Take Time – Establishing Usability Work in a University Context	KiA	#2
V	Swinging Machetes in the Jungle – Technological Frames, ICT Leaders and User Centred Perspectives	KiA	#2
VI	Students Envisioning the Future	SISU	#2, #3
VII	What is the Use of Vision Seminars? – An Evaluation from the Perspective of Participants and Stakeholders	SISU	#2, #3

The papers are presented here with title, authors, publication status, abstract, and detailing my contribution to each paper.

3.1 Paper I: Mind the Gap – Towards a Framework for Analysing the Deployment of IT Systems from a Sociotechnical Perspective

Authors: Thomas Lind and Åsa Cajander

Publication status: Published in Proc. Past History and Future Challenges of Human Work Interaction Design (HWID) INTERACT workshop 2013 – 14th IFIP TC13, Cape Town, South Africa. September 2013, p 34-39.

Abstract: Deployment of IT is little discussed in research literature, despite the fact that a successful deployment encompasses complexities and difficulties well worth investigating. The deployment phase of IT systems can be a make-or-break moment for usefulness of the system due to sociotechnical factors. We argue that there is a gap between the technological artefact produced and the social requirements that govern how well the system will fit in the organisation. Hence, in this work-in-progress paper we present a framework (the SOT framework) for analysing the deployment of IT from a sociotechnical perspective.

My contribution: I am the first author of the paper as the framework presented was proposed and developed by me, and I wrote the paper. This paper was discussed with my main supervisor, who read and commented on the text.

3.2 Paper II: Evaluation of User Adoption during Three Module Deployments of Region-wide Electronic Patient Record Systems

Authors: Rebecka Janols, Thomas Lind, Bengt Göransson, and Bengt Sandblad

Publication status: Published in the International Journal of Medical Informatics (IJMI), Vol 83, no 6, 2014.

Abstract: Background: In Sweden there are modular region-wide EPR systems that are implemented at various health organisations in the region. The market is dominated by four IT systems that have been procured and deployed in 18 out of 21 regions. Methods: In a 2.5-year research study, deployments of three region-wide EPR modules; a patient administration sys-

tem, eReferral module and eMedication module were followed and evaluated. Health professionals, EPR maintenance organisation, IT and health care managers were observed, interviewed and responded to questionnaires. Results: Although the same deployment process was used during the three deployments, large variations in the units' adoptions were observed. The variations were due to: (1) expectation and attitude, (2) management and steering, (3) end-user involvement, (4) EPR learning, and (5) usability and the possibility of changing and improving the EPR. Conclusions: If changes in work processes are not considered in development and deployment, the potential benefits will not be achieved. It is therefore crucial that EPR deployment be conceived as organisational development. Users must be supported not just before and during the go-live phase, but also in the post- period. A problem often encountered is that it is difficult to make late changes in a region-wide EPR, and it is an open question whether it is possible to talk about a successful deployment if the usability of the introduced system is low.

My contribution: My main contribution to this paper was through the planning and data collection involved in one of the studied deployments. For the data collection, this encompassed developing an interview template for semi-structured interviews and subsequently conducting 28 interviews with nurses and physicians, performing participatory observations at different phases of the deployment as well as electronically distributing two surveys to 142 nurses and physicians. I was the second author, taking part in discussions, analysis, and writing effort together with the other authors.

3.3 Paper III: Development of Novel eHealth Services for Citizen Use – Current System Engineering vs. Best Practice in HCI

Authors: Isabella Scandurra, Jesper Holgersson, Thomas Lind, and Gunilla Myreteg.

Publication status: Published in Proc. Human-Computer Interaction – INTERACT 2013: Part II, 14th IFIP TC13, Cape Town, South Africa. Springer Berlin/Heidelberg. 372-379

Abstract: Many new public eHealth Services are now being developed. Often a conventional customer-vendor process is used, where the customer is a public authority, e.g. a county council, and the vendor a commercial actor, e.g. an IT development company. In this case study the engineering process regards a novel eHealth service aiming to provide patients with online access

to their electronic health record. A complicating factor in conventional customer- vendor processes for public e-services is that "the future user could be anyone". In the light of best practice in Human-Computer Interaction, this study examines the joint effort of the customer and vendor when developing novel services for citizen use. The results include delimiting factors, recommendations for public authority customers and proposed new actions for the research agenda.

My contribution: In this paper, I am the third author. I participated in data collection during three of the six interviews conducted, analysed audio recordings and transcriptions from all interviews, and discussed and wrote the paper with the other authors.

3.4 Paper IV: Things Take Time – Establishing Usability Work in a University Context

Authors: Åsa Cajander, Gerolf Nauwerck, and Thomas Lind

Publication status: Published in EUNIS Journal of Higher Education IT, ISSN 2409-1340, Vol. 2, no 1, 2015.

Abstract: This short paper presents a project spanning over two years with the goal of establishing usability work in a university context. The project was a collaborative project in which members from the university administration's planning division worked together with action researchers in order to reach the project goals. During the first year, the project members educated almost 200 of the IT professionals working at the university, and organised seminars and workshops. In the second year, the project conducted two studies on the work environment and usability issues of the people working with financial administration, which were well received within the organisation. To summarize, one can say that the project was successful and the collaboration within the project worked well despite the fact that it was difficult to measure organisational changes of this nature. Usability work is now an integrated part of the development plans at the university, and usability work will be catered to by the establishment of a knowledge center to enable continuous development in this field. However, one can conclude that a sustainable work environment requires sustainable change process regarding usability. There are surely no quick fixes, and things take time.

My contribution: In this paper, I am the third author. The paper presents the KiA project, in which I was the researcher with the most time devoted to performing the planned activities. The responsibility for planning and organ-

ising the activities in the project was shared between me and two senior colleagues. I was in charge of evaluating the educational activities in what was referred to as phase one as well as planning the workshops, and had sole responsibility for the second study in phase two. In writing the paper, I was primarily involved in discussions and providing feedback on draft versions of the text.

3.5 Paper V: Swinging Machetes in the Jungle – Technological Frames, ICT Leaders and User Centred Perspectives

Authors: Gerolf Nauwerck, Thomas Lind, Åsa Cajander, and Marta Lárusdóttir

Publication status: Submitted to Behaviour & Information Technology

Abstract: User centred perspectives are difficult to incorporate in organisations despite strong evidence that taking the user into account leads to better usability and healthier work. Previous research has established that leaders are crucial when establishing a user centred perspective. Hence this paper have studied the technological frames of three kinds of leaders in order to understand their view of the organisation they work in and change related to ICT and a user centred perspective. Eighteen interviews were recorded, transcribed and analysed using the theory of technological frames. Results show that user involvement is seen as a critical success factor by many specialists, but that the systems are built around the needs of management and not the end users. Moreover, driving change related to ICT is described as extremely energy consuming and difficult, like "swinging machetes in the jungle". Finally the relevance of technological frames is discussed, and some implications for the successful establishment of a user centred perspective in organisations are presented.

My contribution: In this paper, I was the second author. I was the principal investigator for the pilot study described as the first phase (which is prior to the 'phase one' described in Paper IV). I planned and organised the 18 interviews included in this study and was the primary researcher in charge of performing them. A second researcher had a supporting role and took notes during a majority of the interviews. During the writing phase, I took part in discussions, analyses, and writing sections of the paper with the other authors.

3.6 Paper VI: Students Envisioning the Future

Authors: Thomas Lind, Åsa Cajander, Bengt Sandblad, Mats Daniels, Marta Lárusdóttir, Roger McDermott, and Tony Clear.

Publication status: Published in Proc. 46th ASEE/IEEE Frontiers in Education Conference. Piscataway, NJ: IEEE Press, 2016.

Abstract: How can students be included as critical stakeholders in the systems and services provided by a university? To address the whole student experience, we engaged students and employees at a large Swedish university in a vision seminar process to elicit how these groups envisioned an ideal future university, and the necessary changes to technology and organisational structures required to achieve this ideal version. The process entailed six four-hour workshops with four groups consisting of six participants each. A survey instrument was used to follow up on the participants' experiences of participating in the vision seminar process and their thoughts on the future of the university. The results show that the participating students were more positive compared to the university employees. The students envisioned harmonized interdepartmental systems, seamlessly integrating a variety of services into one university-provided solution. The employees envisioned their future work as flexible, enabled by technology providing excellent support without hindering pedagogical and organisational development. Using technological frames, these visions of the future are identified, analysed and discussed in relation to the quality of university education and a holistic view on students' university experience. Finally we discuss the broader implications of the visions on the future of university education.

My contribution: In this paper, I was the first author. I designed and managed the application of the survey instrument used in the study and performed the analysis of the data together with one of the co-authors. During the writing phase, I was the lead author, contributing a majority of the text and managing the involvement and contributions of the other authors.

3.7 Paper VII: What is the Use of Vision Seminars? – An Evaluation from the Perspective of Participants and Stakeholders

Authors: Thomas Lind, Marta Lárusdóttir, and Åsa Cajander.

Publication status: Submitted to Behaviour & Information Technology

Abstract: As the complexity of IT systems used at work increases, there is a need for methods that take the whole work situation into account and not only look at one single computer system. This paper presents an evaluation of a Vision Seminar Process (VSP) applied at a large Swedish university with the aim of improving study-administrative work for employees and students. The evaluation is based on an interview study and a survey sent to participants and stakeholders concerning how they experienced the VSP, its value, and what effect they believed it may have on IT-related organisational change at the university. The VSP consisted of parallel workshops with three groups of employees and one group of students, tasked with envisioning the university's study-administration four years into the future. The main results in the paper show that both participants and stakeholders were positive towards the VSP and believed in its applicability. They believed the application of the VSP was time well spent, and the vision presented at the end of the process was perceived as both detailed and useful. However, it is interesting that some also found it unlikely that the vision would have a significant impact on IT-related change in the organisation, despite them being so positive. More studies are needed to increase our understanding of the role and effects of Vision Seminars during organisational change involving IT.

My contribution: In this paper, I am the first author. I designed and managed the application of the survey instrument used in the study, and planned, conducted, and transcribed the ten interviews. For seven of the interviews, one of the co-authors also attended, primarily taking notes. I performed the analysis of the interviews, and was assisted by one of the co-authors when analysing the survey data. During the writing phase, I was the lead author, responsible for writing the text with occasional feedback from, and discussions with, my co-authors.

4 Research Background

In this chapter, the research background of this thesis is presented, including an interpretation of, and my position in, the research area of Human-Computer Interaction, as well as an outline of the history of the sociotechnical systems tradition.

Baxter and Sommerville (2011) argue that even though sociotechnical approaches to systems development lead to more acceptable systems from the users' perspective, and systems that are more likely to satisfy stakeholder expectations, these approaches rarely diffuse further than their own founders. They boldly follow this assertion by proposing a framework of their own, which they describe as informed by research on work design, information systems, computer-supported cooperative work, and cognitive systems engineering. While these subjects are not entirely separate, they are largely considered to be research fields in their own right, having their respective core communities and variations in research culture. For research and practice that adopts a sociotechnical perspective, such a mix is no surprise, and yet it does point to one of the challenges: that of simultaneously belonging in many places and none. The research background of this thesis is rooted in a sociotechnical systems tradition, and, while similar to the work of Baxter and Sommerville in that it draws on previous work from many different fields, Human-Computer Interaction is considered to be its core subject.

4.1 Human-Computer Interaction

Human-Computer Interaction (HCI) is a relatively young research area and can be considered an organic meld of a number of more traditional research areas engaging in the study of humans interacting with computers or with information technology (IT) more generally. With this mixed heritage, it is no surprise that there are many interpretations of what HCI is and how it relates to other research fields (e.g., Baxter & Sommerville, 2011; Kuutti & Bannon, 2014).

The field of HCI has grown substantially over the last decades. Given the proliferation of IT, going from particular to ubiquitous over roughly the same period, this increased interest in the field should not come as a surprise. Rogers (2012) provides a telling description of the changes to the field:

> Judging by the diversity of papers that are now accepted at the annual flagship U.S. conference, CHI, and its galaxy of sister venues (e.g., ItalCHI, NordCHI, SouthCHI, OzCHI), there is no longer a coherent set of aims or goals, or accepted classification of contributing disciplines. It seems anything goes and anyone can join in. The early mantra of HCI 'know your user' has in a few years all but been superseded by the socially aware slogan 'make an impact.' Instead of striving to fix interfaces so that these become easy and obvious in their use, the community is turning towards looking at how it can transform the world to be a better place. (Rogers, 2012, p. xii)

While I cannot say that attending CHI in 2013 gave me the impression that the mutual aim of the HCI field is to transform the world into a better place, I agree with Rogers that it is hard to discern any coherent aims, goals or even contributing disciplines. The research foci in HCI are as plentiful and diverse as the backgrounds of the researchers themselves. However, my attendance at HCI conferences such as CHI, INTERACT, and NordiCHI has given me the impression that while there are many special interest groups and niches, much attention is devoted to the design and exploration of novel technologies and modes of interaction. The real world applications, and perhaps especially how this research contributes to making the world a better place, is often lost on me. Meanwhile, the focus on HCI applications in everyday work settings or in an organisational context in general is a comparably small niche.

Another narrative on the changes in science overall is given by Shneiderman (2008) in his article Science 2.0, in which he calls for a new kind of science in the wake of Web 2.0. He argues that understanding the new collaborative sociotechnical systems made possible by IT requires new ways of performing research studies, as a complement to the predominant orientation:

> Science 1.0 heroes such as Galileo, Newton, and Einstein produced key equations that describe the relationships among gravity, electricity, magnetism, and light. By contrast, Science 2.0 leaders are studying trust, empathy, responsibility, and privacy. The great adventure for the next 400 years will be to define, measure, and predict the interaction among these variables so as to accelerate scientific discovery, engineering innovation, e-commerce, and education. (Shneiderman, 2008)

Similarly, but focusing on a comparatively narrow time-span, Kuutti and Bannon (2014) argue that there are two paradigms within HCI: the interaction paradigm and the practice paradigm. The former is described as the 'prevailing mainstream paradigm' of HCI in which methods traditionally come from psychological sciences; the studies are primarily short-term, conducted in a laboratory-like setting, and revolve around individuals being observed whilst engaging in predetermined experimental tasks. The latter is described as a paradigm that 'examines historical processes and performanc-

es, longer-term actions which persist over time, and which must be studied along the full length of their temporal trajectory'. The methods in this paradigm have predominantly been qualitative, extended over time, extending the focus to an overall activity, involving people and artefacts as well as organisational routines and daily practices (Kuutti & Bannon, 2014).

According to Kuutti and Bannon (2014), the diversity in the field of HCI can be explained by this emergence of two fundamentally different lines of enquiry. For me, with a background in sociotechnical systems (STS), it comes naturally to favour topics that inherently involve the struggle to manage the complexity of real-life contexts over topics requiring a laboratory setting and the control of as many sources of variance as possible. Hence, I identify myself as being part of the practice paradigm of HCI.

