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GOAL-DRIVEN BUSINESS PROCESS ANALYSIS APPLICATION IN ELECTRICITY DEREGULATION†

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Abstract – Current business challenges such as deregulation, mergers, globalisation and increased competition have given rise to a new process-centric philosophy of business management. The key issue in this paradigm is the concept of business process. From a methodological perspective, this movement has resulted in a considerable number of approaches that encourage the modelling of business processes as a key component of any improvement or re-engineering endeavour. However, there is a considerable controversy amongst all these competing approaches about the most appropriate way for identifying the types and number of relevant processes. Existing business process modelling approaches describe an enterprise in terms of activities and tasks without offering sufficient guidance towards a process-centred description of the organisation.

In this paper we advocate the use of a goal-driven approach to business process modelling. A systematic approach to developing and documenting business processes on the basis of the explicit or implicit business objectives is put forward. We argue that such an approach should lead to a closer alignment between the intentional and operational aspects of an organisation. Our approach is exemplified through the use of parts of a large industrial application that is currently making use of a goal-driven business process modelling.

Key words: Business Process Modelling, Business Process Re-Engineering, Change Management, Goal Modelling

1. INTRODUCTION

The traditional practice of managing an enterprise adopts a functional view in which the business is organised along individual types of work performed, resulting in organisational structures which reflect the particular functional view adopted by the business. The main reason for adopting a functional organisation is the achievement of maximum performance of individuals or business functions. Nevertheless, this inward focus on 'internal' performance rather than 'global' efficiency suffers from a number of drawbacks, especially when business improvement is sought. In particular, improvements occur piecemeal and independently of one another, while concentration on the symptoms of one function ignores causes in important cross-functional interdependencies.

Current business challenges such as deregulation, mergers, globalisation and increased competition, have given rise to a new philosophy of business management that organises an enterprise in terms of processes rather than functions and tasks. The basic characteristic of this approach is the re-orientation of business from performing as a cluster of functions or divisions to integrating activities within a limited number of core processes. Each core process captures cross-functional interdependencies and concentrates on few strategic objectives that determine competitive success. Therefore, a process centred approach links improvement efforts in different functions to a shared set of strategic objectives.

Adopting a process view however, requires suitable tools for identifying, modelling and measuring business processes. Existing business modelling approaches describe enterprises in terms of activities and tasks offering little or no guidance towards a process-centred description of the organisation. In this paper we advocate the use of a goal-driven approach whereby a business is seen as a purposeful system aiming to achieve defined objectives which add value to its customers. This approach is part of a larger enterprise knowledge modelling framework, known as the Enterprise Knowledge Development (EKD) approach [15, 16].

Allied to business process modelling is the larger issue of *business change* itself. Business change is also seen as goal-driven in EKD; the need for business change is externalised in terms of strategic business goals, which in turn shape business processes. Therefore, business change management is the

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process of identifying the business goals for change and analysing the impact that these goals have to business processes.

The paper is organised as follows. Section 2 introduces the industrial application which is referred to throughout the paper. Section 3 introduces the notion of business process in terms of its defining characteristics and presents a critique of existing process modelling techniques. Section 4 briefly introduces the goal-driven approach to business process modelling. The application of the approach is illustrated in Section 5, using examples from the industrial application introduced in Section 2. Section 6 reflects on the role of goal-driven business process modelling within the broader context of business change management. Section 7 discusses the relation between the approach proposed in this paper and existing goal oriented approaches. Finally, Section 8 concludes the paper with some observations about current work and future directions.

2. BACKGROUND TO THE APPLICATION

The work presented in this paper is part of a big industrial application that concerns de-regulation of a large European electricity company.

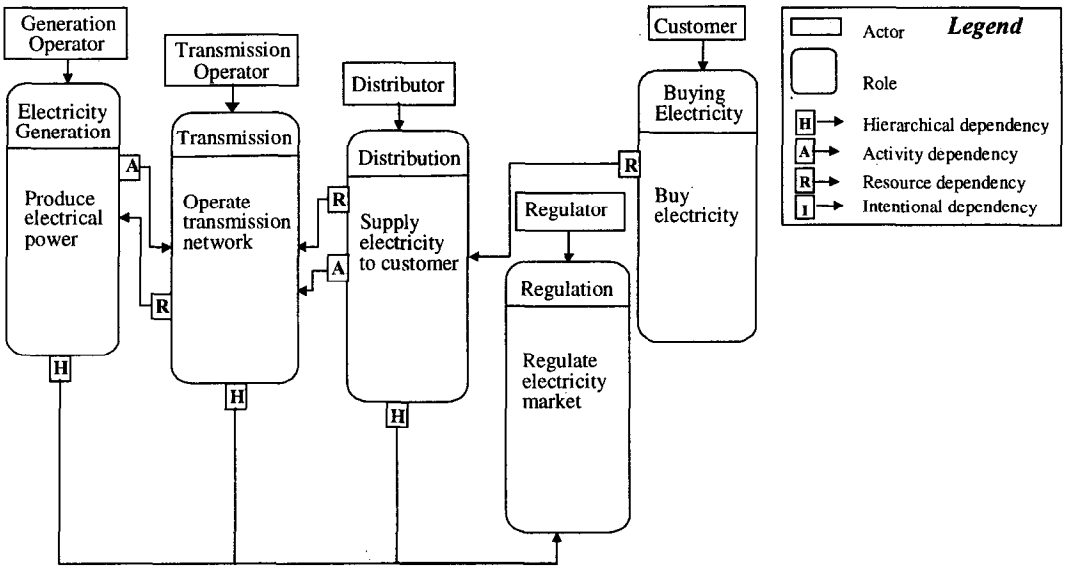


Fig. 1: Main Company Actors and Their Roles in the Monopoly Market

The company is divided in three operational areas generation, transmission and distribution. Generation is responsible for the production of electrical power. Transmission is responsible for the high voltage transport of electricity. Finally, distribution is responsible for the medium voltage (M/V) and low voltage (L/V) transport of electricity, its delivery to consumers and the merchandising of electricity services. These areas operate under the rules and regulations of a governmental regulatory body that controls issues like tariffs, production levels, environmental policies, etc. Currently the company operates in a total monopoly market which means that it is the single operator of all three areas. A high-level view of the main company actors and their roles is illustrated in Figure 1.

In anticipation of the opening of the European electricity market, the company is in the process of re-designing its business structure and planning reforms for the future, in order to increase its competitiveness and retain its market share. This is especially critical in the distribution area which is the interface of the company with the final customer. Adopting a process view of the business is a key factor in this effort.

Experience from previous projects in the company has shown the need for a structured approach for describing and measuring the business processes. Nevertheless current methods focus on *what* it is done (the tasks and activities performed) rather than *how* work is done in terms of processes, offering little assistance in this direction. This study reports on the application of a goal-driven approach whereby business goals are put forward while identification and analysis of business processes is based on their

intentional affinity. For the purpose of this paper we focus on one section of the distribution area, namely the Distribution District.

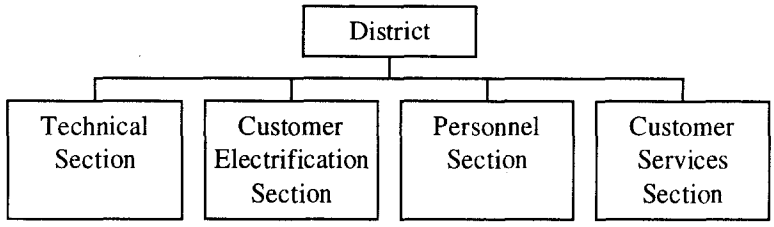


Fig. 2: Functional Organisation of a District

The current structure of a Distribution District is organised along four distinct functional sections illustrated in Figure 2: the Technical Section, the Customer Electrification Section the Personnel Section and the Customer Services Section (or agencies). The Personnel Section deals with internal matters of District employees, including safety and training issues. The Customer electrification section mainly plays a manager role. It is responsible for checking all expenditures and authorising the construction of works that concern the electrification of customers as well as the managing of customer payments to the company. The executive roles are played by the Technical Section.

The Technical Section is responsible for the operation and maintenance of the distribution network, as well as the technical servicing and maintenance of customer installations. Finally the Customer Services Section plays mainly administrative roles being the interface between the electricity consumer and the District. In addition the customer services section performs periodical readings of the electricity metering devices at customer installations in order to calculate electricity consumption and receives customer payments.

3. BUSINESS PROCESS MODELLING

The concept of business process is a key issue in the process centred paradigm. However, there is a considerable controversy around the number and types of processes appropriate to a given organisation [5]. The difficulty derives from the fact that there exists no explicit way for determining business processes. There is a lack of a coherent and universally accepted definition of what a business process actually is. Nevertheless, there are some common features of business process definition in the literature [1, 5, 11, 19] that provide guidance as to how business processes should be defined. In summary a business process in the process-centred organisation demonstrates the following characteristics:

- a business process has well identified *products* and *customers*, such that business objectives are matched through the (product offering) business process and delivered in the form of the product; customers may be external or internal to the organisation; products may include finished goods or services
- a business process has *goals*, i.e., it is intended to achieve defined business objectives aiming to create value to customers
- a business process involves several *activities* which collectively achieve defined business process goals and create value to customers
- a business process crosses functional/organisational boundaries; it concerns the *collaboration between organisational actors* that are contributing to (or constraining) the satisfycing of business objectives

In these terms a business process constitutes the manifestation of what organisational actors do in order to achieve business objectives. Organisational actors include individuals or groups which may be internal or external to the organisation (e.g., company employees, organisational departments, customers, suppliers etc.) and influence the realisation of business objectives. Business objectives aim at creating value to customers in other words they concern customer value goals.

