QUALITY OF INFORMATION

AND THE GOALS AND TARGETS OF THE ORGANIZATION[1]:

A MODEL AND A METHOD

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ABSTRACT

In this paper a framework is presented for the ex-post evaluation of the quality of information in organizations. The framework brings together several approaches to quality that can be found in the literature, which however, offers no approach to the evaluation of the goal-related aspects of quality. Therefore such an approach is described in the second half of this paper.

1. INTRODUCTION

The more dependent on information organizations become, the more important it is to ensure that the information is of good quality. Hence, organizations should, from time to time, assess the quality of the information they use. This means that there is a need for a measuring instrument.

When the research on which this paper is based was started, the idea was to construct such a measuring instrument using the quality concepts that could be found in literature. This instrument should enable a company's management to pass a well-founded judgement on the quality of the information it is provided with, and thus of the quality of the information systems installed. The instrument should, in other words, support an "ex-post" quality assessment.

A first survey of the literature however proved that, although a lot has been written on concepts of quality of information,

the literature offers no uniform or consistent framework from which to approach the subject. Therefore we decided to develop a framework of our own, which is presented in this paper. Next, from this framework an approach to assessing the goal- and strategy-related aspects of the quality of information in an organization is derived.

2. THE QUALITY MODEL

In order to construct a conceptual model for the quality of information in an organization we start with a discussion of the concepts of 'quality' and 'information in organizations'. From these we try to derive the elements of the conceptual model.

quality

The first definitions of the term 'quality' come from the ancient Greek philosophers. In the more recent literature we find studies on the general notion of quality in the works of Pirsig (Pirsig, 1974) and Hofstadter (Hofstadter, 1979). Traditionally the term 'quality' is used in relation to products and people; in more recent definitions, such as for example the one from ISO 8402, it becomes clear that it can also be related to services and processes.

The ISO 8402 definition for quality is:

The totality of features and characteristics of a product, process or service that bear on its ability to satisfy stated or implicit needs.

The concept of quality can be related to processes in two different ways:

- First, products and services to which quality is related are produced in a process. The features and characteristics that determine the quality of products and services are created in that process. Hence, control of the quality of those products and services can be exercised by monitoring the production process. Authors like Deming (Deming, 1982) and Juran (Juran, 1974) argue that all steps of the production process have to be thoroughly monitored in order to create products with the desired quality features.

- Second, quality features and characteristics can be determined for processes and thus also for production processes. Of course the quality features of production processes should be chosen in such a way that they guarantee the quality of the final products.

Any conceptual quality model should take account of the importance of the production process, both for the quality of goods and services and for the possibility of determining quality features for the production process itself.

An important point on which almost all definitions of quality agree is that the quality of a product or service always has to be considered in the light of the use that is made of it. This is clear from the ISO 8402 definition but, for example, also from Juran who states that quality is 'fitness for use' or in other words: 'the extent to which the product successfully serves the purpose of the user during usage'. From this last definition it is also clear that in Juran's view it is the user who decides what are the features and characteristics that are important for the use of the product. Thus we conclude that a conceptual model should relate quality features and characteristics of information to the situation in which it is used. As will become clear later on, the goals and targets of organizations will be used as descriptors of this situation of use.

Another important feature of most quality definitions is that quality is described in terms of a series of specific features and characteristics of a product, a service or a process (e.g. Boehm, 1978; McCall, 1979). The user presents a set of features and characteristics that describe his demands. The producer will try to translate the demand-oriented set into a set of features and characteristics he can make. In the literature the features and characteristics specified by users are associated with the 'fitness for use' or product oriented approach to quality, while the set specified by the producers is associated with the 'conformity to specifications' or production process oriented aspects of quality. In both approaches quality can be decomposed into sets of features and characteristics. This is of course necessary when one wants to run quality-checks in production processes. Such processes cannot be controlled if quality is not specified. A framework for the quality of information should allow such a detailed approach to quality.

information in organizations

Looking at the use of information systems in organizations, we see two main trends.

