Development Scenarios for Organizational Memory Information Systems

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ABSTRACT: Well-managed organizational memories have been emphasized in the recent management literature as important sources for business success. Organizational memory information systems (OMIS) have been conceptualized as a framework for information technologies to support these organizational memories. OMIS development may include several projects and may take many years. This paper classifies and analyzes OMIS development scenarios to provide guidance and support for OMIS development. This includes the definition of the roles of participants, a work schedule, and a definition of deliverables and deadlines. The mostly evolutionary nature of OMIS development requires that the results of these steps be monitored and adjusted when needed. Furthermore, a contingency framework and eight rules have been hypothesized, partially based on *ex-post* analysis of three cases (Veronica Broadcasting, Andersen Consulting, and Nationale-Nederlanden General Insurances). The paper provides concepts and a framework that may be an aid to research on refining the rules for analysis and design of OMIS.

KEY WORDS AND PHRASES: information systems development scenario, information systems project management, memory codification, OMIS superstructure, OMIS infrastructure, organizational memory information systems, process scenarios, situated systems development.

Organizational Memory Information Systems

IN THE PAST, ORGANIZATIONAL MEMORIES WERE RECOGNIZED AS SOURCES of organizational inertia [59, 60]. Recently, however, more positive valuations of organizational memories have appeared in the management literature [42, 57]. Organizational memories (a collection of knowledge, skills, and information) have even been understood as vital sources for sustainable competitive advantage in the core competence

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literature [28, 29, 30]. Consequently, many organizations have been criticized for their poor utilization and undervaluation of their existing memories [47, 52]. It has been claimed that organizational memories need to be better aligned with the strategic goals of a company [27, 39]. Organizational memories also need facilities to improve the likelihood of combining dispersed and fragmented memory pieces [1, 30, 63]. This paper focuses on the information technological facilities known as organizational memory information systems (OMIS). Stein and Zwass have conceptualized OMIS as means to improve the strategic alignment of memories and to support the integration and flow of organizational memory [56]. Consequently, an OMIS is defined as "a system that functions to provide a means by which knowledge from the past is brought to bear on present activities, thus resulting in increased levels of effectiveness for the organization" [56, p. 95].[1]

An OMIS can be realized by the application of different types of information technologies (such as databases, knowledge bases, intranet) that together form the OMIS infrastructure. A conceptual framework [56, p. 95], here referred to as the superstructure, acts as the guide to the OMIS development by providing objectives to the development endeavor. The superstructure aligns OMIS with the strategic requirements (particularly the core competence policy [30]) and selects a specific mix of organizational functions to be supported. The superstructure also provides the (organizational and technical) arguments for integration or loose coupling of OMIS infrastructure means. An OMIS contains various types of knowledge and information, some of which consist of explicit knowledge, for example, action-outcome theories (technologies) [22], explanations, or predictions [63]. This knowledge can be formalized or recorded in manuals, and indexed or processed by several types of IT. Other, frequently major organizational memory contents, however, are tacit and consist of skills and not-expressed experiences [18, 46, 47, 50]. Tacit knowledge handling may be IT-supported by information systems that refer to memory locations (such as skills databases) [2, 52] or by elicitation, so that it may be handled like explicit knowledge [7, 58]. Finally, organizational memories may consist of information that in certain situations can be transmuted to tacit or explicit knowledge. This information is called potential knowledge [24]. Databases might be the most appropriate IT means to support these memory contents.

OMIS, like all information systems, should contribute to organizational functions. These organizational functions are organizational integration, adaptation, goal attainment, and pattern maintenance of a social system [56]. The integrative subsystem must provide multilocal and instantaneous access to shared information. There are two primary metarequirements of this subsystem: integration of memory over time and space possibly enabled by shared databases, knowledge bases, and shared distributed work templates (delivered over communication networks). The adaptive subsystem includes boundary-spanning activities to recognize, capture, organize, and distribute knowledge about the environment to the appropriate organizational actors. Features of the metadesign for the adaptive function include representations for the retention of cross-linked historical information on stakeholders, pattern recognition and matching, knowledge bases of user preferences, and links to external sources of information.

The goal attainment subsystem assists organizational actors in planning and control. Features of the metadesign include templates of the context-plan-result nature, expert planning knowledge, evaluation models, company performance data, and temporally labeled snapshots of past and current commitments and the circumstances under which the commitments were made. The emphasis of the pattern maintenance subsystem is on human resources. "Pattern" pertains to the attitudes, values, and norms held by members of the organization, personal routines, and personal knowledge. Effective organizations "maintain" values, attitudes, and norms that contribute to corporate cohesion and morale. The metarequirements at the individual level are a human-resource information system containing the work history of individuals, with the emphasis on project descriptions, capabilities, skills, and aspirations. Training is another aspect of human-resource development that might be supported by this subsystem. The metarequirements at the organizational level are to support the preservation of organizational protocols and the values implicit in them.

Obviously, an OMIS provides information and knowledge on many possible topics and also provides IT facilities to exchange memory elements among systems and users. Thus, in addition to content, an OMIS comprises processes and memory media. According to [33, 59], organizational memory processes may be parsed into acquisition, retention, maintenance, search, and retrieval of information and knowledge. These processes are referred to as mnemonic processes [56]. Memory acquisition is the gathering and placing of memory into memory stores. This necessitates a memory directory giving a storage location for memory fragments and an index providing retrieval keys. Organizational memories make use of seven storage media: individuals, culture, transformation, structure, ecology, external environment, computer-based information systems, and non-IT-based records and files [59, 63]. All these storage media differ on their opportunities and limitations for storing memory, as well as in speed, reliability, physical degeneration, and availability. Memory maintenance is the management of the integrity of retained memory. An inherent problem is the integration of new memory with existing memory, and applying an effective method of removing obsolete memory. Search is the process by which retained information is selected as relevant to particular problems or goals on the part of the user. Retrieval is the reconstruction of the selected information in order to satisfy the user's request. Sometimes the retrievable memory permits satisfactory formal definition, and the OMIS is able to deliver standard reports with interpretations. Often, however, the actual memory-retrieval demands are unpredictable and the required knowledge or information is difficult to describe (tacit) [18, 39, 31, 46, 47, 50]. Consequently, much knowledge may best be kept tacit, which means that only the location of memory will be retrieved [2].