4.2 Sociotechnical Systems

A sociotechnical system is a system that can be seen as a combination of two interdependent subsystems, one social and one technical (L. Klein, 2014). Society can be regarded as consisting of several interconnected sociotechnical systems of varying size and complexity. These range from large societal functions, such as the systems for energy distribution or public transportation, to small firms and businesses and even to individual users of technology. As a research tradition, sometimes referred to as Sociotechnical Systems Design, it dates back to the 1940's and 50's and studies of coal mines in the United Kingdom (Griffith & Dougherty, 2001; Pasmore, 1982; van Eijnatten, 1993).

Since the inception of sociotechnical systems research at the Tavistock Institute of Human Relations in London, by its pioneers Eric Trist, Ken Bamforth and Fred Emery (Emery & Trist, 1960; Trist & Bamforth, 1951), the concept and its guiding principles have been formulated, reformulated, extended and revised by different authors and for different purposes (e.g., Baxter & Sommerville, 2011; Cherns, 1976, 1987; Clegg, 2000; Cooper & Foster, 1971; L. E. Davis, 1977; M. C. Davis, Challenger, Jayewardene, & Clegg, 2014; Eason, 1988; Klein, 2014; Mumford, 2006). The principles were originally formulated by Trist and Bamforth (1951) and concern how to increase productivity as well as worker satisfaction through what they referred to as the 'joint optimisation' of the social and technical components of an organisation. As a core concept this has remained quite constant, considering the proliferation of information technology in organisations and the evolution of work, workplaces, and society in general.

The idea that the people and technology in an organisation are interdependent and that, because of this, the introduction of new technology needs to be performed with the consideration of an organisation's current struc-

tures and processes in mind is still being championed, for example as expressed by Klein:

> Each affects the other. Technology affects the behaviour of people, and the behaviour of people affects the working of the technology. It is inevitable, it is a real part of the situation, and one therefore needs to take account of how they affect each other. (L. Klein, 2014)

The sociotechnical principles also promote a democratic approach to the design of work and to regard humans as complementary to machines instead of subordinate. This fuelled the initial popularity of sociotechnical systems as a design philosophy, as an alternative to the instrumental perspective on the role of humans provided by Taylorism and scientific management. Mumford refers to this heritage and the adoption of sociotechnical principles for design as a move away from 'the dictatorship of the moving assembly line' (Mumford, 2006). Since their formulation, the principles have been criticised for being too philosophical to serve as principles for design, and successful application has thus proven dependent on the principles being distilled into more concrete methods (Baxter & Sommerville, 2011; Mumford, 1993). Revisions have also been proposed to accommodate for software development as a necessary part of the design process (e.g., Baxter & Sommerville, 2011; Clegg, 2000). Mumford adapted the principles in her ETHICS methodology for the design of information systems (Mumford, 1993). Unfortunately, ETHICS and other approaches have not escaped similar criticism of not being easy for systems developers to apply.

5 Research Methodology and Methods

This chapter introduces action research as my research methodology and provides an outline of this tradition in relation to my projects, as well as my multi-grounded theory approach (Goldkuhl & Cronholm, 2010) to theory building and choice of methods. In addition, the final section provides a description of the research process regarding the development of my definition of inertia in sociotechnical systems in the iterations prior to the current definition presented in section 7.1. For additional details regarding methods, I refer the interested reader to the methods section of each paper respectively.

The methodology and methods used in my research are aligned with a constructivist view of the world (Crotty, 1998). If there is such a thing as objective truth, it is unavailable to us in its 'pure' form since we always experience the world around us subject to how our brains interpret sensory stimulus. We construct the world around us through our interpretation of the objects and phenomena we observe, and, through these interpretations, we create knowledge and meaning. In alignment with this worldview, the studies I have conducted have been predominantly qualitative and based on qualitative content analysis (Braun & Clarke, 2006; Hsieh & Shannon, 2005) of interviews. In several studies, I have used surveys to enrich and support the qualitative data gathered through interviews, observations, and from other sources, such as the studies covered in Papers II, VI, and VII.

5.1 Action Research

Action research is a research methodology in which the research project has the dual aim of conducting research studies while at the same time solving a problem in the studied context (McKay & Marshall, 2001). The approach is built on the idea that, through collaboration with practitioners and the sharing of knowledge and experiences, the researchers can aid in the development of a solution while simultaneously developing theory around the problem being solved. The focus on collaboration is also highlighted by Rapoport (1970), who defines action research as a methodology that 'aims to contribute both to the practical concerns of people in an immediate problematic situation and the goals of social science by joint collaboration within a mutually acceptable ethical framework'. By this definition, all the research projects that I have participated in can be considered to be action research pro-

jects as I have participated in trying to achieve the overarching goals of the projects and at the same time performed research studies in the context of those projects.

Action research is iterative by design and often referred to as performed in cycles between action and reflection, and sometimes with 'planning' included as a separate step (Reason, 2006). The researcher must decide, though influenced by the availability of time and other constraints, how many cycles to perform, how to balance between action and reflection, and whether to converge on an increasingly refined research question or a widening exploration of discovered issues. Though often depicted in neat diagrams, Reason (2006) observes that how the action research cycles unfold in practice is usually 'messier'. I agree with this observation, as even though I recognise these cycles within each of the projects I have participated in, the cycles are often both implicit and overlapping.

There are several instantiations of action research that widen the conceptual scope of the methodology through a variation of definitions of, for example, the nature of the problem addressed, the relation between researcher and subject, and the nature of science itself (Elden & Chisholm, 1993). Despite this diversity, one can argue that there are some common features and, particularly, a common view of how to conduct research. Among the different variants of action research, Rasmussen (2004) has found three features that unite them, presented below:

1. The first is the participatory nature of the methodology and the synergistic relationship of research informing practice and practice informing research.
2. The second is the process of data collection, which is often an integral part of the research process and, as such, one that Rasmussen argues is not strictly formalised and bound by any particular rules.
3. The third common feature is that the researcher often takes, and shifts between, different roles in the project as mentioned earlier.

These three features presented by Rasmussen (2004) are here related to my action research projects.

First, the research projects that I have participated in all have the first feature of action research presented by Rasmussen, and we have collaborated with the participants in these projects to work towards the overarching project goals. The synergetic relationship between research and practice has also been very present in our numerous meetings and workshops. The active and deliberate involvement in the studied context in this manner is unlike many other methodologies, in which intervention is prohibited and the researcher is expected to observe with as limited an effect on the observed phenomena

as possible. In contrast, intervention is at the centre of action research, combined with studying and learning from the act of intervening (Oates, 2005).

Second, the data collection methods used has indeed been an integral part of my research. In addition to more traditional data collection methods, as described in the included papers and partly covered in the next section, taking on different roles as a researcher in action research projects has also constituted valuable forms of data collections through the observations and experiences gleaned in this way. This overlaps with the next paragraph, where several of these roles are exemplified.

The third feature presented by Rasmussen (2004) is that the researcher in an action research project takes on different roles, such as facilitator, mentor, conflict mediator, knowledge generator, or educator (Rasmussen, 2004). Which role the researcher adopts may vary throughout a research project, depending on the current phase of the project and on the conditions given by the studied problem and its context (such as scale, complexity, and surrounding organisational structure) (Westlander, 2006). In my research projects I have indeed taken on several different roles as a researcher, such as for example:

- **Traditional researcher.** I have collected data, performed analyses and written research publications in all the four action research projects.
- **Educator.** I have participated in an educational programme as a part of the KiA project.
- **Knowledge generator.** I have participated in numerous meetings and workshops where the participants have generated knowledge and solutions for problems that have emerged.
- **Vision seminar facilitator.** I have facilitated two vision seminar groups with students and employees as a part of the SISU project.
- **Focus group facilitator.** I participated as a facilitator during focus groups with representatives from health-care and patient organisations in the DOME project.
- **Coach/Mentor.** I have been a personal coach on the topic of IT-related change as a part of a professional coaching program in the SISU project.

Some of these roles have been the result of planned activities in the projects while others have emerged in response to needs and opportunities presenting themselves.

5.2 Methods

On an overarching level, my research approach is multi-grounded theory building (Goldkuhl & Cronholm, 2010). I allow my experiences from research studies (empirical grounding), and theoretical knowledge of the research area (theoretical grounding) as well as reflections on the material (internal grounding) to inform the research, including the design of my data collection instruments and my analysis of data, such as the themes for my interview templates or the questions included in my surveys, see Figure 1.

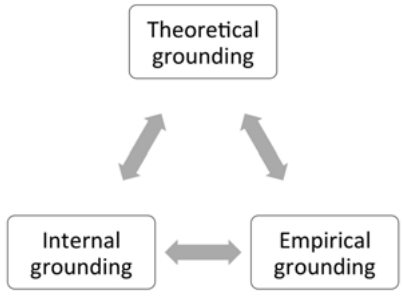

Figure 1. Multi-grounded theory building is an iterative process where theoretical grounding, internal grounding, and empirical grounding inform the research.

Moreover, as all of my studies have been performed within action research projects, the aims of these projects have also influenced the research questions being pursued and the choice of methods for doing so.

In my studies, I have used established frameworks such as Technological Frames (Orlikowski & Gash, 1994) to structure and analyse qualitative data, and I have also used qualitative content analysis techniques (Braun & Clarke, 2006; Hsieh & Shannon, 2005) to code and elicit themes from my data. My approach to qualitative content analysis is inductive and based on iterative coding, and, in that regard, it has similarities with Grounded Theory as proposed by Glaser and Strauss (1967). However, it is not purely inductive because of the theoretical grounding in previous research taking place before and in parallel with the empirical grounding through the data analysis. This synthesis of deductive theoretical grounding and inductive empirical grounding is a good representation of how I have conducted my research in practice, and it is in line with Multi-Grounded Theory as presented by Goldkuhl and Cronholm (2010).

5.2.1 The Previous Iterations of My Definition of Inertia in Sociotechnical Systems

The development of the theory of inertia has been iterative and informed by external theories and research as well as my studies and experiences from

the research projects, as presented in Figure 2 and further described in this subsection. The figure is adapted from Cronholm (2004):

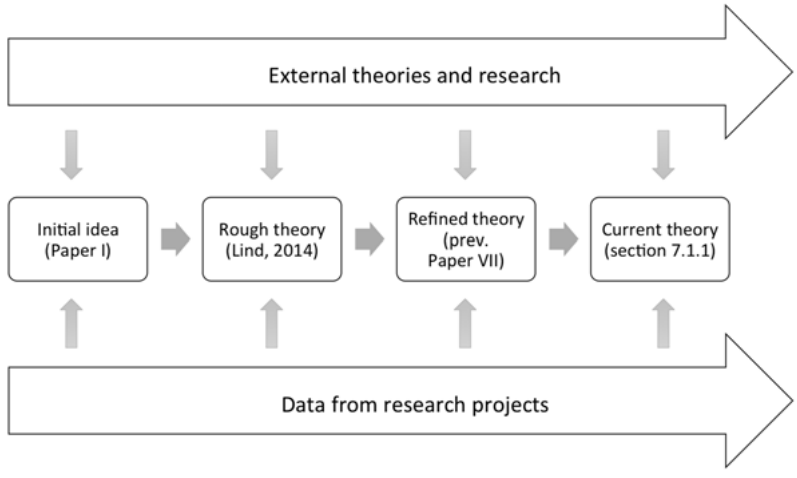

Figure 2. The development of the concept of inertia has been iterative and informed by external theories and research as well as data from the research projects and studies.

My interest in inertia as a sociotechnical concept was spurred by one of my supervisors' use of inertia to imply that organisations are generally hard to change. It kept recurring in discussions about the organisations related to our research projects, often followed by reflections on the lack of a more detailed and useful definition of inertia as an organisational phenomenon. Having realised that there was a significant research gap in the human-computer interaction (HCI) literature regarding the impact of IT deployments on organisations, beyond the well researched user-level adoption models such as TAM and UTAUT (Benbasat & Barki, 2007; F. D. Davis, 1989; Venkatesh, Morris, Davis, & Davis, 2003), I figured I could help fill that gap by developing inertia into a more useful concept. Using the relevant literature I had reviewed by then, about one year into my studies, in combination with a sociotechnical deconstruction of organisations I had been taught during my previous education, the framework presented in Paper I was born. With literature reviews and empirical studies running in parallel, the concept of inertia in sociotechnical systems has developed along with my understanding of IT-related change processes in organisations in what can be described as a hermeneutic circle (H. K. Klein & Myers, 1999; Myers, 1995). The principle of the hermeneutic circle states that our understanding of the whole is established in relation to the individual parts, while our understanding of the parts is established in relation to the whole. In my research this has presented itself through, for example, relating particular study results to findings in previous research and in discussions with colleagues, and discussing the ap-

plicability of theories and frameworks in the particular contexts of my research studies.

In the following paragraphs I outline the different stages my concept of inertia has passed through before arriving in its current form as presented in this thesis.

A first attempt at theorising by using the concept of inertia and a sociotechnical systems perspective to describe the dynamics of organisational change involving information technologies was presented in Paper I, proposing the Social-Organisational-Technological framework. At this stage the framework consisted of deconstructing a sociotechnical system using three aspects (social, organisational, and technological) and transferring Keen's concept of social inertia into a sociotechnical context. In the framework, we proposed that there is a relative degree of inertia between each of the three aspects. Each aspect constrains the organisation's ability to close a gap representing the potential performance gains that could be realised if the social, organisational, and technological aspects better supported and complemented each other. We proposed the concept of a 'sociotechnical gap' to refer to this phenomenon, similar to the research by Ackerman (2000) and by Abdelnour Nocera and Camara (2015). In the conclusion of Paper I, we argued that, while in need of further theoretical grounding, the framework had potential as a tool for the analysis of IT-related change processes.

The second iteration of the concept was presented in my licentiate thesis, investigating inertia in the context of introducing e-health services in Sweden (Lind, 2014). Here, the explicit deconstruction of a sociotechnical system using different aspects was omitted due to the difficulty of delineating and defining the aspects as separate from each other while simultaneously incorporating the idea of interdependence, one of the traditional characteristics of sociotechnical systems theory (L. Klein, 2014). Though downplayed, the three original aspects were still present and reframed as sources of inertia that greatly influence the possible rate of organisational change: information technology, procedures and institutions, and social and political processes. With the distinct aspects from Paper I gone, the graphical representation from Paper I and the accompanying gap analogy were dropped. Inertia was instead defined as a property of sociotechnical systems, describing the effort necessary to alter the current 'trajectory' of a system. Trajectory was added to clarify that stating that there is considerable inertia in a sociotechnical system is not the same as it being inert or static, but rather that it will keep on changing in the same manner and rate as it has been historically. With user resistance and stakeholder influence being hot topics for the encompassing action research project, examples of this were prominent in my empirical data, and further theoretical grounding for the concept of inertia was sought within policy studies (Bardach, 1977), science and technology studies (Winner, 1980), and in concepts such as status quo bias (Kim &

Kankanhalli, 2009; Samuelson & Zeckhauser, 1988) and path dependence (Burns & Scapens, 2000).

