A Method to Redesign the IS Portfolios in Large Organisations

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Abstract

Over the past decades, large organisations have developed increasingly complex portfolios of information systems to support business processes. Maintenance and leveraging of these so-called system complexes have become a major challenge to many executive boards. The challenge is even bigger for organisations that are the result of mergers. The question arises whether, from both an operational and a strategic perspective, it would be feasible to migrate to a single (new) system complex. In this paper, we describe the 'picture approach', a method for analysing, redesigning and combining system complexes in information-intensive organisations. The method was applied successfully in three cases (insurance companies), all operating multiple system complexes. The method consists of mapping an organisation's information systems and showing their roles in the business processes. The picture approach is evaluated in three ways, one of which is a comparison with design principles for process modelling in Enterprise Application Integration.

Keywords: IT strategy, insurance companies, mergers, integration strategy, systems integration.

1. Introduction

Over the past decades, large organisations have developed increasingly complex information systems to support their business processes [1]. Such organisations can be said to maintain a so-called system complex consisting of automated and manual systems that are linked to one another and to external systems and actors in various ways. Maintenance and leveraging of system complexes has become a major challenge to the executive boards of information-intensive organisations. The challenge is even more formidable for organisations that are the result of mergers between (or acquisitions of) previously autonomous entities with virtually identical activities [2, 3]. These organisations can be regarded as operating multiple system complexes that generate more or less the same output. In such situations, common questions to arise are whether, from both an operational and a strategic perspective, it would be feasible to migrate to a single (new) system complex, and whether such migration would be advisable from a functional, economic and technical viewpoint.

These questions were relevant in relation to several large organisations in the Netherlands, such as a health insurance company, a social security implementation agency, and an insurance company with a diverse insurance product offering. All organisations had multiple system complexes and asked our advice on how to reduce complexity and to increase transparency, maintainability, effectiveness and efficiency. We refer to Table 1 for a description of the three cases. Conducting a comparative study of the details and every aspect of the multiple system complexes in an organisation is not a practically viable solution for a going concern because of the study's long lead-times, the large number of details to be analysed, and the related costs [4]. That is why we took the avenue of reliable simplification, referred to in this paper as 'the picture approach'.

This paper presents a method for analysing, redesigning and improving system complexes in information-intensive organisations. The method aims to find relatively quick (i.e. within several months) practical answers to the above questions, and consists of mapping the organisation's information systems and showing their roles in the business processes (popularly referred to as 'taking a picture' of the processes). The pictures taken represent the system complexes and thereby create a language that facilitates communication about the system complexes among the multiple stakeholders in the decision-making process. The method has now been applied successfully in three cases, all of which involved multiple system complexes.

Before we describe the success of the method, we will first define the complexity of information systems and list some options for reducing IS complexity (refer to Section 2). Then the 'picture approach' is described and its application in one case, i.e. in that involving the Dutch social security system (refer to Section 3). Obviously, the method is subject to practical validation: a method is valid if it meets the requirements set by the client (i.e. the executive board) and if the advice following from the application of the method can be successfully implemented. Additional validation is provided if the picture approach meets the requirements described in the related literature (refer to Section 4). Conclusions are given in Section 5.

2. Reducing complexity

Information systems in information-intensive organisations have become highly complex due to changes in the business environment. The environment changes because of the constant flow of statutory and other changes, rules, implementation guidelines, often inviolable entitlements accrued over the course of time, the organisation of the implementation process and the level of process automation, combined with the diversity in the IT domain itself [5]. Within this scope, the complexity of a set of information systems is of a different nature than that of a single information system, which is often expressed in terms of number of lines of code, number of function points or complexity based on structure and type of code (cyclomatic and Halstead complexity) [6]. The complexity of the set of information systems (or 'system complex') is the complexity of the aggregate of its information systems.

There is no universal definition of complexity. An observer will find an object complex if he or she is not able to oversee its operation or the combination of elements at a glance or within a limited amount of time. This makes complexity a *subjective* phenomenon. Backlund [7] sees complexity as a subjective phenomenon and defines the complexity of a system as: 'the effort (as it is perceived) that is required to understand and cope with the system'. This definition implies that the complexity of an object in the eye of an observer may change without the object changing itself: i.e. the observer evolves. Moreover, an object may be complex for one person, while another person may not find it complex.