To summarize, OMIS is defined in terms of its content, superstructure and organizational functions, processes and media. Content-wise, OMIS is not simply a knowledge-based system or a database system, but might include both. In terms of its functions, an OMIS is not just an integrative, adaptive, goal attainment, or pattern maintenance system, but might be all four. This gives rise to high levels of complexity in describing (codifying) the required organizational memory content and functions.

Process-wise, an OMIS might require various media and high levels of infrastructure maturity [11], to enable it to perform as multiple subsystems serving one integrated superstructure.

Challenges to OMIS Development

THE FIRST CHALLENGE OMIS DEVELOPMENT FACES IS THE MODELING of the memory content. Many publications have provided methods for knowledge/information description and codification [4, 14, 25, 28, 38, 54, 61] but were inadequate in treating the high complexity of dealing with different memory contents in concert. Some interesting points have been made by the development of ontologies [9, 25, 28], but the applications were restricted to technical areas where the knowledge is complex but relatively stable. In situations of high environmental dynamics, the resulting models might well be obsolete before they are completed. Such situations are typical of professional and administrative organizations [2, 31, 61]. Furthermore, much knowledge can best be kept tacit [47, 55] and as such has great value [18, 50, 55]. Even where its codification is technically possible, the efforts required might be huge, and the temporal nature of the memory's validity may be such that the elicitation efforts do not pay off [17]. More precisely, the extent to which a formalized OMIS is needed and is economically feasible will determine the extent to which the analysis of OMIS contents must be based on formal techniques. It also determines the role played by knowledge engineers and system analysts in memory content codification and the abilities of OMIS users to define their own information needs (see [43, 48, 53]). Particularly where the explicit definition of the information and knowledge content required by OMIS users are difficult to define explicitly, this will be problematic for managers and IT experts. The user then has to take the leading role in the memory contents definition, and the memory content will likely change constantly. Accordingly, the content definition is not complete after installation of the OMIS infrastructure components. Such a development process is referred to as improvisational [15, 50]. However, the improvisational process also requires global high-level modeling to achieve the integration ambitions of the OMIS superstructure. Weiser and Morrison [61] have argued in favor of the use of the object-oriented modeling approach to OMIS at the global level, but the OO approach may not be effective in modeling all OMIS contents (e.g., production rules) most effectively. Furthermore, no modeling method will solve the required interactions and involvements of users, IT experts, and management in OMIS development.

Where the memory contents can be clearly defined (codified), as in simple and stable environments, the outcome will be clear and project planning and control may be incorporated in a so-called linear work breakdown structure (WBS) led by IT experts and managers. Where the redesigned situation leads to a structural change in power and thinking, organizational change processes will need to run parallel with the development process to avoid any counterimplementation and increase the likelihood of successful use [37].

A second challenge in developing OMIS is that organizational memory users and owners may be at different locations, complicating effective combination of memories [2, 27, 39, 61]. Multidisciplinary teams are often proposed for combining memories present at different locations, but only for the duration of a project [16]. Furthermore, during the course of everyday business, people with different skills and knowledge often need to be linked, independently of location and time, therefore necessitating information systems supporting the combination of physically dispersed memory. In many cases, however, this requires higher levels of media richness [19], and thus more complex interfaces and higher levels of systems compatibility [11, 25]. To realize this potential, organizations need higher levels of IT capabilities, referred to here as the OMIS infrastructure, and this, in turn, requires a learning process conducted by users, IT experts, and management alike [3, 11, 45]. An OMIS infrastructure's growth involves a series of different stages [3]. The IT experts, with their advantage in technological knowledge, may play a leading role in this process, provided they understand the problems faced by users and management. Difficulties in defining memory contents may give rise to an improvisational design process, led by IT experts and users together, with no fixed delivery scale. In cases of high codification of contents, one fixed project might be feasible, with the IT experts playing the leading role, and the ultimate project objectives fixed. There would then be clear WBS and project closures. With low OMIS infrastructure maturity needs, the development process might be user-dominated. Managers would accordingly need to define a policy (superstructure) enabling the developments to be appropriately framed. Following this line of reasoning, it is contended here that, depending on the needs for organizational integration and the required memory content codification, OMIS requires different levels of OMIS infrastructure maturity. The more dispersed organization members are, the less they will be able to share tacit memory, and the lower the opportunity to share tacit memory elements, the greater the media richness that has to be provided for memory sharing via the OMIS infrastructure. The greater the media richness required in an OMIS, the more complex the OMIS infrastructure will be, and thus the greater the OMIS infrastructure maturity that must be available. The greater the diversity in required memory content codification, the more heterogeneous the set of supportive IT applications has to be. The resulting complexity of the IT infrastructure will require more skills to get the IT components up and running and appropriately supported.

This analysis of the challenges relating to memory codification and infrastructure maturity enables the following consequences to be drawn with respect to the OMIS development trajectories, here termed scenarios. Depending on the required OMIS infrastructure maturity and level of memory codification, the OMIS development scenario will to a greater or lesser extent extend over the launching process, have predefined deliverables, and be led by users, management, or IT experts. This leads to the following propositions:

1. Low OMIS infrastructure maturity and low memory-codification needs require a user-led scenario with an informal WBS, loosely defined deliverables (improvisational design) and the extension of the development process over the OMIS infrastructure launching period.

2. Low OMIS infrastructure maturity and high memory-codification needs require a manager or analyst-led process, with a formal WBS, predefined project deliverables (a plan scenario), and clear project closings.

3. High OMIS infrastructure maturity and low memory-codification needs require an IT expert-led and well-planned basic OMIS infrastructure project, followed by a user-led improvisational design with an informal WBS, loosely defined deliverables and extension of the development process over the OMIS infrastructure launching period.

4. High OMIS infrastructure maturity and high memory-codification needs require an IT expert and management-led process, with a formally defined WBS and clearly predefined project deliverables.

This section has postulated that different OMIS scenarios[2] are required in different situations. As no previous research has been done on the effectiveness of these scenarios, the paper will continue to explore a contingency scheme for OMIS development by analyzing the practice in particular cases.

Research Strategy

Objectives and General Methodological Considerations

GIVEN THIS THEORETICAL OVERVIEW, THERE IS SOME REASON for believing that different levels of memory-codification needs and OMIS infrastructure maturity require different types of OMIS development scenarios. Since no previous research on OMIS development scenarios exists, the previous propositions are highly tentative and are accordingly not tested in this study. Furthermore, this research focuses on how OMIS development scenarios could be best designed given the development context. The related research question therefore is: "How can one define an effective OMIS scenario?" Part of the answer has already been given in the previous theoretical review. The other part may be found by confronting the propositions with practice. These research objectives typically require a case study approach. Cases that went some way in developing an OMIS, however, are scarce, or have low external validity (tending to be laboratory studies or prototypes; see [1, 4, 14, 31, 56, 61]).