Inertia in sociotechnical systems in its third iteration was originally presented and applied as a theoretical lens in a previous version of Paper VII. At this stage, I had discovered that while defined as a property of sociotechnical systems in my licentiate thesis (Lind, 2014) and applied as such during analysis, it was also treated as dependent on the actor and action in question. Discovering this fact prompted the separation of the second use into a concept of its own, 'leverage', to refer to the agency of an actor-action pair in relation to the system. As it was then defined in Paper VII, '[a]n actor's leverage is his or her ability to affect the sociotechnical system through a given action as a result of the actor's relationship to or position within the sociotechnical system, as well as the particulars of the action'. Put another way, leverage is a measure of agency as a function of inertia and the concerned actor and action. However, in this 'equation' inertia is a variable representing a considerable complexity, as it is the result of the interactions between all the parts of a sociotechnical system. Expressed on this conceptual level, inertia and leverage made for a blunt tool, and while perhaps useful for facilitating discussion and highlighting the existence of complexities in a sociotechnical system, it was not useful enough as a tool for making sense of and managing these complexities. This drawback was also pointed out by reviewers of the previous version of Paper VII, which is why it was omitted from the paper and further developed into its present state as presented in this thesis.

Throughout the development of the concept of inertia in sociotechnical systems, there has been a constant tension between keeping the approach simple and easy to explain on the one hand, and increasing the level of detail on the other. The latter was avoided in the iterations prior to the one presented in this thesis. This choice was made (1) in an effort to thereby avoid increasing the time and effort required to convey how it might be applied, (2) in an attempt to avoid the same criticisms of earlier sociotechnical approaches by, for example, Baxter and Sommerville (2011), who contend that sociotechnical design methods are too challenging to apply to diffuse beyond their creators, and, finally, (3) in response to experiences of senior colleagues of mine–that approaches championed by researchers frequently fail to take hold in industry due to these being considered too resource intense. Whether the fourth iteration of my concept of inertia in sociotechnical systems can be considered lightweight I leave for the reader to be the judge of. It is presented and applied in sections 7.1 and 7.2-7.3 of this thesis, respectively.

6 Inertia and Related Concepts

This chapter presents and exemplifies how inertia and related concepts have been used in previous research.

6.1 Inertia in Physics

In classical physics, the principle of inertia is defined by Newton's three laws of motion (Nordling & Österman, 2006). The first law, commonly referred to as the law of inertia, states that the velocity of an object will be constant as long as the net sum of forces acting on that object is zero. The second law states that if the sum of forces is not zero, the resulting net force will accelerate the object in the direction of that force at a rate proportional to the object's mass. Finally, the third law states that for every action there is an equal and opposite reaction. While dependent on a simplified version of reality, for example, one in which all objects are considered to be single points of mass, these three laws can be applied to analyse the interaction between objects in our surroundings. They are accurate enough to sufficiently explain the behaviour of a soccer ball when kicked, as well as the movement of the planets around our sun. The laws dictate that, if no force is acting on an object, it will either be in a state of rest or continuing forever with constant speed in the direction that previous forces have pushed or pulled it. The latter possibility, continuing forever, might seem odd. On Earth, the presence of forces such as the pull from Earth's gravity, the friction between surfaces and resistance from air or water means that most things in our surroundings do not fly around indefinitely with constant velocity. Instead, objects tend to end up in states of rest when the sums of the forces acting on them cancel each other out.

6.2 Organisational Inertia and the Stability of Societal Functions

Besson and Rowe (2012) refer to inertia in organisations as an essence of the act of organising. To become organised entails the *entrenchment* of routines and patterns, and it is this entrenchment that becomes the source of inertia

for change processes in which existing routines and patterns need to be changed. The level of entrenchment is essentially a measure of the permanence of, for example, formal and informal hierarchies, routines and procedures, and technical infrastructure, but it also includes influences from less tangible factors such as people's norms and values, fears and beliefs, agendas, and vested interests (Besson & Rowe, 2012).

Similar to the entrenchment of organisational routines and patterns, but on a societal scale, is Geels' (2005) description of the stability of societal functions as resulting from networks of dependencies within them, observable as, for example, legal contracts, financial investments, social rituals, institutional arrangements and regulations. Geels explains that, when reliance upon a certain technology grows, this contributes to its dominance and in return increases stability in the sociotechnical systems of which the technology is a part. As such, once a technology has started to gain dominance, it may benefit from increasing returns and become increasingly embedded and relied upon in its societal or organisational context. An example of becoming embedded by dependencies is when the number of integrations between an organisation's information technologies increase. From a technological standpoint, to create and maintain the integrations provides one source of stability as the necessary expenditure of resources (e.g., time and programmers) can grow at an exponential rate for each new technical system to be integrated. From a social and organisational standpoint, the reliance of work processes on the (it is hoped) increased efficiency provided by the integrated information systems is another source of stability, and yet another is provided by the eventual loss of knowledge and experience related to how work was done before the integrations.

Entrenchment, dependencies, and stability have also been discussed in studies of businesses and financial markets, using the concept of path dependence, regarded as a result of lock-in effects and organisational choices (Arthur, 1989; Burns & Scapens, 2000; David, 1985; Vergne & Durand, 2010). Path dependence on a societal level is exemplified by David (1985) in his account of the proliferation of the QWERTY keyboard layout for typewriters and, eventually, computers. David (1985) describes path dependence as a lock-in effect consisting of three crucial factors: technical interrelatedness, economies of scale, and quasi-irreversibility. The first factor refers to compatibility between system components in a wide sense. In the case of typewriters, the compatibility at issue, or technical interrelatedness as the factor is called, is that between the keyboard's layout and the layout a typist has acquired the skill to touch-type on. The value of a typewriter from the perspective of a business intending to buy it is interrelated with the availability of typists skilled at using such a typewriter. The second factor, economies of scale, refers to how the mechanics of open markets can result in the de-facto standardisation of products or of a certain product characteristic. An example from the present case is the contribution to this standardisation pro-

cess through aspiring typists being influenced by the availability of typewriters when deciding what keyboard layout to learn. Adding to this effect, the typewriter manufacturers naturally considered their sales figures as well as their knowledge of the current distribution of skilled typists when deciding what layout or layouts to manufacture. By the time the design of keyboard layouts had become less constrained by limitations in the products' mechanical design (e.g., to avoid jamming) or manufacturing cost constraints, one of the early keyboard layouts was already dominant. Why this dominance was not subsequently lost to a more efficient keyboard layout is explained by the third factor, quasi-irreversibility. In this context, quasi-irreversibility means that, while technological advances made the choice of typewriter layout more and more arbitrary from a manufacturing perspective, the 'cost' of switching remained high for typists. While certainly not impossible, the incentives for typists to invest the time and effort required to learn and become proficient on a new keyboard layout were few and became even fewer. In David's (1985) analysis, as typewriter manufacturers sought to expand their market share by providing the most common layout(s), the market adapted to the skills of existing typists and removed the need for typists to adapt, until virtually only one layout was left.

While compelling, the use of QWERTY as an example of a significantly inferior design has since been contested, shown to be largely exaggerated, and the history of competing typewriter manufacturers more complex than David's (1985) paper conveys (Liebowitz & Margolis, 1990). However, path dependence and lock-in are still recognised concepts that exemplify, in my interpretation, what Geels (2005) refers to as technology becoming embedded by dependencies. Burns and Scapens (2000) describe this as an effect of history on organisational choice that may result in organisations maintaining or actively choosing products or technologies that, if studied in isolation, could be considered inferior. More specifically, Burns and Scapens found that when introducing a new accounting system in an organisation, existing routines and institutions affected the selection and implementation process. This effect, and other particulars of the organisation's present state, provide a bounded rationality through which the criteria for a satisfactory choice change. As a result, what could otherwise be considered an inferior product can become the most rational choice for an organisation (Burns & Scapens, 2000).

6.3 Social Inertia and Resistance to Change

Keen (1981) explains the inherent difficulties of changing information systems in organisations as a result of social inertia, with social inertia summarily defined as 'a complicated way of saying that no matter how hard you try, nothing seems to happen'. According to Keen, social inertia is caused by

different forms of resistance, in particular resistance through the application of different forms of counter-implementation techniques. He identifies resistance to new information systems as caused by the future users regarding the decision-making processes involved in their work as unsuitable for formalisation through technology. The workers consider the new technology as simultaneously threatening and unneeded in addition to being an embodied criticism against them.

In Keen's (1981) analysis, the contemporary body of research on implementation of information systems fails to take into account the full complexity inherent in their implementation. In particular, much research ignores the political aspect of implementation, the presence of which has since been highlighted in other studies of information systems development and implementation (e.g., Hirschheim & Newman, 1988). Keen (1981) finds that the strategies presented by Bardach (1977) on how to counteract policy change in politics also apply when implementing information systems into organisations. Bardach identifies three general strategies for countering change initiatives: diverting project resources, deflecting goals, and dissipating energies. The first strategy, diversion of project resources, revolves around supporting a project while simultaneously trying to get more in return than what has been invested, for example by making sure that the parts of the project that the diverter consider to be beneficial receive ample resources. The second strategy, deflecting goals, goes one step further and takes advantage of any ambiguity or lack of clear mandate to shift the goals towards the deflector's own, to recruit allied stakeholders to the project, or to assume leadership of the project completely. The objective of the third strategy, dissipating energies, is to slow down the progress of a project as much as possible either to hinder it from ever being finished or to stall it until the dissipater's own agenda has been fulfilled. These strategies can be used either to steer a project towards one's own goals, or to make sure that the project is unsuccessful by impeding progress or completion. If expertly executed, the actor or actors applying such strategies may ostensibly come across as supporting the project. An example relevant for the introduction of information systems, as given by Keen (1981), is to exploit the difficulty of reaching an agreement in larger groups. This can be done by enthusiastically insisting that a wide array of stakeholders be involved in the project 'to make sure it is done properly', which, in addition, will increase the risk of project objectives shifting or multiplying.

Keen (1981) suggests that information systems implementations are most effective when they are conducted as small-scale projects, propose incremental change, and rely on face-to-face facilitation. He notes that the counter-implementation strategies identified by Bardach (1977) primarily target ambiguity and lack of control, rendering a project particularly vulnerable until its broad goals have been turned into operational objectives and a clear mandate for change. Large-scale change is seen as a process of coalition

building, in need of senior-management leadership with the formal authority required to negotiate with all affected parties. If politics are recognised as a necessary part of information systems development and implementation, as a process of gaining support, commitment, and momentum for change, the organisational mechanisms will adjust naturally (Keen, 1981). This sentiment is also supported in the conclusions of more recent research (see e.g., Fernandez & Rainey, 2006; Kotter, 2012; van der Voet, 2014).

Social inertia, including political aspects, remains a source of prominent challenges for information systems implementations. In a comparatively recent literature review by Ziemba and Obłąk (2015) concerning critical success factors for successful change management of information systems projects, twelve factors are identified as central to success:

1. The support of top management in both words and actions.
2. A recognised and well-defined need for change.
3. Clear objectives for what to change and a shared vision for how.
4. Project planning activities that clarify necessary tasks and required resources.
5. Managerial commitment and involvement at the line-level.
6. Effective communication, regarding the particulars of the planned and performed changes as well as for sustaining engagement and motivation.
7. Organisational readiness to deal with the resulting changes.
8. Employee training to facilitate the transition to a new way of working.
9. Employee involvement in the change process.
10. Employee satisfaction with both planned and actual change outcomes.
11. Continuous information flow regarding the state of the change project.
12. Continuous performance measurements, evaluating the progress of the project against set goals and objectives.

This review and other research in the same vein shows that critical success factors for information systems implementations, though varying in presentation and framing, have remained fairly stable over the last two decades (Chrusciel & Field, 2006; Cocks, 2014; Coombs, 2015; Davenport, Harris, & Cantrell, 2004; Kotter, 1996; Lorenzi & Riley, 2000; McLeod & MacDonell, 2011; Ram, Corkindale, & Wu, 2013; Scott & Vessey, 2002). The framing used in Ziemba and Obłąk's (2015) presentation of their results suggests a focus on how the factors enable or support making sure that the people in an organisation are as knowledgeable and engaged as possible regarding the particulars of a planned or ongoing change, and that these people contribute towards achieving that change. While the research on success factors indi-

cates that these factors are correlated to positive outcomes from the implementation of information systems and technologies, it is often a challenge in itself to determine whether the criteria of a success factor have been sufficiently satisfied (Ram & Corkindale, 2014).

6.4 Windows of Opportunity in Policy Studies

In the context of launching a spaceship to another planet, a window of opportunity refers to the period of time during which an opportunity for launch is created by the favourable alignment between Earth and the target planet, for example, Mars. The window of opportunity closes as the planets keep moving along their orbits, and, if the spaceship is not successfully launched within the window, there may not be another chance for a very long time, if at all. Kingdon (2003) evokes this example when proposing the concept of policy windows to help explain the dynamics of governmental policy development in the United States. In Kingdon's terminology, a policy window occurs when three 'streams' are in alignment. The first stream, the problem stream, contains the conceptions of problems and, to be in alignment, it is required that the problem to be solved is known and recognised as a problem as well as something on people's minds. The second stream is the stream of proposed solutions, which contains solutions in terms of proposals for policy changes that can be approved and implemented. For the policy stream to be in alignment, there must be at least one proposal for policy change available that solves (at least in theory) the problem under consideration. Lastly, the third stream is the political stream, containing the current political forces, alignment of which requires, for example, that solving the given problem using the proposed solution is in line with the agendas of parties or individual politicians. This stream also includes influences from political forces such as lobbying organisations or public opinion. According to Kingdon's theory, the likelihood of successfully implementing policy changes is at its height when the three streams are in alignment. To intentionally create a policy window is not impossible, nor is it a simple task, and Kingdon (2003) notes that the most important personality trait for a person trying to facilitate the opening of a policy window is *sheer persistence*.

7 Results

In this chapter, I present the result of my research in relation to my research objectives:

1. To define the concept of inertia in sociotechnical systems.
2. To explore how the concept of inertia in sociotechnical systems can be used to explain effects observed in IT-related change processes.
3. To investigate whether vision seminars are a way to mitigate unwanted effects of inertia in sociotechnical systems on IT-related change processes.

First, my definition of inertia in sociotechnical systems is presented in section 7.1, along with proposed handles for its application (research objective 1).