Complexity can also be regarded as an *objective* phenomenon, when it is defined as having objective characteristics: many elements (a large number of functions) and many links (a high level of mutual interaction) that are subject to change [8]. Decisions on migration to a new system complex can only be taken if options and choices can be made transparent, meaning that the complexity of the current system complex or complexes should be reduced. Various opportunities for avoiding or reducing complexity have been reported in the literature [9-13]. Methods to reduce objective complexity are 'reduction in the numbers of systems functions' [9-12], 'components, interfaces' [10-13], 'dynamics' [10, 11], and 'reduction in the numbers of people (users, owners, developers) that deal with a system' [9-12].

Reducing the *subjective* complexity of an information system or a system complex also requires reducing the effort (as it is perceived by actors) that is required to understand and cope with the system. This requires a presentation of facts about the information system or the system complex in such way that (all) actors can understand it and relate it to their objectives [7].

Reorganisation and migration issues relating to information systems and system complexes involve many different actors, including at any rate the organisation's directors, line management at various levels, users of various types, information managers, administrators, technical designers, builders, and administrators. A major communication challenge arises for a large number of persons who are involved in resolving the issue by virtue of their specialist knowledge and/or responsibility, and are called in to work on shared meaning from the very first day. How do the stakeholders know that they are talking about the same thing? The education enjoyed and the experience gained by the stakeholders differs from person to person and, obviously, they all have their own, naturally limited, perspective [4].

Only seldom do comprehensive and coherent descriptions and images exist of system complexes and information environments based on which communication with stakeholders can take place. Each group of stakeholders tends to use their own descriptions and images that have been prepared for their own purposes and in their own jargon. This often involves a multitude of binders containing system documentation at various levels. Experience shows that these descriptions, which, in fact, are very important for systems maintenance, are frequently out of date. In addition, it may even be impossible to gain and maintain insight based on these detailed descriptions [5].

In summary, system complexes can be regarded as multiple complex: a large number of stakeholders with diverse backgrounds using inconsistent, trendy and professional IT jargon create a major communication gap that must be bridged in order for all stakeholders to be able to make comparisons and take decisions. Put simply, all stakeholders have to talk about the same thing; there has to be at least a minimal basis of shared knowledge in order to facilitate communication about the objects to be analysed. But how is reality best described? Can we gain insight into it? How do we reliably simplify inherent complexity to enable effective communication?

The analysis of a system complex can be regarded as peeling away layers of complexity (the method of reliable simplification). This implies that the organisation's various stakeholders gain insight into the issue at hand and agree on this issue. As soon as the stakeholders have gained any or better insight into the outside layer of complexity, they can make pronouncements about the inside layers and reductions in the complexity of these inside layers. The system complex can be seen as consisting of layers of relations between business processes and information systems.

For lack of an appropriate methodology to combine business process modelling and information systems modelling [4], the practical 'picture approach' was developed in order to map out system complexes. In the first place, the picture approach aims to reduce subjective complexity (by enabling communication processes), followed by a reduction in the objective complexity of system complexes.

3. Picture approach

We will describe the picture approach in the following four subsections. In the narrowest sense (Subsection 3.1), the approach consists solely of the so-called *pictures* that are taken of the system complex and the additional information in the form of fact sheets of the IT architecture and information systems. In a broader sense, the picture approach can be described as the entire *picture project* (3.2), the *picture process* (3.3), and the *decision on the system complex* (3.4), which starts with the acceptance of an engagement and ends with the provision of advisory services to the board of directors.

3.1 Pictures and descriptions

A picture is an image of the organisational processes that maps out the functions of the various information systems within processes. The term 'picture' was chosen because an image is a reflection of a situation at a particular moment. The pictures are printed in large format. On average, ten pictures are needed to describe a single system complex. A photo album typically shows two or more system complexes in their current state and can include pictures of a target system complex (3.3).

A picture visualises the information flows that run through the organisation and the role of information systems in these flows. A picture should generally be read from the top down, in the sequence in which the process actions are performed. Various information systems are consulted or used during the process. The information flows running to and from the information systems (the rectangles in the picture) are visualised by arrows. Any physical documents or tapes used in the process are also mapped out. The use of colour coding allows for a breakdown of the various types of information systems (e.g. by ownership or dominant technology). The scope of the system can be expressed in the size of the rectangle. External and internal actors are represented, as are their positions in the business processes and flow of information.