The methodological literature mentions many reasons why a case study approach would be most appropriate. In the MIS field particularly, Benbassat, Goldstein, and Mead [6, p. 370] list the following reasons:

1. The researcher can study information systems in a natural setting, learn about the state of the art, and generate theories from practice.
2. The case study method allows the researcher to answer "how" and "why" questions, that is, to understand the nature and complexity of the processes taking place.
3. A case approach is an appropriate way to research an area in which few previous studies have been carried out.

All these arguments are valid here, because OMIS are "systems" with a strong link with the organizational context. Case studies have been included in this research as they answer questions concerning "how" and "why" people acted as they did while developing information systems which, *ex post*, could be conceived of as an OMIS. These questions are vital for developing any understanding in development processes.

Because the existing theory says that scenarios will differ given IT maturity and codification, cases will be researched with different levels with respect to these two variables, in the hope of encountering sufficient details on the four possible scenarios. Methodologically, observations are deemed to be led by theoretical notions, even where these are tacit [51]. Therefore, the preference here has been to elucidate these notions as far as possible by outlining the propositions and variables used in the observations. The reader then understands the context and is better able to draw conclusions than otherwise. The aforementioned propositions accordingly govern the method of case selection (variety among the variables of codification and maturity); this procedure is called theoretical sampling [26, pp. 45–77]. The propositions also explain how the observations and interpretations have been biased [26, pp. 12–15]. The observations, however, give sufficient information for refutations and conjecture, since none of the propositions has been defined as "true" in a positivist sense, while, nonetheless, "sensitizing" and directing the researcher's work [26].

Selection of Cases and Analysis

In order to study the interaction of OMIS contexts (knowledge codification and OMIS infrastructure maturity) and OMIS development scenarios, three cases have been selected that have developed their own OMIS: the Dutch broadcasting company Veronica Broadcasting, the worldwide organization consulting firm Andersen Consulting, and a division of the largest Dutch insurance company Nationale-Nederlanden. Because not all organizations welcome outsiders behind the scenes of complex development processes, the cases were also selected for their accessibility. To gain as much variety as possible in the main variables, the cases were selected according to convenience and theoretical expectations, meaning they have different levels of codified memory and OMIS infrastructural maturity. In a larger population of cases, they may have more in common than the rest of the population, but nevertheless theoretical patterns can be found from the material [64]. Each case has been analyzed separately to draw conclusions about the relationship between the conditional factors and the scenarios.

Observation Instruments

Insights into the variables and observation instruments matured during the course of the study as a consequence of evolving theoretical developments. The Veronica case (first studied in 1994, and again in 1997) was initially analyzed with the least formal observation instruments, and the Andersen Consulting case (studied in the second half of 1997) with the most elaborated instruments. The final operationalizations of the variables are described below.

Memory-Codification Needs

Memory-codification needs are defined as the extent to which the memory contents can be formalized. Knowledge defined as explanation, prediction, and technology might be measured in terms of the control one has over one's task or environment. Such a measurement has been previously developed by Bohn and Jaikumar [7, 8, 34, 35], who identify eight stages of "knowledge" on a process (which in fact includes skills and potential knowledge) (see Table 1). This paper proposes to regard the level of knowledge on a process as a valid operationalization of the codification construct. Codification is the extent of knowledge that is explicit, ranging from initial recognition, to measurement, and finally to incorporation into a larger theoretically and practically valid framework.

This determination of levels has high content and construct validity for the measurement of organizational memory codification. Stages one to four concern information (the definition and measurement of relevant variables and its resulting information), and the higher stages are typically knowledge in the sense of explanations, predictions, and technologies.[3] The measurement was developed in the context of developing intelligent systems, information systems that have a similar, however basically more formal, pretension than OMIS (see [8, 34]). Bohn and Jaikumar did not report on the reliability of their measure, and it is not referred to in the literature. The resulting problems, however, can be effectively treated as proposed at the end of this section.

OMIS Infrastructure Maturity

Following Broadbent et al. [11, 12], IT infrastructure is the basic IT capability (technical as well as human) that is shared in any given organization. The basis of this infrastructure is the IT components, such as computers and communication technology. Superimposed on these components is a second component set containing a set of shared services for the running of effective applications, namely (1) communication management (networks), (2) application management, (3) data management, (4) management of standards, (5) IT education management, (6) services management, (7) security, and (8) IT R&D. The IT components are employed in useful services via the application of the human IT infrastructure components: knowledge, skills, and experience. Each of these three components has its particular capabilities and limitations. The limitations could cause problems with the interactions of IT components (e.g., different technological standards). Another type of problem often recognized is caused by shortcomings in the human IT infrastructure: lack of knowledge, time, and problem-solving tools, and insufficient efforts on exploitation and maintenance. Shortcomings in required services might include lack of processing capacity, inappropriate data networks, insufficient security measures and contingency plans, and insufficient support personnel [11].

Table 1 Levels of Memory Codification*

Level of codification	Nature of codification
1	Statements about quality of a situation
2	Recognition of variables at stake
3	Evaluation of importance of variables (key factors)
4	Definition of measures for variables
5	Ability to keep variables locally under control (skill)
6	Theory that explains the impact of changes of a local variable on the output of the system
7	Theory that enables predictions and simulations within certain tolerances of uncertainty.
8	Complete knowledge of a process (within less than x % of tolerance band)

*Based on Bohn and Jaikumar's [7, 8, 34, 35] concepualization of control levels over a production process.

The OMIS infrastructure maturity thus has three types of components: human infrastructure with respect to OMIS development; IT components (in particular, availability and diffusion of software and hardware throughout the organization); and IT services (in particular, applications management, data management, education, security, and user support).

The three dimensions of OMIS infrastructure maturity can be separately graded as indicated in Table 2.

OMIS Development Scenarios

An OMIS development scenario is a description of an organization's capability of achieving an effective OMIS. This capability is the organization's IT maturity for OMIS development. The Nolan and Gibson stages theory [45] is often regarded as a milestone in thinking on IT maturity [13, pp. 42–45]. The Nolan-Gibson line will not be followed here, in view of its fundamental weaknesses from an academic point of view [5]. The theory explains little about IS development, as its focus is on the development of the IS management function in general. The main explanatory power of this theory is in organizational adoption of (innovative) IT, whereas OMIS does not necessarily require new technologies [56].