First, the amount of information produced in organizations has been growing tremendously. There are reasons why the use of information in organizations should probably also be growing. One reason is that the growing size and complexity of organizations makes it impossible to control them only on the basis of one's own observations. Another important reason is the growing complexity and dynamism of the environment in which most organizations operate.

Second, the way in which organizations use information systems is changing. Initially they were mainly used to automate such specific, labour intensive types of information processing as financial administrations. Later on the attention shifted to the information needed to monitor the business processes and the organization as a whole. The next step was to use information systems not only for internal purposes but also for reaching a good competitive position (e.e. Porter, 1980; Porter, 1985; Parker and Benson, 1988; Wiseman, 1985). The most recent development is to use information systems for new ways of organizing (e.g. Nolan, Pollock and Ware, 1989).

All of these changes in the use of information systems cause changes in the way in which decisions on information systems are (to be) made. In the period of automating labour intensive systems decisions could be made for each system separately. When the attention shifted to management information systems, decisions to be made often involved an integrated set of systems. Because of the later shift to strategic use of information systems, decisions were taken against the background of the organization's strategy. Since market strategies are decided on at the level of the lines of business, the decisions on information systems are also taken at this level. Decisions on information infrastructure enabling the redesign of organizations are also taken at a high level in the organization. The same goes for decisions on systems that are considered vital for the organization as a whole (Keen, 1988).

The changing ways in which information systems are used within organizations and in which decisions on information systems are taken have to be incorporated into our concept

of quality of information. This means that the set of quality features and characteristics that together make up the quality of an information system should not only reflect the very specific and detailed demands that are important when decisions are made on specific systems at a low level of the organization, but also the more general demands (supporting decision making, strengthening the market position, contributing to the organization's strategy) that play a role at higher levels of decision making. From the introduction of this paper it will be clear that none of the existing approaches to quality pays attention to this kind of consideration. It is, however, possible to make use of the literature on information planning and on strategic use of information systems and incorporate it in a conceptual model for the quality of information in an organization.

constructing the quality model

From the discussion of the concepts of 'quality' and 'information in an organization' we can now derive the elements necessary to construct a conceptual framework for the quality of information in an organization.

Our starting point is that the definition of quality allows us to look at the quality of information from a causal and from a teleological point of view:

From **the causal point of view** the quality of information is seen as the result of the quality of the process in which it is produced. The first step in this process is information analysis. During this stage the link between the organization's needs and the information systems is established. First the information policy is formulated and then the more detailed information needs are derived. The next step is that of designing and building information systems. The ISO 9000-3 quality standard is related to this stage of the process. This standard describes which measures have to be taken in order to deliver information systems of good quality. Finally the systems produced during the designing and building stages are used during the dataprocessing stage to produce the information the organization needs.

Several authors have elaborated on the quality features and characteristics of the production process that influence the quality of the final product. Delen and Rijsenbrij (Delen en Rijsenbrij 1990) describe quality features of both the design and construction stages and the dataprocessing process and also of the information originating from these processes.

The essence of the causal point of view in ex-post quality assessments is that not all aspects of the quality of information can be measured from that information itself. For some features it is necessary to look at one or more of the steps of the production process. It is, for example, very hard to directly measure the reliability of information. This can, however, be assessed by looking at the level of reliability measures taken in systems development and in dataprocessing. In order to get a complete picture of the quality of information in an organization it may therefore be necessary to look at the stages of information analysis, designing and building the systems, and of dataprocessing.

From the **teleological point of view** the quality of information is seen as the degree to which it satisfies "stated or implicit needs", derived from the situation in which it is used. This expression, used in the ISO definition of the quality concept is ,however, still very general. We make it more specific by stating that the quality of information is the degree to which it supports the goals and targets of the organization in which it is used. These goals and targets can be divided into a number of categories:

- The **organizational goals**. Almost every organization is characterized by the fact that its members come together to realize some kind of common goal. This common or organizational goal reflects the expectations, ambitions and/or aspirations of those who depend on the organization. At the level of the organization as a whole, organizational goals have to be translated into strategies that describe how these goals can be reached. Strategies arise in an interaction between structure, culture and goals of the organization. Traditionally we suppose that information has to support the organization's strategies. Recently we see, however, that information systems can also

be used to shape, instead of support, organizational strategies and that they make it possible to aim for new goals.

