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Management information needs a common conceptual framework

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Abstract

The presentation of management information on screens and paper is aimed at the initiation of control actions in order to bring about predefined goals. The terms and concepts used in this control information can be interpreted in different ways. It is of vital importance that adequate definitions for these terms and concepts are provided, because of the area of tension between those that control and those being controlled. The creation of a common conceptual framework and the maintenance of concepts and definitions can be supported by a the construction of an organization-specific lexicon and the use of modern IT tools.

1. Introduction

This paper deals with the definition of concepts and terms that are part of the general management's or chief executives' management information. Management information is used to enable managers to perform adequate control actions. Starting from the organization's goals and critical success factors performance indicators are identified that are given a planned (norm) value. Periodically the realized values of the performance indicators are measured, using internal and external information sources. When a significant difference between planned and realized values is detected the manager needs to initiate control actions, in consultation with other managers. It is important that the controlling managers and those being controlled use a common conceptual framework. The provided management information has to be interpreted uniformly by all. In practice one usually aims at the rapid development of automated executive information systems (EIS) where emphasis is put on the data, while communication, language- and action aspects are underestimated. We feel, however, these aspects play a crucial role in the successful and large-scale implementation of EIS.

In the rest of this paper emphasis is put on language-related problems within a large organization with hundreds of independents business units, that together use a restricted number of automated information systems for tactical and strategic decision making. The general problem is as follows: management information often contains concepts and terms of which the meaning is not (precisely) clear. Managers receiving more and more information want to know which data is incorporated in the information, what it means and which actions created it, in order to provide a basis for directed control actions.

In section 2 we take a closer look at the concept of controlling and the impact it has on organizations, since this seems to be a typical Dutch approach. In section 3 a problem situation from everyday practice is described. The management and control situation at Rabobank Nederland is worked out, describing the strongly felt need to adequately define the concepts used in management information for a broad group of managers and chief executive officers. Based on this, section 4 describes a corporate lexicon as a solution that can be realized using a modern IT tool. Section 5 describes the Definition tool, that can be used for setting up and filling the corporate lexicon. The corporate lexicon itself has not (yet) been realized.

2. Management control

2.1 Control theory

Controlling seems to be an inherent property of people. It is defined as "a form of directed influence a person has (or tries to establish) over (groups of) objects and subjects in its environment". Within an organization this is done by using control cycles and their contained processes of control, usually leading to a specific form of control with which the (right of) existence of that organization is continued [Hamers, 1996a,b].

Control is based on a line of action set beforehand, i.e. the norm. If over time one (threatens to) deviate from the line a correction (or feed back control action) has to be made. The management tries to apply the feed back so the organization gets back on track. This not always succeeds at once. The feed back is either to little or to much, resulting in other feed back actions to be taken. This form of control yields a management control cycle. Each control cycle consists of four phases: planning the line of actions, i.e., the norm, measuring historical and actual values, comparing and evaluating them, detecting differences between norm and actual values, and adjusting to the original or plan.

Following the control paradigm a number of roles can be distinguished in a controlling situation. These roles are: the environment, the control unit, the management information system, and the transformation process to be controlled (see figure 1).