Karimi, Gupta, and Somer [36] define IT maturity as a firm's evolution in planning, control, organization, and integration of its IS function. A high level of IT maturity would imply significant formalization of these IT activities [36, p. 63]. They published high reliability scores for each dimension, and the factor analysis applied to twenty variables confirmed the previously mentioned four dimensions empirically (a four-factor solution was obtained by principle component analysis).

Table 2 Dimensions and Variables of OMIS Infrastructure*

Dimension	Variables
Human infrastructure	IT experts' experience with OMIS development IT experts' experience with type of relevant scenario Users' experience with IS development involvement Users' general knowledge of relevant IT components and services Managers' experience with IS development projects Management of the costs and benefits
OMIS IT components	Use of one or more of the following information technologies for OMIS purposes: databases, expert systems, decision support and modelbases, groupware, internet applications and sites Technological linkages among components of OMIS
IT services	Communications management Management of OMIS-relevant applications Data management of the whole OMIS Standards management User support (including education) Services management Security management IT R&D

*The greater the representation of these items in the cases, the higher the OMIS infrastructure level.

Karimi et al. [36] further operationalize planning maturity as the extent of alignment of the IT plans with the firm's business plans, and the extent of infusion and diffusion of IT in the firm. In terms of OMIS, this implies a clear superstructure definition and extensive use of information technological components in organizational memory.

The IT control dimension is operationally defined as the extent to which IT activities are performed in a tight/refined way (instead of loose/informal and in separate projects) and the domination of a managerial orientation (instead of project and technical orientation). Both dimensions can be directly applied to the scenario for OMIS. The tightness refers to the extent to which deliverables are either clearly defined or emerge, and the work has a planned or improvisational work breakdown structure [48]. Finally, tightness also refers to the definition of project-closing criteria. Some OMIS scenarios will use fixed delivery dates, whereas others will use evolutionary design principles.

The IT organization maturity dimension is operationally defined in terms of the extent of user awareness and involvement, the understanding of the business by the IT specialists, the constructiveness of the IT specialist and user relations, and the fit of the IT organization's structure with the rest of the organization. This also has considerable implications for the role of the IT director and the IT organization structure. This dimension refers to the extent to which users are given opportunities to participate in or lead particular development-related activities. In addition, it is the substantive role definition of intended users and IT experts. The substantive roles for the IT experts can be defined as leader or support. For users and management, the roles can be defined as leader or follower, and leader or facilitator, respectively.

The IT integration maturity dimension was operationally defined in terms of the extent of effective linkages of systems with the organization's plans and business units. Unlike the Karimi et al. [36] operationalization, this dimension of OMIS first and foremost concerns the fit with the intentions (superstructure) of an OMIS and not with general strategy. Second, it is the integration of the OMIS (subsystems) with actual business operations.

In summary, OMIS development scenarios are defined in terms of roles, project management dimensions, and integration. The indicators of these dimensions are given in Table 3.

Tables 1, 2, and 3 provide a list of observation items applied in the research. The list consists of so-called sensitizing concepts [26] to generate data that are later analyzed in relation to existing theory and to other cases. The final definition of the variables mentioned in this section therefore differs operationally from the definitions applied in the case study observations.

Assessment of Validity and Reliability of the Research

Checks and precautions were applied to check the construct validity with respect to controlled observations, to check for internal validity with respect to controlled deductions, to check external validity with respect to generalizations, and to check reliability with respect to controlled observations [6, 40, 64].

For construct validity, Yin [64] proposes three precautions: the use of multiple sources of evidence, the establishment of a chain of evidence, and having key informants review the work. To be able to comment on the propositions (and possible scenario design rules), three different cases were studied, with some variation on the independent variables. The first case, Veronica Broadcasting, was studied by several interviews with the then director of information services Bert Mulder in 1994, and an interview with the subsequent director of information services Peter Van Schaik. Furthermore, a workshop was held in 1994 with Mulder and a group of M.Sc. students specializing in MIS, during which the students critically examined Mulder's view. Van Schaik also supplied some additional documentation concerning the information plan and the use of the SAP system for production management of the Holland Media Group (HMG), the organization of which Veronica Broadcasting became a part in 1995. The Nationale-Nederlanden case was built around interviews with knowledge coordinator M.G.G Van Ast in 1996.[4] The Andersen Consulting case was initially built around interviews with Conny Renema of Andersen Consulting Netherlands. These interviews were supplemented by internet site information and a publication in *Trends* magazine. Markus Kappenberger (Andersen Consulting Germany) subsequently supplied additional information on the technical structure of the KX system. In all the cases, a chain of evidence was established by critically checking inconsistencies in the initial interviews with other information sources. Apparent contradictions were fed

Table 3 Dimensions and Indicators of the OMIS Development Scenario Construct

Dimension	Subdimension	Indicator
Substance of roles	Expert role	Leader or supporter
	User role	Leader or follower
	Management role	Leader or facilitator
Role formality		Formal or informal role definition
Project management	Superstructure definition	Existence or not of an explicit definition of longer-term goals of OMIS development and explicit statement of organizational functions to be supported
	WBS	Planned or improvisational work breakdown
	Deliverables	Predefined or emerging deliverables
	Project closure	Closure moment defined (deadlines) or evolutionary design (extension of process after IT launch)
Integration		Correspondence of OMIS project results with superstructure definition
		Correspondence of OMIS project results with business practice needs

back to the interviewees, which led to further explanations, often with corrections. The case of Veronica Broadcasting was checked by Van Schaik, the case of Nationale-Nederlanden was approved by Van Ast, and the case of Andersen Consulting was approved by Renema, Kappenberger, and the Chicago headquarters.

In the interest of internal validity, Yin [64] proposes three methods: evaluation of predictions for a case, explanation building, and time-series analysis. The evaluation of predictions is performed directly after each case, when the case data are confronted with relevant propositions. Explanation building is performed by the construction of alternative or additional propositions arising from the results of the comparison of the predictions. This is the subject of the analysis subsection of the case sections. The concluding section draws conclusions for scenario design on the basis of the propositions and their required modifications. Some observations through time have been made, sufficiently to draw some conclusions with respect to dynamic aspects of a scenario. The required rigor of time-series analysis, however, has not been applied.

