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The Effects of Computerization as a Multi-Stage Process Model

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Abstract: The objective of this paper is to present an analytical framework that will help us reconstruct and analyse the process of computerization and its effects. The result of the analysis can be used in order to evaluate effects of computerization. By drawing on empirical data from the purchase and implementation of a software package for elderly care, it is illustrated how the model can be used.

Keywords: Computerization, Effects, Evaluation

1. Introduction

When practitioners and researchers discuss the effects of computerization it is difficult to know what they actually refer to, since a number of different concepts are used to refer to the same thing, the phenomena of "impacts of computers". It is my opinion that difficulties in comparing and value studies on the effects of computerization to a large degree is a function of lack of analytical clarity and an inconsistent and vague use of terminology. There have also been contradictory results relating to the impacts of computers (Robey and Bourdreau 1999), which might be explained by lack of stringency, as well as differences in research methods and focus.

This vague use of terminology is exemplified by the various expressions researchers use to refer to the impacts of computers. Bannister & Remenyi refer for instance in a paper from 2000 to the evaluation of IT investment decisions, while Willcocks (1992) as well as Davern & Kauffman (2000) discuss the evaluation of information technology investments and IT-projects. Fitzgerald (1998) focuses evaluation of IT/IS investments together with information systems projects and Remenyi et. al. (1995:40) analyse the benefits that may come from "appropriate use of information technology". Computerization involves many activities, not necessarily directly linked to the use of computers, which contributes to organizational effects. Therefore is it hard to know the origin of the observed effects. Are the effects we witness an effect of planning and working with the requirement's specification, of training or of computer use? As computerization is a highly social activity it is difficult to isolate the effects of computerization. Therefore we should view computerization from a process perspective, involving different activities during different phases that may give rise to effects. This will help us to better isolate, analyse and understand the effects of computerization. In order to understand the effects of computerization we need to understand "the process through which it was given meaning and purpose" (Robert 1999). This can be done by opening up the black box of computerization and disclose the actions and negotiations that take place before an IT system is taken into use.

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There is a need for an analytical framework that can help us to evaluate the effects of computerization. As effects can occur from many different activities during the computerization process, must this framework consider the different phases of computerization. The framework should also take into account what we want to focus and evaluate in the analysis.

The objective of this paper is to present an analytical framework designed to help us better understand the process of computerization and its effects. The model divides computerization in different phases. The model distinguishes between the results and effects of activities during the system's different phases. By drawing on empirical data from the procurement and implementation of an IT system for elderly care, it is illustrated how the model can be used in a real case scenario. In order to secure confidentiality has the name of the IT system used in this case been altered, and the referred historical documents do not disclose the name of the analysed organization.

The paper is organized as follows: the first part describes the framework, next follows a short description of the research method. Section number three descries the research method and section four is devoted to the case study and testing the model. The paper ends with conclusions.