Business process modelling is a generic name that refers to a collection of techniques which are used to model the behaviour of business systems. Existing process modelling approaches mainly originate from the software engineering field and fall in one of three categories:

- *Activity-oriented* approaches describe a process as a set of ordered activities (e.g., SADT [20], IDEF0 [12], DFDs [6], Workflows [22], the F3 process model [3]). The emphasis is on what activities take place. Each of these activities is decomposed in smaller tasks corresponding to smaller steps in the process. In addition to a collection of tasks activity-oriented models define the order of task invocation or condition(s) under which tasks must be invoked, task synchronisation, and information flow.
- *Agent-oriented* (or role-oriented) approaches specify and analyse the role of the agents that participate in the process (e.g., Role Interaction Nets [21], Role Activity Diagrams [19], the *i** model [23], the ORDIT approach [7]). The focus is on the entity that performs a process element. Roles represent the sequences of activities carried out by agents engaged in a co-operative behaviour.
- *Product-oriented* approaches represent a process through the evolution of its products (e.g., [8], [10]). Product oriented models do not put forward the activities involved in a process but rather the result of these activities. The focus is on products and transformations made on them. Each product entity has a defined sequence of states and triggers that cause state transformations.

All the above approaches promote a view of a process that is based on the notion of activity. Activity-oriented approaches focus solely on description of activities. In addition product-oriented approaches couple activities to their output (the product), while agent-oriented approaches establish an explicit link between the activities and the agent responsible for these activities.

Existing approaches offer little guidance for identifying business processes. In activity-oriented approaches the main mechanism for grouping activities into processes is that of composition/de-composition. This mechanism however, does not offer a unique way to identify a process. The difficulty derives from the fact that processes are almost indefinitely divisible; the activities involved in fulfilling a customer order, for example, can be viewed as one process or hundreds. Agent-oriented approaches on the other hand, group activities into processes according to the organisational agent that performs these activities. Yet, a process may cut across the organisation involving several organisational agents. Finally, product-oriented approaches group activities based on the product that they manipulate and this notion of a process is in accordance with the suggested business process definition as the delivering of products to customers. However this focus on product rather than organisational behaviour fails to describe other important components of a business process such as the business goals that the process intends to achieve and the collaboration of the agents that contribute to the realisation of process goals.

4. THE EKD APPROACH TO BUSINESS PROCESS MODELLING

4.1. Overview

It becomes obvious that taking a single modelling perspective (product, activity or role) is not sufficient for expressing business processes. A different approach towards business process modelling is taken in the EKD approach promoted in [15]. EKD is a systematic approach to developing and documenting enterprise knowledge, helping enterprises to consciously develop schemes for implementing changes. EKD advocates a goal oriented view to business process modelling. Instead of imposing a single modelling criterion EKD offers a more general modelling framework that allows several modelling views (or rather modelling components), using the notion of business goals to structure business components in coherent business processes. The above are summarised in Figure 3 which presents an overview of the EKD modelling concepts.

In more detail, a business enterprise in EKD is described as a network of related *business processes* which collaboratively realise *business goals*. To this end the EKD framework integrates three complementary views (or submodels), namely: the *enterprise goal* view, the *enterprise process* view and the *information systems* components view.

The enterprise goal submodel uses a 'network' of goals that are used to express the causal structure of an enterprise, in terms of the *goals-means* relations from the 'intentional' objectives that control and govern the system operation to the actual 'physical' enterprise processes and activities available for

achieving these objectives. The enterprise process submodel represents the organisational and behavioural aspects of an enterprise. An 'enterprise process' is a *composite* of four key enterprise components: (a) the roles that are played by enterprise actors in order to meet the process goals; (b) the activities involved in each role; (c) the objects that are involved together with their evolution from creation to extinction (within the context of the enterprise process); and (d) the rules that determine the process components. In other words, an enterprise process may transcend any functional divisions an in this sense it is truly a dynamic view of the enterprise. Finally, the information system component submodel focuses on the information systems components that support enterprise processes.

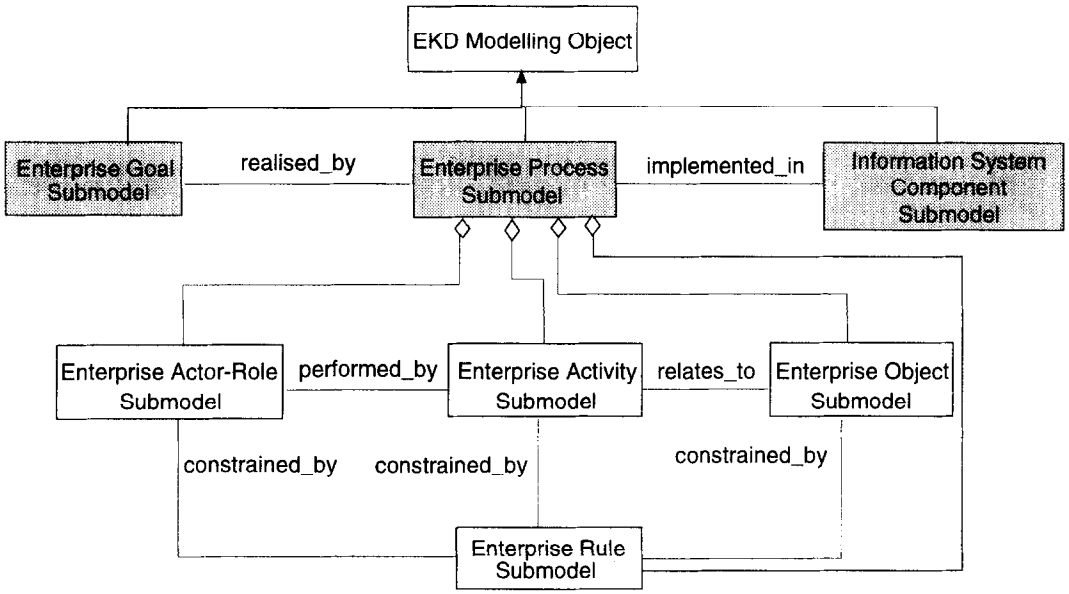


Fig. 3: Modelling Views in Enterprise Knowledge Modelling

In using the EKD modelling concepts one may start at any enterprise knowledge submodel (enterpise goals, processes or systems) and move to other levels, depending on the situation. For example, when dealing with business re-engineering, the typical, 'top-down' approach starts with the business objectives and then proceed with the modelling of how these objectives may be realised in terms of business processes as well as information systems components that support these processes. A different way of working might start at the enterprise processes level. Modelling at this level will yield an organisational description of the business, in terms of the roles that actors play in order to fulfil their obligations and achieve business goals. By analysing this description one can build an intentional description about current business goals thus advocating a 'bottom-up' approach.

The totality of the EKD concepts form the enterprise knowledge ontology, i.e., the enterprise knowledge metamodel (EKM). This defines the *logical form* of the enterprise knowledge. The metamodel includes information about the semantics of the enterprise knowledge; it identifies the enterprise entities their attributes and explicit relationships between them. The next Sections 4.1.1 and 4.1.2 provide a detailed view of the enterprise goal and enterprise process submodels respectively. These are further illustrated with empirical examples taken from the electricity application case (discussed in Section 5).

4.1.1. The Enterprise Goal Submodel

The enterprise goal submodel is illustrated in Figure 4. Central to this view is the concept of *enterprise goal.* An enterprise goal is a desired state of affairs that needs to be attained. Typical goals are `'satisfy customer demand for electricity'`, `'decrease time necessary to fulfil a customer application by 25%'`, `'increase District competitiveness'` or `'transform from monopoly market to a deregulated market with electricity pool'`, etc.

Goals pertain to stakeholders. A *stakeholder* is defined as someone who has an interest in the system design and usage. Examples of stakeholders are: company managers, company customers, software

system designers, system users, regulators etc. A stakeholder may not necessarily be an actor in the enterprise (e.g., `'government regulator'`).

Goals are generated because of issues. An *issue* is a statement of a *problem*, *threat*, or *opportunity* that leads to the formation of the goal. For example the goal Issues are shown as arrows entering the bottom left side of the goal. `'increase District competitiveness'` is formed because of the issue `'conform to the European Commission directive regarding the de-regulation of the European electricity market'`.

Goals are realised as *enterprise processes*. Though enterprise goals can be stated in a brief they cannot be mapped directly onto business processes. There is a sizeable gap for example between the desire for a more competitive District and the implementable District processes that achieve this goal.