Yin proposes the handling of external validity by replication in multiple-case studies. The three cases were specifically selected to show variation and thus to build the explanation instead of merely replicating it. Other publications on Andersen Consulting on the Internet and on Nationale-Nederlanden [21] do, however, provide several sources of replication. The Veronica Broadcasting case study is more unique. The situation is somewhat similar to the case of CNN (see [49]), which Veronica Broadcasting was partially trying to emulate.

Yin [64] proposes two measures to control reliability of observations: define a case protocol and make available a case study database. The case study protocol emerged during the study. The Veronica Broadcasting case was conducted in 1994 when understanding of relevant variables was very poor. The Nationale-Nederlanden case was conducted in 1996, at which point the model was clearly developing. The Anderson Consulting case was conducted in 1997, with the application of a very concrete checklist. The final definition of the variables, however, took place after the case studies. The main data from the database can be seen in the case studies section. Additional sources were listed in the discussion of the sources of evidence in this section.

Case Studies

Veronica Broadcasting

VERONICA BROADCASTING (VB) IS A DUTCH BROADCASTING COMPANY whose activities include radio and television program production and publication of a program guide and magazine. This case describes the situation up to September 1997. VB is funded by government grants, sponsorship, membership fees from members of the Veronica Members Club, and subscriptions to their magazine.

Memory Codification Needs

The roughly 250 (1994) employees at VB strongly adhere to the individualistic values communicated by VB and its programs. The result is the absence of any formal long-term planning (except for specific programs), and the lack of formal arrangements that might obstruct flexibility in the organization. Therefore, the memory codification need with respect to basic values and work practice does not exceed level 3 (identification of important variables) of the memory codification scale. VB employees are highly practical and active people, and little reflection is done about goals and work methods. The personnel must, however, keep a clear view of the key factors in mind and monitor them daily (level 3) (e.g., political and cultural events). The management has an interest in measuring certain of the key factors, especially concerning productivity, finance and market share, and required knowledge to keep local variations under control (level 5). This did not give rise to any further formalization or automation in the years up to 1995, but after 1995, VB began formalizing the broadcasting production process and adopted the SAP ERP system for the optimization and simulation of broadcasting (level 7).

OMIS Infrastructure Maturity

Before 1995, an information manager at VB was confronted with pragmatic, direct-return-thinking individuals who did not adopt any changes unless they made a direct positive contribution to their work. They were therefore certainly not interested in courses on an operating system or more complex user software, and the decision was taken in favor of Apple Macintosh personal computers with easy-to-use software (a word processor, database, time scheduler, and a spreadsheet). User experience and general IT knowledge, then, were low at that time. The user had to find out for him or herself what the most appropriate alternatives were, since nothing was prescribed by the organization. This was in sharp contrast to VB's administration department, which had to work with IBM-compatible personal computers because they were required by law to run a financial and membership administration system prescribed by the government and developed for the entire Dutch broadcasting industry. VB established a local area network and online access to external databases to increase the information-sharing potential. In those days, this was a new experience for the IT experts. The LAN was poorly used, but after 1995, groupware applications went into common use. The OMIS infrastructure maturity was low prior to 1995: There was no IT policy, IT costs were regarded as overhead, and the organization of IT services was highly informal. Before 1995, IT experts were not experienced in complex analysis and design projects and basically provided word processing, a few databases, and a standard financial package. This changed after 1995, when VB became part of a larger broadcasting firm, Holland Media Group (HMG). The IT management and IT experts became responsible for the IT management of the entire HMG and thus had to serve an organization with three times as many broadcasting hours. Consequently, the IT budgets were substantially raised. Since 1995, therefore, the human infrastructure has matured, and the IT components have been supplemented by groupware systems, decision support systems, and Internet applications to coordinate the activities of many more people. The IT services have had to manage a greater number of applications and the level of professionalism of data management and user support (and possibly also security) has been raised because of increased infrastructure complexity.

The OMIS Development Scenario

In VB's pre-1995 IT environment, actual use of information technology was based on individual choice. The role of information management then was coauthor of the role IT was required to play in accomplishing VB's OMIS superstructure. This superstructure was defined as accomplishing effective interactions between individuals and information technological tools, consisting of 250 work groups (individuals as well as teams), and about 60,000 documents with online access to external information providers. Information management installed Apple Macintoshes, and later the LAN, and information management managed user satisfaction and supported users. In some cases, new software was announced but was never made compulsory, since it first had to prove its value. This meant that, in this pre-1995 situation, the IT expert was the supporter, the user was the leader (however passive), and management was the facilitator (providing money).

After 1995, HMG management placed greater emphasis on the team nature of broadcasting production and product development, using IT to improve group performance. The information manager now had a new role: leading the establishment of the new business processes. The main restructuring of these processes consisted of improving collaboration and knowledge/data sharing among organization members. This required a considerable increase in IT infrastructure maturity as well as higher memory codification to achieve compatibility of data exchange within the group. The role of management in the OMIS development process thus changed from one of facilitation (supplying funds) to selecting a new IT management committed to realizing a more codified and mature OMIS infrastructure. The Apple Macintoshes were replaced by IBM compatibles in an LAN and with full Internet access. In contrast to the pre-1995 situation, a formal WBS with clear project closures and predefined deliverables came into being. The new OMIS corresponded explicitly with the new superstructure and new methods of collaboration.

Analysis

Prior to 1995, VB displayed a user-led, improvisational, and informal WBS scenario. This was consistent with the propositions, as knowledge codification was rated 5 and lower and infrastructure maturity was also very low. The case indicated that the increases in codification and infrastructure maturity led to a different OMIS development scenario after 1995: IT and management-led, clear project closures, and formal WBS. It is also interesting to conjecture here that, when the new business processes are finally accomplished, VB might want to go back to a user-led scenario so that more time is spent managing tacit knowledge. In this situation, the user may also be more active and take the initiative, as he or she had before 1995.

Andersen Consulting

This case describes Andersen Consulting in September 1997. Andersen Consulting, the world's leading consultancy firm with a work force of 53,000 people, is organized as follows:

- Global market units: government, financial services, and other industry groupings.
- Competencies: Change management, technology, process management, strategy, practice enablement, and innovation.
- Global services organization: buildings, internal technology and knowledge management.
- Global business practices: human resources, marketing, finance, quality.
- Geographic areas: the Americas, EMEAI (Europe, Middle East, Africa, and India), Asia Pacific (Asia and Australasia).