2. The multi-stage model of computerization

In order to reconstruct and evaluate a computerization process I suggest that we view an organization's computerization process as comprising of one or several IT systems' lifecycles. These cycles, can be in parallel or follow each other, where the effects of using an IT system from one cycle may trigger the start of a new cycle of developing or purchasing an information system (see figure 1). This model can be used in order to reconstruct an organization's entire computerization process, one phase or the life cycle of an IT system
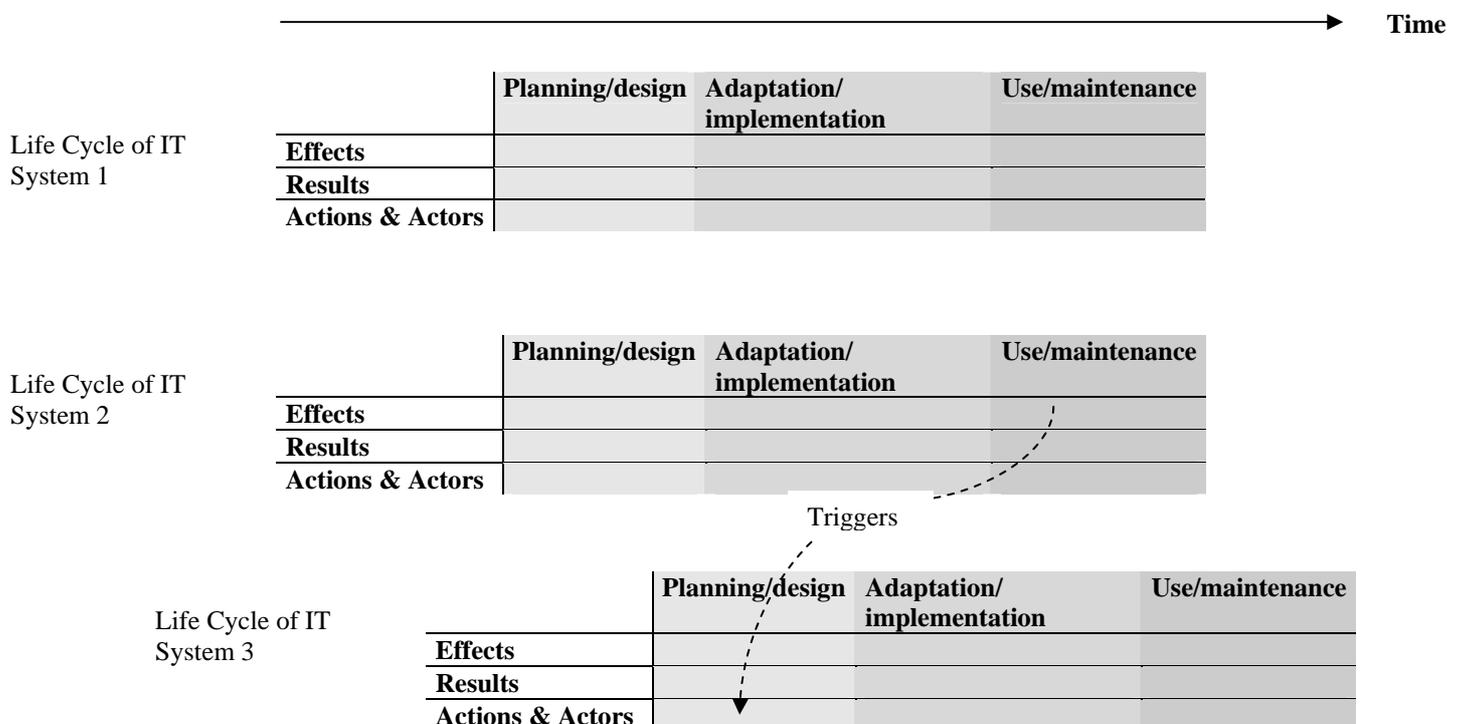

Figure 1:   An organization' computerization process

2.1 The Different Phases

An IT system's life cycle within an organization is divided in three but overlapping phases that cover different activities: the planning/design phase, the adaptation/implementation phase and the use/maintenance phase (see figure 1). This way of analysing computerization is supported by Walsham (Walsham 1993) who proposes that we should analyse the computerization process from a multi-stage process perspective. The planning/design phase refers to the initial discussions when the reasons to computerize are first raised and the IT project is officially formed. It is here the change analysis and the work with the requirement's specification takes place. In the second phase, implementation/adaptation, the system is implemented, tested and adapted. In the last phase, use/maintenance, the IT system is taken into use and maintained, and the IT system is managed by the regular organization. When the IT system has been in use for a while it is possible that something will trigger a need for major change or the acquisition of a new IT-system, and thus starts a new IT project involving the same system, or an IT project with the objective to develop or acquisition a new system (see figure 1). Minor changes are usually seen as part of the maintenance work and do not necessitate a new IT project. The computerization process can consist of several, interrelated, system development projects. One phase do not need to start exactly when the former ends, it is possible that the different phases will, at least for some time, be in parallel. The phases should be seen as containers holding actors, activities, results and effects that belong to activities during that specific phase. It is the actors who through their actions construct the computerization process and also the final result – the IT system. As Latour (1986:267) says: "…the spread in time and space of anything – claims, orders, artefacts, goods – is in the hands of people; each of these people may act in many different ways, letting the token drop, or modifying it, or deflecting it, or betraying it, or adding it, or appropriating it". Actors who make different types of decisions according to interests and values drive the process of computerization, and thus it is important to include actors..

2.2 Results and Effects

There is an important difference between results and effects. Results are consequences of actions that an actor has control over, a consequence he or she can direct, while effects are the more long-reaching consequences that the actor initiating the effect is unable to control (I am in debt to Annie Röstlinger who pointed out this distinction for me). It is the other actors who have the power and the means to use the results, and thus create effects (compare with (Latour 1986)(1986) concept translation). This difference can be found in the origin of the words. Result originates from the Latin word "resultare", which means "spring back" (Persall 1998). Effect comes from Old French or Latin where there are two words preceding today's use of the word "effect"; the concept "effectus" meaning "accomplish", and "efficiere", which is a combination of "out or thoroughly", and "do" or "make" (ibid.). Result is thus something that springs back, or bounces off an action, while an effect is a thorough accomplishment that goes beyond the immediate control of the actor. By relating to the meaning of the word "efficiere" we can see that an effect is a consequence that "does" something "out" of the actor's reach.