Second, in section 7.2, the concept of inertia in sociotechnical systems, as defined in the previous section, is applied retrospectively to illustrate the presence and impact of inertia in the cases covered by the papers included in this thesis and using more general insights from my participation in the action research projects (research objective 2). This involves using the concept to perform meta-analyses of each of the analyses already performed in Papers II, V, and VI. The first meta-analysis is based on the factors identified as both potential barriers and enablers for IT-related change processes in health-care, presented in Paper II. The second is a meta-analysis of the identified technological frames (Orlikowski & Gash, 1994) of respondent groups in the KiA and SISU projects, presented in Papers V and VI. The two final subsections are devoted to a retrospective analysis of a change process in the DOME project (supported by Paper III), and a retrospective analysis of the KiA project itself (supported by Papers IV and V).

Third, section 7.3 contains an analysis of how a vision seminar process was applied in the SISU project and how it supported the mitigation of inertia during the preparations for the New Ladok student information system and the envisioned future of study-administrative work (research objective 3).

7.1 Defining Inertia in Sociotechnical Systems

In this section I present the concept of inertia in sociotechnical systems, as I have defined it, and, in addition, present a set of handles that describe how it can be applied to IT-related change processes in organisations.

7.1.1 The Definition of the Concept

Inertia is a term commonly used when referring to something as hard to change. In research on IT-related change processes in organisations, the word 'inertia' is often preceded by the term 'social', as in social inertia (e.g., Keen, 1981; Li, Liu, & Liu, 2016; Lucia-Palacios, Pérez-López, & Polo-Redondo, 2016; Österlund & Lovén, 2005), or 'organisational', as in organisational inertia (e.g., Baron & Hannan, 2002; Besson & Rowe, 2012; Jacobs, van Witteloostuijn, & Christe-Zeyse, 2013; Tsoukas & Chia, 2002). However, I have never come across a definition of inertia or similar concept that enables an analysis of the phenomena that is being referred to in the context of an organisation and IT-related change processes. Prior to the writing of this thesis, I made three iterative attempts at constructing a definition of my own, the first being the work-in-progress framework presented in Paper I, the second being the definition presented in my licentiate thesis (Lind, 2014), and the third being a definition included in a previous version of Paper VII. Improving upon these attempts, I here present the definition of inertia in sociotechnical systems in its fourth iteration. In the subsequent sections (7.2 and 7.3), this definition is applied to perform a retrospective analysis of the studies covered in the included papers as well as more generally to cases from the action research projects in which I have participated.

> I define inertia as the impact of those characteristics of a sociotechnical system that affect the effectiveness and efficiency of a specified change process in the system.

This definition is general enough to accommodate all sociotechnical systems, from large societal functions, such as for energy distribution or public transportation, to small firms and businesses, and even individual users of IT. However, what it is that constitutes a change process and what the characteristics are that contribute to inertia is context dependent and will be further explained below. In the context of this thesis, the unit of analysis is change processes in organisations that include information technologies in some regard. As such, the change processes are planned and actively pursued by people, whether these individuals are current members of the organisation or brought in from outside. Change can more generally be defined to encompass how a sociotechnical system evolves over time, regardless of human involvement and perception.

Since inertia is so intimately tied to a specified change process, it is necessary to first specify the change process to enable an analysis of which characteristics of the system it is that affect this particular process. While organisations, like most sociotechnical systems, are constantly undergoing change in one form or the other, the change processes under consideration here are processes that have demarcated starting- and end-points. Here, the starting- and end-points refer to points in time as well as to the state of the organisation in terms of what is actually being (or intended to be) changed during the process. Furthermore, it must be possible to either identify some kind of intended purpose, that is, an intended end-point for the process, or, if the process is looked at in retrospect, some account of how the process actually unfolded. Most projects in organisations, whether labelled as organisational change, development, deployment, or something different, can be considered as change processes in this regard.

The effectiveness of a change process refers to whether or not, or to what extent, the goals of the process are achieved. Some kind of formulation of an intended end-state for the change process is therefore necessary to assess its effectiveness. Such a goal could, for example, be to remove the need for printed paper in a change process where the intended end-state is a paperless office.

The efficiency of a change process refers to the resources required to reach the end-state of the process. While effectiveness can be seen as 'whether or not' or 'to what extent' the goals of a change process are achieved, the efficiency is tied to 'how' these goals are pursued, the particular design of the change process. Simple measures of efficiency are, for example, the time or money spent on activities that are intended to advance the change process. Continuing on the example of the 'paperless office' change process, simply requesting that employees print less paper and posting notices to this effect next to each printer is an activity that does not require much effort. As such, it might be efficient in relation to the effect it has. However, if the goal is to remove paper completely, it is not likely to be very effective. It will require more fundamental changes to, for example, the organisation's work processes, IT systems, use of office space, and employee habits to achieve such an ambitious goal. With no golden standard for efficiency, it is difficult to say how efficient such a change process is in its entirety other than by comparison with similar change processes attempted in the same or similar organisations. The comparison-approach is also applicable to activities that address necessary sub-goals, such as how the need for physical signatures on documents can be more efficiently removed.

A characteristic of a sociotechnical system describes its current state in some regard. In the case of organisations, the characteristics range from enumerable and easily measured characteristics, such as number of employees, IT systems, management levels, or an organisation's yearly turnover, to characteristics that are more difficult to measure and represent, such as em-

ployees' competencies, organisational culture, flexibility of IT systems, or to what extent formal descriptions of business processes correspond to actual practice. All conceivable characteristics do not necessarily contribute to inertia in a change process, and can contribute differently depending on the intended change. For example, organisational culture is a characteristic that can contribute very differently to inertia depending on the goals of a change processes. In addition, the effects of a change process can be expressed as changes to different characteristics, and, as these characteristics change in response to actions undertaken during a change process, their contribution to the inertia affecting that process can change over time as well. Characteristics such as status-quo bias, employee engagement, and employees' trust in what is communicated by managers or from a project are examples of characteristics of a social nature that can vary considerably and rapidly in response to actions or events during a change process.

The key terms of the definition, as presented above, are summarised in Table 2:

Table 2. *A summary of the key terms of the definition of inertia in sociotechnical systems and their explanation.*

Term	**Explanation**
Inertia	The impact of those characteristics of a sociotechnical system that affect the effectiveness and efficiency of a specified change process in the system.
Characteristic	The state of a sociotechnical system in some regard, for example, its current IT systems, business processes, rules and regulations, social norms, or organisational culture.
Change process	A process with a specified timeframe and goals describing the intended change. Usually organised as a project in an organisational context.
Effectiveness	The degree to which the change process achieves its intended change (e.g., the goals of a project).
Efficiency	The amount of resources required to complete the change process in relation to the (often unknown or hard to estimate) minimum required amount.

The concept of inertia in sociotechnical systems, as defined above, satisfies the first research objective of this thesis. In the subsection below, a set of handles is presented that describe how it can be applied to IT-related change processes in organisations.

7.1.2 Handles for Applying the Concept

This subsection provides handles describing how to apply the concept of sociotechnical inertia to analyse change processes in organisations, to predict potential contributors to inertia or to identify contributors in a retrospective evaluation. The proposed steps of the process are first briefly presented, from the perspective of a predictive application. This is followed by a more detailed presentation of each of the steps and their adaptation for an application in retrospect.

The process of analysing a change process to identify characteristics that will potentially contribute to the inertia affecting it can be summarised as:

Step 1: Define the change process.
Step 2: Identify intended impacts (e.g., based on project goals) of the change process.
Step 3: Interpret and express the intended impacts as changes to the organisation's characteristics.
Step 4: Identify planned or possible actions for realising the changes.
Step 5: Identify preconditions and side-effects of the actions, and express these as additional impacts and actions as necessary.
Step 6: Identify dependencies between the characteristic(s) that will be changed by an action and characteristics that will affect the efficiency or effectiveness of that action.

When going through these six steps, it is always possible to return to a previous step to add more impacts, characteristics, or actions as the need for these are discovered or realised. Though this is deemed more likely to occur in steps five and six. If the scope of the change process has grown considerably during the change process, it might also be necessary to revisit how the change process is defined (step one). An overview of the process is provided in Figure 3.

The first step is to define the change process under consideration. This can be done in brief and on an abstract or overarching level, such as 'introducing IT system X' or 'transitioning to fully digitized work processes'. Higher granularity will then be added in the subsequent steps.

The second step is to express the change process in more detail by identifying its intended impacts. For change processes managed as projects, the formulated goals of the project are likely to be a suitable starting point. Example impacts could be, for example, more efficient work processes, improved communication, and increased customer/employee satisfaction.

The third step is to interpret and express the intended impacts from step two as changes to an organisation's characteristics. Compared to how the intended impacts are formulated, expressing these as changes to characteristics relates more explicitly to how some aspect of the organisation needs to change to achieve the intended impact. For example, achieving 'more efficient work processes' can involve either a redesign of the work processes, improving the performance of IT systems supporting the work processes, redesigning the use of office space to improve collaboration and/or communication required by the work processes, or, more likely, a combination of several such changes.

To assist performing the third step, the application of a framework for categorising characteristics can be used to facilitate considering characteristics that may otherwise be overlooked. I suggest using Porras and Robertson's (1992) model of planned organisational change as inspiration for such a framework, as it provides a general categorisation of an organisation's characteristics into the categories presented below. Please note that I have substituted Porras and Robertson's use of 'arrangements' and 'factors' with the term 'characteristics' for consistency across the four categories:

- Organisational characteristics, such as organisational goals, strategies, structures, procedures, and incentive systems.
- Social characteristics, such as culture, leadership styles, forms of collaboration, informal networks and hierarchies, as well as individual traits, skills, and competencies.
- Physical characteristics, such as workplace ergonomics, office design and architecture.
- Technological characteristics, such as current technical infrastructure, level of integration and compatibility between technical systems, technical feasibility of migrating to other technologies, configurability/adaptability, and the pace of development.

To assess how characteristics will react to changes, it is important to consider how the change is performed. Changes in social characteristics can contribute to inertia in the form of user resistance if, for example, new technology is deployed during a change process without also providing the users with training in how to use the technology. Organising user training is in itself an expenditure of resources for the change process towards attaining the goal of retrained users, and thus constitutes a part of the inertia affecting the process. However, the user resistance that might be generated if the training was considered inadequate could contribute to even more inertia, requiring more resources to mitigate than a more rigorous training scheme had consumed.

The fourth step is to identify planned or possible actions for realising the changes. This shifts the perspective even more from 'what' needs to change to 'how' this change will be realised, expressed as one or several activities or actions. Continuing on the example of 'more efficient work processes', and focusing on the redesign of work processes, activities towards realising this could include, for example, surveying the current processes and organising workshops to produce proposals for new processes.

The fifth step is to identify preconditions and side-effects of the impacts and actions identified so far, and express these as additional impacts or actions. Specifically considering preconditions and side-effects can lead to discovering ways in which the scope of a change process is wider than originally estimated. For example, in addition to focusing on the redesign of work pro-

cesses to improve their efficiency, being able to implement the redesigned processes may depend on also being able to redesign IT systems used in the processes. In this case, depending on perspective, redesigned or new IT systems can be seen as either a precondition or a side-effect.

The sixth step is to identify dependencies between the characteristic(s) that will be changed by an action and characteristics that will affect the efficiency or effectiveness of that action. A fairly straightforward example of dependencies between characteristics is the interdependence between a work process, the IT systems required to perform the work described by that work process, and the competence and willingness required from the worker to successfully complete that work. There is a limit to how much either characteristic can change before requiring reciprocal changes to one or both of the other characteristics as well. Again, echoing the identification of preconditions and side-effects in step five, identifying and analysing dependencies between characteristics can lead to discovering that the scope of the change process is, or needs to be, wider than originally planned for. In addition, the intended impacts will require more resources and perhaps additional mandate to accomplish.

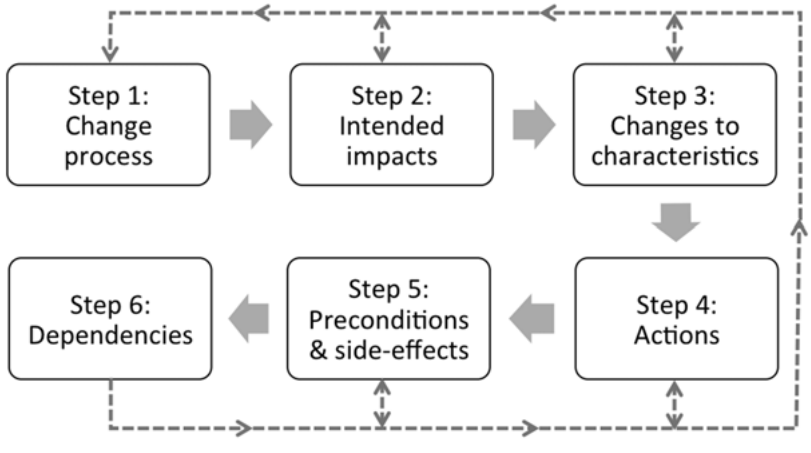

Figure 3. An overview of the proposed steps involved in the application of the concept of inertia in sociotechnical systems. The dotted line signifies the possibility of returning from a step to previous steps.

The most prominent indicator of inertia is the expenditure of resources, with the caveat that there is often no clear-cut approach to identifying what an ideal expenditure of resources would be for a certain change process or associated activity. If an organisation has undertaken several change processes that can be considered comparable, then these can be used to establish a baseline for estimating the required resources and the activities these need to be spent on. The activities can also be categorised using the same four cate-

gories as for the characteristics, and, if possible, expressed in terms of what particular characteristic(s) each action targeted. In a retrospective analysis, the change process' effectiveness can also be used as an indicator of inertia related to goals that were not met during the process. For the goals that were met, the conclusion must be that, regardless of how much inertia might have affected the pursuit of that goal, the resources spent on achieving it were clearly sufficient.

The retrospective and predictive applications involve the same steps, though rather than identifying the potential inertia affecting a planned change process the retrospective provides an analysis of the impact of undertaken actions on characteristics, and, vice versa, how actions have been affected by characteristics. The steps are not necessarily performed in the prescribed order, but rather visited and revisited iteratively depending on how information regarding the change process becomes available for analysis.

In the next section, the concept of inertia in sociotechnical systems, as defined in the previous subsection, is applied retrospectively to illustrate the presence and impact of inertia in the cases covered by the papers included in this thesis and from the action research projects more generally. This involves using the concept to perform a combination of meta-analyses of analyses already performed in the papers and more generally for analyses of cases from the action research projects.