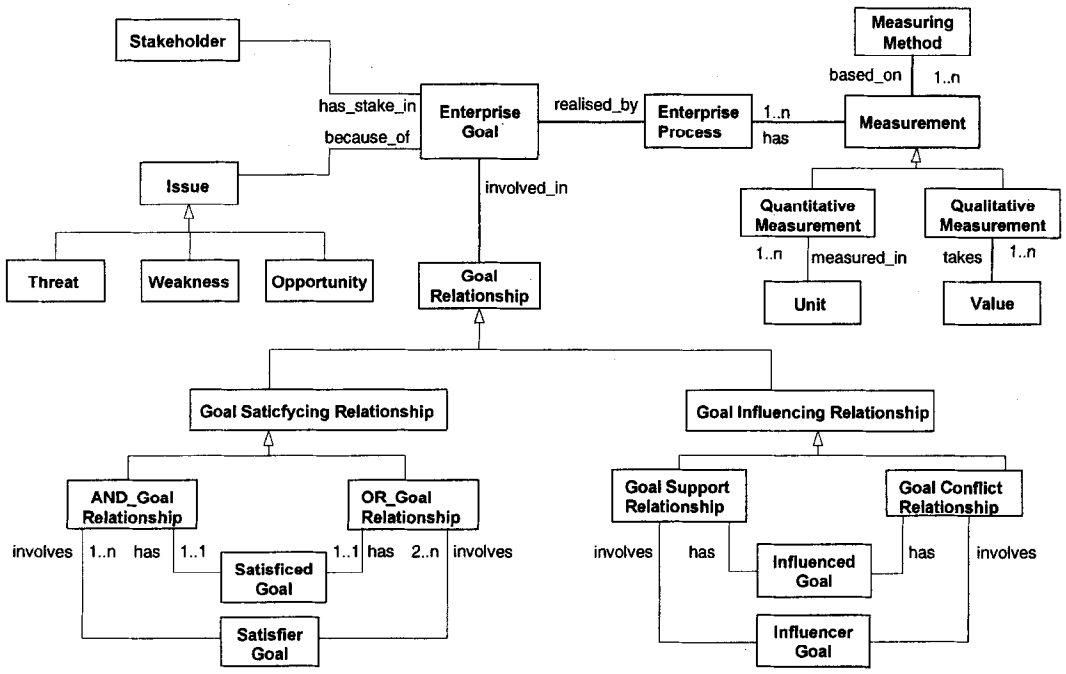


Fig. 4: The Enterprise Goal Submodel

The transition process from intentions to processes encompasses the 'causal transformation' of general goals into one or more subgoals that constitute the means of achieving desired ends. Each step can result in the identification of new goals that are linked to the original one through causal relations thus forming a hierarchy of goals. A directed edge form a goal A to another goal B implies that the achievement of A depends on the achievement of B. This goal transformation is usually referred to as goal *operationalisation*. For each goal more than one alternative operationalisations may be identified, thus leading to different ways of achieving this goal. In addition the same subgoal may contribute to the achievement of two or more goals. Thus, the resulting structure is a goal graph rather than a hierarchy. Relationships between goals in the goal graph are of the AND/OR type and are defined as such in the metamodel presented in Figure 4.

In addition to AND/OR satisfycing relationships between a goal and its successor goals, the enterprise goal submodel supports two additional goal influencing relation types namely: goal support and goal conflict relationships. A *support relationship* between goals A and B suggests that achievement of goal B assists achievement of goal A; however achievement of goal B is not a necessary condition for achievement of goal A, or else goal B would be a successor goal of goal A. On the other hand, a *conflict relationship* between goals A and B suggests that achievement of goal A hinders achievement of goal B.

Coupled to goal operationalisation is the way of analysing potential 'solutions' at every step of the ends-means process. Due to the very nature of uncertainty and value conflict, the task of defining and agreeing on a set of options that satisfy an enterprise goal may be problematic. Normally, this would be ameliorated by initially setting hypotheses, and subjecting these hypotheses to a process of disconfirmation. This hypothesis setting and evaluation within a goal-directed design paradigm is central to establishing a *rationale* for a particular enterprise design.

Often the choice of a particular solution is determined by the cost attributed to the enterprise process that realises the enterprise goal. This can be measured using some *measuring method.* Two kinds of *measurements* are defined. *Quantitative measurements* are measured in *units* (e.g., kg, meters, gdr/KWh). *Qualitative measurements* can take different *values* (e.g., TRUE, FALSE, HIGH, AVERAGE, LOW). Such measurements can then be subjected to 'what-if' scenarios in order to evaluate alternative designs for the operation of an enterprise.

The identification of the key enterprise process components which can be measured (such as activity duration, actor skills, resource costing etc.) is achieved through the use of the enterprise process modelling concepts, defined in the enterprise process submodel presented in the next section.

4.1.2. The Enterprise Process Submodel

The enterprise process submodel is concerned with the way that an enterprise process is performed through the involvement of enterprise actors in discharging their responsibilities through their role in a process and the interaction of their role with other roles which collectively bring about the realisation of the enterprise processes. This synergistic view of an enterprise process has a closer alignment to the functioning of real-world rather than using some abstract notion of 'process' that is assumed somehow to be decomposable into smaller components and so on.

An enterprise process is derived through empirical observation of the way that people work in a particular business setting. The enterprise process metamodel considers an enterprise process as a collection of roles whose behaviour determines the satisfycing of the process goal. For example the `'electricity supply fulfilment'` process, realises the goal `'satisfy customer demand for electricity'`.

We describe the enterprise process modelling components in terms of two complementary views: the *actor-role* view and the *role-activity* view. The actor-role view (presented in Figure 5) depicts the actors of the enterprise and the roles that they play. An *actor* is the physical entity (e.g., the `'District technician'`, or the `'District Technical Section'`) that plays one or more roles. A *role* expresses a collection of responsibilities (e.g., `'service providing'`, `'service administrative handling'`, etc.) and involves a set of *activities.* For example, the `'service providing'` role involves activities such as, `'construct customer installation'`, `'install metering device'` and `'connect meter to the electricity network'`.

An important point to note is the distinction between the *actor*, i.e. the physical enterprise entity, and the *role*, a notion which expresses the responsibility of performing the various activities within the enterprise. Roles are assigned to actors and summarise a set of skills or capabilities necessary to fulfil a task or activity. A role can be acted by a person or a group. A role can be acted by person X on one day and person Y on another day. The role is separate from the actors that play the role. For example, a `'managing director'` may play multiple roles such as `'setting the budget'`, `'approving expenses'`, etc.

This view also describes dependencies that exist between the roles. There are two parties involved in the dependency: the *depender role*, i.e. the one that needs something in order to fulfil its responsibilities, and the *dependee role*, i.e. the one that can provide the missing component. This *dependency relation* can be of various types: (a) *hierarchical dependency* denotes hierarchical dependencies that can exist between roles; the provider role gives authorisation to the requester role, (b) *intentioanl dependency* reflects the fact that the achievement of a goal that the role brings about is dependent on the achievement of a goal of another role, (c) *activity dependency* expresses the need for one role to wait for completion of another role's responsibilities before it can complete its own, and (d) r*esource dependency* illustrates the need for one role to use a resource that can be provided by another role.

Role dependencies take place according to a particular logic (or *rules*); enterprise rules determine the allowable states of enterprise objects and determine the interactions between different roles. An example of a enterprise rule concerning the `'installation'` object is `'WHEN application form submitted IF contract = signed THEN authorise construction of customer installation'`.

An additional element represented in this view is the goal (or goals) that the role must satisfy. 'Private' role goals are components of enterprise process goals in the sense that they support the achievement of the enterprise process goals that the role must fulfil.