In each of the phases actors perform certain activities that produce results that have effects. These activities, results and effects can be seen as forming a chain where results are used as a precondition for the coming action, which produce results, used as a precondition for the next action etc. How to delimit this chain of events depends on the analyst's focus.

Results and effects can have different forms; they can be in the form of individual or shared knowledge, objectivated knowledge (Berger & Luckmann, 1967) manifested in artefacts as

e.g. an IS or as signs in an illustration or a text. An effect or a result can also be in the form of an action, where knowledge, artefacts and other types of objectivated knowledge are used as a ground for action (Goldkuhl and Braf 2002).

Effects originate from actions during an IT system's life cycle but have an impact on the organization the system is supposed to support. Effects can be found on different levels, depending on what the analyst wants to focus. Effects are the results we want to pinpoint or measure and compare with the objectives of computerization. Effects are what are considered as valuable for the people performing the evaluation. It is possible both to isolate effects from each phase and from a system's complete life cycle within the organization. Effects are relative, whether we consider something as a result or effect depends on who we are and from where we look. Which effects different actors see is dependent on their interest, values and role in the organization. Effects are socially constructed (Kling 2000). Since the reasons to implement a system are to bring about changes in the organization, this paper focuses effects in the surrounding organization. These are effects that are not taken care of during the IT project. System's usage is meant to produce results that effect the organization. Effects can be anticipated or experienced, where anticipated effects often coincide with the reasons for computerization, and experienced effects are the different effects different actors experience or observe from actions during an IT system's (organizational) life cycle. These two types of effects can viewed as positive or negative by the different actors in the organization.

The result from the analysis can be used in order to better understand what happens during computerization, as well as evaluate the effects of computerization. If we also analyse the goals, the anticipated effects, we can compare these with the observed and experienced effects.

In order to cover in-house development as well as the acquisition of standardized information system, this model have two variants. During in-house development is the design phase very important, while adaptation is central when an organization is buying a standardized IT system. Nilsson (Nilsson 1990) means that the acquisition of a software package is a type of systems development, just as in-house development. As the empirical case used as an example in the paper concerns a local government's acquisition of a software package for elderly care, the model will support the analysis of a software package's life cycle within the buying organization.

2.3 A Model for a Software Package's Life Cycle in an Organization

As mentioned earlier, covers the model the purchase of a standardized IT system as well as in-house development. For a standardized IT system there is normally no initial design in the first phase whereas adaptation is a very important activity. The model is thus divided into the four phases of 1. planning, 2. adaptation, 3. implementation, 4. use/maintenance (see figure 2). Nilsson (ibid.) has studied the acquisition of software packages, and he divides this activity into three main phases: selection, adaptation and implementation. In the model presented in this paper, the selection process takes place during the planning phase, while the activities during adaptation and implementation are similar. As framework views computerization from the perspective of the buying organization, the model also includes the activities in the planning phase prior to the decision to purchase an IT system.

	Planning	Adaptation	Implementation	Use/maintenance
Effects				
Results				
Actions & Actors				

Figure 2:   A Software Package's Life Cycle in an Organization

Planning includes discussions leading up to the decision to computerize, requirement's speci-fication, sending out tenders, analysing the offers, deciding which system to buy and negoti-ating the contract. This phase comprises all activities prior to the payment and deliverance of a specific system. The computerization process shifts from phase 1 to phase 2 with the deliv-erance of an IT system.

In the phase adaptation, the buyers have purchased a specific IT system, but there is usually a need to modify and change it according to the needs and requirements of the organization, as well as modify and change the organizational activities according to the IT system. Different types of technical tests in order to minimize problems with implementation can also be car-ried out during this phase as well as development of plans for training people in the new sys-tem. Training is an activity that crosses the phases adaptation and implementation. Training may commence during this phase, but might just as well begin in the beginning of phase four, implementation. The transition from the phase adaptation to the phase implementation starts when the organization feels that the IT system as well as the organization is ready to start using the system.

During implementation the system is implemented on the end-users' computers. This phase might involve activities related to problems with implementation, the system might for in-stance need further adaptation (jumps back to the preceding phase) or there might be techni-cal problems not discovered in the earlier phases. The implementation phase might not occur at the same time over the entire organization. If the implementation takes place in a large organization or with a large IT system, there might be a need to implement the IT system in parts and/or to start with a limited number of users and later increase the usage of the system. The shift from phase three to phase four occurs when the group responsible for implementing the new IT system decides that the IT system and the organization is ready to start using the system.