- The **business process targets**. The existing division of labour in the organization is the basis for translating organizational goals and strategies into targets for each business process, department and individual within the organization. The degree of detail to which these targets have to be described when studying the quality of information depends on the organizational level that is chosen as a starting point for the analysis. Some organizations have explicit mechanisms for adjusting organizational goals and business process targets for different processes and hierarchical levels, others don't. In some organizations there even is no strictly hierarchical relationship between goals and targets at all levels.

- The **personal interests**. Each individual in the organization also has its own individual interests. Status, power, responsibility, prestige and money are well known examples of personal aims, which can be influenced by background, experience and knowledge. Since the information needs of a person in a certain function in the organization are influenced by both business process targets and personal interests, a judgement of the quality of information available to the individual has to take both elements into account.

- The **user's targets and the provider's targets**. Goals and targets can not only be subdivided according to levels in the organization but also into targets of those who are using information and targets of those who are providing others with information. A difference in position may lead to differences of opinion on the quality features and characteristics of the information received or provided.

Judging the teleological aspects of the quality of information in an organization means assessing how much the information systems in the organization contribute to each of the goals and targets described above. Of course, it is also possible to take only a subset of

goals and targets into consideration. If we look at individual systems at the level of user's or provider's targets, we will have to study in detail which quality features and characteristics determine the contribution of systems to the reaching of targets and how well the systems do so for each of these. If we look at the configuration of systems available to the organization as a whole, we take a much more global view. In that case we ask ourselves which functional contribution the systems make to the goals and targets of the organization without specifying detailed quality characteristics. Thus the detailed view of quality is replaced by a more global view in which quality of information in the organization is understood as the degree of fit between the goals and targets of the organization and the information systems supporting them.

Since the organizational goals are mostly derived from the environment in which an organization operates, the influence of the environment on the need for information systems should also be taken into account in a teleological assessment of the quality of information. Likewise the strong connection between organizational goals and targets and the structure and culture of the organization make it worthwhile to include cultural and structural aspects in the teleological evaluation.

Bringing together the elements of the causal point of view and the elements of the teleological point of view, as is done in figure 1, we arrive at the conceptual framework for studying the quality of information in an organization. At the bottom of the figure we see the steps of the process that has to be studied in the causal approach. On the upper right-hand side of the figure the set of goals and targets that has to be considered in the teleological approach has been presented. The vertical lines indicate the correspondence between the different levels of goals and targets and the hierarchical levels of the organization depicted on the left-hand side.
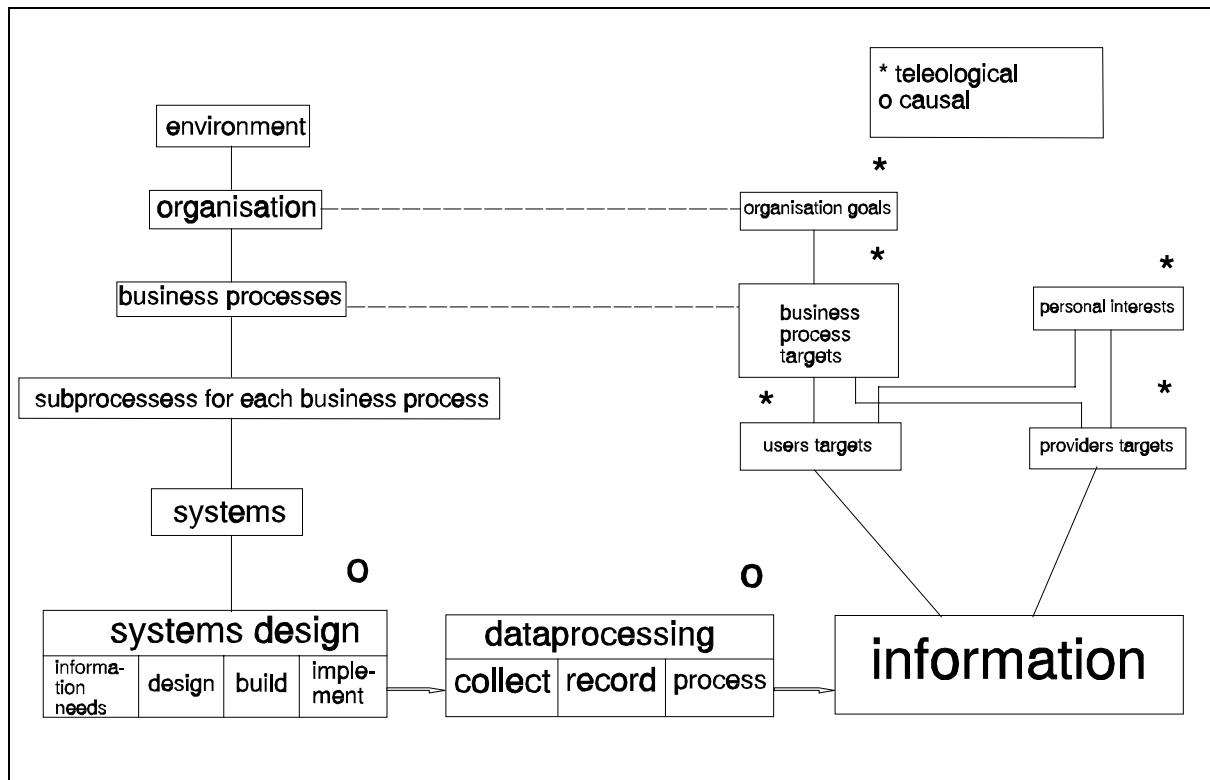
figure 1: The quality model