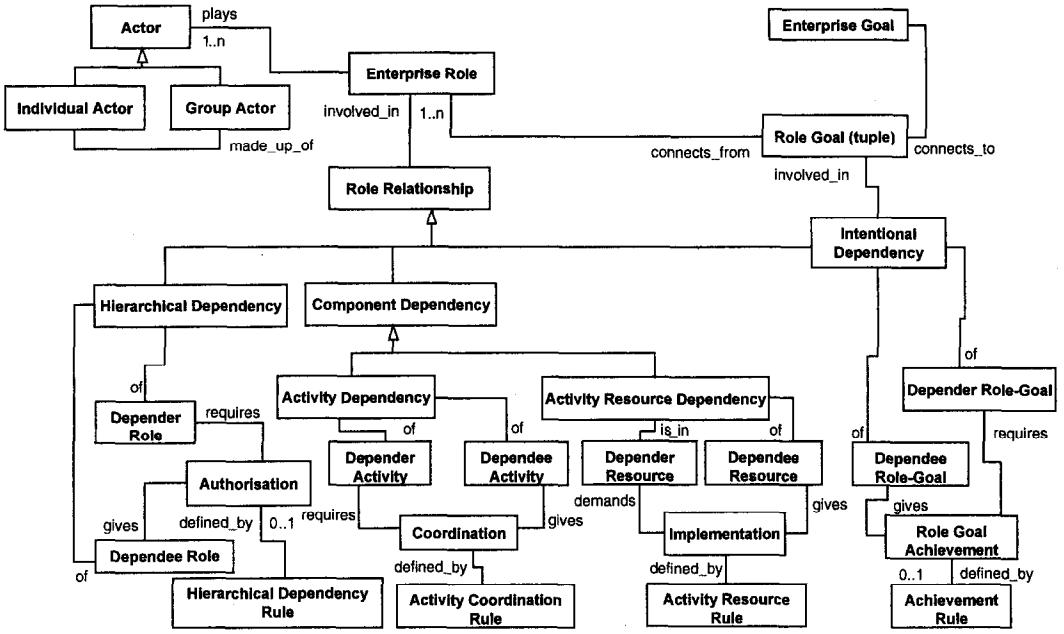


Fig. 5: The Enterprise Process Submodel: Actors, Roles and Their Activities

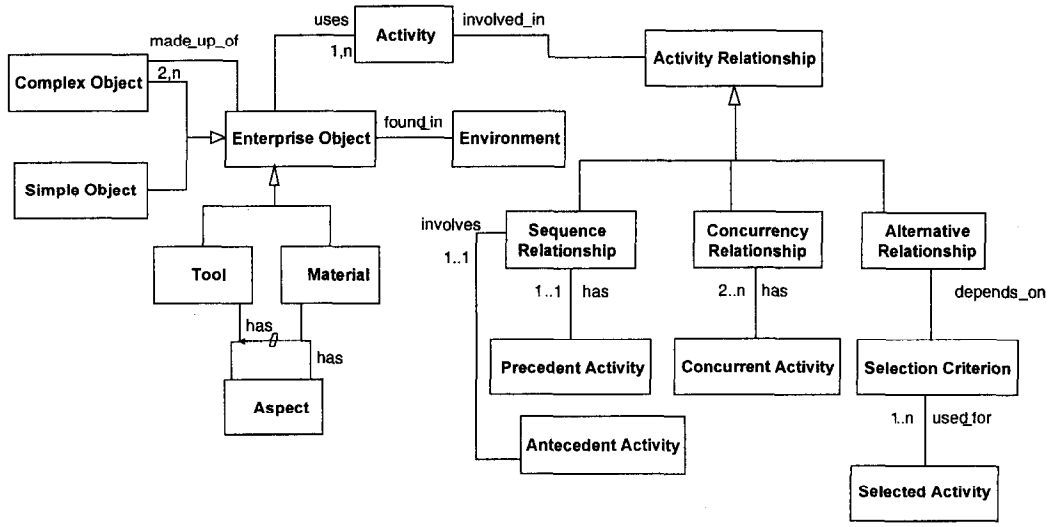


Fig. 6: The Enterprise Process Submodel: Activities and Resources

For each role involved in the process model, information is given about the responsibilities that are assigned to the role in terms of the *activities* that the role carries out and the enterprise *objects* that the role requires in the *role-activity view* illustrated in Figure 6. This view describes in detail how the role performs each of its responsibilities, in terms of activities undertaken. In addition the model explicitly defines relationships between activities that take place in a role. These are *sequence*, *concurrency* and *alternative relationships*.

Activities carried out by different roles, use enterprise *resources*. From a resource point of view an *enterprise object* may be either a *tool* or some *material*. The two are not exclusive since a tool may be a material itself and vice versa depending on the context of the activity being performed; for example when recording electricity a meter will be considered as a tool but when replacing a malfunctioning meter then it will be considered as a material. Since the fitness of purpose between a tool and the material on which it is working is dependent on having the appropriate binding between the correct aspects of tools and

material, we introduce the concept of *aspect*. For example, if an 'electricity meter' at a customer installation is to be electronically read then the meter must be 'electronically readable' (the meter's aspect) and the 'meter reading' activity must be carried out by a 'meter reading tool' that has the capability to do the reading electronically (the tool's aspect).

4.2. Goal-Driven Business Process Modelling

An important aspect of business process modelling in EKD is the representation of business goals. Indeed business processes constitute the means to fulfil strategic business goals. A business process is also seen as a purposeful system in itself. Each role involved in the process intends to achieve one or more defined goals. This does not necessarily mean that every role in a process aims to achieve the same business goal rather that satisfaction of the 'private' goals of individual roles supports the achievement of the business goal that is realised by the business process. Therefore, goals related to a business process present a hierarchical structure whereby individual role goals constitute refinements of higher-level goals that ultimately make up the business goal fulfilled by that business process (see Figure 7). In this sense business goals not only define but also shape business processes.

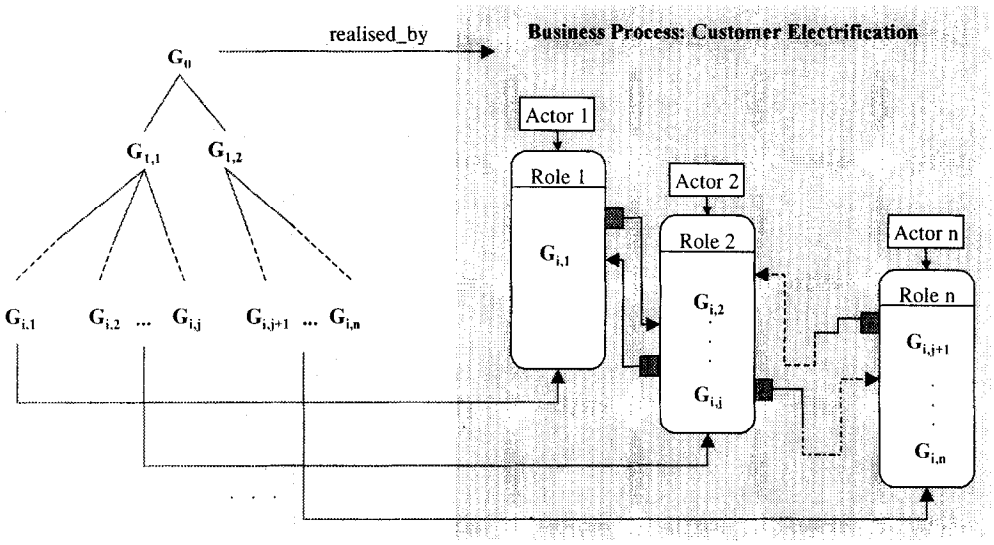


Fig. 7: Relation between Business Goals and Business Processes

In the example illustrated in see Figure 7, Role1: 'service providing' role achieves goal $G_{i,1}$:'construct new customer installation and connect it to the electricity network'. On the other hand Role2:'service administrative handling' role achieves many goals one of which is the goal $G_{i,2}$:'administer servicing of customer's request for electricity'. Achievement of both goals supports achievement of the overall business goal G_0:'satisfy customer demand for electricity' which is realised by the 'customer electrification' process. Thus 'service administrative handling' and 'service providing' roles form part of the 'customer electrification' process.

Business goals do not just shape the current business structure. They also set the vision for business change or business improvement. To this end, business goals establish the context of business change (i.e. the objectives towards which the business change effort is targeted). For example the business goal 'increase District competitiveness' sets the context of business change for the District case. Achieving this goal can be seen as a gradual process which encompasses the *causal transformation* of the initial goal into one or more subgoals until a plausible business process specification that satisfies the original goal has been defined. In our example the original goal 'increase District competitiveness' can be refined in the subgoals 'create new markets', 'build a commercial profile' and 'improve current functioning'. The latter can be consecutively refined into 'improve existing services to current customers' and 'reduce response time of any customer request'. This is graphically represented in Figure 8. Any goal at each

refinement level describes WHAT needs be done. At the same time this goal can also be considered as an end (WHY) for another goal, as well as means (HOW) for still another goal at a higher level.

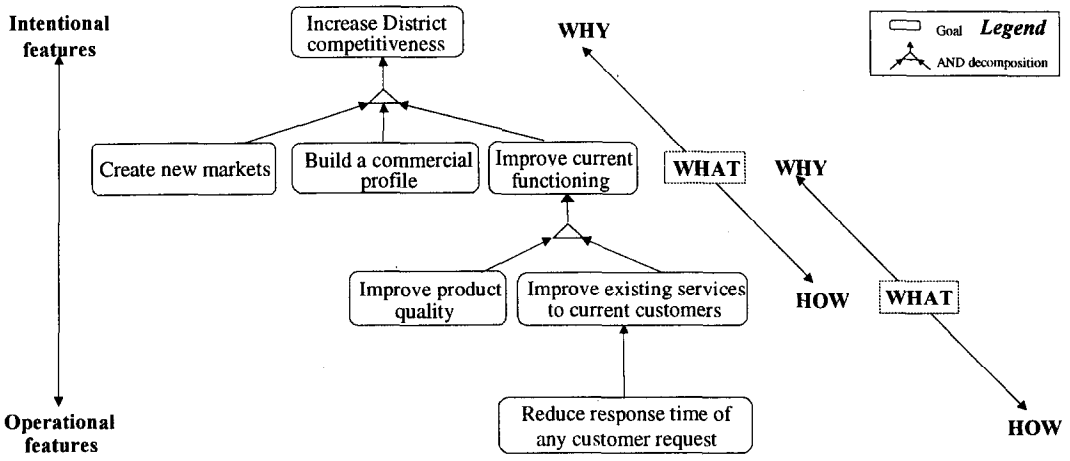


Fig. 8: Business Goals Define the Context of Business Change

In many cases more than one alternative subgoals can be identified. This will lead to the identification of alternative ways to achieve a business goal and therefore alternative ways of shaping the business. We must note here that goal achievement is not a strict top-down refinement sequence. One could also proceed by finding simple goals and then connecting them to higher level ones. Of course, the initial change goals are defined first – otherwise there would be no subject-matter for the whole process.

5. APPLYING GOAL-DRIVEN BUSINESS PROCESS MODELLING

5.1. Relate Business Goal Satisfycing to Process Modelling Strategy

In this section we discuss the empirical results and observations from applying the approach briefly discussed in Section 4, to the industrial application (introduced in Section 2).

Any design task for change normally involves multiple stakeholders and decision makers. One of the aspects of the EKD approach is the support of a reasoning cycle that involves *goal setting*, *deliberation* and *agreement*. Space limitations prevent us from giving a full treatment to this subject but, since it is relevant to the business process modelling activity we briefly describe its use with reference to the industrial application.

- Goal setting consists of establishing the stakeholder goals which designate any objectives to be reached, demand to be satisfied, problem to be resolved, issue to be discussed, etc. in general anything that one would like to achieve in using EKD.
- Deliberation includes the expression of hypotheses for achieving stakeholder goals (e.g., expressing alternative problem resolutions, making proposals concerning the satisfaction of some demand, etc.) as well as generating arguments for or against such hypotheses.
- Finally, agreement generates decisions that can alter (produce/modify) the product (the EKD models) while in turn generate new goals to be achieved.