Through the last phase – use/maintenance – the end-users are using the system for their work activities and system's administrator, technicians and other system's people work with main-tenance and support. After some time, the system's life cycle might jump back to an earlier phase. The vendor might offer a new module or an enhancement, which means that the com-puterization process might not start from phase one, but perhaps from phase two or three – depending on whether there is a need for adaptation or not. Another scenario could be that a decision is taken to replace the installed system with a newer IT system. Consequently a new life cycle develops and the process starts all over again, from phase one, but with a new IT system in mind.

3. Research Method

This case is focused on and a reconstruction of the acquisition and use of a software package within home help service (CareSys). The entire case material covers CareSys' life cycle from the planning phase from 1994 until use/maintenance in 2001.

3.1 Data Collection

The empirical data has been collected through interviews, document analysis and observations. The case centres the work in one home help service unit, where the following actors were interviewed: users (home help service assistants, administrators and home help service mangers), project leader for the IT/Change-project, system owner, vendor and the system administrator. The interviews focused questions such as reasons for computerization, the process of computerization, results and effects of computerization and the actors' roles in the process.

The second type of empirical data, which has proved to be very important, is different historical records such as protocols from political board meetings (1996-2001), documents directly linked to CareSys: contracts, system documentation, requirement's specification, offers, etc and reports from the IT/Change-project.

In order to gain an understanding of the system as well as assess how well it supports the work of the users in the home help service unit, we also performed an evaluation of CareSys (Hedström and Cronholm 2002).

4. Computerization of Home Care – the Case of CareSys

The aim of this section is to illustrate how the framework (see figure 2) can be used in order to understand the process of computerization with an emphasis on CareSys' life cycle. As CareSys is a software package, the variant in figure two showing a software package's system cycle is used as an analytical framework. The analysis is performed with a procurer perspective, and the result of the analysis could be an in-put for an evaluation of the effects of purchasing and using CareSys in the purchasing organization.

4.1 A Short Description of CareSys

The purpose of home care is to make it possible for the elderly to stay longer in their homes. The home care unit we studied take care of elderly living in service flats as well as elderly living in their own houses. The nursing assistants help the elderly with daily routines such as hygiene, cleaning, doing laundry, shopping etc.

CareSys is an organization wide software package with modules for planning, carrying out and following up home help service. The system supports administrative routines around home help service. It is used for high-level administrative routines such as billing, handling clients' contracts, registering home help service hours, statistics etc. A user can choose which modules to use. The modules available for the users at the studied home care unit are: "commission", "debiting", "living", "client", "others" and "staff". Every module is attached to a chain of sub-modules in a hierarchical fashion. A brochure issued by the company that distributes and develops CareSys describes the system in the following way (the author's translation):

> [CareSys] is a system created for supporting the daily work of administrators and managers in local government care…But not only is [CareSys] a system that meets the needs of an organization's daily tasks. Managers on different levels can through the system get access to current data for following-ups and evaluations. This increases the possibility to take part in the development of the organization.

The elderly care and services committee describes CareSys as "a platform for administration of the amount of information that is needed for following-up according to the need of home help service units' high-level managements, government and the elderly care and services

committee. CareSys is also a platform for administration of fees and rents and administration of compensation to the [home help service units]" (Protocol, the elderly care and services committee, 1998). CareSys is a rather old IT system, launched in 1990, not using Windows-standard. New functionality has been incrementally implemented, leading to a lack of over-view. There is a wide range of users, from novices to experts. Many of the users, especially the home help service assistants, had never worked with computers prior to the introduction of CareSys. The politicians stated that the reason to computerize was to "secure satisfying routines for debiting of fees, bases for compensation for home help service units' high-level management and following-up of achievements, etc." (Protocol, the elderly care and services committee, 1997). Prior to CareSys the local government had an older system that mainly supported the debiting routines, but as the year 2000 grow closer, they felt that this older system might not be able to handle the shift from 1999 to 2000. This together with problems of maintenance and lack of IT support in many areas, made them decide to start looking for a new organizational wide IT system.

4.2 CareSys' Life Cycle in the Local Government

The aim of this section is to show how the model can be used in order to better understand the computerization process involving a specific system. CareSys' planning phase will be used as an illustrative example, but the same technique can be used for any administrative IT system and any phase. The text begins with a narrative description of the planning phase, followed by a graphical description (see figure 4) showing actions, actors, results and effects.