Different arrows indicate different types of interfaces. We distinguish between direct interfaces (intensive, on-line), less intensive automated interfaces (file transfer) and manual interfaces (refer to the listing in Appendix A). Manual interfaces may involve the transfer of information on paper, but they may also point to the use of two information systems in parallel, requiring users to connect the two systems. Although this may seem old-fashioned, it is usually an effective form of interfacing [10]. By depicting manual and automated interfaces it becomes clear which systems in the process are used in combination to perform a certain task (by an individual staff member or a department). The interfaces are of key importance. Existing and desired interfaces greatly affect the complexity of the system complex and the reduction issue.

Appendix A shows a sample picture of the Dutch social security system. It was drawn up in MS Visio™. Please note that the picture covers three subsequent business processes in the social security organisation (from the top down): (i) registration of employees applying for unemployment benefits, (ii) approval of the benefits, and (iii) payment & continuation. This picture includes 9 external actors and 8 internal actors that appear once or on multiple occasions during the processes, 17 paper documents, 2 tapes, 11 process specific systems, 24 systems shared by other processes, and 4 external systems. Two information systems are mainframe-based and perform activities in seven different positions in the total process. Five information systems are client-server based. There are 66 direct-access links (actor-system) or on-line connections (system-system), 10 links for file exchange (system-system), and 23 manual interfaces (actor-actor or actor-system).

The four fact sheets that come with the picture in Appendix A are not given here in detail, but include:

- IT architecture description, including hardware, operating software, development tools, application software and its quality, data, databases, DBMS, interfaces, migratability, portability, scalability, maintainability, and sustainability. An example of a characteristic of the data in a system is that they cannot be migrated at all;
- Systems functionality description: a description of key features in a language mastered by all stakeholders. The term 'functional wealth' is sometimes used to designate the functionality of each individual system or subsystem as a whole. An example of functional wealth is the existence of a shared customer view;
- Description of the level of process support: this refers to the division of tasks between the systems and the users. It includes the definitions of process efficiency and process control (also in case of workflow applications).
- Costs, benefits and risks of the system complex.

The pictures make clear that one business process often covers multiple departments and that one department is involved in multiple processes. The logic (or illogicality) of organisational structures is shown,

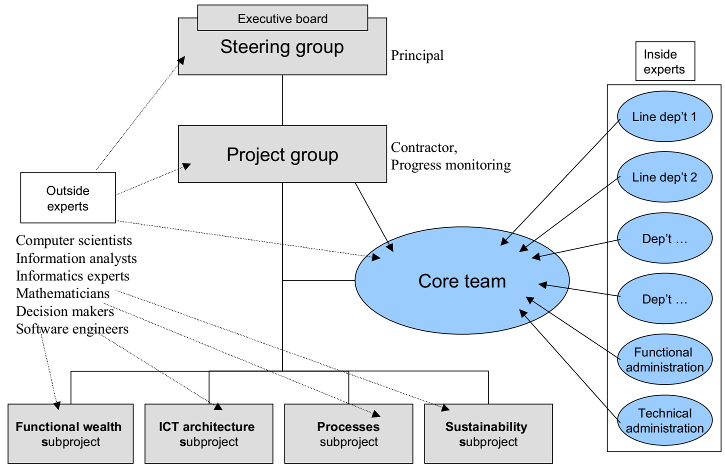

Figure 1. Project organisation for the picture process

thereby creating a potentially new basis for considering current organisational and process structures.

The production of a picture, let alone a photo album, is not an easy task. It not only requires knowledge of the picture concept and skills, but most of all experience in complex accounting, control, and information systems, knowledge of IT and information management and the ability to constantly switch between low-level concrete solutions and high-level general and conceptual solutions. Many people (or design projects) call it a day after having depicted a (part of one) process due to the great number of and diversity in components and interfaces: a high level of complexity. Determination of the level of detail (or abstraction level or 'level of granularity' [19]) is very important to finalise the complete picture. If too many details are eliminated, the decision-making process is impeded because there is not enough information on which to base a well-balanced choice. If too few details are eliminated and all processes are extensively discussed, the profusion of information renders a choice impossible as well, since existing situations and options cannot be compared in outline. The actors involved in the picture process decide when a picture sufficiently represents reality, as described in the next section.