Andersen Consulting has about 350 "knowledge management professionals" who are responsible for facilitating effective and efficient use of organizational and information technological means for capitalizing the organization's knowledge resources.

Memory Codification Needs

Andersen Consulting started on the creation of an OMIS in 1991.[5] According to Luc van der Biest, Associate Partner of the Change Management Group of Andersen Consulting, this OMIS has created a shift of mindset: "We shifted from knowledge protection to knowledge sharing. . . . You're a star now at Andersen when you share your knowledge. From know-how in the head to know-how in the database, that is the essence" (*Trends* magazine, February 20, 1997).

Many databases (with data and full text) have been developed. Because the formality of the system's content is low, no expert systems or case-based reasoning systems exist. Because Andersen Consulting is such a large organization, there are many knowledge objects, and it is hard to develop a logical structure for the systems as a whole. Consequently, the documents are indexed by key words, but retrieval is also possible via full text. The West Europe Virtual Office has recently been established as one of the first comprehensive knowledge maps for the organization. This map is a gateway to all the databases.

The structure of the memory can best be described by the contents supported by the OMIS infrastructure (known as the Knowledge Xchange®, KX for short). All KX memory falls into three knowledge-sharing application groups, called "Key Entities," "Core Knowledge," and "Communities of Practice." "Key Entities" has globally standardized information consisting of databases concerning business relations, jobs and engagements, and people and skills. The related variables are thus at the level of measurability in many cases, but the link with work control is tacit (often absent or ad hoc). Consequently, the "key entities" do not have a level of codification higher than 4. "Core Knowledge" has globally standardized databases on methods and techniques to be applied in projects and databases on industrial and technological data. The methods define *the* Andersen Consulting project approach. Whether you work on a project in Japan, the United States, or somewhere else, this methodology is the starting point. The "core knowledge" shows the input needed, the competencies required, the potential results, and ways of estimating the amount of work, and it includes lessons from past projects. The level of codification is thus a minimum of 5 (skills), but probably 7 (simulations and predictions), the methods being based on an understanding of what goes right and what goes wrong in the performance of a given task. For example, computer programming requires knowledge at the level of enabling simulations, level 7 of the memory codification scale, whereas other tasks (e.g., consulting in organizational change) will not score higher than the identification of key factors to keep the project locally under control (level 5). The "Communities of Practice" component supplies a wide range of information and communication facilities for specific interest and competence groups. These applications have been specifically designed by the user group and thus are not globally standardized. The memory contents may vary, but will often be very low (level 1 or 2), because people use this medium to communicate tacit knowledge, which may be the subject of formalization into methods or key entities at a later stage.

Andersen Consulting at the global level matches a case of low memory codification, because the diversity of memories is large and the "Key Entities" and "Communities of Practice" indicate the unpredictable nature of knowledge needs.

OMIS Infrastructure Maturity

Andersen Consulting has developed a human OMIS infrastructure in a community of 350 knowledge management professionals. These professionals serve a particular Competency or Industry group (GMU). They play a vital role in the management of organizational memory contents and the media of knowledge management by initiating and advocating technological use, knowledge management, and coordinating the whole. Most of them have wide experience in running large IS development processes and the related scenarios.

The critical IT tool in knowledge management at Andersen Consulting is the groupware package Lotus Notes™. Lotus Notes is used in all Andersen Consulting offices and by most of its consultants, and enables electronic mail, databases, discussion forums, newsfeeds from major news outlets and industry publications, and an Internet gateway. In total, there are about 4,000 databases in the system. Some of the databases are accessible to Andersen Consulting worldwide, some are job-specific, and some are office-specific. The number of databases can easily become confusing. The "West European Virtual Office" application was therefore recently created to integrate the many memory sources and to improve the navigational tools. The structure of the memory is associative (supported by WWW and links between documents: doc_links) instead of an integrated schema (as in databases and knowledge bases). The only OMIS IT-component not available is expert systems, but in general the IT components used are very modern and sophisticated.

The size and diversity of Andersen Consulting's knowledge base make tight bureaucratic control of its integrity impractical. Therefore, other methods of data management and infrastructure services have been developed for OMIS. These include:

- The knowledge management professionals have developed training for consultants to make effective use of the KX and to teach and motivate them to make contributions to the system.
- Knowledge management professionals inspect the quality of inputs as far as possible.
- Subject matter experts review documents from the point of view of accuracy and relevancy of content.
- To avoid redundancy and inconsistency of contributions, new documents can be submitted to a drop box if the best location for the document is uncertain. If no single location seems appropriate, the original document is stored in an attachment database and an abstract (with a doc_link to the orginal document) is stored in the various locations required.

Security has been arranged for the whole net, as well as for separate databases.

Although the knowledge management professionals give user support, the users appear to have insufficient time to attend to the KX. A high level of management, IT expertise, and user maturity are highly likely to be present in a management and organization consulting firm such as Andersen Consulting.

The OMIS Development Scenario

The OMIS initiative was piloted in 1991 by some of the chief executives (partners); thus, management was the leader. Soon after the launch of the initiative, management adopted the facilitation role (supplying budgets) and gave the lead to the IT experts. Several IT experts were appointed "knowledge management professionals" at various locations and triggered the spread of the initiative to the whole organization. During the first six years, technology was the focus. Once the OMIS infrastructure had become well established, the IT experts handed over the leading role to users. The organization was then in the middle of the process of developing this role for users. Management again had to take the leading role in creating the conditions in which users were sufficiently equipped to take the leading role. Andersen Consulting did not apply very rigid and formal role descriptions, but in this OMIS scenario the roles of users, management, and IT experts were clear. The OMIS development was an "initiative"; it was hard, even impossible, to define it as a project. It still continues to develop from the technical, motivational, and content perspectives.

The global OMIS development process is long term and connected to in-depth organizational change issues (especially changing motivational structure); it is regarded as vital for the working methods to which Andersen Consulting aspires (to be knowledge-driven instead of driven by time and materials). The role of the knowledge management professionals (originally IT experts) is significant in this process: initiating, advocating, user support, explaining and motivating, and enabling the OMIS infrastructure. Senior management strongly supports this initiative. Consultants (users), however, need to adopt the system as part of their everyday working life, as it is a source of essential professional information. The consultants should make the major efforts to enhance the system and its contents. Unfortunately, their time is rather limited, and the integration of the OMIS with the superstructure objectives and business practices is still incomplete.