The benefit from using such an approach is twofold. First, the important components of any deliberation are captured and can be used in tracing the history of the rationale of decisions. Second, it can be used as the baseline for evaluating these decisions, relating these to the business goals, business processes and support systems and acting as a framework for quantifying design options.

Application of EKD in the District case involved several technical and managerial staff together with EKD experts. An example of the reasoning cycle applied to the way that we approached the business process modelling task is shown in Figure 9.

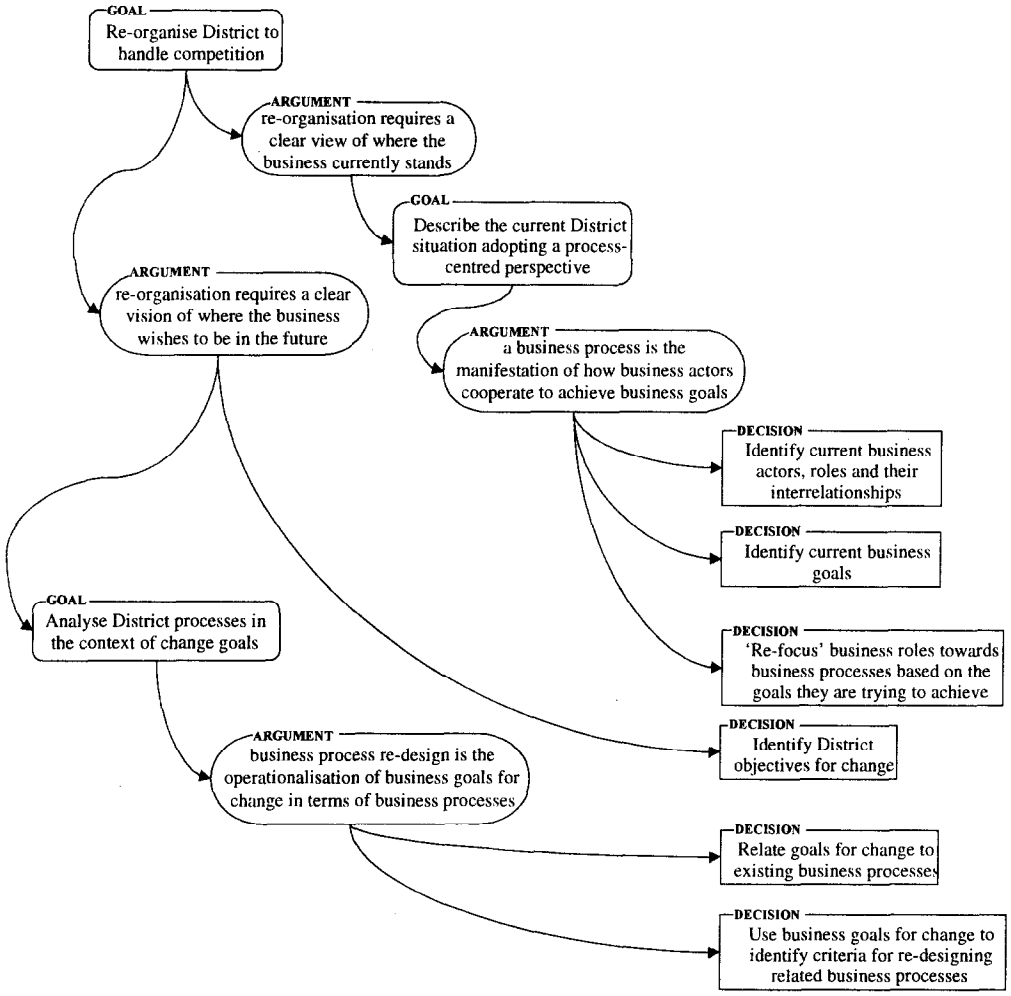


Fig. 9: Reasoning in the District Application

5.2. Model District Micro-Processes according to Current Functional Organisation

A summary of the business activities performed in each functional section is presented in Figure 10 which presents a map of District activities as described by the District employees. This map represents a 'vertical' view of the District in which District activities (or rather micro-processes) are organised along the four functional lines introduced in Figure 2.

As illustrated in Figure 10 in the majority of cases District customers contact the company through the Customer Services Section. To fulfil the customer demand there is a need to involve the Technical Section of the District. The service requested by the customer will be delivered by the Technical Section after authorisation by the Customer Electrification Section.

By studying the District micro-processes one can easily conclude that while many activities are performed within different functional divisions they are parts of the same business process. For example micro-process `A1:'Electricity Supply Application Fulfilment for the L/V Customers'`[†] and micro-process `B3: 'Performing Study of Electricity Supply through modification of the L/V Network'` are parts of a bigger process which deals with the supply of electricity to District customers. However, this is not obvious in the functional organisation description since there is no description of the interrelationships between different functions.

[†] L/V = Low Voltage

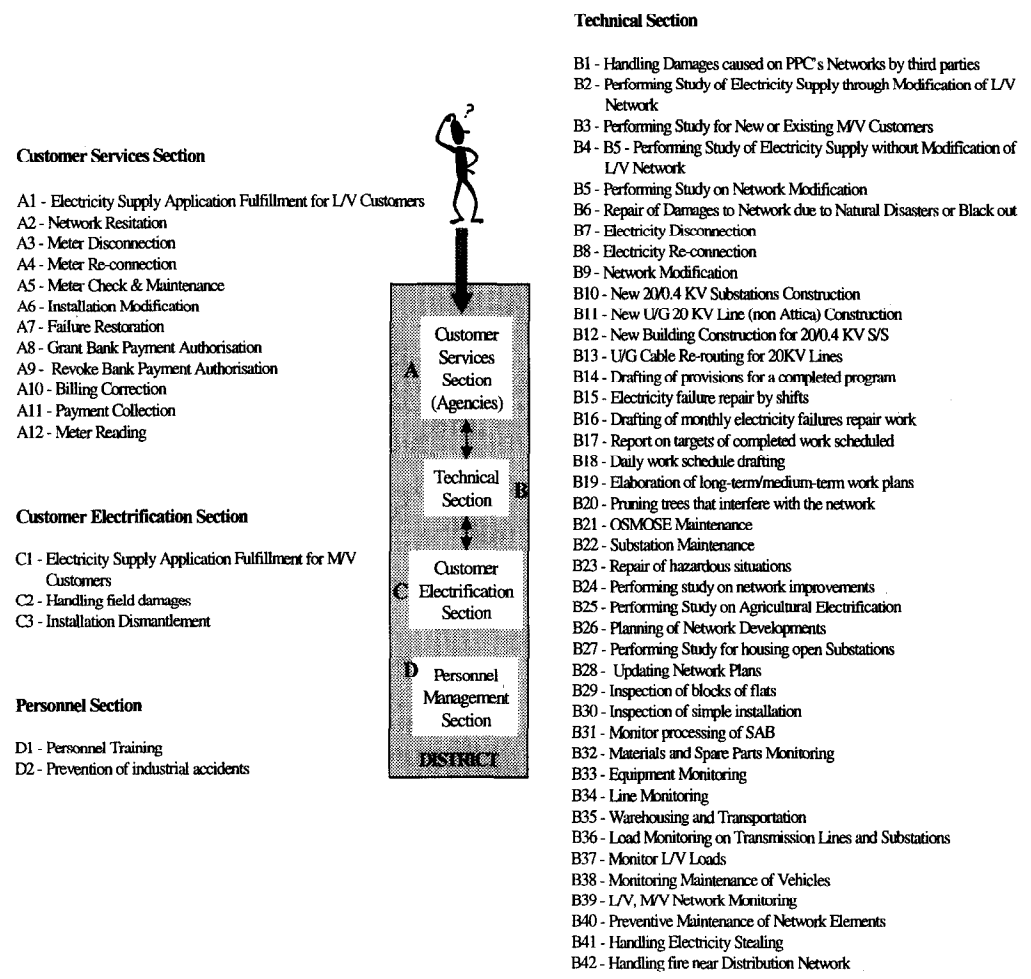


Fig. 10: Overview of District Micro-Processes According to the Functional Organisation

In order to understand the interactions between the functional unit described in Figure 10 we proceeded to modelling the current District behaviour in terms of actor-role diagrams of District activities. An actor-role diagram presents a high-level view of the association between actors and their different roles. An example of an actor-role diagram for the `A1:'Electricity Supply Application Fulfilment for the L/V Customers'` is illustrated in Figure 11. This diagram describes the actors involved in supplying electricity to a L/V customer. This is a core District activity and is realised through the co-operation of several District actors. This co-operation is modelled in terms of dependencies between roles.

For example in Figure 11, the `'service requesting'` role depends on the `'service administrative handling'` role for the achievement of its goal `'to get connected to the electricity network'`. On the other hand the `'service administrative handling'` role depends on the `'service requesting'` role for receiving money (resource dependency). Similarly the `'service providing'` role depends on the `'service authorising'` role for authorising the construction of customer installation (hierarchical dependency). Finally, the `'service authorising'` role depends on the `'service administrative handling'` role for completing the contractual and financial tasks before it can give authorisation (activity dependency).