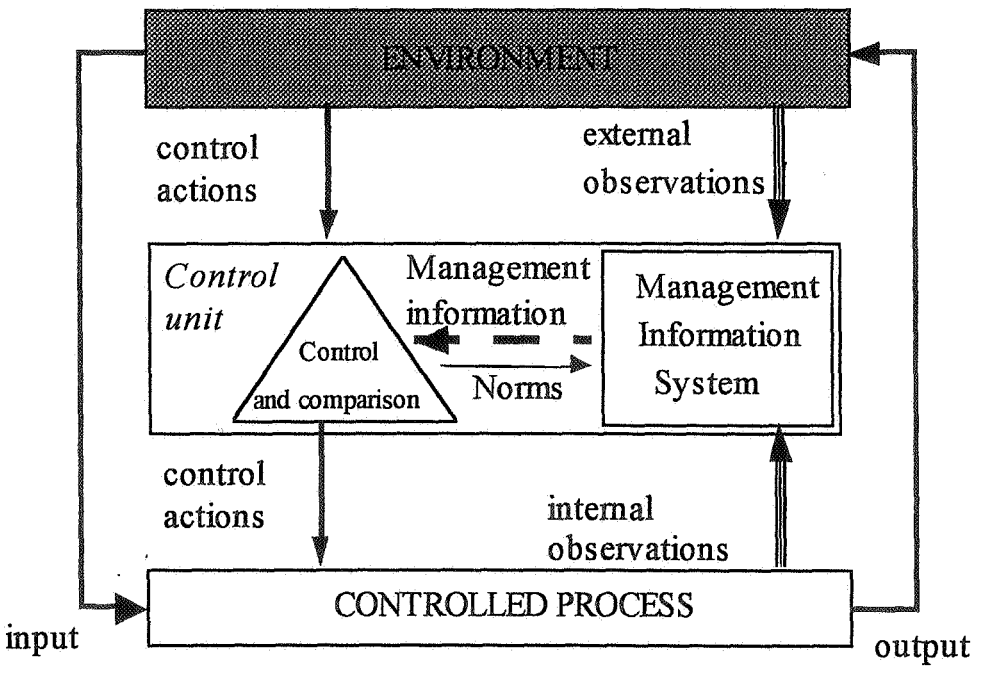

Figure 1: Control paradigm

The environment provides the input for the transformation process to be controlled. The environment is also responsible for steering the control unit (by control actions) regarding its functioning. The control unit will translate this steering information into control actions directed towards the transformation process. Optionally extra 'local' control actions can be added. The control and comparison component generate norms that are recorded in the management information system. Through feed back in the transformation (controlled) process internal observations are generated that are also recorded in the information system. From the environment external observations are collected in order to obtain a more complete picture of what goes on inside and outside the control unit and transformation process. The management information systems provides the control and comparison component with management information that is based on both the norms and data from the internal and external observations, Management information therefore can be defined as "information that is oriented towards the development of possibly new control actions and norms based on data from internal and external observations that are compared with the original norms".

2.2 Control within the organization

To measure the results within an organization, according to the principles of management information, demands an explicit line of action to be determined. The desire to quantitatively measure the results by using an automated information system strengthens this requirement even further. The line of action is established in a mission statement, a strategy and the formulation of long-, medium- and short-term goals for the different management levels.

The consequence of making the control cycle and its phases explicit is that the previously rather informal and non-obligated way of doing business has to be changed to formalized planning and control cycles with concrete and measurable concepts like important performance indicators, control variables, i.e. specific information needs by the management. Several methods are available for taking inventory of the management's information needs ([Akkermans, 1993], [Kaplan and Norton, 1992, 1996], [Rochart, 1979], [Rochart and Treacy, 1982]).

Furthermore, goals on the several control levels should be related, per aspect, in a certain structure, so their connection (in time) is made clear. Also the relationship with new projects and available resources are part of this structure. All this raises specific requirements on the verbal and data-oriented description of those entities. Deviating interpretations, misunderstandings and differences of opinion on the goals and realization of them have a great impact, especially on higher management levels of an organization, and particularly if control actions are deemed necessary at a certain moment. Since the communication between managers is language oriented, it is of crucial importance attention is paid to the linguistically correct definition of the goals, critical success factors and performance indicators, and thereby establishing a relation between the internally and externally obtained data.

3. Problem situation

3.1 Rabobank

The Rabobank organization consists of over 530 independent local Rabobanks, their umbrella cooperation Rabobank Nederland and a number of related institutes. Rabobank Nederlands supports the local banks and monitors their liquidity and solvency. Rabobank Nederland also functions more and more as a holding for specialized subsidiaries like Rabobank International (corporate banking, investment banking and private banking), Interpolis (insurance), De Lage Landen (leasing and factoring) and Nedship Bank (shipfinancing). Soon, Robecam, the holding company for the Roberco Group (investments), is economically integrated within the Rabobank organization.

The local banks are independent cooperative societies. Their goals are: 1) helping realize the members' and other customers' ambitions by offering the best possible financial service at the best possible rate; 2) contribute to the development of the local community. For this the Rabobank organization offers a diverse service package to both companies and individuals.