Analysis

Andersen Consulting globally matches the predictions of a very mature OMIS infrastructure and low-codification situation. This initially requires an IT-led infrastructure development scenario followed by a user-led process in the near future. OMIS development at Andersen Consulting was defined as an initiative, and the firm is now considering how to take this improvisational process further. The role of management (in motivation and realizing preconditions) will again be vital in this follow-through. Furthermore, this case shows that, in large organizations, global codification needs may be low, yet they may be highly diverse in terms of separate elements of the organizational memory contents. This implies that there may be logical hierarchical relations among OMIS developments in an organization with varying contexts and scenarios.

Nationale-Nederlanden General Insurances

This case study describes the situation at Nationale-Nederlanden General Insurance (NNGI) in the beginning of 1996. Nationale-Nederlanden Insurance is the largest Dutch insurance company, with approximately 4,000 employees. It sells its products to business and private markets via independent agents. Outside the Netherlands, Nationale-Nederlanden Insurance mostly presents itself as ING insurances. Nationale-Nederlanden Insurance has two main divisions: general insurance and life insurance. This case is about Nationale-Nederlanden General Insurance (NNGI), which in mid-1995 changed from a product-group foundation to a foundation based on market segment. This market segmentation is geographical in nature and has resulted in the creation of nineteen regional units. The idea was that personnel should become client experts, rather than product experts. The diminished product-centered focus was expected to damage the organization's professionalism and functional expertise, which management considered unacceptable; thus, their response to this possibility motivated the OMIS development.

Memory Codification

It was considered important that the memory from the former product sectors should be easily accessible to the nineteen regional units. One option was to use manuals, but knowledge contained in manuals is difficult to handle and maintain and slow to distribute. Furthermore, NNGI has a large store of important tacit knowledge that is difficult to define and handle by formal means. The ease of maintenance and distribution of memory elements were considered important, because of the frequent changes required for the day-to-day handling of insurance products. It took no more than a few years for NNGI to create this OMIS (referred to at NNGI as the "electronic knowledge bank"). The OMIS not only contains knowledge and information on regular procedures, tariffs, and conditions, but is also context-oriented. The context orientation implies that the OMIS contains information on specific types of clients (e.g., school buildings, pharmacies), enabling preventive advice to be given to specific clients, and suggestions of the best product to be delivered. Clients can also be advised via telephone, direct from the computer screen. This level of knowledge codification is therefore minimal at the level of skills (level 5). Furthermore, NNGI possesses knowledge that is considerably more difficult to define, concerning problems with specific products and clients, not covered by the OMIS but via the "knowledge maintenance circle." In many cases, understanding extends little beyond an awareness that something is wrong (level 1). The circles analyze the problem and often come up with new rules to increase local control of process (level 5). In some cases, product and market problems require detailed and extensive statistical actuarial analysis to redesign products. This type of knowledge is at the level of prediction and simulation (level 7).

OMIS Infrastructure Maturity

NNGI has invested heavily in computers for managing its routine memory (administrative rules and explicitly defined information), storing existing explicit knowledge from manuals and other paper media in hypertext. The resulting OMIS contents are structured according to the product classification. Tacit knowledge for handling nonroutine cases is typically stored in individuals' own memories. To take full advantage of these individual memories, NNGI puts strong emphasis on developing informal networks to discuss and deal with specific issues and supports such networks with groupware facilities. Decision support and expert systems technologies are available where necessary. NNGI appointed eighteen knowledge coordinators to maintain contacts with regional contact persons and experts. Regional contact persons are appointed in cases where the experts are dispersed over the newly created regions. The knowledge coordinators are responsible for the maintenance of the hypertext documents. They are also responsible for storing historical information on each product, and are in charge of the knowledge maintenance circles belonging to their expertise domain. A knowledge maintenance circle consists of coordinators from each region who must detect and solve problems with products experienced by the product users. The knowledge texts are updated each week.

The OMIS Development Scenario

After a year and a half of experience with the OMIS and the knowledge management circles, the old manuals were removed. NNGI is typical of the high codification (in its bureaucratic process) and high OMIS infrastructure maturity type. The implementation of the new OMIS was firmly directed from the top of the organization and managed by means of an explicit and detailed WBS. To ease the change, management decided to combine it with the move to a brand new building. User involvement was reduced to a bare minimum. This type of detachment made it a very radical and short-term shift.

Knowledge maintenance calls for strong motivation and initiatives from the workplace. Because needs for knowledge maintenance are hard to predict and require a very creative problem-solving process, the enhancement process has very informal procedures. This is not so for the updating of information, which is a rather bureaucratic process. The knowledge updating process is supported by an enhancements circuit, with clear roles, but the IT experts and management have only a marginal role. The enhancement process is especially difficult because of the geographical distances of experts. E-mail and other groupware also have limitations in providing the required media richness in such cases.

Analysis

NNGI is characterized by two different contexts. One is high memory codification and high OMIS infrastructure maturity, resulting in a very tight management and IT-led project and a very formal WBS for the bureaucratic knowledge area. The other context is low codification and high OMIS infrastructure maturity, resulting in a user-led, informal WBS and improvisational OMIS development scenario for the memory maintenance area. (The infrastructure is already present.) These observations are in line with the propositions. In addition, however, it was recognized that organizations may have parallel, but not unrelated, OMIS development processes differing in their context and scenario.

Conclusions, Discussion, and Further Research

THIS PAPER BEGAN WITH THE GENERAL PROPOSITION THAT OMIS infrastructure maturity and memory codification would account for the required development scenarios for OMIS. Three cases were studied to explore the related propositions. An observation manifest from the analyses of the cases was that, in practice, several OMIS scenarios might exist in the same organization. The scenarios may run in parallel (NNGI), in sequence (Veronica Broadcasting), or in different logical hierarchies (Andersen Consulting). It is important to recognize that a scenario establishes certain norms and patterns that may become inert [60]. The resulting inertia was observed at Veronica Broadcasting, where the new scenario took effect after Veronica Broadcasting was taken over by HMG. This problem was also manifest at Anderson Consulting, as it was difficult for them to move from an IT-led to a user-led development process. This transition to another scenario might require substantial energy on the part of the management. The superstructure defines the longer-term OMIS scenario objectives that must be well aligned with the business objectives and intent [32], resulting in a view of required information technologies, their organizational functions [56], their linkages, and possible diversity of scenarios.