7.2 The Research Projects through the Lens of Inertia

In this section, the concept of inertia in sociotechnical systems, as defined in the previous section, is applied retrospectively to illustrate the presence and impact of inertia in the cases covered by the papers included in this thesis and using more general insights from my participation in the action research projects. This involves using the concept to perform meta-analyses of each of the analyses already performed in Papers II, V, and VI. The first meta-analysis is based on the 'categories of variation' identified as both potential barriers and enablers for IT-related change processes in health-care, presented in Paper II. The second is a meta-analysis of the identified technological frames (Orlikowski & Gash, 1994) of respondent groups in the KiA and SISU projects, presented in Papers V and VI. Next, the two final subsections are devoted to a retrospective analysis of a change process in the DOME project (supported by Paper III), and a retrospective analysis of the KiA project itself (supported by Papers IV and V).

After the subsections covering these topics, section 7.3 provides an analysis of how a vision seminar process was applied in the SISU project and how it supported the mitigation of inertia during the preparations for the New Ladok student information system and the envisioned future of study-administrative work.

7.2.1 Inertia during the Deployment of Electronic Patient Record Systems

The health-care organisations studied in the IVAN project (Paper II) used a deployment process that was designed and managed by professionals from a central unit in charge of the training and support as well as maintenance and configuration of the Uppsala County Council's (UCC) electronic patient record (EPR) system. The process depended significantly on local involvement and commitment. Local teams were utilised to adapt the process' prescribed steps to local conditions and leverage their positions within the organisation to help facilitate change. The success of this approach varied considerably, and, through our study, we found that using the same deployment process did not result in preventing significant variation in the outcomes of the deployments. Five categories of variation were identified as affecting user adoption of EPR systems in these organisations. Actions, or lack thereof, addressing these categories were found to either enable the change process or hinder it. The categories indicate characteristics with the potential to contribute considerably to the inertia affecting the intended change process but not whether the contribution is considerable enough to prevent the proposed change. In addition, the finding that the same category can act as a barrier or as an enabler in different situations reflects the difficulty of knowing whether these categories have been sufficiently addressed.

The first two categories identified in Paper II (1–expectation, attitude and outcome, and 2–management and steering) are both indicators of characteristics categorised as social. These can contribute to inertia through humans not supporting or actively resisting the planned change, which is likely to increase the amount of resources necessary to achieve the goals of the change process, thus reducing its efficiency. Conversely, activities in the change process can lead to heightened expectations and a positive general attitude towards the intended change. This is likely to decrease the contribution to the inertia affecting the change process, through the absence of actively resisting individuals, and thus the efficiency is increased. Those who actively support the change process may further increase its efficiency by becoming a resource, for example by rallying more supporters, and in this way further reduce the contributions to inertia from social characteristics, or by engaging in activities that serve to mitigate inertia from organisational, physical, or technological characteristics. At that point, the potential barrier has not only been avoided, but it has also been turned into an enabler.

In the case regarding the implementation of an e-Referral module in the EPR system (Paper II), inertia from social characteristics was not initially estimated to be high as the attitudes of physicians were positive with regard to the new technology. However, the change in work practices following the deployment was significant, and the combination of new routines, unfamiliar technology, and a high workload rendered physicians stressed and irritable.

Poor user-adoption followed, and several instances of users circumventing the EPR system or using it in an unintended fashion were reported.

As designed, the utilised deployment process did not merely target the technological characteristics by installing the software containing the new module in the EPR system. It also aimed at addressing social and organisational characteristics, but relied heavily on successfully creating a local group of user champions who could do so. In terms of the technological characteristics, the intended change was achieved when the e-Referral module was installed, and the organisational characteristics were changed in terms of the official work processes surrounding referrals. The occurrence of circumventions could be considered a sign of the failure of the change process to achieve the intended change in terms of social characteristics, specifically training in how to use the system or manage the expectations of the physicians and the benefits of using the e-Referral module. Deficiencies in the design of the EPR system could be a contributing factor, but, even so, there were no deficiencies considerable enough to actually force the physicians to circumvent the EPR system. As such, not having successfully achieved the intended change to social characteristics meant that the prevailing social characteristics contributed to considerable inertia and in effect prompted changes to organisational characteristics in terms of the unofficial work practices (the circumventions and unintended use).

In the last three categories identified in Paper II (3–end-user involvement, 4–EPR learning, and 5–usability and the possibility of changing and improving the IT system), dependencies between technological characteristics and social characteristics are found to be potentially prominent contributors to inertia, for example, through how the usability (or lack thereof) of the different health-care systems influence the opinions of the health-care staff. This is exemplified in the case regarding the implementation of an e-Medication module. In this case, health-care staff's view of the expected outcome was to a limited extent negatively influenced by rumours from colleagues at other health-care organisations. These rumours regarded low usability in the e-Medication module, making work less efficient. The prevailing attitude among the staff at the studied site, however, was a sober notion of the e-Medication module representing a necessary step towards more efficient management of medication, and that a transition period in which the new work routines would prove inferior to the old was to be expected and accepted as part of the transition process.

In the case of the e-Medication module, the primary contribution from social characteristics to the inertia affecting the module's introduction was the preconceptions of the module as having a low level of usability, in combination with a sense of diminished control over technology. The latter was based on having received negative or no feedback on earlier requests for improvements in the current EPR system and its modules. This had also led to a lack of confidence in whether efforts were made to develop the EPR

system in accordance with the needs of health-care staff. In turn, lack of confidence constitutes a social characteristic that contributed to the inertia affecting the introduction of the e-Medication module. As such, this example touches upon both the first category identified in Paper II, managing expectations, attitudes and outcome, and the fifth category, the technology's usability and staff's ability to change it.

Included in the normative deployment process was the organising of educational sessions in the new EPR modules for end users, and this organisation relates to the fourth category identified in Paper II, EPR learning. The educational sessions focused on familiarising the staff with all of the new functionality. However, the sessions did not sufficiently support the staff in creating an understanding of how the new technology could be, or had to be, incorporated into their current routines and work processes. Despite including practice cases and assignments, learning how to perform basic functions through step-by-step instruction in a classroom setting did not translate into knowing how to use the system in clinical practice. In this sense, the educational sessions did not sufficiently contribute to mitigating inertia from the social characteristic of health-care staffs' skill in using the module to accomplish their work. In particular, the sessions failed to relate how the changes to technological characteristics–through the new EPR module–would in turn affect organisational characteristics in terms of how the use of the module would replace previous work practices. To contribute to mitigating inertia, the educational sessions would have needed to stimulate the staff to reflect on how their existing work environment would have to change to accommodate the new technology in terms of changes in routines and work processes. This issue also touches upon the third category, end-user involvement, as an opportunity (however late) for the health-care staff to reflect upon the proposed change and become active designers of that change and not only recipients. However, from the cases in Paper II, we found that users and physicians, in particular, were rarely involved at any stage of the design process. This deficiency was explained by the staff as a result of their not being asked, a belief in participation not having any effect in terms of significant improvements, or finding it hard to participate due to their heavy workload.

Common for all the cases in Paper II is that experiences from earlier introductions and changes to the EPR system had already negatively affected the nurses' and physicians' perception of change processes involving information technologies. This history meant that the health-care organisation's social characteristics would likely affect all change processes interpreted by health-care staff as involving IT by contributing to inertia, and, in addition, contributing to an extent that would pose a significant challenge for the proponents of such change processes to mitigate.

7.2.2 Inertia and Technological Frames

In two of my studies, I have applied the theory of Technological Frames as presented by Orlikowski and Gash (1994) to analyse my data. The first study regards the KiA project and is presented in Paper V. The second regards the SISU project and is presented in Paper VI. In the subsections below, I perform a meta-analysis of these studies focused on how the Technological Frames of the respondents can contribute to the identification of inertia in sociotechnical systems.

7.2.2.1 The KiA Project

In preparation for the KiA project, my colleagues and I conducted 29 interviews. The original purpose of these was to provide us with a better understanding of what roles the different parts of the university administration played in relation to IT-related change processes. One main finding was the lack of user-centred methods in the processes for development, procurement, deployment, and evaluation of new technology. Using the theory of Technological Frames as presented by Orlikowski and Gash (1994), we (the authors of Paper V) revisited interviews with those respondents who had leadership roles in relation to information and communication technology (ICT) at Uppsala University. Among the total of 29 respondents, we found 18 such leaders, representing three different leadership roles: managers, project leaders, and specialists.

The analysis of the technological frames of the three types of leaders provides a richer description of the social and organisational characteristics that I interpret as the main contributors to the inertia that affected the KiA project itself. These characteristics seemed to be mainly related to how straightforward it would be to include usability methods in the current organisational processes concerning ICT as well as the employees' abilities to both perform this redesign of the processes and to also identify and apply the appropriate usability methods.

The leaders described the university as an organisation lacking user-centred perspectives in several regards, such as the fact that new systems were sometimes developed in order to explore new technologies rather than to satisfy identified user needs. In addition, the development projects frequently limited the involvement of users to a superficial level. For change processes, these findings suggest that there is a lack of balance between the focus on changing technological characteristics of the organisation and changing the organisational, social and physical characteristics. This view is also supported by the reports of driving change being seen as tiresome and energy consuming. However, without more insight into the design of the change processes these experiences refer to, and how resources were actually allocated to mitigate inertia from the non-technological characteristics, explaining why the inertia was perceived as high remains speculative. The

findings in Paper V indicate that the university has a long history of not involving users in ways that allow them to have a significant impact on the design of new ICT. In addition, the users are subjected to deployments of new ICT in which neither the change process nor the technology is well-designed from a user perspective. With this history, high levels of user resistance may have had time to become a normal aspect of the organisational culture, and a normal part of the starting-point for each new change process. If so, this fact could be interpreted as the social characteristics related to user resistance having become more firmly embedded and demanding more resources to be mitigated during a change process.

Inertia from organisational characteristics experienced during the KiA project can also be discerned through the technological frames of the leaders. These suggest that the lack of a user-centred perspective with regard to ICT persisted despite many leaders recognising that change was needed. The leaders posit that this persistence was in part explained by an inhibiting effect of the university's governance model for ICT, and that this situation would improve, they hoped, as a result of the newly-initiated strategic change programme at the time of the study in Paper V. My interpretation of the inertia from organisational characteristics affecting the KiA project regarded how straightforward it would be to include usability methods in the current organisational processes concerning ICT. I would not hypothesise that it would be easier to include usability methods into processes governed under a more rigorous management structure. However, that the KiA project and its additional push for the inclusion of a user-centred perspective and usability methods came early in the development of the strategic change programme is likely to have contributed to the impact of the project. In the organisation prior to the strategic change programme and the KiA project the lack of governance regarding the processes related to ICT would most likely have been one of the main contributors to the inertia from organisational characteristics affecting the establishment of a user-centred perspective. Today, after the strategic change programme, it is likely that this situation has changed and that the main contributor is now the very governance structure that was introduced by the strategic change programme.

7.2.2.2 The SISU Project

Using the theory of Technological Frames by Orlikowski and Gash (1994) to analyse the envisioned futures that were elicited through the vision seminar process in the SISU project, we (the authors of Paper VI) were able to discern how the technological frames of students differed from those of university employees. In common with our application of technological frames in Paper V, the unit of analysis was groups of individuals rather than change processes. Interpreting the technological frames of the different groups using my definition of inertia provides a meta-analysis of what these groups perceived as possible to change within the relatively near future.

During our application of the vision seminar process in the SISU project, four groups consisting of six participants each were engaged in envisioning the future of study administrative work at Uppsala University. As with the SISU project itself, this initiative was prompted by the imminent new student information system, 'New Ladok', but had a wider scope that encompassed study-administrative work as a whole. The four groups that were involved in the vision seminar process consisted of one group of students, one of study-administrators, one of teachers, and the last group of a mix of senior staff with experience serving as, for example, head of studies, programme coordinator, or student advisor. The groups were engaged separately in four workshops each, during which their respective visions of the future were developed iteratively, before meeting together in a joint fifth workshop to discuss their results and whether these could be merged into one shared vision of the future. For more details on the method and execution, I refer the interested reader to Papers VI and VII.

The results of the three groups of employees were complementary in nature, as were parts of the results of the student group. However, where the employee groups had their respective roles and responsibilities to guide their focus within the general concept of study-administration, the student group had a more difficult time finding a clear distinction between study-administrative tasks and other aspects of student life in general. The students agreed with the employees on, for example, the need for better systems that would make it easy to follow the status of study-administrative processes, and the employees agreed with the students on, for example, the need for study-administrative processes to be less varied across university departments, in order to make it easier for students with their studies spread across the university. The students, however, also envisioned a university that provided a wider array of support for life as a student, such as managing student housing and supporting students with visa applications, career advice, and finding jobs towards the end of their education. In the students' vision, the New Ladok system would enable them to go on virtual tours of the university's campuses, notify them of where their next class was held and, if necessary, assist them in finding their way there. It would also provide a communications platform for interacting with classmates and faculty in multiple contexts, and notifications of a range of events related to student life.

In the technological frame of the students, technology and life are intimately connected and intertwined. In the technological frame shared by the employees, technology represents the tools enabling them to do their jobs. During the workshops, all four groups received the instruction that the future they were aiming for was four years from the present. However, in terms of the change processes required to realise these futures, the one envisioned by the employees and the one envisioned by the students were different in scope. The employees' future was centred on enabling them to improve their work through, for example, increased flexibility and higher quality. These

goals for change could primarily be characterised as changes in the organisational and technological characteristics of the organisation, with an emphasis on altering the current organisation of work and the ICT's support of that work. The students' future was centred on increasing the support students received from the university. In terms of goals for change, this can also be characterised as changes primarily to the organisational and technological characteristics of the organisation. In addition, however, beyond the current work processes and the ICT, the increased support also encompassed extending the responsibilities of the university, for example, to managing student housing issues and visa applications.

Neither future suggested science fiction technology-wise: the students and employees both envisioned futures that were possible to create using technologies already available. However, the realisation of the visions also depended on being able to manage these changes, to technological as well as non-technological characteristics, while minimising disruptions to the organisation during the change process. The New Ladok system, as envisioned by both students and employees combined, constitutes a list of features that extends the current scope of the New Ladok development project and goes beyond what can be considered a student information system. At the time of this writing, the system is in the process of being deployed at Swedish universities, with the development project running into its eighth year since its initiation in 2010. The development of the system continues in parallel, however, to accommodate the needs of the larger universities that are, therefore, the last to receive the New Ladok system. As one of the largest, Uppsala University is scheduled for 2018. Given this record of time already invested, it seems unlikely that a significant extension of the New Ladok system would be possible to realise within four years. It would be possible to write the necessary program code, surely, but when considering the time needed to be spent on decision-making processes and/or lobbying and negotiating between the 37 member universities and agencies of the Ladok consortium, such an extension appears unrealistic. As a potential for inertia regarding change processes at Uppsala University, the consortium constitutes an interesting case. If the consortium's members were to agree that the changes required to realise the future envisioned by the Uppsala University employees and students constituted a desired next step for the development of the New Ladok system, then there would be no added contribution from, for example, resources spent on lobbying the other consortium members to the inertia affecting the change process at Uppsala University. On the other hand, since the Ladok consortium is democratically organised, if Uppsala University would need to negotiate with many other consortium members in order to turn the development of the New Ladok system into alignment with the university's change process, the resources required to do this are likely to exceed what is feasible. Depending on the impact of New Ladok in relation to the goals of Uppsala University's change process, this could mean that the

effectiveness of the change process goes down. If resources are nonetheless spent on what turns out to be an unsuccessful endeavour, lobbying again being a good example, this will also have a negative impact on efficiency.