In balance sheet figures the Rabobank organization is the second largest bank in the Netherlands. In market shares it is the largest in the domestic market. Over a third of the total Dutch payment transactions is handled by the Rabobank. Internationally it belongs to the forty largest banks in the world. To service its clients worldwide the Rabobank organization, through Rabobank International and its daughter organizations, controls an international network of 84 branches in 32 countries. In Europe the bank has 33 branches in 12 countries. Within Europe the customers are services both from the own offices and a network of 35.000 offices of foreign strategic alliance partners.

3.2 Language domains

The Rabobank organization in the Netherlands has 3 management levels with their own management information language domain (see figure 2). With a language domain is meant: a common conceptual framework used by all parties involved. Within each management level parties play either the role of control unit or controlled process. Through the levels a party can play in one situation the role of control unit and in another situation that of controlled process, thereby acting in several language domains.

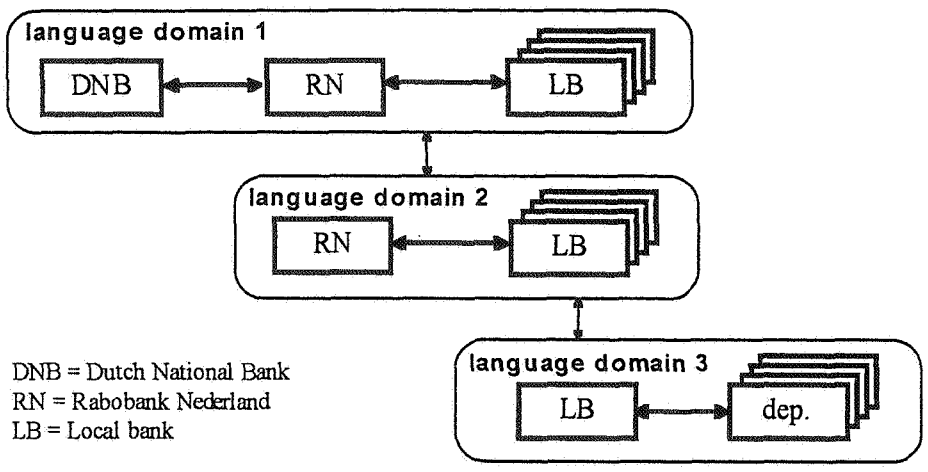

Figure 2: Language domains

Every language domain has its specific characteristics:

- *Language domain 1:*

  Rabobank Nederland (RN) has the legal obligation to periodically report a consolidated balance sheet and profit account, together with a number of ratios and some special (commercial) data from all Local Banks (LBs) to De Nederlandse Bank (DNB). DNB uses separate guidelines for the classification and calculation of the components for this. This information in fact is the joint accounting information of all local Rabobanks to DNB (In this paper we do not distinguish between accounting and management information, since this is not of vital importance to the definition problem).

- *Language domain 2:*

  Besides the accounting obligation, RN also has the need for separate control information for all LBs in total (also called ΣLB) and for each LB separately. In general, each concept used here has the same meaning for each LB, so that the LBs can be compared on performance.

- *Language domain 3:*

  The individual LBs furthermore need their own control information, based on their specific environment and their organization in departments, each with their own (deviating) interpretation of certain general concepts (from language domains 1 and 2).

3.3 Definition problem

The concepts and terms used in the language domains may overlap. There are (commercial, financial, personnel, ...) concepts that appear in all three, or in two, or only in one language domain (see figure 3; the overlap is fictitious). Furthermore, concepts from different domains can be related. A LB can introduce a new term in which concepts from other domains are used (e.g. in a calculation).

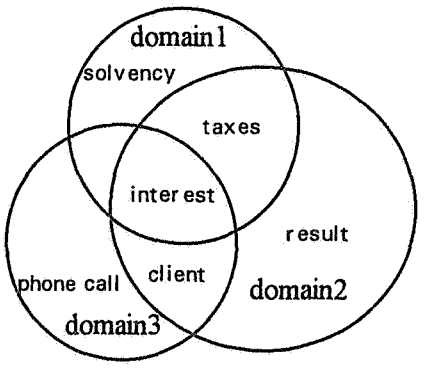

Figure 3: Overlapping language domains

Since the banking world hosts a broad range of concepts there is a strongly felt need for a clear and correct interpretation of these concepts by bank managers. Besides ordinary dictionaries a special dictionary for banking concepts was published [Banklexicon, 1987]. However, this does not suffice for the Rabobank. In an information processing organization like the Rabobank numerous overviews and reports with information and data are produced using different but closely related or similar concepts. It seems obvious to streamline this enormous mass of concepts by carefully defining them, in order to increase efficiency in mutual communication between senders and receivers of (control) information and effectiveness of the initiated (control) actions based on it. The concept definition, together with the associated information analysis, is not meant to determine (the extension of) a functional information need in order to generate a technical datastructure in a database. Rather, it is aimed at the creation of a common semantic framework for management information ranging over the three language domains.