With respect to how an OMIS development scenario can be designed, the following rules can be formulated on the basis of the lessons learnt in the cases:

1. Define the OMIS superstructure.
2. Check the memory codification need and the OMIS infrastructure maturity of the organization as a whole.
3. Define the global OMIS development scenario.
4. Rehearse this analysis in the case of the different logical hierarchies in an organization. Use the core competence definition to identify different memory areas, and define a scenario for each area.
5. If different scenarios are required for different parts of the organizational memory, define the linkages of the parallel development processes.
6. Define the roles and project management dimensions of each scenario.
7. Check the results of the OMIS (sub)projects against the superstructure and business process integration needs.

8. Decide on further OMIS developments.

The theoretical limitations of this study are manifest in many ways. For instance, no analysis has been made of the organizational functions (part of the superstructure) of an OMIS as a context variable. In retrospect, it is manifest that none of the OMIS observed had the goal attainment function as a target, although this is also a potential constituent of an OMIS [56]. Veronica Broadcasting initially tried to accomplish an OMIS with an emphasis on pattern maintenance (especially personal routines and personal memory storage). The integrative function was very poorly developed (except at the news office). In the Veronica Broadcasting case, after 1995, the emphasis shifted to integration (in the work groups) and adaptation (picking up all kinds of interesting information from all over the world, e.g., via the Internet). Andersen Consulting aimed principally at internal integration of its many memory sources. NNGI emphasized pattern maintenance in its bureaucratic process and adaptation in its memory maintenance. In a further study, it might be interesting to explore the possible consequences of these OMIS functions to elaborate this theory on OMIS scenarios. In addition, it also might be interesting to further explore the requirements of the different stages in the memory logistic process [33, 56]. For instance, at NNGI it was interesting to observe that the maintenance process required an entirely different OMIS and a different scenario than the storage and retrieval process.

If we look back at the codification and maturity variables, we see that no observations in this study have been made on a low OMIS infrastructure and high codification context. This context is typical of expert systems and artificial intelligence-type projects, as has been documented on many occasions (e.g., [38, 58]). The broader context of OMIS may help to place these projects in a relevant organizational context and prevent expert systems projects from becoming IT wallflowers. The KADS design approach [54] may help place these developments in an organizational context by linking them with business activity requirements. However, KADS does not explicitly link up with the company's competence policy and knowledge management. The superstructure concept, however, does provide this link. This conclusion shows, again, the importance of superstructure definitions that align the development process with a company's strategic intent and organizational functions [29, 30, 56].

An interesting topic for further consideration concerns the methods and techniques for OMIS analysis and design (see [10, 28, 38, 58] for an overview). Reviewing the work on method engineering in the broader perspective of OMIS development might contribute to this work, whereas method-engineering research could also contribute to greater consistency in the analysis and design of OMIS and its diverse list of subsystems. It would be particularly interesting in this respect to study the effectiveness of the object-oriented approach to global OMIS design (see [61]). The object-oriented approach, however, has limitations in modeling more formal and more codified memories. For this purpose, ontology modeling, production rules, and workflow modeling techniques (e.g., Petri nets) might be much more successful (also see [4, 10, 14, 25, 38]). The codification level may thus be an important indicator of which methods and techniques to select. At the moment, however, the codification measure is still very rough, and some further research on this measure in the context of method and technique selection would be useful.

The attention of the IS community should also be drawn to the need for further research in IT infrastructures. In the field of OMIS, this could contribute to further insights into the technological feasibility of the superstructural ambitions.

Further research could also be carried out on the definition of the effective roles and skills of IT experts, who in many cases need to develop as knowledge managers (see Andersen Consulting). The line set out before by Markus and Benjamin [41] could be continued by identifying the most approporiate roles in varying scenarios and equipping the IT experts with the appropriate skills. It would also be interesting to study the management of projects that can no longer be termed projects because of their lack of purpose and structure. This takes place in scenarios and thus entails serious risks. Innovative organizations should be able to take risks, but at the same time greater insights and precision in how the superstructure could best be defined might help in coping with these risks. The research in strategic intent definitions, OMIS infrastructure maturity, and codification needs assessment might be of greatest value here.

NOTES

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1. In the MIS literature, knowledge management systems (KMS) are often equated with knowledge-based systems [58]. These KMS contain formally specified and computer processional knowledge. In the OMIS context, these KMS might be only one of the many alternative ITs that constitute the OMIS [56]. To avoid any misunderstanding and confusion of OMIS with KMS, the term OMIS is preferred. Further confusion surrounding the term KMS may also be caused by use of the term KMS by certain management scientists (particularly in organization science) to identify certain organizational arrangements for knowledge management (see [49]). Because the OMIS discipline has a strong interface with organization science, this terminological confusion should be avoided by opting for the term OMIS.

2. Two streams can be recognized in the scenario concept. One is based on the strategic planning literature and defines scenarios as possible futures [20]. This approach is now also being applied to the IS development field, because of the high complexity and unpredictability of the IS context (see [15, 44]). The other stream defines a scenario as a future state of the organization after the proposed IS have been implemented effectively. The definition of the ideal state is recognized as an important tool in requirements engineering [62]. Because this study concerns development processes, the first definition is used here.

3. A very similar conceptualization is proposed by Nonaka and Takeuchi [47], who defined a now famous "5-phases model of organizational knowledge creation" (pp. 55–56) in which stage 1 is a process of sharing tacit knowledge among organization members; phase 2 is the creation of concepts for the verbalization, phrasing, and explicit conceptualization of tacit knowledge; phase 3 is the factual and judgemental justification of the knowledge created in phase 2; phase 4 combines justified knowledge with more complex concrete and tangible architetypes; and phase 5, called cross-leveling, triggers the previous phases anew, albeit intra- or interorganizationally at another level. Knowledge creation, thus, is a continuous process. Basically, this model is about the knowledge-creation process and less about how a certain level

of knowledge codification can be measured. Nonaka and Takeuchi do not precisely define knowledge codification and do not give operational definitions of this construct. In addition, they give no treatment of organizational memory and its maturity. Their line of research does not therefore contribute significantly to measuring memory codification.

4. Furthermore, Den Hertog and Huizenga [21] published a similar text in 1997 with nearly the same results. Its focus, however, was not on OMIS but on knowledge management in general. Den Hertog and Huizinga [21] used entirely different informants, who did not know of the other study taking place either. Quite by chance, both investigations were carried out independently from each other.

5. The terms electronic memory bank, KX, databases, and knowledge management were commonly used for this initiative in Andersen Consulting.

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