4.3 Using the Multi-Stage Process Model

I started with arranging every action, result and effect belonging to that action in a time sequence. Since it is impossible to take every action into consideration, the actions that are lifted up should be the ones that drive the computerization process and somehow changes the status of the computerization process. It can for instance be actions that lead up to important decisions. One example of an important action in the first phase could be the decision to finance a new IT system. Different actions and results are usually related to each other, where an earlier result is a ground for action later on. It is also important to decide which perspective the actions are viewed from; which stakeholder's voice you want to articulate. As an aid for the analytical process I used Action Diagrams (Goldkuhl 1992) (see figure 4) as a tool to order activities, results and effects. The Action Diagrams illustrate in a sequence how a result is used as a prerequisite for the following action, which produces a result that may be used as a prerequisite for the next action etc. The diagrams also show the actors who carry out the actions. As the diagrams tend to be long, connectors are used to connect them with each other.

During the analytical process it is important to locate the activity that marks the transition to the next phase. When that is done it is possible to differentiate activities, results and effects for each phase. The model user can decide the level of detail. The model works equally well for a detailed description and a more sketchy description.

4.4 Planning CareSys

The planning phase, e.g. the work to plan for the purchase of a new IT system, started in 1994 when the elderly care and services committee (ECSC), and later the municipal executive committee (MEC) who acting on information from the city administration office decided to "Inspect certain fundamental issues within the jurisdiction of the elderly care services committee" (Protocol municipal executive committee, 1994).

