

Assessing the organisational aspects of SDI: metaphors matter

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Abstract. It is often mentioned that organisational aspects should be incorporated in SDI assessments, yet an assessment instrument is still lacking. In this chapter an approach for assessing organisational aspects of a Spatial Data Infrastructure (SDI) will be developed and used on literature covering management aspects of Geographical Information Systems (GIS) and SDIs. Organisational aspects will be analysed by using a multi-view approach that is based on organising metaphors. The implicitly underlying metaphors and paradigms of organisational theory are categorised and provide both a framework for analysis and a basis for intervention.

12.1 INTRODUCTION

Organisational aspects are often overlooked in SDI assessments. SDI assessment criteria are mostly shaped by technical, financial, economic and governance aspects (Crompvoets, 2006, Crompvoets and Grus, 2007). Organisational aspects are considered as important but seem hard to conceptualise. When some successful SDI implementation is celebrated as a success, technical features are mentioned yet organisational issues are not incorporated in the analysis. However when the implementation is proclaimed as a failure, organisational factors are mostly blamed. This dynamic is a

clear signal that a better understanding of organising is needed and that organisational aspects should be incorporated in SDI assessments.

In managing geo-information two concepts are dominant: GIS and SDIs. Generally speaking, GIS is the concept used for managing geo-information within organisations and SDI is the concept mostly used for sharing spatial data between organisations. Implementation processes focus mainly on technology and (spatial) data. SDI policy advisors are, most of the time, aware of organisational aspects but do not consider them as important, let alone treating them as manageable phenomena (Georgiadou et al., 2005). The development of a GIS or SDI is often treated as an implementation process that stands apart from, rather than being part of, organisational change. Of course, every now and then implementation projects have their delays, disappointments, pitfalls and setbacks but in the end they are delivered and operational. Again, when GIS and SDI implementations are considered as a success, it is depicted in a technical way and organisational aspects are ignored most of the time.

The myth that the needs of the user can be fulfilled without any limitation still seems to be alive. Implementation specialists give us the impression that all problems can be solved with technology. When this line of thinking is followed, the post-implementation period (when a GIS or SDI gets its real life test) is treated as a blind spot. This blind spot makes implementers insensitive to organisational consequences and a relationship between the implementation of a GIS or SDI and organisational change is not perceived. Organisational structures, modes of cooperation and work relations are subjects that the SDI implementer pays rare attention.

However developments over the last fifteen years suggest a slow but steadily growing inclination to take organisational aspects into account. Consequently, researchers have gained interest in studying the relationship between GIS or SDI and the organisations that are involved. The main focus of the research however, remains on the implementation process; that is the effort to get hardware and software up and running in order to share data. ideas, theory, and models to guide the implementation are borrowed from political science, the economy and the management information systems (MIS)-discipline among others. While these theories are of great value to GIS and SDI implementation, they ignore the post-implementation period.

The advancement of SDI, considered here as a GIS moving across organisational borders, has made implementation processes

more complex. Probably due to the very fact that SDIs move across organisational boundaries, appealing projects take longer than expected, are delayed or sometimes even cancelled. The most striking fact is that while explaining setbacks and failures practitioners point at organisational impediments, but do not know how to deal with them.

This chapter will focus on how GIS and SDI relate to organising theory. First, a framework for the assessment of organising aspects of GIS and SDI will be provided. Next, an enumeration of literature that deals with organising in the realm of GIS and SDI will be given. It will become clear that the selection of organising theories used to guide GIS and SDI implementation has been rather one sided, using mainly conservative theories. Finally, a conclusion is given with suggestions for practitioners.

The topic of this chapter emerged while the author monitored the development of the Dutch Geoportal Network (for a detailed description see Zevenbergen et al., 2006). During meetings and discussions of the coordination board, individual members were willing to advocate a more organisational approach but had no idea how to do so. While studying relevant literature, it became clear that there is no consistent line of thinking as far as organisational aspects of GIS and SDI are concerned. This observation has led to the analysis which forms the body of this chapter.

Like technological developments, organising theories are not developing in a one-way, straightforward manner. Organising theories are part of a process of developing and expanding a world of thoughts, ideas and paradigms and trying to anticipate on current organisational problems. The framework provided helps to make sense of that process and can be used as a metaphor-based tool to analyse GIS and SDI literature on the organising aspects.