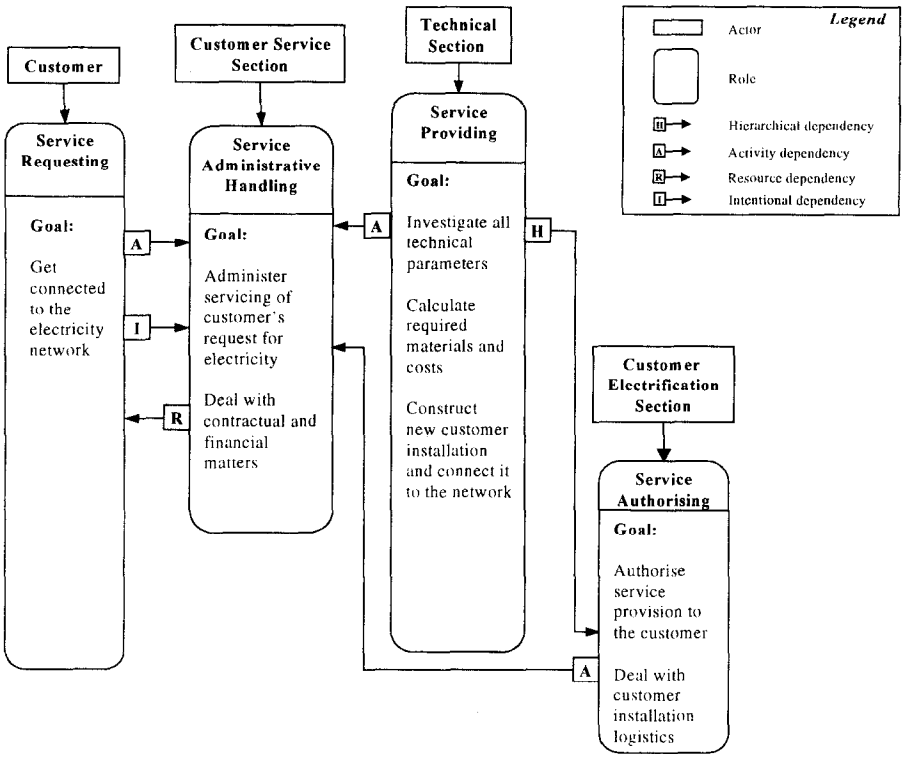


Fig. 11: Actor-Role Diagram Concerning the 'Electricity Supply Application Fulfilment for the L/V Customers'

The advantage of the actor-role diagram is that it provides a clear view of the interactions across different functional divisions. In this way it becomes apparent that fulfilling a L/V customer application for electricity supply is not solely the responsibility of the Customer Services Section but also depends on the co-operation of the Technical and Customer Electrification Section. Such interactions would appear as inputs/outputs in an activity-oriented view, thus obscuring the fact that `'Electricity Supply Application Fulfilment for the L/V Customers'` cannot be performed independently of other activities performed by other sections. In addition the ability to include the customer role in the actor-role diagram, is a step towards a process-centred view of the organisation in which each process has a customer.

The actor-role diagram gives a first-cut view of the organisational aspects regarding the responsibilities of individuals or groups in their involvement in the operation of a business process. A more detailed view of these roles was constructed in terms of role-activity diagrams [19]. These diagrams show the set of activities that are generally carried out by an individual or group within the context of their role.

An example of a role-activity diagram for the `'electricity supply application fulfilment for L/V customers'` is illustrated in Figure 12. Role-activity modelling encourages the identification of the key operational components which can be measured (activity duration, actor skills, resource costing etc.). In that sense role-activity models provide the context for performing evaluation of process efficiency.

5.3. Construct Intentions from Roles

In Section 5.2 we presented a small example of micro-processes organised according to the current functional structure of the electricity company. The key question however of "what are the types of processes and how should they be logically organised?" still remains unanswered. We address this question by using the business goals that represent the intentions of processes. These goals are presented in the 'body' of each role in the actor role diagram in Figure 11. Such goals are mainly operational goals, that is they are expressed in terms of business objects and activities that realise them. For example the `'service providing'` goal to `'construct customer installation and connect it to`

`the network'` refers to the `construct installation`, `install meter` and `connect meter` activities identified in the role-activity diagram in Figure 12.

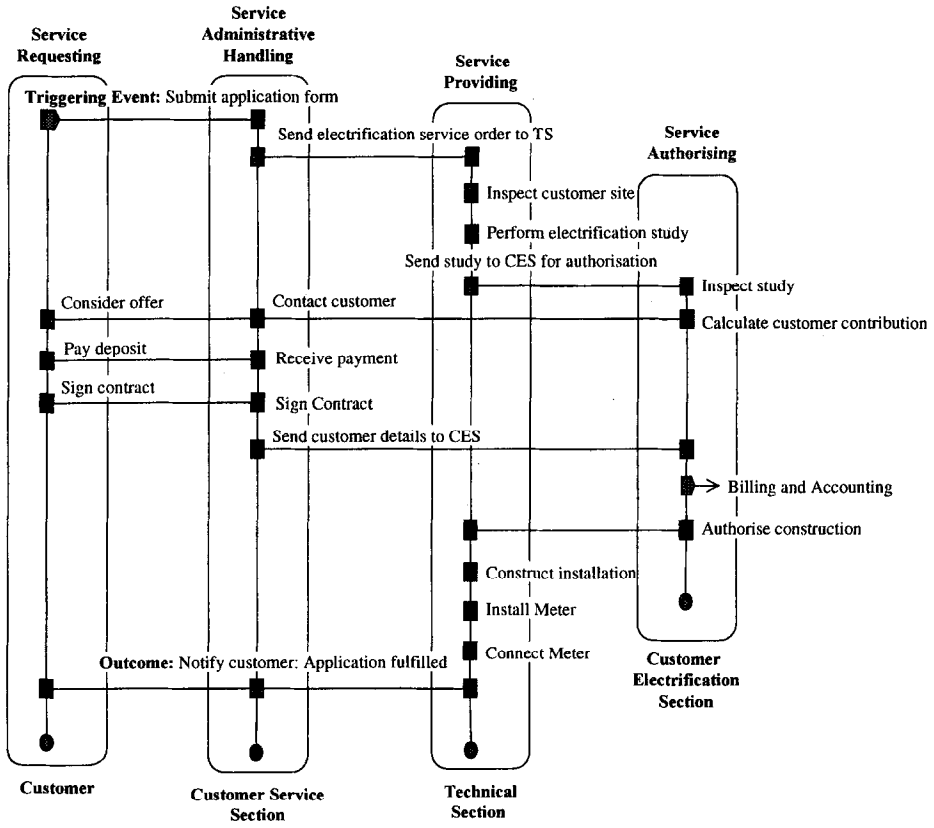


Fig. 12: Role-Activity Diagram for the 'Electricity Supply Application Fulfilment for the L/V Customers'

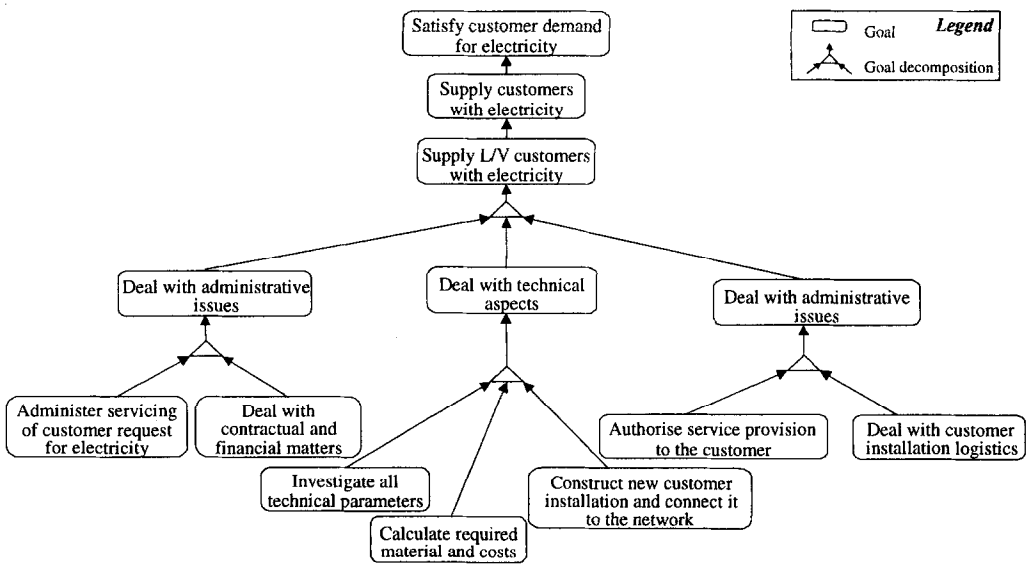


Fig. 13: Partial View of District Goals

As explained in Section 4.2 role goals represent low-level goals in a goal hierarchy. Having identified the role goals (i.e. those goals in the goal graph that represent operationalisations of the business objectives) there was a need to establish their causal relationships to higher-level goals. Starting from the goals identified in Figure 11 we constructed the goal graph presented in Figure 13.