The result of the municipal executive committee's decision to "Inspect certain fundamental issues within the jurisdiction of the elderly care services committee" was the formation of an IT/Change project. In March 1995, the city administration office (CAO) commissioned consultants to carry out an organizational analysis of elderly care (Project plan for the introduction of a new IT system within elderly care). The organizational analysis was completed in September 1995. The documents from the analysis are later used as a basis for the requirement's specification (Project plan for the introduction of a new IT system within elderly care). The same year, the IT/Change project develops an activity- and time plan that among other things announces that the project's objective is to "produce new technology for time registration, debiting, invoicing and documentation" (Experiences and conclusions from one year of work with the IT/Change project).
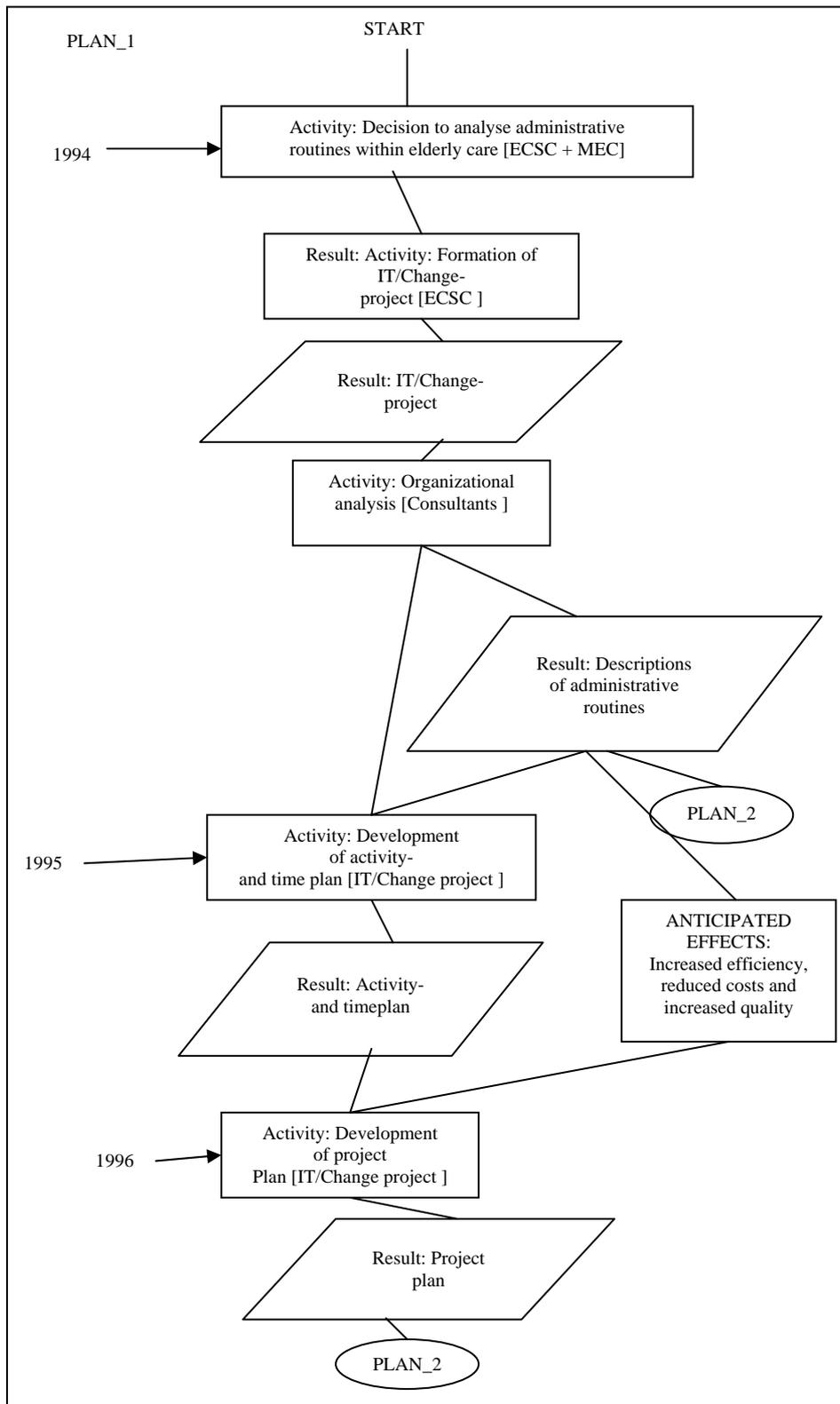
The project plan is developed and presented by the IT/Change project in 1996 (IT/Change project, a report). It states that the anticipated effects of using IT in elderly care are improved administrative routines for following up as well as less time spent on administration. These improvements will hopefully result in increased efficiency, reduced costs and increased quality. The management group decides the same year to assign founding for project management (ibid.), the municipal executive committee allocates money for the process of acquisition and implementation (Acquisition of CareSys) and the elderly care and services committee states that they are prepared to finance a new IT system (ibid.).
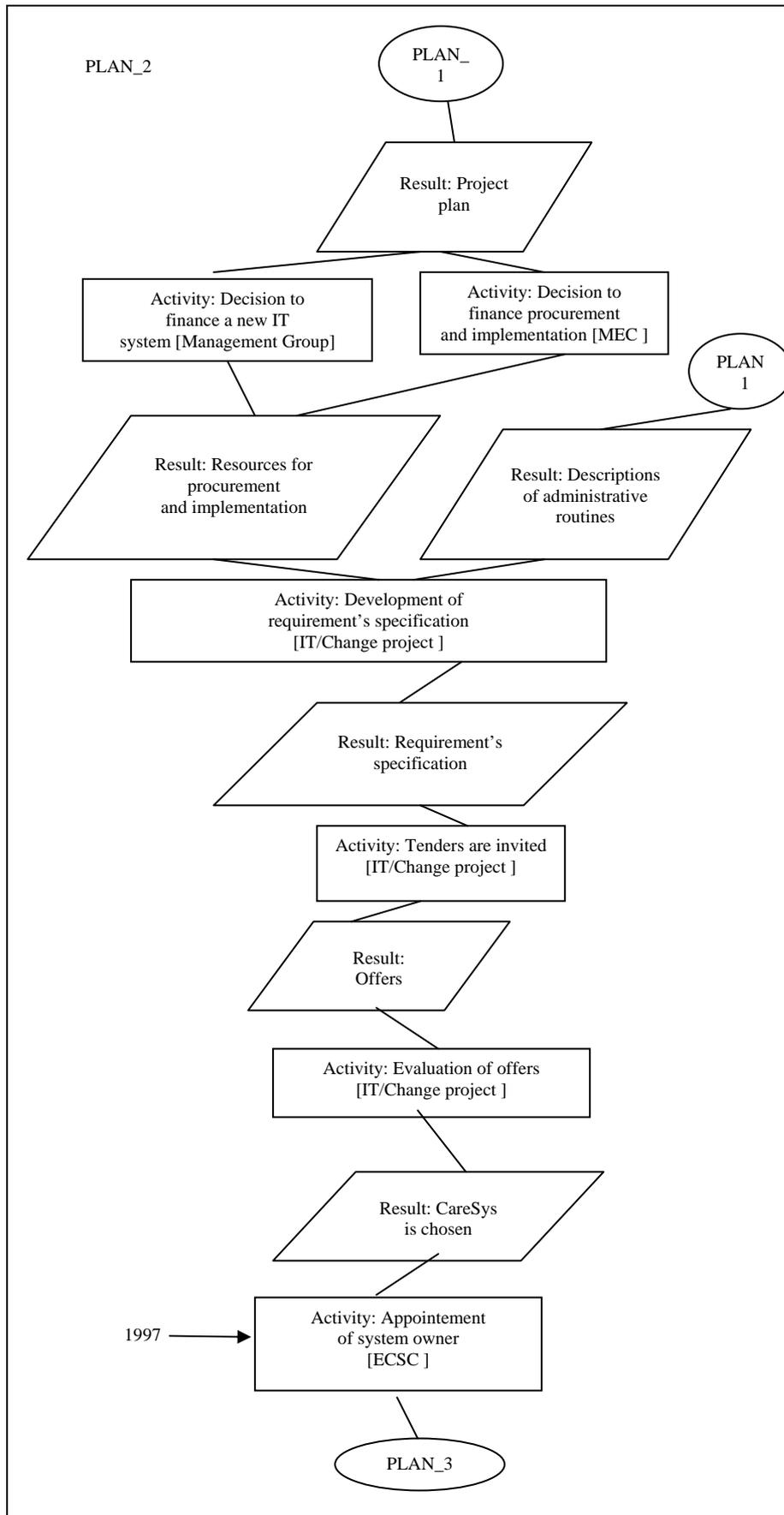
The work with the requirement's specification takes place during 1996 (Final report IT/Change project). Tenders are invited later the same year, and the evaluation of the different offers finally results in CareSys (Acquisition of CareSys). The elderly care and services committee is appointed system owner in 1997. This means that they are purchaser of operation and maintenance in order to ensure full control over CareSys and its use (ibid.). A contract is drawn, which after some negotiation is signed in 1997 by the vendor and the elderly care and services committee (ibid.). The planning phase ends with the payment and deliverance of CareSys.