12.2 METAPHORS AS AN ORGANISING-THEORY INVESTIGATING TOOL

Man has always been busy organising life. Even in early history complex organisations were to be found. In the 19th Century organising became a subject of scientific investigation and the development of theories concerning organising started.

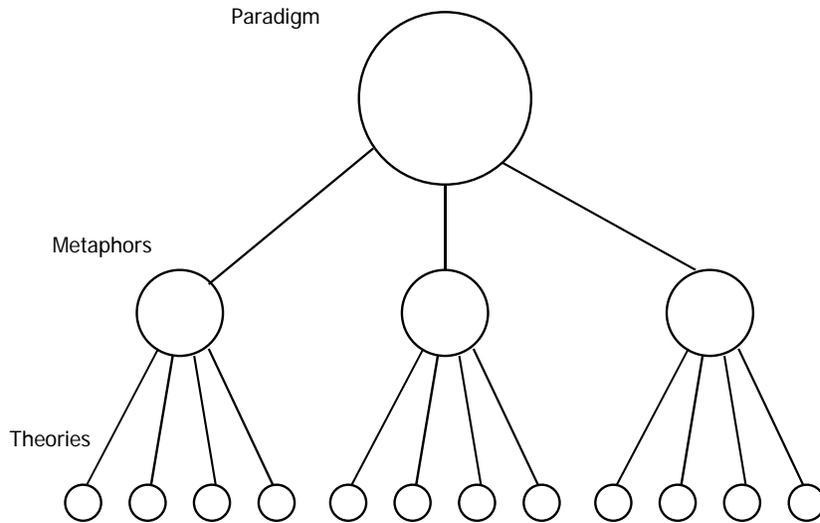
Over the years attempts have been made to describe the development of organising theory (in order to make sense of it) by using different scientific perspectives (Ritzer, 1975; Donaldson, 1985;

Burrell and Morgan, 1979; Hassard, 1993). Gareth Morgan wrote a more practitioners-oriented book (Morgan, 1986) where Morgan connected specific organising theories with a worldview, or paradigm, of the person inventing it by using metaphors. The metaphor was, in this respect, a connection between a paradigm and a particular organising theory. Morgan used metaphors like machines, organisms, cultures and brains to make sense of all the different organising theories invented over time.

To demonstrate the relationship between theories, metaphors, and paradigms, we can make a reference to the founding fathers of organising science. Fayol, Taylor and Weber were the first organisational theorists to gain recognition and impact, each developing specific organisational theories. They unconsciously and implicitly viewed the world as if it was a machine. Organisations, like machines, could in their view be designed and tuned towards an optimum. The machine metaphor depicts the pursuit of rationality within organisational boundaries, of which the theories of Fayol, Taylor and Weber are clear examples (Hofstede 2004).

Another example is the sociologist Herbert Spencer, who already in 1873 referred to an organisation as an organised body. An organism needs nutrition and is of benefit to its surroundings. This relationship with its environment is central to this metaphor, as is the ability of the organism to adapt to its environment. For instance, a crocodile would not survive on the North Pole. Like animals, organisations adapt themselves to their environment. Organisations and the environment are dependent on each other; therefore organisations are looking for resources to produce, and customers to buy, their product (Lawrence and Lorsch 1967).

Organising theories do not exist in isolation; they are related to the world and time of its inventor. The concept of metaphor can be seen as a hinge between the broad view of the paradigm of the originator, of a specific theory and the theory itself. Figure 12.1 shows how paradigms, metaphors and theories relate to each other. More than one metaphor can be a representation of a paradigm and multiple theories can be identified as belonging to a metaphor.



**Figure 12.1: The relationship between paradigms metaphors and theories
(adapted from Morgan, 1980)**

The argument that a theory is based upon a certain worldview is thoroughly elaborated by Burrell and Morgan (1979). They described all metaphors and categorised them into four paradigms (Figure 12.2.) The categorisation of paradigms is based upon two dimensions: the objective-subjective dimension and the regulation-radical change dimension. Objective paradigms presume that humans know the real world, while the subjective paradigms consider this as impossible as humans ‘construct’ their reality. On the other dimension, radical action paradigms consider organising as leading to chaos, while regulative paradigms treat organising as movement towards harmony. The paradigms in the four boxes of Figure 12.2 reflect corresponding schools of thought that can be connected to different metaphors.