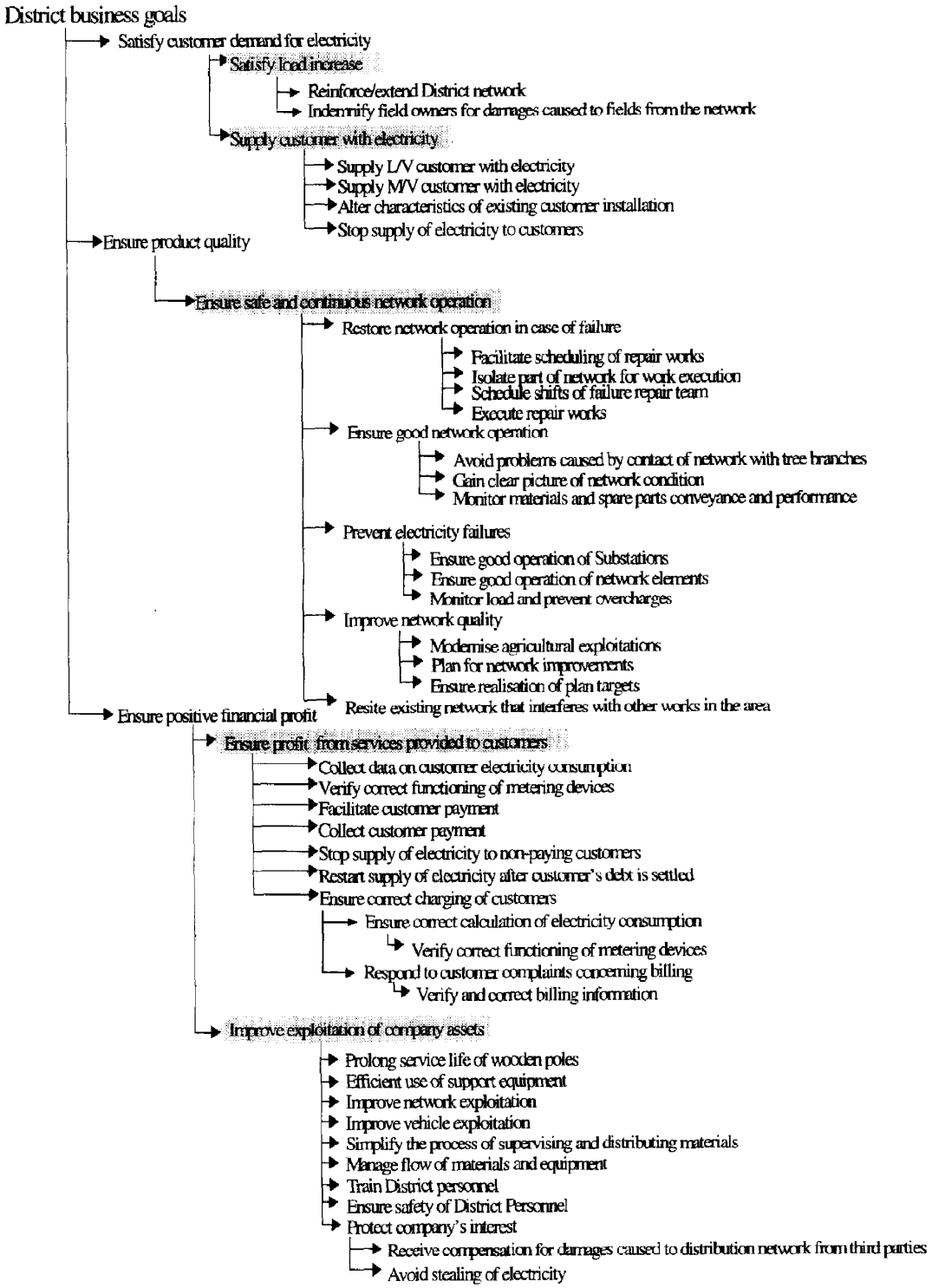


Fig. 14: Overview of District Business Goals

In Figure 13 it can be observed that goals related to the roles involved in fulfilling the application of a L/V customer for electricity supply, satisfy the higher goal `'supply L/V customers with electricity'`. This in turn supports the satisfaction of the goal `'supply customers with electricity'` which ultimately supports the achievement of the strategic District goal `'satisfy customer demand for electricity'`.

This process of abstracting from operational goals to higher intentions, naturally involved different stakeholders. The result was a clear, agreed view of the reasons for the business process (the WHY dimension, see also Figure 8).

By repeating this process for all District roles we delivered the following goal hierarchy that explains what the District is currently trying to achieve. A global view of the District goals and the associated activities is presented in Figure 14. Each leaf goal in this goal tree refers to specific business micro-processes studied in the actor-role/role-activity modelling step.

5.4. Adopt a Process View, Driven by Discovered Goals

Using the goal graph illustrated in Figure 14 District micro-processes are grouped in five core business processes each aiming to achieve a strategic business goal. These are:

Business Process	*Business Goal*
Customer electrification	Supply customer with electricity
Network reinforcement/extension	Satisfy load increase
Network operation	Ensure safe and continuous network operation
Exploitation and maintenance of company assets	Improve exploitation of company assets
Customer Billing	Ensure positive profit for services provided to customers

Table 1: List of District Business Processes

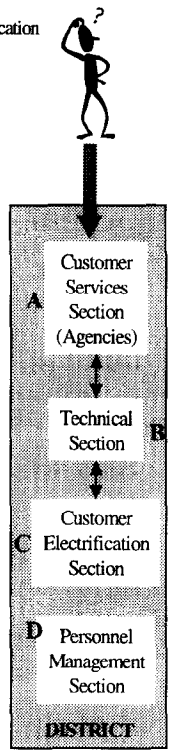
The business processes presented in Table 1 process correspond to the goals highlighted in Figure 14. Each process is composed by the micro-processes that realise the subgoals of the goal that is realised by the entire process. Thus the map of District micro-processes is re-organised in terms of the *goals these activities aim to achieve.* The result is illustrated in Figure 15.

In contrast to the 'vertical' map illustrated in Figure 10, Figure 15 presents a 'horizontal' view of the District whereby each District process crosses functional boundaries and requires the collaboration of more than one District sections. Indeed it can be seen in Figure 15 that for each business process there is a horizontal referencing, including micro-processes from two or more District sections (shown as A, B and C and D in Figure 15). For example the `'customer electrification'` process involves the collaboration of the Customer Services Section, the Technical Section and the Customer Electrification Section.

Customer electrification
A1 - Electricity Supply Application Fulfillment for L/V Customers
B2- Performing Study of Electricity Supply through Modification of L/V Network
B4 - Performing Study of Electricity Supply without Modification of L/V Network
C1 - Electricity Supply Application Fulfillment for M/V Customers
B3 - Performing Study for New or Existing M/V Customers
B30 - Inspection of simple installation
B29 - Inspection of blocks of flats
A4 - Meter Re-connection
A6 - Installation Modification
A7 - Failure Restoration
A3 - Meter Disconnection
C3 - Installation Dismantlement

Network reinforcement/extension
B9 - Network Modification
B5 - Performing Study on Network Modification
B10 - New 20/0.4 KV Substations Construction
B11 - New U/G 20 KV Line (non Attica) Construction
B12 - New Building Construction for 20/0.4 KV S/S
B27 - Performing Study for housing open Substations
B28 - Updating Network Plans
C2 - Handling field damages

Customer billing
A12 - Meter Reading
A5 - Meter Check & Maintenance
A8 - Grant Bank Payment Authorisation
A9 - Revoke Bank Payment Authorisation
A11 - Payment Collection
B7 - Electricity Disconnection
B8 - Electricity Re-connection
A10 - Billing Correction



Network operation
A7 - Failure Restoration
B23 - Repair of hazardous situations
B42 - Handling fire near Distribution Network
B6 - Repair of Damages to Network due to Natural Disasters or Black out
B16 - Drafting of monthly electricity failures repair work
B14 - Drafting of provisions for a completed program
B15 - Electricity failure repair by shifts
B20 - Pruning trees that interfere with the network
B31 - Monitor processing of SAB
B34 - Line Monitoring
B32 - Materials and Spare Parts Monitoring
B13 - U/G Cable Re-routing for 20KV Lines
B22 - Substation Maintenance
B40 - Preventive Maintenance of Network Elements
B36 - Load Monitoring on Transmission Lines and Substations
B19 - Elaboration of long-term/medium-term work plans
B18 - Daily work schedule drafting
B17 - Report on targets of completed work scheduled
B26 - Planning of Network Developments
B24 - Performing study on network improvements
B25 - Performing Study on Agricultural Electrification
A2 - Network Resitation

Exploitation and maintenance of company assets
B21 - OSMOSE Maintenance
B33 - Equipment Monitoring
B35 - Warehousing and Transportation
B37 - Monitor L/V Loads
B38 - Monitoring Maintenance of Vehicles
B39 - L/V, M/V Network Monitoring
D1 - Personnel Training
D2 - Prevention of industrial accidents
B1 - Handling Damages caused on PPC's Networks by third parties
B41 - Handling Electricity Stealing

Fig. 15: District Process Map Based on District Goals

6. DISCUSSION

The purpose of business process modelling is ultimately the improvement of the enterprise in order to deal with change. In general therefore, we advocate that change management should be seen as the process of identifying business goals and relating business processes to these goals.

Returning to the District application, capturing goals for change presented a number of problems stemming primarily from: (a) the uncertainty of the future situation and (b) the different perceptions that different District personnel had on the issues for change.

In order to facilitate the acquisition of District goals for change, a co-operative, discussant approach was employed which gave the ability to participants to:

- loosely define and rationalise issues regarding the future situation
- refine and categorise future requirements
- prioritise requirements through a variety of voting procedures
- analyse interdependencies between the requirements
- hinder dominant participants so that they did not adversely affect the outcome.

The whole process was assisted by the use of Ventana GroupSystems©. GroupSystems is a suite of team-based decision software tools that were used for the identification, elaboration and resolution of requirements. It includes a number of useful tools including the Issue Categoriser, Electronic Brainstorming, Group Outliner, Topic Commenter and Voting tools. By engaging in such activities the participants managed to agree on a number of critical issues relating to the future of the District. The identified goals were extensively discussed and rationalised in a process that necessitated several sessions involving both strategic and operational District personnel.