3.2 The picture project

The picture project and process are just as important as the images contained in the pictures and the related descriptions. The process leading up to the ultimate decision, taken by the executive board, involves the organisation's experts in the project as a result of the composition of the project team. Staff's active and close involvement in the study leads to shared meaning, which is a prerequisite for a decision that is supported by all: the persons involved know about the course of the decision-making process and support the decision taken based on the knowledge they have gained in the process. Gaining knowledge about the organisation-wide processes during the production of the pictures is already a result in itself.

A project organisation as given in Figure 1 is needed to create pictures (the picture process), the photo album, and the fact sheets. The project group supervises the entire project on the instructions of the executive board (the steering group, often also the 'owner' of a system complex). The project group is supported by the core team, which is made up of different experts from various departments. The experts are a mix of process experts, functional administrators and system administrators. Subprojects are set up to draft fact sheets on ICT architecture, functionality ('functional wealth'), and business processes. In addition, a group is formed that is responsible for defining the organisation's vision for the future ('sustainability'). The members of these subprojects are experts from the core team and, where necessary, other staff members. As a group, these experts have extensive and comprehensive knowledge of the system complexes. Where necessary, the subprojects, project group and core team are supported or supervised by outside experts (information management and auditing experts, mathematicians, computer scientists, decision makers and software engineers).

Integration of system complexes into a single system complex is a challenging task, not only because it is difficult to gain insight into the composition and performance of the separate system complexes, but also because there may be great resistance among staff, especially after a merger or acquisition. The key question in Case 2 (Table 1) was to select one of six different system complexes in the organisation as the best complex and to integrate the others into this target system. The decision-making process was made as transparent as possible involving people of most levels in the core team. This included experts who were capable of retrieving the information relevant for comparing the system complexes as well as staff who reviewed the result; after all, they are the ones who have to operate the systems.

The picture approach covers the entire project, from accepting an engagement to providing advisory services to the executive board. A typical project spans approximately 10 weeks in total, producing a 'pressure cooker' image. A plan of campaign is drafted in the consultative stage prior to the actual engagement. This plan documents requirements and expectations. The requirements not only include the duties to be performed by the outside experts, but also describe the level of cooperation required from the principal.

3.3 The picture process

The total picture process includes the creation of multiple pictures; on average 10 pictures per system complex. The total project typically involves 40 to 60 pictures.

The first step to produce one picture is taken by a multi-disciplinary team of experienced external experts in close interaction with a limited number of internal stakeholders (i.e. managers, users, information managers, and functional, application and technical administrators). The outside experts organise a series of consecutive meetings ('*photo shoots*') over a short period of time. The photo shoots are intensive meetings that frequently result in the conclusion that a process functions differently than the team members thought, or that it should be extended or reduced. This is how photo shoots create more complete pictures and help participants to learn more about the process, resulting in shared meaning. Usually three photo shoots are required to create a draft picture of a business process. The first photo shoot leads to a conceptual model of the key actors, documents, applications and business processes. In the social insurance case, three key business processes were defined: 'registration, approval and payments of benefits', as were two main applications: NCM and UAS (Figure 2, on the left). The second and third photo shoots (Figure 2, on the right) zoom in on each part of the business process and identify precise relations between processes, actors, documents, and systems. NCM then turns out to be the main system in the approval process and UAS in the other two processes. The picture gradually starts to resemble the one presented in Appendix A.

The second step in the process is when the draft picture is presented to the core team using a large-size video screen and colour hardcopies. The presentation of pictures and fact sheets usually results in changes and additions ('what are the precise relations between systems?', 'which data are exchanged?'). At times it stirs up spirited discussion about the true nature of the process and has team members exclaim things like 'Oh, that's how it works. I never realised that!' Ideas about, insight into, and the correctness of the image converge gradually. As soon as the pictures are widely supported by the members of the core team, they make the system complex negotiable and tangible. Then it becomes possible to collect targeted additional information that can be used for comparison purposes.