In the past efforts were made to capture limited areas of the language domains using concept lists. Those lists contained:

- the concept (alphabetically ordered), and
- its definition, based on the verbal connection to other concepts; often aimed at the mathematical decomposition of the concept (e.g., net profit is the gross profit minus turnover taxes).

The implementation of a new (management) information system usually caused the addition of such a list in the user documentation of the system. This resulted in many unrelated concept lists, that in the course of the advancing automation era only increased the confusion of concepts.

Also attempts to come to grips with the matter using a large data dictionary have not yet led to a solution. With the introduction of database management systems large companies have tried to record the layout of files, records and data attributes using data dictionary tools. This resulted in standardized technical codes and naming conventions aimed at automation experts. However, this offered no solution for the linguistic and semantic interpretation of the produced management information by the end users.

In 1995 the Rabobank started the construction of a word list for a specific control situation. It was aimed at defining all control variables on detailed management information reports. Each control variable has associated a unique name and explanatory definition, as described above. This list is administrated using a database application (Microsoft ACCESS) on a PC. Through time the following problems have occurred:

1. Concepts used in the definition of a certain control variable, that do *not* occur as control variable in the management information itself, could not be defined, despite the need for it. E.g., in the definition of the control variable 'number of consultations per mortgage offer' the concept 'consultation' is used, which is not part of the management information itself. But what precisely is a 'consultation' ? Is it a conversation with a client about mortgage information at the office for at least 10 minutes, or do phone calls count too ?
2. There is not one single definition of a control variable, but several, depending on the context. E.g., the 'profit' on a product A is built up of different components, and therefore defined differently than the 'profit' on a product B.
3. An official foundation for generally used concepts used by the Rabobank organization is missing. E.g., is it 'associated bank' or 'local bank', is it 'client' or 'customer' ?
4. There are no guidelines for naming conventions of control variables. E.g., should the form and type of the control variable (% or number) be part of the name ?
5. Defined control variables are calculated using available data from internal and external transaction and information systems. Each system has its own (and often undocumented) language domain or dialect. Coupling the data to the control variables is done on indication by the system manager or a local domain expert and therefore results in an arbitrary connection.
6. The definitions of the control variables should be offered in the most up-to-date version to the end user that requests them. Since the lists are distributed over the PCs of the end users and not accessed centrally this is not possible.

7. Concept definition is not studying all existing interpretations of the concept, but the mutual agreement and acceptance of a steady definition of a named concept.

For management information services a common conceptual framework is needed for several language domains within the Rabobank organization. This should include interrelationships between the concepts and a direct accessibility of the most up-to-date name and definition. Defined concepts are related to (registered process) actions. The results of these actions are collected, stored, processed and distributed as information. Defining the concepts requires one to know which actions form the basis of which information. It is then possible to discover that for certain concepts the wrong actions are performed. In turn this has repercussions for the business process design and administrative processing thereof. In itself the understanding of the relationship between linguistic terms and actions within an organization is a first result of the definition of concepts and terms. The second effect is aimed at the decision process of managers. They will reconsider the goals and ways of achieving them. Obtaining management information based on defined concepts leads to control actions that are taken by mutual agreement. These actions often have a great impact on the organization. The linguistically based definition of concepts therefore span across the operational short-term actions in an organization on the one hand, and the long-term decisions and actions on tactic and strategic management level on the other.

The goal is to develop a corporate lexicon for the Rabobank organization. The next sections describe how such a corporate lexicon can be set up, and we also take a closer look at a (prototype) tool that can be used to define the structure of the lexicon and fill it.

4. *Setting up a corporate lexicon*

To set up a corporate lexicon such as needed by the Rabobank, we must first answer two questions: what is the structure of the lexicon, and how it is filled (the process).