4.5 An Analysis of CareSys' Planning Phase
The story of CareSys' planning phase is represented as a graphical illustration in figure 4 below. The figure shows activities of CareSys' planning phase that somehow changes the status and drive the computerization process. The figure discloses the computerization process and its activities, actors, results and effects.

The diagrams show how the planning phase starts with a decision to analyse the administrative routines within elderly care. The result of that decision is the formation of an IT/Change project, which results in a number of people who are members of that project. The IT/Change project generates an organizational analysis, which results in descriptions of a number of administrative routines in the organization. These descriptions are used as a basis to develop the time- and activity plan as wall as a basis for the requirement's analysis (see diagram "plan_2"). The time- and activity plan is used as a prerequisite for developing the project plan, which states that the anticipated effects of using IT in elderly care is increased efficiency, reduced costs and increased quality. The project plan is a prerequisite for the decision to finance the new IT system. After the requirement's specification is completed, the IT/Change groups invites tenders who send in offers. The offers are evaluated, which results in the choice of CareSys. When system and vendor is chosen, a contract is drawn, which later is signed jointly by the elderly care and service committee and the vendor. The planning phase of CareSys ends with, as was stated before, the payment and deliverance of CareSys.

START

PLAN_1

1994 → Activity: Decision to analyse administrative routines within elderly care [ECSC + MEC]

Result: Activity: Formation of IT/Change-project [ECSC]

Result: IT/Change-project

Activity: Organizational analysis [Consultants]

Result: Descriptions of administrative routines

PLAN_2

1995 → Activity: Development of activity- and time plan [IT/Change project]

ANTICIPATED EFFECTS: Increased efficiency, reduced costs and increased quality

Result: Activity- and timeplan

1996 → Activity: Development of project Plan [IT/Change project]

Result: Project plan

PLAN_2

PLAN_2

PLAN_ 1

Result: Project plan

Activity: Decision to finance a new IT system [Management Group]

Activity: Decision to finance procurement and implementation [MEC]

PLAN 1

Result: Resources for procurement and implementation

Result: Descriptions of administrative routines

Activity: Development of requirement's specification [IT/Change project]

Result: Requirement's specification

Activity: Tenders are invited [IT/Change project]

Result: Offers

Activity: Evaluation of offers [IT/Change project]