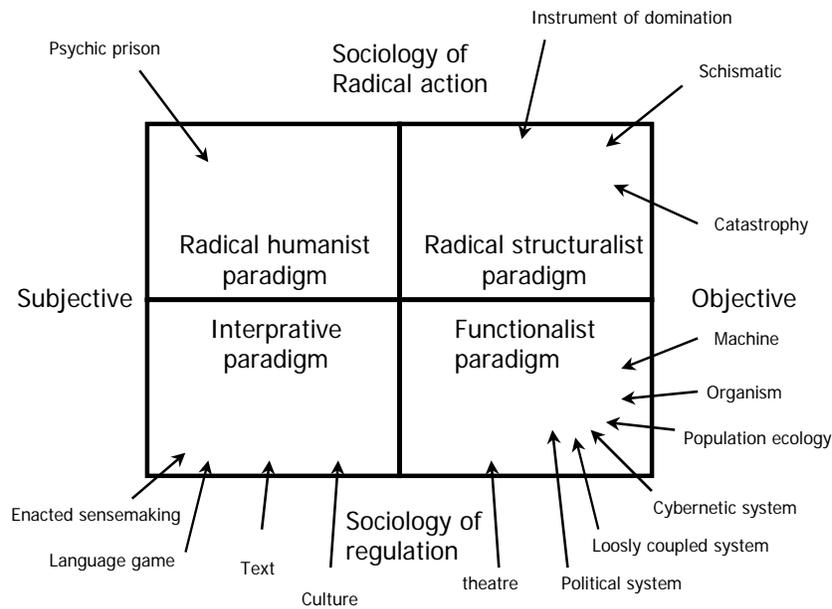


Figure 12.2: Paradigms and metaphors (adapted from Burrell and Morgan, 1979)

The *functionalist paradigm* treats society as a concrete, real world with a systemic character. Behaviour is bounded in that real world of tangible relationships.

The *interpretive paradigm* assumes that the social reality does not exist; it is the product of subjective experience. The world can be understood through the eyes of the participant, rather than that of the observer.

The *radical-humanist paradigm* emphasises that reality is socially created. Yet while reality is constructed, at the same time human beings become part of it and they feel as if they are imprisoned by it. In that sense reality, like for example capitalism, is viewed as ideological domination, moulding technology, logic, science, etc.

The *radical structuralist* paradigm focuses on society as a real and concrete dominating force. It is concerned with the way those in power seek to maintain their position.

The framework discussed in this section will be used for analysing organisational literature concerning GIS and SDI. Every publication will be scanned and connected to a metaphor, which is in

turn connected to a paradigm. Sometimes this process can be done because a specific organising theory is mentioned. In most cases, however, this must be done by analysing the content of the text. To shed some light on this procedure, each piece of literature added to the analysis is introduced briefly in the next section, depicting the metaphor used in this chapter.

12.3 ORGANISATION IN SDI LITERATURE

Every implementation of an information system includes organisational impacts. Projects need to be managed and future users prepared for their new job and role. It is a complex and demanding operation that will seriously affect the organisation at stake. From literature it can be determined how the (international) geo-information world thinks about organising. Handbooks and research articles are examined in order to assess the organisational mindset offered to the GIS and SDI community.

The time frame we are looking at is roughly between 1990 and now, covering a period of increasing organisational awareness. All literature known and available was used, including international and local, both ‘cookbooks’ and research. In Table 12.1 all reviewed literature is summarised and categorised according to paradigm and metaphor.

12.3.1 Literature Based on the Functionalist paradigm

This section summarises all literature labelled as functionalist, meaning that it is focusing on ‘real’ structures, in most cases these are the (geo) information systems in an organisation.

The Machine Metaphor

The scope of the machine metaphor is internal, focusing on literature that is aimed at rationalising the organisation from an internal perspective.

Aronoff provides a view on implementing GIS that focuses on a variety of aspects concerning the introduction and management of GIS, including organisational aspects (Aronoff, 1989). Aronoff states that GIS will affect the way things are done in an organisation, but does not make clear what will change and how. Aronoff’s focus is on the internal database management system (DBMS) and all management activities are in some way related to that concept.