Drawing on theories of lexical semantics, we propose a two-layered structure. The kernel of the Lexicon consists of a network of concepts that are defined solely by their interrelations. For verbal predicates, these are their typically defining actions. Such relations include for example the argument structure: what are the participants in the action and what is their role. For nominal predicates, we have other relations, such as hyponymy (generalization, specialization), part-of relationships and function links. In the next section, this semantic network is described in more detail, and also a (prototype) tool, the Definition tool, is introduced that can support the process of filling in the lexicon.

Around the kernel we have a layer of defined concepts. Performance indicators that play a crucial role in the management information system are (often quantitative) terms that can be defined by a formula or verbal definition, using the basic terminology provided by the kernel. In contrast to the concepts in the kernel, a precise meaning definition of these terms can be given. Since the concepts are not defined further, but only interrelated, the definition process does not lead to an infinite regress.

The defined concepts can be used in several ways; first as performance indicator, or item on management information reports, etc. Secondly, using modern IT and network facilities the Rabo-lexicon can be made available over the intranet of the Rabobank. The information systems producing the reports can access the lexicon, and the definition (and semantic network) of selected concepts can be displayed on request. Information profiles of both the user and the information system can be used to determine the most appropriate and likely context of the concept. The user should be able to browse the lexicon and retrieve relevant definitions of related concepts. Thirdly, other authorized parties within the Rabobank organization can use the general (kernel) definitions in the lexicon to define and update their own terms (from their language domain).

4.1 Theories of lexical meaning

The Definition Tool is built on linguistic theories of word meaning. In this section, we review some relevant work in this area.

In lexical semantics, the study of word meanings, we can distinguish two different approaches: primitive-based theories and relation-based theories. Those advocating primitives assume that word meaning can be exhaustively defined in terms of a fixed set of primitive elements. These elements can

be simple binary features such as ANIMATE ([Katz, 1972]) or conceptual primitives (such as CAUSE) from which more complex structures can be composed (e.g., [Schank, 1975]). Although each of these approaches has its merits and weaknesses, one general problem is that the choice of the primitives remains rather arbitrary. In contrast, a relation-based theory of word meaning claims that there is no need for decomposition into primitives if words are associated through a network of explicitly defined links (e.g., [Miller and Fellbaum, 1991]). The traditional "meaning postulate", in which a word is described by other words (in a verbal definition) is relation-based, but other approaches limit themselves for establishing links, such as for hyponymy ("isa" relation) and meronymy ("part-of").

Both theories have a fundamental problem with the *dynamics* of word meanings. By this we mean that speakers constantly use words in a creative and flexible way, thereby slightly moving its basic sense. Words have a prototypical meaning ([Lakoff, 1987]), but not all of the features of the prototype need be present. E.g., a purely "biological mother" is a mother, but not prototypical; and nor is a "raising" but not biological mother. Words can be used in a metaphoric or metonymic sense. E.g., a computer program can be called an agent, although "agent "is defined to be human. Metonymic sense shifts occur when the same word (e.g., "bank") is used for both the institution and the building. One recent approach to deal with these dynamic aspects in a systematic way is [Pustejovsky, 1991].

Since De Saussure, most theories of word meaning acknowledge that word meanings are not determined (only) by their referent, but also (or exclusively) by their contrasts to other words. Each language throws a different conceptual "web" over reality. The task of the lexicographer is not to come up with an exhaustive definition, but with a definition that explicates the differences with neighbor terms. To this purpose, words are grouped together in *word fields* (e.g., the field of color names), and for each of the elements of the word field, a definition is built that distinguishes it from the other elements in the field.

For the design of the Definition Tool, we are not only interested in the definition itself, but also in the process of defining. Unfortunately, traditional lexicography has little to offer in this respect. Its goal –building dictionaries for the public– is different from our perspective. It is usually a solitary enterprise, based on large text corpora. In our case, we don't have these text corpora, usually, and an essential characteristic is that deviating, or even opposing, views have to be reconciled.