7.2.3 Inertia during the Deployment of e-Health Services

In Paper III, the focus of the study was on the customer-vendor process and the development of the e-Health service that provided patients in Uppsala County with access to their electronic health records via the Internet. Of considerable interest in addition to this was the relationship between the Uppsala County Council (UCC), as the organisation in charge of the change process, and union representatives of health-care staff within Uppsala County. To illustrate the inertia affecting the change process of deploying the e-Health service, and the difference in inertia depending on the goals of the change process, this subsection concerns the context in which the study presented in Paper III was performed.

As the coordinating member of the SUSTAINS project, funded by the European Commission, UCC initiated the project that encompassed the development and deployment of an e-Health service that would enable patients treated at any of Uppsala County's public health-care institutions to access their electronic health records via the Internet. The e-Health service went online in November 2012, but the development of the service continued, and new features, bug-fixes, and modifications were continuously deployed every three weeks.

Previously, a patient who wanted to see his or her medical records was required to submit a written request for a printed copy. This request was sent to an administrative unit where the patient's records could first be reviewed and censored, removing any parts considered potentially detrimental to the patient's health if revealed to the patient. In practice, this measure was considered necessary only occasionally, with the exception of records from a few departments in particular (e.g., child and youth psychology, women's clinics, and clinical genetics) where the physician in charge of the patient would routinely be consulted. Data from the excepted departments were not available through the e-Health service. Data from other departments, however, were copied directly from the database of the electronic patient record (EPR) system used by health-care staff to document their work. Upon logging in, a patient would be able to see entries older than 14 days, allowing health-care staff sufficient time to first deliver any news to the patient face-to-face or over the phone. The service was later updated to allow patients to deactivate the delay and immediately read all new records. Even with the 14 day delay, however, the service entailed a considerably improved level of accessibility. The added possibility of patients' reading news of their health directly from their health records before being contacted by health-care staff became one of several significant causes for concern among health-care staff

within the county. Some believed that for patients to read their own records was detrimental to their health. There was health-care staff who regarded this new e-Health service as a step in the right direction, but those who opposed the service were in the majority.

UCC's project was politically supported from the international level of the European Commission through the SUSTAINS project, the goals of which were supported nationally in Sweden and on the local level of Uppsala County. One of the ambitious goals was that the e-Health service would enable a change in the health-care staff's work practices towards using the electronic health record as a communicative tool not only between themselves but also between staff and patients. But the concerns and fears of the health-care staff constituted social characteristics that contributed considerably to inertia that affected the goal of changing the behaviour of health-care staff. On the other hand, the more technology-focused goal of providing patients with access to their electronic health records via the Internet was not as affected by this inertia.

An activity that did affect UCC's project to deploy the e-Health service was that appeals for investigations into the project were submitted to what the project manager described as 'every national regulatory agency except Swedish Customs', and that as a result of this the project became the most thoroughly investigated he had ever heard of. This was presumably done by individuals suspecting that the investigations would uncover wrongdoing on behalf of the project and/or that the authorities would conclude that the service constituted a threat to patient safety, to the health-care staffs' work environment, or find other grounds for halting the project. Attending hearings and responding to requests from the authorities on account of the investigations did divert resources from the project, and some of these required that the deployment of specific functionality was postponed pending the outcome. One example of such functionality was the ability for patients to add comments to entries in the patient record, comments that health-care staff could then potentially read with the patient's consent, because the project's interpretation of the legal status of such comments was challenged. Ultimately, however, no grounds for halting the deployment of the e-Health service resulted from the investigations.

The concerns of health-care staff can be considered to have had a very limited impact on the goal of deploying the e-Health service, despite the additional effort required to attend to the investigations, when compared to the goal of changing the behaviour of health-care staff and the relationship between health-care staff and patients. The impact could have been very different if the union representatives of Uppsala County's health-care staff had been more involved in UCC's project, as these shared the concerns of health-care staff more generally. As it were, however, the union representatives were not part of the project and maintain that they were never properly invited, while representatives of the project maintain that they were. In any

case, the concerns were instead spread widely through national media coverage. Many of the raised concerns could not be substantiated, however, for example due to this being the first service of its kind in Sweden, and the lack of knowledge and experience of previous deployments of this type. Because of this situation, the concerns were not seen as sufficiently well-founded to re-evaluate UCC's decision to deploy the service. As mentioned above, however, some concerns became the subject of regulatory agency inquiries into the project and therefore delayed.

Since the majority of health-care staff were concerned about the introduction of the e-Health service and the negative effects it could have on patients as well as on their own work environment, very few asked their patients if they knew about or used the service or intentionally informed them that it existed. However, the news coverage and media reports not only made the general public aware of the concerns of health-care staff, it also advertised the existence of the e-Health service, thereby contributing to its adoption by patients and citizens in Uppsala County.

If the change process under consideration is defined as only deploying the e-Health service with the purpose of enabling patients to access their electronic health records, then the inertia from social characteristics can be interpreted as relatively low. It would primarily be contributed by the social characteristics that led to health-care staff not informing patients about its existence and to requesting inquiries that ultimately delayed some of the service's functionality. However, since improved patient empowerment was one of the goals of the service, the desired change can also be considered to include changing the behaviour of health-care staff to actively use the service as a tool for improved communication with the patient. Including this fact in the scope of the change process means that the concerns and resulting behaviour of health-care staff constitute social characteristics that contributed considerably to inertia and a resulting low effectiveness in reaching that particular goal.

The social characteristics in the local health-care community are still such that they contribute to considerable inertia against the goal of incorporating the service as a tool for the benefit of both staff and patients, even though the e-Health service has been deployed and its use increased steadily over subsequent years. By 2017, all other Swedish counties and regions have deployed or are in the latter stages of deploying similar services and approximately one million users have logged into these nationally. For UCC, the manner in which the relationship with union representatives of health-care staff was managed is likely to be remembered by the health-care community, with the risk of negatively affecting similar change initiatives in the future. The main lesson to be learned from Uppsala to mitigate inertia from social characteristics is to maintain a more collaborative relationship between change projects and health-care representatives. On the other hand, when the Skåne region deployed a similar service in March of 2014, such a relation-

ship appears to have contributed to a comparable reduction of provided functionality at the time of its deployment. If this is indeed a concession to concerns presented by the Skåne health-care community, then it can be described as inertia from social characteristics having had a more direct influence on the change project than that in Uppsala. However, the Uppsala and Skåne cases are also different in other regards, and it could be that inertia from technological characteristics had a more decisive impact on what functionality was provided than the impact of the social characteristics. The technological characteristics could, for example, be related to the challenge of integrating Skåne's existing IT infrastructure with the e-Health service. Considering the definition of inertia as dependent on a specific change process, the interpretation of inertia is also contingent on the use of the Uppsala service's functionality as the norm. If a goal of the change process in Skåne was to accommodate the concerns of the health-care staff, then their influence cannot be considered as a contributor to inertia in need of mitigation. Though still contributing to inertia because of the effort involved, for example to organise meetings with health-care staff along with other stakeholders, it can be considered a necessary part of the change process that contributes to its effectiveness.

7.2.4 Inertia when Establishing Usability Work

The KiA project (Papers IV and V) was designed to contribute to improving the Uppsala University administration's processes for development, procurement, deployment, and evaluation of administrative information technology. Using the concept of inertia in sociotechnical systems, the presence of inertia can be identified for the action research project itself. As it is presented in Paper IV, the ambitious goal of improving the university's processes for development, procurement, deployment, and evaluation of administrative information technology was in practice operationalised into 'establishing usability work' at the university administration. This entailed educating nearly 200 of the IT professionals working at the university as well as organising seminars and workshops on the topic of usability. These were the main activities pursued during the first year of the KiA project. Corresponding to the project goals, the activities served to promote usability work as a way of improving the quality of developed or procured technical systems, in particular with regard to how well these systems enabled and supported high quality work. Improving the participants understanding of the relationship between the usability of a technical system and the work this system intended to support was seen as one of the ways in which the focus on usability also served to improve the deployment and evaluation processes.

The usability-promoting activities were well received and appreciated by those who attended. However, a sign of inertia appeared in comments regarding the lack of clear instructions for how to actually incorporate usabil-

ity activities into the current practices of development, procurement, deployment, and evaluation. Indeed, discovering the lack of such activities during the preliminary stages of the project provided the motivation for its continuation, but the experienced need from the project members to first provide a general introduction to usability work was difficult to combine with tailored support to the different process areas. This example of inertia affecting the change process attempted by the KiA project can be interpreted as contributed by a combination of social and organisational characteristics. The social characteristic regards the knowledge of the participants and how well the usability activities enabled them to incorporate usability methods in their work. The organisational characteristic concerns how well-suited the current work processes are to the introduction of usability methods, for example, if it only involved adding a step somewhere in the current process or if the entire process had to be reworked.

As a change process, the KiA project suffered from what was identified by the participating researchers as a lack of recipients. In this context, the role of such a recipient would be to become the curator of knowledge regarding usability and to be the champion of its incorporation into local routines and work practices. Essentially this would be a kind of usability champion. Explaining this lack of recipients in terms of inertia, my interpretation is that organisational characteristics made it hard to incorporate the role of usability champion into the administration's organisational model. This shortcoming was likely combined with inertia from social characteristics because most employees would probably still be uneasy at the thought of being assigned such new and unfamiliar responsibilities, given that they had just recently started learning about usability. While such a substantial impact as the establishment of a user champion role in the organisation was not achieved during the project, the general understanding of usability issues was improved within the university administration, and steps have since been taken towards establishing a competency centre for issues related to usability, as concluded in Paper IV. In addition, one clearly discernible outcome of the KiA project in terms of having an impact on the organisation was that a section on usability, paraphrasing documents provided by the project, was included in the university's 'action plan for information technology'.

The effectiveness of the KiA project as a change process, with effectiveness denoting whether or not the goals of the KiA project were achieved, can arguably be considered to be high. The goal of 'having a positive impact on …' reduces the evaluation of this goal to an indication of whether or not there was a positive impact. The extent to which the KiA project had a positive impact on the processes for development, procurement, deployment, and evaluation of administrative information technology within Uppsala University has not been evaluated per process. As was intended, however, the focus on promoting usability work was considered a successful approach towards improving the university's processes by both the researchers and the pro-

ject's members and contacts within the administration. Concerning the formulation of the KiA project's goal, evaluating the efficiency of the KiA project becomes problematic. With the goal essentially amounting to a direction without also specifying a distance, it can be interpreted as 'get as far as you can in this direction given the resources at your disposal'. However, as mentioned earlier in this subsection, the inertia affecting the efficiency of the KiA project can be interpreted as mainly contributed by social and organisational characteristics of the university. These characteristics seemed to be mainly related to (1) how straightforward it would be to include usability methods in the current processes as well as (2) the employees' abilities to both perform this redesign of the processes and also identify and apply the appropriate usability methods. As I have no similar change process to compare KiA's with, it is hard to benchmark the efficiency of the KiA project. However, that the work on incorporating usability work into the university's processes continued after the conclusion of the KiA project, as evidenced by the establishment of the competency centre, can be interpreted as indicating that the KiA project was efficient enough to succeed in making itself superfluous.

7.3 Using a Vision Seminar Process to Mitigate Inertia

The vision seminar process can contribute towards mitigating inertia during change processes related to IT in organisations, and the evaluation of the vision seminar process applied in the SISU project (Paper VII) provides insight as to how. In this section, I present relevant results from Paper VII and use my concept of inertia in sociotechnical systems to analyse impacts of the introduction of New Ladok and how the application of the vision seminar process is likely to have assisted in mitigating inertia in the New Ladok change process.

The results of Paper VII suggest that the main contribution of the vision seminar process towards mitigating inertia in a change process is by creating 1) awareness and 2) engagement in the organisation. These two contributions of the vision seminar process are further explained below:

The **awareness** in question is with regards to the present state of the organisation and the effort required to move to the future state described in the vision. The people who participated in the vision seminar process, or who read and listened to the presentations of the resulting vision, improved their understanding of the gap between their present situation and the future described in the vision.

In the vision seminar process defined by Hardenborg and colleagues (Hardenborg, N., 2007; Hardenborg, N., Kavathatzopoulos, I., Sandblad, B., 2007; Olsson, E., Johansson, N., Gulliksen, J., et al, 2007) the focus is not on identifying the effort required – the resulting vision is centred on what needs

to change rather than how. The 'how' is indirectly addressed, however, by the techniques that aim to keep the vision realistic, such as instructing participants to strive for a realistic future within only a handful of years, defining a scope for the vision (such as study-administration), and identifying constraints that the vision must take into consideration (such as the New Ladok system being a central tool). The outcome in the SISU project is not that the vision became realistic enough to be realised within four years, as was the instructed aim, but rather realistic enough for stakeholders and employees in general to be able to engage with the vision and feel involved in its realisation. This **engagement** includes being able to:

> (1) recognise the improvements compared to the current situation, including whether ongoing change processes move the organisation towards the vision or not, and
> (2) for managers and leaders to apply their professional judgment and experience towards realising the parts of the vision touching upon their area of expertise and responsibility.

The former (1) is supported by the results of Paper VII, where one of the interviewed participants suggested that this was an outcome of the vision seminar process based on his/her experience. Examples of the latter (2) were also observed in the SISU project. One example was when the assistant project manager of the local New Ladok deployment project used her expertise to elicit specific requirements per technical system from the vision. These were subsequently forwarded to the appropriate administrative division or unit within the university. Another result from the evaluation of the vision seminar process (Paper VII) which supports that it is useful for mitigating inertia is that the participants experienced that participating in preparatory activities such as the vision seminar process was beneficial even if the vision would turn out to have little or no effect on the design of New Ladok. Their rationale behind this is the experience that the act of reflecting on one's own professional role and tasks assist the participants in preparing themselves for, and coping with, a new way of working when New Ladok is introduced.