2. AN APPROACH TO ASSESSING THE TELEOLOGICAL ASPECTS OF QUALITY

In the literature several methods to look at the causal aspects of the quality of information (e.g.ISO-87) are described. There also are methods for judging systems in the light of low level user targets (e.g. the measurement of usersatisfaction, Bailey and Pearson, 1981). There are, however, no generally applicable methods for assessing the quality of information systems or the complete information architecture of an organization in the light of the higher level goals and process targets of the organization. Therefore an approach was designed for judging the teleological, i.e. strategy- and goal-related, aspects of quality. In this approach the organization's environment, its goals and targets, its structure and its culture are described. From these the need for information and the types of information systems required are deduced. In other words, the "SOLL position" is established. Next the existing information architecture is described: the "IST position".

Finally the quality assessment can be made by comparing the required and the available information and the required and the actually installed information systems. In the rest of this paper each of the elements of the approach will be discussed.

environment

An analysis of the opportunities offered and the threats posed by the environment makes it possible to draw conclusions with respect to the information needs of the organization. Porter (Porter, 1980) presents a framework for analyzing an organization's environment. The framework distinguishes suppliers, buyers, potential entrants and substitutes as important forces in the environment. Information systems can strengthen or weaken the position of the organization viz à viz each of these forces. Thus in our quality assessment we check whether the possibilities of information systems are used for this purpose as much as possible. Therefore in our analysis of the environment we carefully study the relationship with each of the market forces and systematically look for the possibilities of information technology. The description of these possibilities forms the "soll position" that can be compared to reality.

Another element of the analysis of the environment is to establish its diversity. The reason for this is that different parts of an organization will probably deal with different parts of the environment. Lawrence and Lorsch (Lawrence and Lorsch, 1973) demonstrated that departments of an organization attune their behaviour to those parts of the environment with which they communicate most intensively. Therefore, the bigger the differences between partial environments are, the bigger the differences between the departments dealing with them will be and the less likely one is to find a strictly hierarchical and unequivocal structure of goals and targets in the organization.

Thus if we find that the environment of an organization is diverse, we won't be surprised to find a diversity of goals and targets for different levels and groups in the organization in the next steps of the analyses.

organizational goals

In the teleological approach to the quality of information we look for the contribution of information systems to the goals and targets of the organization. Therefore describing the relationship between systems and goals is the heart of the method. We try to assess as explicitly as possible how important the information systems are for reaching each of the organization's goals. For the important systems we then check whether they are functioning well.