Having considered several theories, we have chosen for a relation-based theory of word meaning (networks), with particular attention to word fields. Advantages are:

- users don't have to learn and agree on semantic primitives;
- the result can be expressed in natural language and stored in a dictionary for reference;
- in the future, it might be possible to support the process with already existing lexical resources with a similar set-up (in particular, WordNet [Miller and Fellbaum, 1991]). This is not yet achieved in the first version (see below);
- although the first version also does not support explicitly the dynamic aspects of word meaning, this can be worked out later without changing the present set-up.

5. *Overview of the Definition Tool*

The Definition Tool is used in a collaborative setting in which a group of domain experts together with a facilitator give input to the definition process. The way of working with the Definition Tool follows a divergence/convergence phasing. Divergence occurs in the first creative phase, which is then followed by a convergence phase leading to consensus. More in particular, the following stages are distinguished: brainstorming, organization and voting.

(1) Brainstorming

The first stage starts with a list of "problematic" terms. Usually, this list will be the result of discussions preceding the Definition Process, in which case the facilitator can enter it. Otherwise, the group members can be asked to enter them, after which they are collected in one list.

Following this, the group members are asked to type in associations. This is done by selecting a term and filling in the Association field. A maximum number of associations per term can be set by the facilitator. The group members can not only enter the association, but also giving a weight to the link. These weights can also be given separately, after all associations have been entered first.

All associations are entered anonymously and collected in a single list.

(2) **Organization**

"Organization" is done by the facilitator in verbal interaction with the group. Here, the given associations are made more precise, missing associations are added, and non-relevant ones are skipped.

The facilitator can enter the Organization Window for a term. The associations can be ordered on the average weight assigned, or on the number of occurrences (Times made). In this way, it is easy to select a subset of most important associations.

To achieve more semantic precision, associations are named. The Definition Tool contains a predefined list of basic relations. This set is derived from WordNet ([Miller and Fellbaum, 1991]) and analysis of conventional dictionary entries ([Dik, Meijs, Vossen, 1992]). It contains (see also figure 4):

* ISA (or hyperonym, or "Broader Term")
* neighbor
* children (hyponym, or "Narrower Term")
* PARTOF (meronym)
* function (or purpose)
* synonym

Number	Relation	Description
1	Parent	The concept is a kind of the association
2	Neighbour	The association and the concept share the same parent
3	Child	The association is a kind of the concept
4	Part	The association is a part of the concept
5	Not a Part	The association is not a part of the concept
6	Function	The concept has the function described by the associati
7	Not a Function	The concept does not have the function described by th
8	Other Relation	The association is related to the concept by another rela
9	Relates to Homonym	The association is related to a homonym of the concept

Figure 4: The relations defined in the Definition Tool

For example, if a knife is defined as "an instrument made of steel for cutting", it has an ISA association with "instrument", a PARTOF relation with "steel" and a FUNCTION relation with "cutting".

In some cases, it is also desirable to make a negative statement (what it is not). This is also allowed. Although this does not really add to the definition, it can short-cut unspoken misunderstandings.

In some cases, it must be concluded that group members have radically different views. In that case, the word can be said to be ambiguous (homonymy). It is possible to distinguish different senses, and each sense can be defined then separately. If needed, the group can decide later to use both senses, perhaps with a different name, or select one by voting. The advantage is then that at least both senses have been made explicit, so the vote is not based on misunderstanding.

If an association can not be categorized according to the basic list, it is possible to leave it unnamed. It is also possible, for the facilitator, to enter new relation names.

The discussion about an association is done by the whole group and per association. In this way, the discussion is oriented to specific issues, instead of a heavy all-or-nothing agreement on a complex whole. If there is agreement on some associations, this can be a recognized even if there is still disagreement on other associations.

The Definition Tool helps in keeping the associations consistent by making the relation two-way immediately. For example, if one defines a knife as an instrument, then there is also a hyponym (child) relation between instrument and knife.

(3) Voting

When all the associations have been discussed , it is possible to show them in one window (figure 5). On the basis of this information, a verbal definition can be generated. At the moment, this is not done automatically yet but by the facilitator. The definition assembles the various associations, or the most important ones.