Result: CareSys is chosen

1997 →

Activity: Appointement of system owner [ECSC]
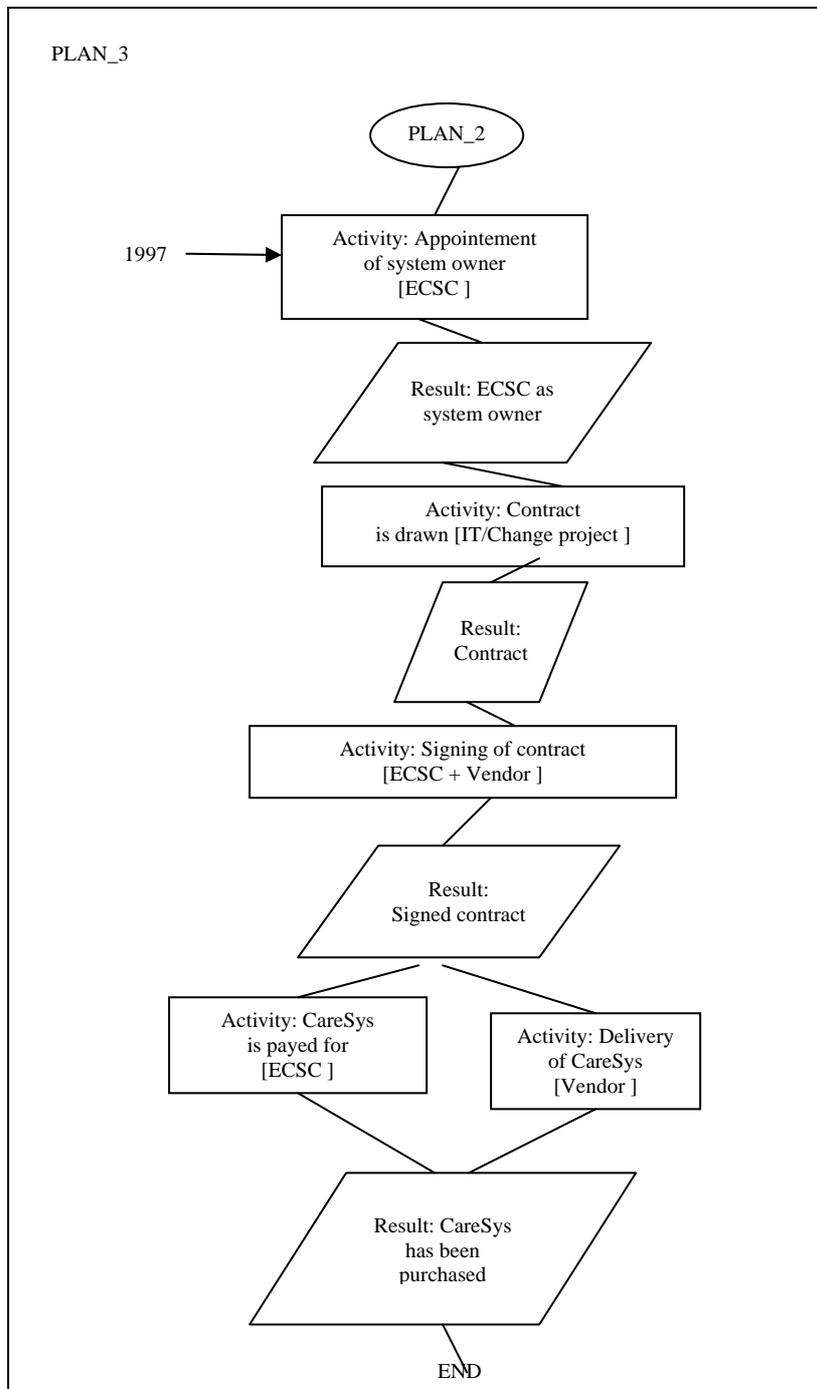
PLAN_3

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Figure 4:   Graphical illustration of CareSys' planning phase

5. Conclusions

That "impacts of computerization" is a highly relevant and important area is clearly illustrated by the vast number of articles and books related to the subject. To evaluate and assess whether the implementation and use of an IT system has produced the desired results and effects is a subject that has been on the agenda ever since the dawn of computers (Symons and Walsham 1988); (Bannister and Remenyi 2000; Fitzgerald 1998)). By viewing the effects of computerization from a time-perspective, we are able to analyse not only the planned and anticipated effects that come from using computers, but also the unexpected and unplanned effects that not only come from computer use, but also from activities the other phases of computerization. By distinguishing between the different phases of an IT system's life cycle we can begin to understand the roots of these different types of effects. By investigating and identifying actors, activities, results and effects we disclose the negotiations that forms the computeriza-

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tion process and the IT system. The distinction between result and effect is also valuable for stressing organizational impact. What we see as effects depend on our interests and perspective, what role we attribute IT systems in organizational change, and what we want to analyse and evaluate. By lifting up and analysing actions, results and effects in the different phases of a system's life cycle in the organization we can begin open up the black box of computerization. This is helpful when we want to understand and evaluate the effects of computerization.

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