For Uppsala University, the change process in focus is that of bringing study-administrative work from its current state to the desired future state described in the vision. In an ideal scenario, the change process encompassing the introduction of New Ladok would fit perfectly as a constituent part of the change process for achieving the vision. Looking at the role of New Ladok in the university's change process, (1) *the system itself* constitutes a change of the university's technological characteristics. In addition, (2) *how the system is managed* through the university's relationship with the Ladok consortium and development project constitutes a change to the university's organisational characteristics. And then there is (3) *the particulars of the change process*—when New Ladok is in place it will have affected (during

the preparations for its deployment), and continue to affect (during the subsequent use of the system) the university in, for example, these ways:

- The university's **organisational characteristics** will change in response to how the design of New Ladok affects the study-administrative processes. Besides process design, another outcome could be that organisational roles, and the responsibilities assigned to these, are modified to either take advantage of new possibilities provided by New Ladok, or to accommodate limitations in its design.
- The university's **social characteristics** will change. One such example would be through the users' learning how to use New Ladok to perform tasks that were previously performed through other means, such as faculty signing and checking the correctness of lists of results digitally. It is also likely to affect other social characteristics such as different user groups' perception of, and attitude towards, study administrative tasks more generally.
- For **physical characteristics**, the potential for completely digital work processes, without, for example, requirements for handwritten signatures on official documents, removes some constraints on where study-administrative tasks can be performed. Teachers as well as administrators become less tied to their respective offices during times when it would otherwise be problematic to work from home or travel, such as when students' grades are to be finalised. Less reliance on paper as such would also contribute to facilitating more creative use of office space, such as envisioned by, for example, proponents of activity-based workspaces.
- The university's **technological characteristics** will change as New Ladok and the other technical systems related to study-administration are integrated with each other or otherwise adapted to the new configuration of the technical systems and redesigned work processes.
- **In addition**, instead of learning how to use New Ladok as intended some users may resort to finding or inventing workarounds. These can primarily be considered as changes in the technological, organisational, and perhaps also physical characteristics that constitute the particulars of how a workaround is executed. However, a subsequent effect can be expected on social characteristics when knowledge of the existence of workarounds spread and may for example become a seed for a perception of the system as broken or insufficient among the users.

To successfully mitigate inertia, the vision seminar process must affect the effectiveness and/or the efficiency of the change process under consideration. So when looking at the introduction of New Ladok as the change pro-

cess, with the expected effects outlined above, the impact of the vision seminar process can also be expressed as changes to the university's characteristics. Deconstructed using the four categories, presented in section 7.1.2, the activities related to the vision seminar process is likely to change or have changed the university's characteristics in the following ways:

- **The organisational characteristics,** by pushing for the reduction of unnecessary diversity in study-administrative processes and by creating a greater awareness of which processes exist at each department and how these are designed. The increased awareness and streamlined processes would contribute to reducing the effort involved when each department prepares for New Ladok by investigating its impact on the local study-administrative processes.
- **The social characteristics,** by creating engagement in preparing for New Ladok early, before the particulars of New Ladok's design are known, the vision seminar process can contribute to reducing workload peaks during the time-period immediately surrounding New Ladok being taken into use. With regards to learning how to use New Ladok, an increased awareness of the study-administrative processes is likely to improve the employees' abilities to make sense of the role of New Ladok in the processes.
- **The physical characteristics,** where one possible outcome of reviewing the study-administrative processes is the realisation that some processes would become more efficient if some roles were co-located, as this would enable easier communication and faster resolution of issues.
- **The technological characteristics,** by raised awareness of the expected impact of New Ladok and other technologies that support study-administrative work. For example, in the evaluation of the vision seminar process (Paper VII) one of the participants related having stopped an initiative to develop or procure a new technical system because s/he now expected the desired functionality to be provided by New Ladok.

What this means for the introduction of New Ladok is that the awareness and engagement raised through the vision seminar process and its associated activities will reduce the effort necessary to replace the old Ladok system with New Ladok. The available resources can instead more efficiently be devoted to taking advantage of the benefits New Ladok has to offer and reducing the impact of any flaws or drawbacks compared to the old Ladok.

8 Discussion

In this chapter I discuss how the three research objectives have been addressed in this thesis, I discuss the impact and significance of the work, and, finally, I discuss my concept of inertia in sociotechnical systems in relation to other concepts of relevance.

8.1 On the Research Objectives of this Thesis

The first research objective of this thesis was to define inertia in sociotechnical systems. A common general definition of inertia is 'a tendency to do nothing or remain unchanged' (Oxford Dictionary of English, 2017). There is, however, a lack of previous definitions of inertia that go beyond this colloquial use of the term in relation to sociotechnical systems or organisational change processes. The focus on sociotechnical systems and organisational change processes, though still a wide scope, has enabled me to formulate a definition that is precise and applicable in this context. As such, I have successfully satisfied the first research objective of this thesis. In my review of previous uses of inertia and related concepts in research, I have found relevant contributions to the understanding of IT-related change processes. Together with my studies and experiences from the action research projects I have participated in, this previous research has provided relevant input to my work on the definition presented in this thesis. However, I frequently discover new and interesting research that will be of benefit to subsequent iterations of the concept of inertia in sociotechnical systems.

The second research objective of this thesis was to explore how the concept of inertia in sociotechnical systems can be used to explain effects observed in IT-related change processes. I have done this through a retrospective application of the concept on example cases from the action research projects I have performed my studies within, including using the concept for meta-analyses of the categories of variation presented in Paper II and of the Technological Frames (Orlikowski & Gash, 1994) presented in Papers IV and V, as well as using the concept to analyse the role of a vision seminar process in mitigating inertia. My analyses have been limited by the information I have had access to through my data collection for the included studies and my participation in the research projects more generally. An additional limitation is that none of the studies was originally designed to test my

concept. Such a study would be required for a more exhaustive analysis that would enable forming comprehensive hypotheses regarding the complexities of a studied IT-related change process.

The third research objective of this thesis was to investigate whether vision seminars are a way to mitigate unwanted effects of inertia in sociotechnical systems on IT-related change processes. Considering that the New Ladok student information system has yet to be introduced at Uppsala University at the time of this writing, in July 2017, the results of this investigation can be regarded as a set of hypotheses that are yet to be tested. In relation to established success factors for change processes (e.g., Ziemba & Obłąk, 2015), several of these are targeted by the vision seminar process. For example, one success factor is having a vision that includes clearly defined needs for change, which was indeed the main objective and output of the vision seminar process. This vision was subsequently used as a tool when advocating for active and explicit top management support, another success factor, and when communicating and creating engagement across the university, yet another. As such, the research on success factors supports that the vision and associated activities will improve the likelihood of a successful introduction of New Ladok, and by extension the introduction of the new study-administrative work described in the vision. Expressed in the terminology of my concept, targeting these success factors will have the effect of increasing the effectiveness and/or efficiency of the change process under consideration, both of which are effects that mitigate inertia.

8.2 On the Impact and Significance of this Thesis

This thesis increases the understanding of IT-related change processes in organisations enabled by my definition of inertia in sociotechnical systems. This concept highlights the complex relationship between the design and development of technical systems, the inclusion of user-centred or participatory approaches, and organisational change processes. In my research I have found that there is a gap here that warrants further attention in the HCI community. In particular, there is a need for knowledge on the use of vision seminars and other such methods that take a wider approach to design than merely the development of one technical system at a time. The popular agile development framework Scrum already has a vision concept in place that could be interpreted as intended to address this, to take the wider context of a development project into account, but sadly it seems not to satisfy this purpose in practice (Lárusdóttir, Cajander, & Gulliksen, 2012). In addition to knowledge on the use and value of current methods, there is a need for new or improved methods that take the sociotechnical context of systems design into account and bridges the gap between organisational change and systems

design. Through the concept of inertia in sociotechnical systems, this thesis provides one technique for a sociotechnical analysis of this context.

My definition of inertia in sociotechnical systems, with the suggested handles for its application and examples of its impact and dynamics covered in this thesis, provide researchers and practitioners with basic guidance towards its application. However, the characteristics that contribute the most to inertia are likely to vary between organisations and from one change process to another. Though this makes things more difficult, it is still possible to identify trends based on historical change processes or similarities between organisations. Nonetheless, given the track record for change projects involving information technologies in organisations, learning from history is either not enough or a lesson still waiting to be learned. The necessary steps of identifying contributors, analysing their impact, and performing an assessment of how resources are most efficiently spent to successfully mitigate unwanted inertia will require a combination of local knowledge and experience to be done appropriately. As such, it is likely that assessing or identifying inertia in advance, as an initial activity in an organisational change project, will rely heavily on the skills and experiences of the person or group of people participating in this activity, similar to risk identification and assessment techniques (Engwall, Kling, & Werr, 2005). This potential limitation notwithstanding, I am confident that the concept of inertia in sociotechnical systems can be useful in this context.

Today, many Swedish workers rely completely on technical systems to be able to perform their jobs. However, in a survey of Swedish white-collar workers, only 36 % felt that the introduction of new technologies was implemented with clearly defined and expressed goals in mind (Unionen, 2015). This thesis shows that the use of vision seminar methods can improve this situation in many organisations. In addition, the results can help to improve the situation reported by the workers' union Vision, where 38 % of their approximately 1,400 surveyed members felt that they lacked the knowledge necessary to use their technical systems efficiently and another 38 % felt that the technical systems did not contribute to alleviating stress or preventing disturbances in their work (Vision, 2014). The use of the concept of inertia in sociotechnical systems can assist in analysing the complexities of IT-related change processes aimed at realising the output of a vision seminar process, which can be used as input when striving for an improved alignment between technical systems and the work these systems are intended to support.

8.3 On Inertia in Sociotechnical Systems in Relation to Other Concepts

In these subsections I discuss my definition of inertia in sociotechnical systems in relation to the use of inertia and similar concepts presented in chapter six, and their contributions to the development of my concept.

As mentioned in the introductory chapter of this thesis, apart from being a physics concept, inertia is colloquially established as a general tendency to remain unchanged or be difficult to change, and is often applied as a characteristic of organisations and institutions (e.g., Alter, 2001; Besson & Rowe, 2012; Walker, 2000) or social groups (Keen, 1981). However, its use in research studies is rarely accompanied by a closer definition, neither as an organisational concept nor as a physics metaphor.

8.3.1 Inertia as a Physics Principle

An engineer by training, when first attempting to develop inertia as a concept I started by trying to keep it as close to the physics principle as possible. I believed that this could lead to a clear and concise definition. But, I was soon discouraged. Even though the principle of inertia and Newton's laws nicely approximate the dynamics of objects interacting in the physical world, it is not easily transferrable to the context of sociotechnical systems and IT-related change processes in organisations.

One of the challenges of transferring the principle of inertia from physics to sociotechnical systems is that while Newton's laws apply to closed systems, sociotechnical systems are open systems. The distinction between them is that a closed system is completely isolated from its environment and has no interaction with it, while the presence of such interactions is what makes an open system open. For example, when modelling an organisation as a sociotechnical system, it is not a problem to consider that there are interactions between the organisation and the environment, for example, other organisations. For a closed system such interactions must not exist, or at least be identified and included as known variables, otherwise the laws governing the system (such as Newton's laws) will not hold.

Another challenge is the question of how to define the mass of a sociotechnical system. Since the principle of inertia in physics is intimately related to the mass of a physical object, finding a definition and method of measuring the equivalent of mass for a sociotechnical system would perhaps provide the most intuitive translation of the principle of inertia to the context of sociotechnical systems. However, I have not been able to find a fully satisfactory definition. Instead, my concept of inertia in sociotechnical systems includes the identification of relevant characteristics that can vary between contexts and application. This can be seen as a limitation through its depend-

ence on the people involved in the analysis of inertia, but also as a strength as the application, for the same reason, becomes context aware.

8.3.2 Inertia in Organisational and Societal-level Sociotechnical Studies

When looking for sources of inertia and how these affect change processes in an organisation, a wide range of factors within the organisation and in its environment emerge as potential contributors to inertia. Besson and Rowe (2012) describe inertia in organisations as intimately tied to the very act of organising, that it is the entrenchment of routines and patterns resulting from organising activities that is the source of inertia. This phenomenon also occurs on a societal level, where striving for dependability results in networks of dependencies that provide stability between and within organisations and institutions, as described by Geels (2005).

This previous research provide two insights for my definition of inertia: firstly, inertia is affected by how the routines and patterns are designed, and secondly, by the dependencies between routines and patterns and other parts of the sociotechnical system. Of course, 'routines and patterns' must be interpreted in a general sense to cover not only organisational routines and patterns such as work processes, but also social, physical, and technological 'routines and patterns' such as norms, values, habits, office arrangements, and technical infrastructure. If all dependencies were equally difficult to undo, it would follow that a higher number of dependencies would guarantee increased stability. While this is not strictly the case when applied to dependencies within a sociotechnical system, it can at least be said that the *potential* for inertia increases with the number of dependencies. In organisations, how these dependencies contribute to inertia in a change process is observable through the permanence of, for example, formal and informal hierarchies, routines and procedures, and technical infrastructure, as well as factors such as people's norms and values, fears and beliefs, agendas, and vested interests (Besson & Rowe, 2012).

Because any part of a sociotechnical system can potentially contribute to inertia, and dependencies can potentially exist between any parts of a sociotechnical system, inertia can be considered a result of the current state of the sociotechnical system in its entirety. The range of possible states for an organisation as a sociotechnical system covers every conceivable combination of technologies and the way they are configured and utilised, of the people employed and their positions within the organisation, of the organisational arrangements such as hierarchies, roles, processes and routines, and also includes the physical arrangement of the organisation. As the sociotechnical system and its surrounding environment changes over time, the inertia affecting change processes in the system changes as well. David's (1985)

account of lock-in effects is one example of how forces outside of an organisation are a complicating factor since the system's potential contribution to inertia is in part a response to societal changes, such as the invention of new technologies, the availability of appropriately skilled labour, changing laws and regulations, and the evolution of social conventions or religious views. Owing to this dependence on time and the state of the sociotechnical system, different change processes aiming for the same desired state will encounter different levels of inertia, depending on the path taken, and over which period in time. While path dependence in the sense discussed by Burns and Scapens (2000) relates to the perception of choice in an organisation, the actual impact of inertia on a change process can be expressed in terms of the effort and resources required to guide the sociotechnical system from its current state to a future desired state.

8.3.3 Social Inertia and Resistance to Change

Bardach's (1977) counter-implementation strategies, though centred on the influence of managers, or actors in otherwise influential positions, can be described as forms of resistance to change and as expressions of social inertia. As a social phenomenon, social inertia is closely related to the concept of status quo bias in organisations (e.g., Kim & Kankanhalli, 2009; Samuelson & Zeckhauser, 1988) and which, judging by the collection of success factors for information systems implementations identified, for example, by Ziemba and Obłąk (2015), remains a considerable challenge for change managers to overcome. The concept of social inertia itself, which is not properly defined by Keen (1981), can more generally be interpreted as a characteristic of the social structure in an organisation which determines how much this structure contributes to increasing the effort required to change the organisation in some way. In this general sense, social inertia has contributed to my comparatively wide definition of inertia in the context of sociotechnical systems as a special case and example of its social aspect.