The third step is a reflection on (i.e. stepping back from) the detailed picture created in Step 2: 'what additional information do we need, and how do we show this information in the pictures?' Step 3 results in the adding of more colours to the pictures and additional data collection (fact sheets) on:

- The functionality of information systems. This is particularly important if the project or steering group considers switching to another system, which may result in functionality gains or losses.
- Opportunities for migration and sustainability. The systems should be compatible (to facilitate administration) and sustainable.
- Process support by the systems. Adequate support may reduce the number of transfer moments in the system complex. Transfer moments are caused by segregation of duties and result in piles of paper (stocks), leading to process delays. The core issue once again is the required or desirable level of specialisation, departmentalisation and transfer of data from one department to the next.
- Costs, benefits and risks. In addition to estimating the potential for using a system in another environment (architecture), migration also involves estimating the required effort and associated risks, e.g. to the organisation's continuity during the migration process.

Table 1. Overview of three organisations and the applications of the picture approach

<table>
<tr><th>Organisation</th><th>Size</th><th>System complexes</th><th>Key question</th><th>Target system (conclusion)</th><th>Result</th></tr>
<tr><td>Insurance 1</td><td>10 million clients;
5,000 FTEs</td><td>A, B, C, D, E (5)</td><td>How to adapt A? How to migrate ABCDE to A (adapted)?</td><td>A with fractions of B, C, D, and E</td><td rowspan="3">Consensus on system complex

Advice was implemented</td></tr>
<tr><td>Insurance 2</td><td>10 million clients;
5,000 FTEs</td><td>K, L, M, N, O, P (6)</td><td>Select one of six</td><td>K with fractions of L, M, and P</td></tr>
<tr><td>Insurance 3</td><td>1.5 million clients;
1,500 FTEs</td><td>Q1+Q2, R, S (4)</td><td>Should Q1 + Q2 be replaced by R or S?</td><td>Keep Q1 and Q2, reject R and S</td></tr>
</table>

The (about 10) pictures and additional descriptions of a system complex are presented to the core team in step four; this is where all lines meet: where the individual pictures and processes are linked together and the system complex is defined.

If the core team concludes that sufficient information is available to take a decision, an important meeting is scheduled with the project group during which the system complexes are compared and a choice is made. Please note that, for each picture taken, steps 2 to 4 can run parallel and can be repeated. Step 4 results in the set of pictures and fact sheets that together form the photo album, which is used for taking decisions on the system complex or complexes. During these steps, the outside experts act as the intellectual owner of the pictures and ensure consistency between all pictures; especially during and after the joint presentation of all pictures (step 4).

3.4 Deciding on migration of a system complex

The picture approach consists of two main stages. In the first stage, the existing system complexes are described, by taking pictures and making fact sheets in a relatively short period (refer to Section 3.3). In the second stage, a target system complex can be chosen and defined, again by taking pictures and drafting descriptions. Please note that the target system complex may be identical to (or an update of) one of the existing system complexes, including fractions of other system complexes, or a mix of existing complexes. This stage also includes impact analysis, validation, cost-benefit analysis, and the final choice for migration.

A meeting is organised where the project group and the core team compare the system complexes. The comparison is made only based on the facts that surfaced during the photo shoots and the compilation of fact sheets). Enough facts are available if the information considered necessary at the beginning of the project has been collected and if the production of more information were to lead to repetition or details overload rather than to better insight.

Comparing facts is like comparing apples and oranges. It involves comparison of variables that are difficult to compare by their nature; in addition, some parts of the comparison process are subjective. A tool for simplifying such comparisons is the Analytic Hierarchy Process (AHP), a multi-criteria decision model [14, 15] using Expert Choice™ software for pair-wise comparison of facts. The decision model distinguishes between preconditions (e.g. five) and preference criteria (normally 20 to 25). A target system complex is required to meet every precondition; if it does not, it will not suffice. The system complexes that meet the preconditions are compared with each other based on preference criteria that are decisive in determining the choice of target system complex. The preference criteria match the important facts (qualitative or quantitative) that came up in Step 3, such as functionality, costs and risks.