Table 12.1 List of paradigms, metaphors, author(s), and year of publication.

Author(s)	Paradigm	Metaphor	Year
Aronoff	Functionalist	Machine	1989
Grimshaw	Functionalist	Machine	1991
Obermeyer and Pinto	Functionalist	Machine	1994
Assimakopoulos	Functionalist	Machine	1997
Higgs	Functionalist	Machine	1999
Nedovic-Budic	Functionalist	Machine	1999
Rajabifard and Williamson	Functionalist	Machine	2001
Fox	Functionalist	Organism	1991
Huxhold	Functionalist	Organism	1993
Pinto and Onsrud	Functionalist	Organism	1995
Meredith	Functionalist	Organism	1995
Azad and Wiggins	Functionalist	Organism	1995
Nedovic-Budic	Functionalist	Organism	1996
Reeve and Petch	Functionalist	Organism	1999
Walsham and Sahay	Functionalist	Organism	1999
Van den Toorn and de Man	Functionalist	Organism	2000
Harvey	Functionalist	Organism	2001
Rajabifard and Williamson	Functionalist	Organism	2002
Rajabifard, Feeney and Williamson	Functionalist	Organism	2002
Rajabifard and Williamson	Functionalist	Organism	2003
Nedovic-Budic, Pinto and Warnecke	Functionalist	Organism	2004
Craig	Functionalist	Organism	2005
De Bree and Rajabifard	Functionalist	Organism	2005
Obermeyer	Radical Structuralist	Domination	1995
Campbell and Masser	Interpretive	Culture	1995
Georgiadou	Interpretive	?	2005

Drawing upon insights from information-strategy theory, Grimshaw connects information-strategy with GIS (Grimshaw, 1991). In order to do so, Grimshaw comes with an implementation model that addresses questions that should be asked in order to develop an information system and to connect it with organisational aspects. Only internal features of that system are considered here.

Obermeyer and Pinto provide a management definition based on a study by classic organisation theorist Henri Fayol. This study provides five primary roles of management: planning, organising, supervising, staffing and controlling (Obermeyer and Pinto, 1994). According to Obermeyer and Pinto, a management information system (MIS) is meant to satisfy a manager's need for information in

respect to the roles mentioned. Therefore a MIS needs to enhance the effectiveness of the decision and provide managers at all levels in an organisation with the right information. A MIS is seen as the hub in the wheel, surrounded by subsystems for geography, finance, and human resources which represent the spokes.

Assimakopoulos uses the method of social network analysis to provide a description of the Greek GIS community (Assimakopoulos, 1997). This research shows that land surveying is the dominating professional group here and it is a possible explanation for the technical orientation, expressed by emphasising geometry, data quality and digital map production. The object of research is the GIS community and no external relationships are perceived, making the applied theory internal oriented.

Higgs describes the use of geo-information in the Water project in Wales (Higgs, 1999). Organisational problems are mentioned and explicated, but do not play a role in the discussion and conclusions of information structures. The guiding perspective is internal.

In 1999 Nedović-Budić attempts to build a conceptual framework for managing GIS activities that is based upon a brief review of relevant literature and stems from multiple schools of thought (Nedović-Budić and Pinto, 1999b). The focus is on the organisation, with coordination mechanisms like structure, process and policies. In another article this concept is broadened with notions about standardisation, interoperability, cost-of-coordination and mechanisms for GIS-sharing (Nedović-Budić and Pinto, 1999a).

While pointing to the role of people and data in SDI, Rajabifard and Williamson see data as the main organising factor (Rajabifard and Williamson, 2001). As data has different levels of aggregation, these differences dictate the way organising takes place. The perspective is again internal because the SDI environment is the object of analysis.

The Organism Metaphor

The organism metaphor sees organisations as rationalising themselves, with a focus on external relationships.

In Metz Fox's analysis of institutional issues of spatial information in Asia, contingent, external factors affecting the internal organisation, such as social, economical and political factors (Metz Fox, 1991) are identified.