In order to do so we have to start by describing the goals of the organization as a whole. From the literature on organizational goals it is clear that it is impossible to formulate a normative set of goals that each organization has to pursue. Therefore one has to find out the specific set of goals of a specific organization by analyzing its written statements on this topic and by interviewing the relevant stakeholders.

The literature gives some hints what type of goals to look for. Ansoff (Ansoff, 1965) shows that both long- and short-term goals are relevant. Rhenman (Rhenman, 1973) points out the relevance of both internal and external goals. Bahlman and Meesters (Bahlman and Meesters, 1988) demonstrate that variety in goals and targets (which may arise when parts of the organization have to do with different parts of the environment) can improve the chances of survival for organizations. Simon (Simon, 1960) argues that maximization of goals is hardly ever realistic. This means that we have to look for a set of goals of different parties which can be satisfied instead of optimized at the same time.

Organizational goals will be translated into strategies or strategic actions. From these we try to derive some elements of the "SOLL position" for information systems. We find some instruments in the literature for drawing conclusions with respect to the information needs resulting from strategies. Useful approaches are those of Porter (Porter, 1985) and Wiseman (Wiseman, 1985). According to Porter an organization has a choice between four market strategies. It can try to be the cheapest seller on its market or it can try to add specific qualities to its products that attract specific types of customers. Both of these

strategies can be followed on a market as a whole. Wiseman adds a greater variety of possibilities to Porter's strategies, demonstrating that strategies can be directed at the organization itself but also at the behaviour of the competition. Both authors demonstrate that making the strategies explicit facilitates formulating the features and characteristic of the information infrastructure that is needed to support the strategies.

Finally we can compare the features of the "SOLL position" with the features of the actual "IST-position" in order to arrive at a quality judgement for the information systems.

Within organizations there will always be several levels of goals, ranging from very broad mission statements to concrete targets for business processes or parts thereof. In exceptional situations it is possible that goals formulated at different levels and by different persons fit together nicely, but generally there will be discrepancies. In the context of judging the quality of information in an organization these differences have to be made explicit and translated into consequences for the quality-judgement.

the process targets

In order to reach its goals an organization will arrange its activities as business processes. The organizations goals are, more or less accurately, translated into targets for the business processes. Information systems can be used to reach these process targets. This can be done by automating parts of the business process, using information systems for managing the business, incorporating information technology in the product, or using the communications possibilities of IT-infrastructure.

In order to assess the teleological aspects of the quality of information in an organization we start out to describe the business processes with their process targets and the information systems supporting them.

For a description of the business processes we can use one of the many techniques available in the literature and even in automated form. For production organization

Porter's "Value Chain" can be used as a starting point. The description has to be at such a level of detail that the link between information systems and the (sub)processes they support can clearly be established. For each (sub)process the targets are established by reading documentation and by interviewing people in the organization. Especially if different opinions on the process targets are expected, a wide range of people have to be interviewed. The effects of different views on the process targets on the evaluation of the quality of information systems have to be made explicit.

The description of each information system consists of a number of items:

- a brief description of the functionality of the system. In earlier research the subdivision into automating parts of the business, management information, IT in the product and communication is used;
- the relationship of the system with the business processes: to which targets of which processes does the system contribute?;
- the users and providers of the information. This item is particularly relevant for the management information systems;
- a global indication of the user-satisfaction, based on global questions in the interviews.

On the basis of the descriptions of the business processes and the information systems we have to find out how important the contribution of information systems is for reaching the business process targets and, through those, for the goals of the organization. For this analysis an adapted form of a method proposed by Bedell (Bedell, 1985) is used. The analysis consist of 12 steps which are briefly described now.

The first ten steps determine the importance of one specific system for the organization.

step 1: determine to which (sub)process the system under consideration contributes.
step 2: determine which targets of that process are supported by the system.
step 3: determine how important the system is for reaching each of these targets.

step 4: determine the relative importance of each of the targets supported.

step 5: determine the importance of the system for the process by combining the results of steps 3 and 4.

step 6: determine which goals of the organization are served by the process to which the system relates.

step 7: determine the relative importance of the process for reaching those goals.

step 8: determine the relative importance of each of the organizational goals served.

step 9: determine the importance of the process for the organization by combining results of steps 6, 7 and 8.

step 10: determine the importance of the information system for the organization by combining the results of steps 5 and 9.