AHP leaves little or no room for subjective decisions. For example, the method was used in a case where the technical administrators and users of a department had advised their board to purchase an ERP solution to replace their outdated legacy systems. Their preference was merely based on the challenge of creating and using a new modern system. To arrive at a more rational decision, facts were collected for both alternatives and preference criteria were defined by a core team made up of actors with different backgrounds in the organisation. The structure of the multi-criteria analysis did not allow for cheating, since the AHP model works with the agreed facts, and there were no options to manipulate the outcome. The board now decided for the alternative with the best weighed score, which, in this case, turned out to be the ERP solution after all.

The project group (and ultimately the steering group) decides on a weighing factor for each criterion and then scores the relative preference of one alternative above the other, for each criterion. The final weighed score for each system complex indicates which alternative is most suitable for the organisation. Contiguous sensitivity analysis tests the value of the outcome for robustness. If the shifting of weights (within reasonable limits) should prove to result in a different outcome, the variances between the potential target system complexes are shown.

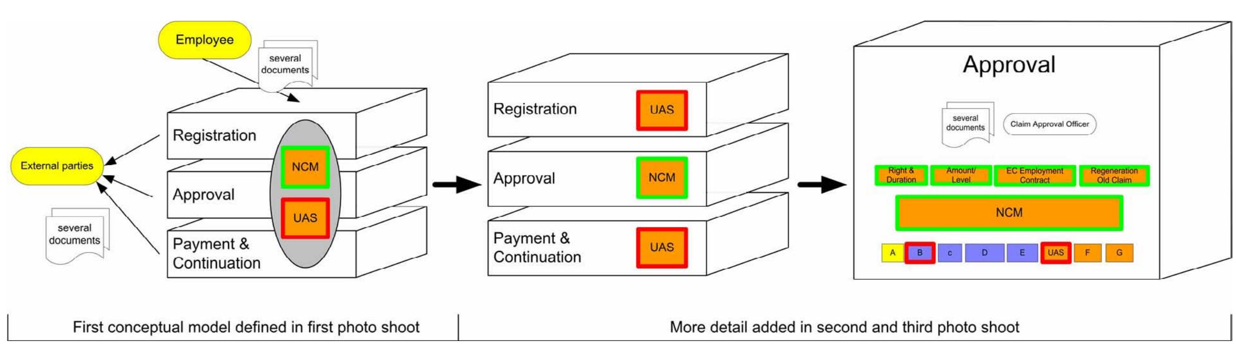

Figure 2. The picture evolves in several photo shoots (from left to right) (refer to Section 3.3).

If multiple alternatives are labelled as 'best choice,' the board may select one. If none of the alternatives meets the conditions, another alternative will have to be developed or the excessive requirements, if any, adjusted. Using AHP enables a transparent decision-making process that is controllable because it can be reproduced and accounted for.

After the core team has formulated an opinion on the target system complex, the project group presents it to the steering group. The fact that the pictures are presented to the steering group requires the pictures to be understandable at this level (executive board). In other words, the pictures should not only be readable by process staff and system administrators, but also by top management. The steering group can change the weights of the preference criteria and perform a sensitivity analysis, if necessary. As soon as the steering group has opted in favour of a target system complex, an additional study is conducted of the feasibility of migration to this particular target system complex. This is referred to as the impact analysis.

One could say that the core team compares, and that the steering group takes a well-balanced decision. The members of the core team make pair-wise comparisons of the alternatives on each criterion, but in the end it is the steering group that – on a higher level – decides on the weighing factor of all criteria. The software tool Expert Choice easily displays the results of a shift in weighing factors. For example, in insurance case 2, the picture approach led to a luxury problem: both K and L were acceptable alternatives. However, they would not lead to the same result. Alternative K would minimise the migration process and associated risks, whereas Alternative L would involve a more extensive migration process, but would, in the end, result in a better-structured and more sustainable system complex.

The choice in favour of the best alternative is based on the facts that surfaced during the process. A detailed impact analysis of the alternative must be conducted afterwards, before actual implementation. The detailed impact analysis must include conversion issues, the testing of cases from the discarded system in the new system and a cost/benefit analysis. The impact analysis may show that the "best alternative" based on the then available facts does not turn out to be feasible after all. In that case, the viability of the second best alternative, if any, should be reviewed.