Huxhold explores the relationship between information systems and GIS (Huxhold, 1993; Huxhold and Levinsohn, 1995). He asserts that theories used in information systems research can be applied in GIS research without restrictions. In that respect he develops a framework where the source of control (Information Systems department, user department or top management) determines the state of development of a GIS. With a traceable influence of Nolan's stage model, Huxhold hints at exploring the relationship between the involvement of management and GIS usage. There is, based on management literature from Moss Kanter, Peters and Waterman, Schein and others, a suggestion about organisational change (Huxhold and Levinsohn, 1995). While environmental factors play a role it is a minor one.

Pinto and Onsrud deliver a model based on the process of information sharing (Pinto and Onsrud, 1995). By using concepts of political science and organisation science, they identify a set of facilitators and some benefits that are both internal and external.

Meredith quotes public administration theorists Thompson, March and Olsen and notes that an organisation is complex, interdependent and needs coordination (Meredith, 1995). According to Meredith, the inter-organisational context should be incorporated in this framework. Rational organisations seek structure and coordination while rapid changing technology, which is the case in a GIS environment, is challenging this process. Because decisions are often made under ambiguous conditions, Meredith tries to identify internal and external conditions for participation, eventually collated in a framework.

Azad and Wiggins consider geographic data sharing as an inter-organisational aspect (Azad and Wiggins, 1995). In their view, based on research by organisation theorists Pressman and Wildavsky, an inter-organisational relation has implications for autonomy and a three step model is suggested. Geographic data sharing, treated as an inter-organisational relation, moves from collaboration to cooperation and eventually to coordination.

Nedović-Budić and Godschalk investigated the adoption of GIS in local government agencies (Nedovic-Budic and Godschalk, 1996). They come with some external factors influencing GIS adoption and try to assess whether they play a role.

Reeve and Petch are aware of the lack of organisational attention (Reeve and Petch, 1999). In their book they promote a socio-technical

approach, with the main message to put people first. In a narrative way they make their point that implementing GIS technology is a success-factor, depending on the way people work with it and how it is managed. They draw a picture of GIS users, formerly constrained in their relation to technology by analysts and programmers but now with unmediated access to technology. Expectations about information systems consequently shifted from plain cost effectiveness to strategic advantages. These notions are used to develop a GIS Systems Development Methodology.

While mentioning literature on structure (Giddens, 1984) and that the social construction of technology (Bijker, 1995) is influential, Walsham and Sahay adhere to actor-network theory on an inter-organisational level when investigating GIS in district-level administration in India (Walsham and Sahay, 1999).

Using a cultural approach, which suggests an interpretationist propensity, van den Toorn and de Man describe cultural factors influencing organisational structural factors (Van den Toorn and de Man, 2000). Because they focus on (national) culture that influences the internal (objective) structure, their approach must be treated as representative of the organism metaphor.

Harvey puts the actor network of the professional GIS-user in the centre of the technology proliferation process (Harvey, 2001). Harvey's approach must be distinguished from social network theory because it incorporates all network activities, including the technological ones. Based on research in Switzerland, Harvey asserts that actor networks and technology, in this case GIS-technology, affect one another. Data exchange stimulates the emergence of effective inter-organisational de facto standards. They help to maintain actor networks, while prescribed standards do not work and will consequently not have an impact.

Rajabifard, Feeney and Williamson see cultural and social factors as contingent to developing the SDI (Rajabifard et al., 2002; Rajabifard and Williamson, 2002; Rajabifard and Williamson, 2003). Contrary to the cultural metaphor as mentioned in section 2, culture is used here as an external influence together with political, technological and economical factors.

An article by Nedović-Budić, Pinto and Warnecke presents research on both internal cooperation and external cooperation with the development and exchange of geo-information between organisations (Nedović-Budić et al., 2004). Saving resources is the

main driving force which leads to simple relationships with locally developed standards. External and internal relationships are different in nature. External relationships are more formalised, less intensive, more externally standardised according to recognised standards, fee-based, financially motivated and legally encapsulated compared to internal relationships.

Craig asserts that structure is not as much a success factor for GIS implementation as is the motivation and role of key individuals (Craig, 2005). Craig depicts a few cases where individuals in his view were the enablers and driving forces of successfully implementing GIS.

Focusing on the wider community, De Bree and Rajabifard propose the use of mass communication to let users become more aware of SDIs (De Bree and Rajabifard, 2005).

12.3.2 Literature based on the Radical Structuralist Paradigm

This paradigm considers organisations that have chaotic aspects and that eventually organisations will collapse due to internal properties.