If we want to get an impression of the importance of the total information infrastructure for the organization as a whole we can add two additional steps:

step 11: determine the importance of the support delivered by all information systems related to a (sub)process by repeating steps 2 to 6 for each system and adding up the results.

step 12: determine the importance of the information infrastructure for the organization as a whole by repeating step 11 for all processes and combining the results.

It will be clear that the analysis described in these twelve steps has to made in cooperation between a researcher and the members of the organization. The method becomes difficult to handle if the diversity in opinions on goals and targets becomes very great. In that case one might decide to limit the analysis to certain sets of goals and targets.

The analysis can be made in a strictly quantitative but also in a more qualitative way. In the first case for each of steps 3, 4, 7 and 8 quantitative scales can be used. In the first applications of the method global indications of the importance of systems, targets and

processes were used. These could be translated into qualitative judgements on the quality of information in the organizations under consideration. In several try-outs with quantitative scales respondents found it hard to give the exact answers that this type of questioning requires.

organizational structure

The structure of the organization is an important determinant of the amount of communication that is needed to coordinate the activities of an organization. When we look at factors influencing the information needs of an organization we therefore also look at its structure.

Again the first step is to describe the structure of the organization. This is done by describing the hierarchy of decision making in the organization and by classifying the organization in terms of Mintzberg's typology. Thus the organization is classified as a simple structure, a machine bureaucracy, a professional bureaucracy, a divisionalized form or an adhocracy.

From the degree of centralization/decentralization and from the classification according to Mintzberg (Mintzberg, 1983) we try to derive aspects of the "SOLL position" in terms of features and characteristics of the information systems. The only author hypothesizing a strict relationship between organizational structure and the information needs of the organization is Leifer (Leifer, 1988), who uses a typology of organizational structure based on Mintzberg. Leifer's ideas, however, have not been tested in practice. In this study we use Leifer's and Mintzberg's ideas to support our common sense intuitions when we look at the demands for information infrastructure generated by the organizational structure.

Finally we compare the "IST situation" with the "SOLL situation" to arrive at a judgement of the structure related aspects of the quality of information.

organizational culture

It seems reasonable to suppose that there is a relationship between organizational culture and the role of information in the organization. There is however no literature describing any explicit relationship. In this study we have tried to describe culture by determining the position of the organization and its parts on a set of scales representing different aspects of culture. The scales are borrowed from Hofstede (Hofstede, 1988). Then again common sense is used to derive aspects of the organization's information needs. Comparing these needs with the actual situation leads to a judgement on the culture-related aspects of quality.

The first tests of the method proved that the aspects of culture distinguished by Hofstede were not easy to understand for respondents in the organization. Furthermore it was not easy to draw clear conclusions related to information systems from this kind of description of the organization. On the other hand, members of the organization had there own views on cultural differences between parts of the organization. From these differences some conclusions on information systems could be drawn. Therefore it may be wise, in future applications of the method, to look for the ideas on culture circulating among the members of the organization.

3. CONCLUSIONS

It is possible to construct a model for looking at the quality of information in an organization that brings together several approaches to the subject found in the literature. From this framework we can derive an approach towards assessing the strategy and goal-related aspects of quality of information in an organization. The approach concentrates on revealing the goal and target structure of the organization and assessing if information systems support these goals and targets. Besides the goal and target structure, also the environment of the organization, its structure and its culture should be taken into consideration. So far this approach has been tried out in two organizations. In both cases it proved helpful in structuring the management's thoughts about the role of information in

their organization. Moreover, the conclusions of the evaluations proved to be good starting points for formulating the future information policy of the organizations.

1. The quality-model presented in this paper was developed in cooperation with mrs. C.A. van Egten (Van Egten, 1992). The approach to assessing the teleological elements of the quality of information is described more elaborately in (Van der Pijl, 1993).

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1.   The quality model presented in this paper was developed in cooperation with mrs. C.A. van Egten [EGTE92]. The approach to assessing the teleological elements of the quality of information is described more elaborately in [PIJL93]