4. Evaluation of the picture approach

We will now evaluate the picture approach in three ways. First, we will analyse the objectives and focus of the method using the Giaglis framework [4], then we will compare the picture approach to design principles for process modelling in EAI based on Johannesson and Perjons [16], subsequent to which we will compare the picture process to the stages in problem-solving according to Mitroff et al. [17].

Two types of modelling methods can be distinguished [4, 18]. One is based on organisational considerations (Business Process Modelling (BPM)), while the other starts from software considerations (Information Systems Modelling (ISM)). BPM methods use techniques such as flowcharting, IDEF 0, and role-activity diagramming and ISM methods use techniques such as data flow diagramming and entity relationship diagramming [4]. Other methods can use a variety of techniques. Giaglis proposes a framework (fig. 3) for comparing and characterising methods, distinguishing between the goals of the method (on the horizontal axis) and the modelling perspective of the method (on the vertical axis). The goal or objective of a method always fits one or more of the five stages of systems development (from 'support human understanding and communication' to 'process execution'). A method can cover one or more of four

	Understanding & communication	Process improvement	Process management	Process development	Process execution
Informational perspective (data)	Systems documentation ***	Systems analysis & design **	Systems project management **	Software reengineering / systems development **N.A.**	Systems operation / management **N.A.**
Organisational perspective (where, who)	Organisational structure representation **	Role redesign *	Human resource management *	Workplace design **N.A.**	- **N.A.**
Behavioural perspective (when, how)	Business process documentation *	Business process reengineering -	BPR project management -	Work flow design **N.A.**	Work flow execution **N.A.**
Functional perspective (what)	Task documentation ***	Task redesign **	CPI/TQM project management **	Quality assurance / control **N.A.**	Automated task execution **N.A.**

Fig. 3. Evaluation of the Picture Approach according to Giaglis [4]

modelling perspectives, from informational to organisational, behavioural, and functional. The framework allows for the analysis and positioning of any method into 20 aspects (refer to cells in Figure 3), where every aspect is a combination of an objective and a perspective. We use the Giaglis framework (refer to Figure 3) to analyse the picture approach and score the approach in every cell indicating 'full support' (denoted as ***) down to 'no support' (-). The score reflects the suitability of the picture approach for the diverse situations in which a modelling method can be used.

The picture approach supports the objective of 'human understanding and communication' and partially contributes to 'process improvement' and 'process management', because it provides better insight into business processes. The picture approach mostly leads to improvements in the process structure and/or the deployment of information systems in the processes. Although process management is not a key theme during the project, the composition of the project team results in better insight into the organisation-wide process among the team members.

The picture approach matches the four perspectives as follows:

- Functional: the pictures (and descriptions) clearly indicate what happens during the process and which activities are performed.
- Behavioural: the pictures partially indicate when an activity is performed. The pictures give a rough top-down overview of the course of a process, thereby indicating the sequences in which the activities take place. The direction of the arrows, however, does not show the sequence of actions (action-reaction). The descriptions somewhat obviate this. The pictures do not indicate how the activities are performed and based on which rules and decision criteria, etc. they take place. Although the descriptions flesh out this perspective, the level of detail is often insufficient.
- Organisational: the pictures describe the organisational processes and give a rough indication of whom performs the activities where. The pictures do not usually indicate the department involved, e.g. the front office or the back office. These shortcomings could be obviated by the use of colour coding. The descriptions indicate to some extent where and by whom the actions are performed.
- Informational: the pictures and descriptions clearly show which data flow through the organisation and the systems during the process. The type of arrow indicates the intensity of the interface. Please note that the pictures do not provide insight into technology, syntax or semantics. Depiction of the role of the systems in the process is the *raison d'êtr*e of the picture approach; this is well provided for.

Johannesson and Perjons [16] describe Enterprise Application Integration (EAI) as a solution to align the applications of an organisation to its business processes. Clearly, this is similar to the picture approach that aims to match business processes with IS and system complexes. The picture approach also helps organisations to decide which systems should stay, be changed, or skipped. After these decisions have been taken, the implementation methods and suitable technology are determined. EAI and message brokers can be suitable technical solutions to implement a system complex after it has been selected.