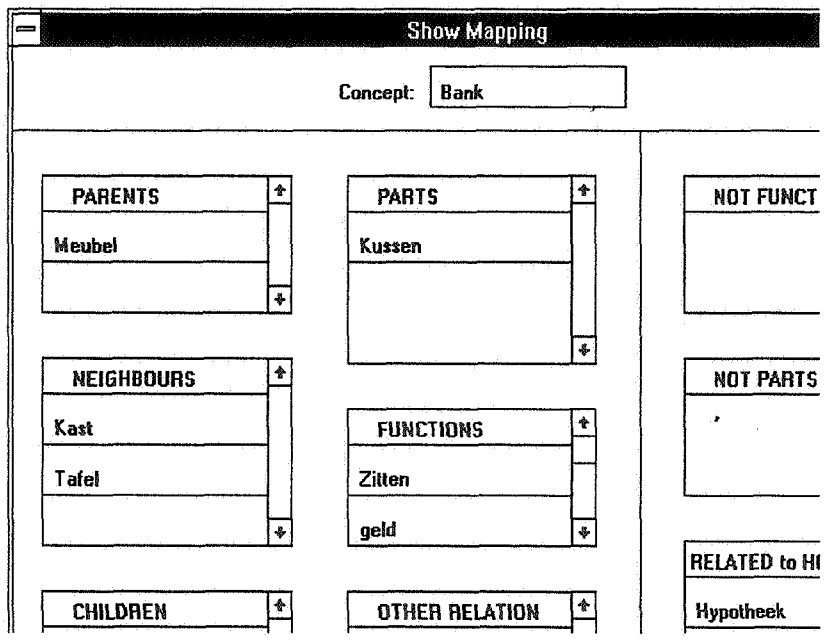

Figure 5: The concept map

If necessary, the group members can be asked to vote for a definition (see figure 6) If the definition is not accepted, the facilitator can enter a second one. Finally, when all definitions are ready and agreed, it is possible to show all definitions. This can be useful in later stages of the decision making. It is also possible to keep the definitions in the database and reuse them in later meetings.

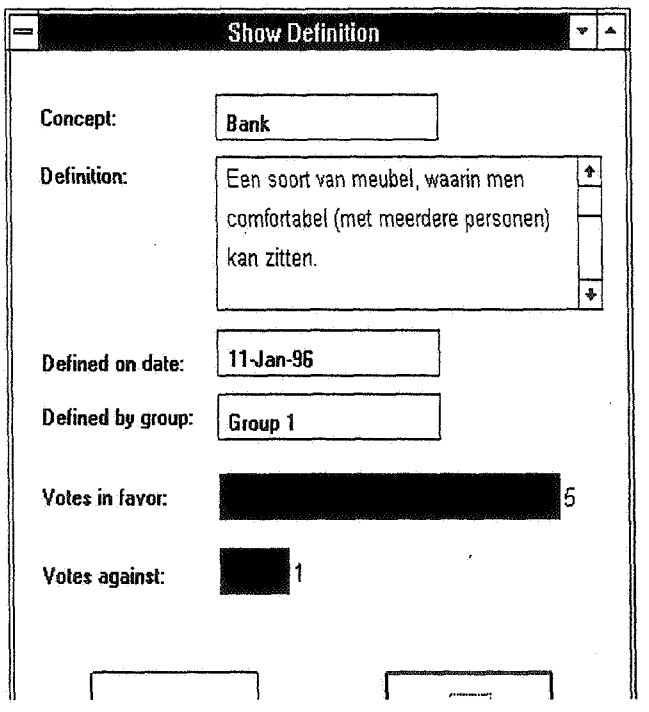

Figure 6: The definition as end result

5.1 Discussion

The Definition Tool has been implemented using VisualWorks for Windows. It uses a shared Oracle Database. Our next goal is to integrate it into our meeting room software (Group Systems) and set up experiments. Since no empirical results are available at this moment, we limit ourselves to a general discussion, including pointer to future extensions.

The strong point, in our view, of the Definition Tool is that it facilitates a structured discussion about concept definitions. By starting with a association generation stage, we avoid the pitfall of positing a definition too early. This would lead to a hot debate in which the underlying misunderstandings creep up only after a long time. By breaking up the definition into elementary associations, the discussion looses its all-or-nothing character. Both consensus and dissensus are made visible. Furthermore, the generating of associations is an anonymous group activity, hence avoiding polarization from the start.

A limitation of the Definition Tool in its first version is that it is not useful for all concepts. It is especially aimed at the description of terms (typically nouns) denoting a entity or state of affairs in reality. It is not well-suited for the definition of verbs and adjectives. We intend to extend the Definition Tool with specific support for verbs, and also for derived terms.