8.3.4 Windows of Opportunity in Policy Studies

As an illustration of the time-dependence of change processes, Kingdon's (2003) concept of policy windows provides an important addition as a dynamic of inertia on a governmental level. For sociotechnical systems in general, windows of opportunities as a concept highlights the practical impossibility of initiating a change process that guides the system from its current state to every other state at any given time. On the other hand, from a sociotechnical perspective, the process of manipulating the three streams defined by Kingdon to create favourable conditions for implementing policy changes can be regarded as a process of changing the system. Nonetheless, another contribution to my perception of inertia in the context of sociotechnical sys-

tems lies in Kingdon's distinction between preparing for policy change by manipulating the three streams, and actually implementing policy change when a policy window has been opened. Though a desired change process might seem to face insurmountable inertia, it might be possible to create more favourable conditions for it. However, once a change process is initiated, sustaining the window of opportunity for as long as required to reach the end of the process is another potentially considerable challenge.

The state of a sociotechnical system changes over time, observable as changes to its characteristics. It does so in response to changes in the system's environment and as a result of ongoing change processes within the system. These change processes can be planned and deliberate such as in the form of projects, or comparatively unplanned and ongoing such as changes in organisational culture or the rate of personnel turnover. Different change processes aiming for the same desired state may encounter different levels of inertia depending on the path taken, and the period in time involved. Kingdon's (2003) theory of policy windows suggests that it is not practically possible to initiate a change process that guides the system from its current state to every other state at any given time. However, it also posits that, while a desired change process can be prevented at a certain point in time by insurmountable inertia, it is not necessarily impossible to create more favourable conditions for the process. The subsequent problem, since it is not uncommon for projects involving the deployment of information technologies in organisations to span over one or several years, is to keep the window of opportunity open for such an extended period of time.

8.3.5 Inertia in relation to Critical Success Factors

Based on Porras and Robertson's (1992) four categories, the twelve critical success factors for information systems projects identified by Ziemba and Obłąk (2015) can be interpreted as primarily targeting organisational and social issues. Even so, and although specifically identified as success factors for the introduction of information systems, the role technology plays in determining how and what is possible to change is left unmentioned. On the other hand, the common theme of these success factors is that they all contribute to making sure that the entire organisation is as knowledgeable and engaged as possible regarding the particulars of a planned or ongoing change, and contributing towards achieving that change. This approach will indeed decrease inertia towards the intended change from an organisational and social standpoint, but the project can still face considerable inertia unless it has comparable influence over the technological and physical factors that may be involved in the change. One example of such a situation is described in a study by Boudreau and Robey (2005) in which employees were quite enthusiastic about the introduction of a new computerised system to replace previously paper-based processes, only to find that the cumbersome design

of the system meant their tasks now took longer to perform. This fact is also an example of the uncertainty involved in the introduction of new technology, especially if the technology is not only new to the organisation but also in need of further development. In a review by Whitney and Daniels (2013) of causes underlying IT project failures, the underestimation of technological factors is evidenced by primary risks identified as, for example, unrealistic project goals and objectives, unrealistic schedules and budgets, and constantly changing requirements, resulting in poorly functioning technical systems that do not meet the procuring organisation's needs. Besides the potential inertia stemming from technology that may not be aligned with the needs of the organisation, the increased uncertainty of managing an IT development project and relationship with a vendor as part of a change project adds to the difficulty of fulfilling the change management success factors as these focus considerably on reducing uncertainty.

9 Conclusions

A number of conclusions can be drawn as a result of this thesis:

- This thesis defines and explains the concept of inertia in sociotechnical systems, which enables an analysis of how IT-related change processes affect and are affected by the characteristics of an organisation.
- If applied to predict the inertia affecting a planned IT-related change process, the use of the concept can potentially increase the chances of successfully achieving the goals of IT-related change processes in organisations through an increased awareness of how the change process affects and is affected by the characteristics of the organisation.
- If applied to analyse how inertia has affected an IT-related change process in retrospect, the use of the concept can illustrate and explain how the change process affected and was affected by the characteristics of the organisation, and linking these effects to the effectiveness and efficiency of the change process.
- The application of the concept of inertia in sociotechnical systems provides a sociotechnical perspective that is often lacking in today's IT-related change processes.
- There is a need for methods that take the whole work situation into consideration during IT-related change processes due to the importance of IT in enabling and supporting work.
- The vision seminar process studied in this thesis can contribute towards mitigating inertia in an IT-related change process by creating awareness and engagement in the organisation.

As these conclusions indicate, this thesis has successfully addressed its research objectives and, in doing so, contributed to research on HCI in an organisational context. In addition, through the work and activities performed in the action research projects, this thesis has also contributed to practice both through the joint creation and sharing of knowledge with collaborators and stakeholders, and through concrete actions such as the application of the vision seminar process in the SISU project.

10 Future Work

This thesis marks the end-point of my progression towards a PhD degree. During my time as a PhD student, each increment in the understanding of a problem has usually prompted more questions than the improved understanding has answered. For such a wide area of interest as mine, IT-related change processes in organisations, there is no risk of running out of interesting and important research to pursue. With both the contributions and the limitations of this thesis in mind, I here conclude this thesis with three potential topics for future work.

The first potential topic for future work regards the continued development of the concept of inertia in sociotechnical systems. The definition presented here is the fourth iteration since my first attempt, presented in Paper I. It has reached a level of maturity where it has started to become useful, as my application of it in this thesis shows. At this stage, an evaluation of the concept from a research perspective, where the study of an IT-related change process is designed with this in mind, would be beneficial for its future development. This could, for example, be performed as an interview study with stakeholders and managers of a recently concluded IT-related change process, where their account of the change process is used as input for a retrospective analysis using the concept of inertia in sociotechnical systems and compared with analyses performed using other explanatory theories. Another venue for evaluation is, of course, the predictive ability of the concept both for practitioners and researchers. One possibility for such an evaluation would be to keep track of the contributors to inertia predicted using the concept when planning a change process, and compare these with how the actual change process develops. Another design for such a study is to adapt the concept to be included as a tool in a vision seminar method. With otherwise comparable groups being guided through a vision seminar process in parallel, the accuracy of the resulting visions could then be compared and evaluated against what the organisation is able to realise within the intended timeframe of the visions.

The second potential topic for future work is on IT-related change processes. With the exception of vision seminars and a few others, the vast majority of the tools and methods for user-centred design and participatory design that I have come across during my education have seemed tailored for small teams, developing a small application, for either a small group of homogeneous users or a generalised user persona. Constraints and challenges

such as customer-vendor relationships and contracts, procurement laws and regulations, legacy systems and other existing infrastructure, the pace of agile development projects compared to the pace of decision-making in large organisations, user's resisting increased digitalisation of their workplace, heterogeneous user groups, and organisational compartmentalisation of 'IT issues', 'work-environment issues', etc., are all examples of aspects and conditions that require creative adaptations and modifications that are not available in textbooks. Extending on previous research on, for example, the inclusion of user-centred activities in Scrum and other agile frameworks and methodologies, to also consider more of the organisational aspects and challenges (e.g. in Swedish authorities and other public institutions) would, I believe, prove to be both interesting and beneficial.

Finally, the third potential topic for future work is on the use of vision seminar methods. These methods seem to have never received much attention and, consequently, have not been properly evaluated. The evaluation presented in Paper VII is, as far as I know, the only example of such a study, but there is much more to do in this vein. The role of vision seminars in supporting the development of healthy digital work environments, to enable a holistic approach to the design of people's work and the IT systems supporting this work, provides an important venue of future research given the proliferation of IT in organisations and the plethora of IT systems, each designed in isolation, that many workers interact with on a daily basis.

Acknowledgements

For their support on my journey, there are a number of people to whom I wish to express my gratitude. First, I would like to thank my main supervisor, Åsa Cajander, for her excellent guidance and for always believing in my ability and my work. In addition, I have had the privilege of two great co-supervisors in Marta Lárusdóttir and Bengt Sandblad, whom I thank for their contributions and support. I would also like to thank all of my co-authors, my colleagues at the Department of Information Technology, and especially those whom I have repeatedly subjected to discussions and seminars on the topic of inertia in sociotechnical systems over the years.

During my participation in the four action research projects that have provided the context for my work, I have met, worked, and collaborated with many interesting, exceptional, and professional individuals. Among these, I would first like to express my gratitude to the participants and respondents who have made this research possible. I would like to thank the members of the DOME consortium and our contacts at Region Uppsala, and my contacts at the Enköping hospital in the IVAN project. In the KiA project, there are a number of people spread across Uppsala University, and some who have since retired or moved on to new adventures, to whom I am grateful and whom I thank for their contributions to my work. The SISU project has in many ways provided an exceptional challenge, and I wish to thank my contacts at the Student Records Office for a very rewarding and educating collaboration. In addition, I would like to thank those who have helped support this research financially: the different divisions of Uppsala University's administration who supported the KiA and SISU projects, Region Uppsala and its hospitals for the support of IVAN, the Swedish Governmental Agency for Innovation Systems, VINNOVA, for its support of the DOME project (2012-02233 and 2013-0451), and the European Commission's indirect support through the SUSTAINS implementation project (No 297206).

Finally, but in many ways most importantly, I thank my family, relatives, and friends for their encouragement, concern, and inspiration. I am particularly grateful to my wife, Jonna, and daughter, Svea, for helping me uphold a healthy work-life balance and for giving me a loving home to return to.

Svensk Sammanfattning

Införandet av ny informationsteknologi (IT) i en organisation är ett sätt att ändra förutsättningarna för hur uppgifter och arbetsprocesser kan utformas och utföras, liksom hur människor interagerar med varandra. Idag är många arbetande i Sverige helt beroende av IT för att kunna utföra sina arbetsuppgifter, samtidigt som de upplever en kombination av kontinuerliga och oregelbundna IT-relaterade förändringar som påverkar denna förmåga. I en undersökning av fackförbundet Visions medlemmar, en av Sveriges största offentliga fackföreningar (Vision, 2014), ansåg 94 % av de svarande att deras IT-system gjorde arbetet enklare, medan 38 % samtidigt kände att de saknade den kunskap som var nödvändig för att kunna använda systemen effektivt. Ytterligare 38 % svarade att deras IT-system inte bidrog till att lindra stress eller förhindra störningar i arbetet. De cirka 1 400 respondenterna uppskattade att de tillbringar i genomsnitt 26 minuter per arbetsdag åt att hantera störningar som orsakas av deras IT-system. Om denna siffra även gäller för resten av Visions medlemmar (190 000 tjänstemän i den offentliga sektorn) så motsvarar detta att cirka 2,6 miljarder kronor i löner årligen spenderas på dessa störningar. Detta utan att räkna med ekonomiska förluster på grund av den lägre produktivitet och kvalitet störningarna kan förväntas medföra, och utan att räkna med medlemmar i andra fackföreningar. För att bekämpa denna trend och andra negativa effekter som identifierades i undersökningen var Visions första rekommendation att öka medarbetarnas deltagande i planering, utveckling och implementering av IT (Vision, 2014). Sådant deltagande är inte vanligt förekommande i Sverige idag, då cirka 70 % av tjänstemännen uppger att de aldrig varit inblandade i arbetet med att införa nya IT-system som påverkar deras arbete. Dessutom kände bara 36 % att införandet av nya IT-system genomfördes med tydligt definierade och uttalade mål som utgångspunkt (Unionen, 2015). Introduktionen av nya IT-system i en organisation är ett exempel på vad som klassas som en IT-relaterad förändringsprocess i denna avhandling. Eftersom IT har blivit en så integrerad del av moderna organisationer är många förändringsprocesser på samma gång möjliggjorda och begränsade av de IT-system som är inblandade. I denna avhandling introducerar jag begreppet *tröghet i sociotekniska system* för att analysera IT-relaterade förändringsprocesser i organisationer och belysa hur uppfyllandet av målen för dessa processer kompliceras av organisatoriska, sociala och fysiska aspekter utöver de tekniska.

Forskningsmålen för denna avhandling är:

1. Att definiera begreppet *tröghet i sociotekniska system*.
2. Att utforska hur begreppet *tröghet i sociotekniska system* kan användas till att förklara effekter som observeras i IT-relaterade förändringsprocesser.
3. Att undersöka om målbildsseminarier är ett sätt att mildra oönskade effekter av *tröghet i sociotekniska system* på IT-relaterade förändringsprocesser.

Arbetet som ligger till grund för denna avhandling är utfört inom svensk offentlig sektor, närmare bestämt sektorerna för sjukvård samt högre utbildning, och avhandlingens bidrag är baserat på forskningsstudier och erfarenheter från fyra s.k. aktionsforskningsprojekt i dessa sektorer.

Avhandlingens bidrag är att definiera begreppet *tröghet i sociotekniska system* som ”effekten av de attribut hos ett sociotekniskt system som påverkar en förändringsprocess måluppfyllnad och effektivitet”, samt tillämpningen av detta begrepp. Avhandlingen visar att tröghetsbegreppet kan användas för att förstå IT-relaterade förändringsprocesser som förändringar i ett de attribut som beskriver ett sociotekniskt system, vilket i organisationer kan tillämpas för att visa hur förändringsprocesser påverkar och påverkas av de attribut som beskriver en organisation. Detta illustreras i avhandlingen genom att tillämpa tröghetsbegreppet på IT-relaterade förändringsprocesser i de fyra aktionsforskningsprojekten. Dessutom visar avhandlingen att användningen av målbildsseminarier kan bidra till ökad medvetenhet om målen med en förändringsprocess samt ett ökat engagemang mot att nå dessa mål. Målbildsseminarier torde därför kunna gynna många av de svenska organisationer som fortfarande introducerar nya IT-system utan tydligt definierade och uttryckta mål (Vision, 2014).

Ett sociotekniskt perspektiv är ett sätt att se på system som en kombination av två delsystem som är beroende av varandra, ett socialt delsystem och ett tekniskt (L. Klein, 2014). Detta perspektiv går att tillämpa på mycket i samhället, till exempel på stora samhällsfunktioner såsom de för elförsörjning och kommunikation, på organisationer och företag och till och med på enskilda användare av IT. I vardaglig användning används “tröghet” (eng. *inertia*) till att beskriva något som ”benäget att förbli oförändrat” eller att ”vara svårt att förändra”, och att vara ”trög” används som en egenskap som till exempel kan tillskrivas organisationer (t.ex. Alter, 2001; Besson & Rowe, 2012; Walker, 2000). Denna avhandling visar att en ökad förståelse för orsakerna till tröghet i sociotekniska system, och i synnerhet i organisationer, kan användas för att förstå och förbättra IT-relaterade förändringsprocesser.

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