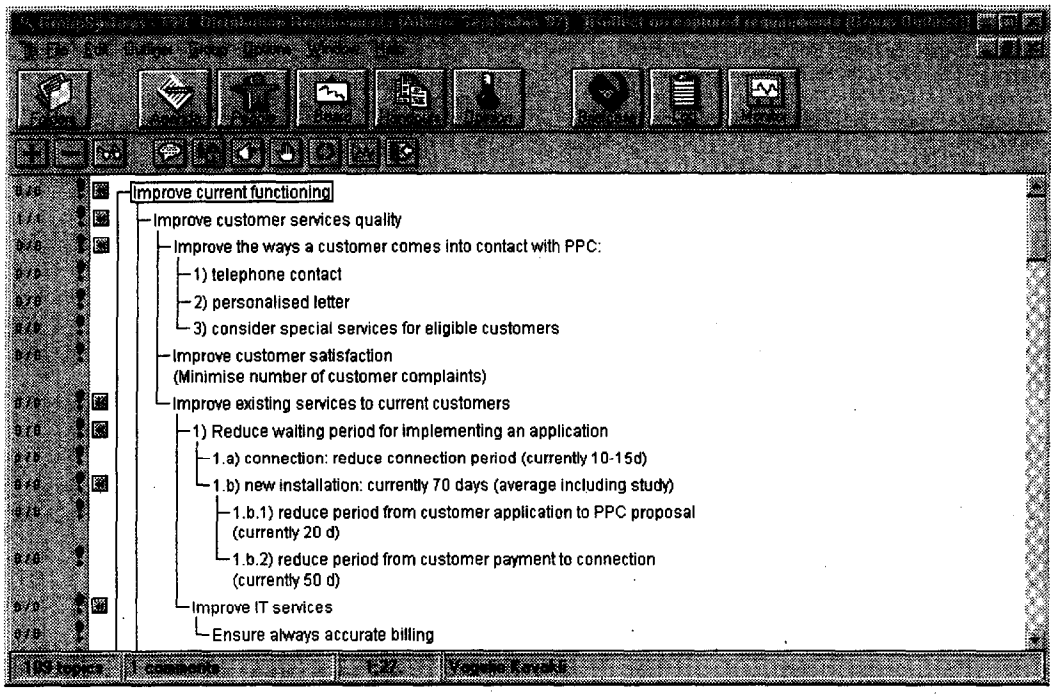


Fig. 16: Refining District Goals for Change

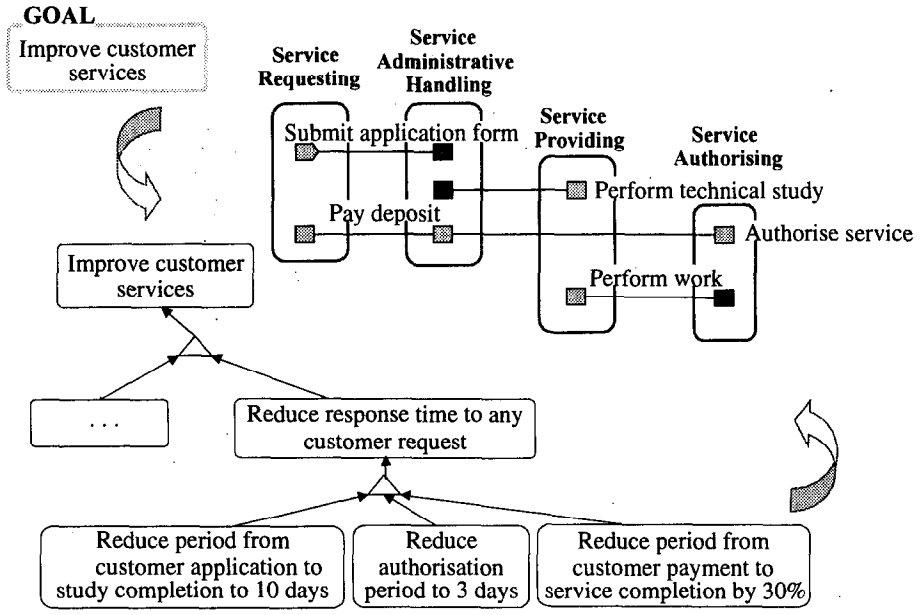


Fig. 17: Reasoning about Goals for Change in Relation to Current Processes

The initial goals were usually quite vague and could be interpreted in more than one way thus they had to be further clarified and refined in less abstract ways that could be related to operational Distribution components. An example of refinement using the GroupSystems software tool is shown in Figure 16.

Identifying and refining goals for change greatly depends on understanding the current situation. For instance, refining District goals was made possible by relating them to existing enterprise processes as illustrated in Figure 17.

As seen in Figure 17, the goal 'Reduce response time of any customer request' can be refined in terms of measurable requirements that refer to specific micro-processes involved in the Electricity Supply Fulfilment process, e.g., 'Reduce period from customer application to study completion to 10 days', 'reduce authorisation period to 3 days', and 'Reduce period from customer payment to service completion by 30%'. In addition, the fact that the Distribution Electricity Supply Fulfilment process have already been modelled in terms of role-activity diagrams, can further assist in evaluating the reasonableness of these proposals and also to reveal the points where process delay occurs and suggesting improvements.

Of course in some cases it is not possible to identify any existing process that can be related to the goal for change. For example, the objective 'build a commercial profile' refers to processes that are completely new for a company that did not have to deal with competition up to now. In this case the new process should be defined from scratch again as a causal transformation of business goals (see Figure 8).

7. RELATED WORK

A number of frameworks in the areas of enterprise modelling and CSCW have introduced the concept of goal and employ goal-oriented techniques to describe the intentional dimension of collaborative group communication and work processes. For example in ORDIT [7] goals appear in the guise of an individual's responsibility for behaviour; i.e., an individual is responsible to some other individual for some state of affairs. In a similar manner, goals in the ***i**** approach [23] are embedded in the intentional dependencies among organisational actors; i.e., an actor depends on another actor to bring about a certain state of affairs. Goals are explicitly represented in the ICN approach [9]. In this approach an organisation is seen as a tuple [G, A, R] where G is a set of goals, A is a set of actors and R is a set of resources. Actors act collaboratively using resources in order to attain their goals.

The focus of these approaches is on individual agents and their goals that drive and justify their individual activities as well as their co-operation. Whilst our approach shares this direction, we also advocate a more holistic framework whereby, business goals as well as individual actors' goals are considered in terms of systematically analysing current business processes.

Goal analysis approaches have also been proposed to facilitate management of business change in terms of (a) understanding the need for change and (b) deriving the future enterprise specification. In the first case goal analysis is performed in the context of business strategy analysis (e.g., [3, 17, 18]). The objective of this analysis is to ensure that business problems to be solved are identified and that these problems are diagnosed correctly. Goals are described separately from other business components and are used as criteria against which business alternatives are evaluated. In the second case, a number of schemes have been proposed using a goal-oriented approach to arrive at future enterprise solutions [4, 13, 14]. The main idea is that the new enterprise situation should be viewed as fulfilling some higher goals in the business environment. By starting at these higher goals, one can arrive at alternative business solutions in a top-down goal reduction process. Business activities and responsible actors come into the picture only after goals have been sufficiently reduced.

This paper advocates a more iterative approach whereby business change is considered as the on-going evolution of an existing situation (as opposed to the design from scratch of an overall system). Thus, management of change starts with observations about the current enterprise state whilst emphasis is given towards analysing the impact of internal enterprise needs on existing business processes. In this way top-down elicitation of business goals from stakeholders is used in conjunction with bottom-up discovery of goals based on the analysis of actual business functionality, the main advantage being that resulting goals better reflect the actual business requirements rather than prescribing some idealistic situation [2].

8. CONCLUSION

The goal of a process organisation is to create a high performance workplace, a high quality work environment noted for excellence in efficiency, effectiveness and customer satisfaction. With a focus on process, it is very common to see process organisations managing interdisciplinary work teams instead of specialised units seen in traditional organisation of enterprises. In this paper we have presented an

approach to business process modelling based on the notion of 'process abstraction through intentional affinities'.

In contrast to traditional business process modelling approaches which focus on business activities, the proposed approach puts forward the concept of business goal in order to describe the collaboration between business actors. In this way it:

- advocates a closer alignment between intentional and operational aspects of the organisation
- links re-engineering efforts in different business functions to strategic business objectives

In addition we showed how the models of the current District processes were used as the basis for capturing business goals for change. These goals describe how changes can be performed, at an intentional level. Analysis of the impact of the District goals for change on the current situation led to the transformation of existing processes as well as the introduction of new processes. This goal-driven deliberative approach presented further benefits from an organisational perspective: (a) it increased the awareness of District personnel about the issues for change (b) it encouraged the active involvement of both strategic and operational District personnel to participate in the creation of the company vision. In addition, the increased transparency concerning existing infrastructure and business objectives, allows optimisation in resources management and better decision support for managing future changes.

Finally, a major benefit of enterprise knowledge modelling is in its ability to facilitate the sharing and of pre-existing domain knowledge. Such knowledge can be externalised in terms of generic knowledge patterns that can be re-used in similar settings in different applications. To this end, the systematic documentation of the District experiences in terms of the EKD concepts represent a major step towards the development of domain knowledge models which can be used to inform the process of change undertaken in other ESI companies. This in effect can drive the identification, definition and ultimately dissemination of *best business practices* to the rest of the ESI sector, which constitutes the current focus of our work.

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