Besides basic terms and derived terms, we can also distinguish evaluatives. Evaluatives denote a property or value assigned to some object, for example, efficiency, reliability, success, failure etc. In some domains, terms that look referential can be in fact evaluatives. This is typically the case in law. For example, if it is forbidden to sleep in the station, it is a matter of evaluation when someone is said to be sleeping. In such a case, a definition typically includes the *decision procedure* that is used to make the evaluation. For example, a new product is considered a success when more than X instances have been sold in the first year. To support evaluatives, the Definition Tool should be extended with a focus on the decision procedure. This has not been realized yet.

Finally, we want to investigate further the use of preexisting knowledge during the definition process. As said above, the design is partly based on WordNet, a massive English lexicon containing about 95,600 word forms. It distinguishes different senses of words. This can be useful in the case that

there is confusion about the sense. The group members can be provided with the list of senses, and they can indicate which sense they have in mind. This will not be sufficient for more complex issues, where the term meaning is closely related to the problem domain in question, but it can be a starting point. Similarly, it is possible to use the results of the Definition Tool over a longer period. This will require some organizational effort in order to keep the definition list consistent. The advantage is that definitions can be simply taken over (organizational learning) or used as starting point for new ones.

6. Conclusion

Based on the desire to achieve certain goals and the need to control this process, it is necessary to obtain clarity on the (management) information that provides insight in the realization of the goals. This clarity therefore concerns the mutually agreed interpretation and definition of the management information. Several management levels can be distinguished within large organizations, each with their own language domain containing concepts from the management information. The language domains can overlap, it can be restricted to a limited number of parties, but also to a large group. Using a corporate lexicon makes it possible to define concepts within a language domain and interrelate them. A tool like the Definition tool can be used to set up, fill and maintain such lexicon. Using modern network tools the concepts and definitions from the lexicon can be made available to the end users while they consult management information from an automated system.

7. References

[Akkermans, 1993]. H. Akkermans, "Participative Business Modelling to support strategic decision making in operations - a case study", in: International Journal of operations and production management, vol. 13, no. 10, 1993.

[Banklexicon, 1987]. NIBE: Banklexicon, Kluwer, Deventer, 1987.

[Dik, Meijs, Vossen, 1992]. S.C. Dik, W. Meijs, and P. Vossen, "Lexigram - a functional lexicon for knowledge engineering", in: *Linguistic Instruments in Knowledge Engineering*. R.P vd Riet & R. Meersman (eds.), Elsevier, Amsterdam, 1992.

[Hamers, 1996a]. Z.F.M. Hamers, "Besturen in theorie en organisaties", in: Informatie, nov. 1996.

[Hamers, 1996b]. Z.F.M. Hamers, "Bestuurlijke informatie met EIS", in: Informatie, dec. 1996.

[Kaplan and Norton, 1992]. R.S. Kaplan, D.P. Norton, "The Balanced Scorecard, Measures that drive Performance", in: Harvard Business Review, January - February 1992.

[Kaplan and Norton, 1996]. R.S. Kaplan, D.P. Norton, "Using the Balanced Scorecard as a Strategic Management System", in: Harvard Business Review, January - February 1996.

[Katz, 1972]. J. Katz, *Semantic theory*. Harper and Row, New York, 1972.

[Lakoff, 1987]. G. Lakoff, *Women, fire and dangerous things*. University of Chicago Press, Chicago, 1987.

[Miller and Fellbaum, 1991]. G. Miller, and C. Fellbaum, "Semantic Networks of English", in:*Cognition*, Oct. 1991.

[Pustejovsky , 1991]. J. Pustejovsky, "The Generative Lexicon", in:*Computational Linguistics* 17(4), 1991.

[Rochart, 1979]. J.F. Rochart, "Chief executive define their own data needs", in: Harvard Business Review, maart - april 1979.

[Rochart and Treacy, 1982]. J.F. Rochart, M.E. Treacy, "The CEO Goes Online", in: Harvard Business Review, januari - februari 1982.

[Schank, 1975]. R. Schank, *Conceptual Information Processing*. Amsterdam, North-Holland, 1975.