Johannesson and Perjons distinguish between two types of process languages: activity-oriented versus communication-oriented languages. The first describe actions in random processes and are, as a result, often made up of a mix of automated and manual actions. Communication-oriented languages have a focus on communicative processes and describe the interaction between people and systems in terms of sending and receiving messages. In the view of the authors, this makes the latter type most suitable for EAI. The picture approach is an activity-oriented process language: it describes both manual and automated actions in the process; although communication lines (i.e. dialogues) are shown, they are not formalised/specified. This makes the approach less suitable for application integration.

The authors state that communication-oriented languages should comply with a number of principles for the design, validation and presentation of process models. The principles are based on the objective to (i) gain better insight into the process at various levels of detail and (ii) allow for completeness checks. The picture approach achieves the first objective, even if the principles are not followed up completely (the use of levels). The second objective is not met as well as the first. The only completeness check of the pictures consists of feedback from the process users. All in all, the pictures and the descriptions do not provide sufficient information for an engineer to actually initiate migration. This requires additional information, which is gathered, in part, within the scope of the impact analysis.

Mitroff et al. [17] note that the entire process leading up to the solution of a problem is at least as important as the ultimate solution and its implementation. Their model cycle consists of translating the problem situation into a conceptual model, breaking down the conceptual model into a scientific model, solving this model and, finally, implementing the solution. Between stages, the scientific model is validated and checks are performed of whether the solution is consistent with the conceptual model. The built-in checks avoid the fleshing out of solutions that are unfeasible or based on wrong assumptions.

The picture approach progresses from the problem situation to a conceptual model (pictures and descriptions) and to a solution by means of a comparison of alternatives based on AHP. The approach does not use a scientific (quantitative) model. The production of the pictures (i.e. the conceptual model) is perhaps the most challenging stage in the process. It involves the creation of order out of the chaos of reality in a language accessible at various levels. The information contained in the pictures and the supplemental descriptions allow an organisation to immediately make a choice based on AHP. The best alternative (solution) emerging from the process may be a good choice but is not necessarily the optimal choice from a scientific perspective. In addition, the approach requires an impact analysis to flesh out the details before the solutions can actually be implemented.

5. Discussion and conclusions

The picture approach has proved in practice to facilitate communication about major decisions in relation to system complexes between various stakeholders of diverse backgrounds and positions in multiple-complexity situations. Over a short lead-time, stakeholders are allowed to communicate with each other about previously intangible system complexes and to compare seemingly incomparable facts. Participation of representatives of the relevant departments leads to shared meaning as indicated by the acceptance and the use of a single – shared – model showing the linkages among business processes and information systems. The stakeholders are involved in the process, understand the issues at hand, follow the discussions about the facts and agree with the outcome. This organisation-wide support is essential for a proper implementation of the final solution.

The project (i.e. the problem-solving cycle [17]) is subject to extreme pressure: there is not enough time, nor are there sufficient resources to investigate all aspects. This leads to a solution that will suffice, although it is not necessarily the best possible solution. It does, however, provide a viable solution that is widely supported by the stakeholders, and leads to business changes and implementations of target systems in all cases where it was applied.

No detailed study was conducted of the impact of this type of process (an extremely intensive project with a mixed core team and various target groups that meet frequently) on the stakeholders. Additional research is recommended to find out if extreme time pressure leads to sustainable support. Or is intensity perhaps so high, that there is no room to stir up or express criticism?

The picture approach differs from system development and design methods in that (i) it focuses on the entire information systems portfolio in one or more organisations, and (ii) it aims to support managerial decision-making on system complexes in stead of (re-) designing (parts of) one information system. Maier and Rechtin [20] note that, in systems architecting, the challenges are at the boundaries between systems. The picture approach meets this challenge because the level of analysis is on how systems are linked together and to business processes.

The picture approach offers an opportunity for uncovering relevant information over a short period of time from and for the purposes of stakeholders at various levels within an organisation, facilitating reliable comparisons between diverse system complexes. It may be a challenge, but it is possible. The picture approach and its application potential are the subject of further investigation.

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Appendix A

Social Security Picture

This is an example of a 'picture' created for insurance case 2 (see the paper for details on how a picture is built up in several steps).

The picture shows detailled information on the business process, the functions of the information systems in the business process and the roles of the actors involved.

The authors are aware that this picture is hard to understand in detail without knowledge of the process. It is intended to give a first impression of the communicative possibilities of these pictures in the organisation.