The Instrument of Domination Metaphor

Nancy Obermeyer offers in ‘The Hidden GIS Technocracy’ a perspective on GIS with both centralising and decentralising tendencies (Obermeyer, 1995). The proliferation of GIS makes spatial data available at more places and will enhance democracy. On the other hand, standardisation causes more centralised control of data and metadata. She argues that ultimately the centralising developments will prevail, causing a domination of technology, which moves power away from user organisations.

12.3.3 Literature based on the Interpretative Paradigm

Georgiadou, Puri and Sahay propose to move away from traditional ways of looking at SDI research (Georgiadou et al., 2005). According to them, revenues from SDI development are not as big as they should be and they name a few fallacies in traditional reasoning when it comes to SDI development. When proposing an alternative they focus on questions concerning dynamics, process and scope and research regarding SDI development. This line of reasoning is elaborated on further by trying to learn from the available body of knowledge regarding National Information Infrastructures (Georgiadou, 2006).

The Culture Metaphor

Campbell and Masser address the topic of organisation and technology (Campbell and Masser, 1995) by mentioning two different cultural frameworks. One based on Greek Gods by Charles Handy (Handy, 1985) and one based on a systemic analysis by Paul Frissen (Frissen, 1986). With these organisational and cultural frameworks in mind, they distinguish different roles and styles of culture, influencing SDI.

12.3.4 Analysis

Figure 12.3 and Figure 12.4 give an impression of which paradigms and metaphors are mostly used. It becomes clear that the functionalist paradigm and the machine and organism metaphor are guiding thoughts on applying organisation theories to GIS and SDI.

Conservative organising theories, stemming from conservative metaphors, guide management perspectives on GIS and SDI. Theorists including Weber, Fayol and Taylor, who developed their ideas approximately a Century ago, attempt to structure the prevailing 19th Century anarchy within organisations, are still applied today in organisational business cases. These theories stress central control (Fayol), structure (Weber) and efficiency (Taylor) and are useful for placing contemporary theories on organising in their context. However these theories are not ready-to-use explanatory concepts for consulting and research (Hofstede, 2004; Morgan, 1980).

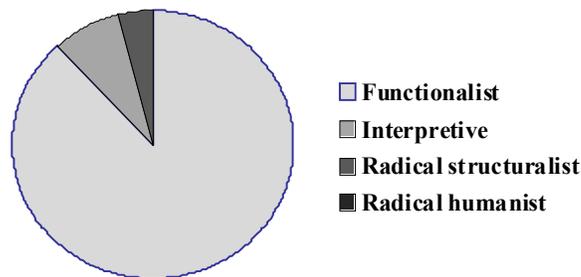


Figure 12.3: Division of paradigms (N=26)

The literature reviewed hardly gives notions about what strategy has been followed. Of course, some thoughts are shared about efficiency, but basic assumptions about how GIS or SDI can be used in organisations and how this affects the way things are done is

absent. Most authors give us the impression that after organisations implement a GIS, or when an SDI is promoted, organisational aspects can be ignored. Just to name a few ‘functionalist’ aspects: task structure, organisation structure, customer profiles or strategy are not mentioned. In this perspective GIS or SDI implementation is considered as a project, not an ongoing process.

Within the functionalist paradigm, only machine and organism metaphors are found. Studies using the machine metaphor focus on internal features, looking only for internal explanations, to explain the performance of organisations. Authors moving within the organism metaphor connect the environment explicitly and seek explanations on the interaction between the organising entity and its environment, focusing on real structures. The relationship of organisations with their environment is focusing on users, stakeholders, government and the like.

The Radical Structural Paradigm focuses on deteriorating aspects of organisation structures that can be found in the Instrument of Domination Metaphor, of which the article by Obermeyer (1995) is a perfect example.

Literature originating from the interpretationist paradigm tries to look at the world from a participant perspective. To them, there is no real world that can be observed but only interpretations of reality. Campbell and Masser (1995) offer a cultural approach by summing up some cultural theories and Georgiadou et al. (2005) are working on an interpretationist perspective, borrowing from insights developed in information systems theory. Both articles propose to move away from the ‘classic’ systems approach and give some hints for alternative research strategies, but also lack a focus, let alone a research agenda of some kind.

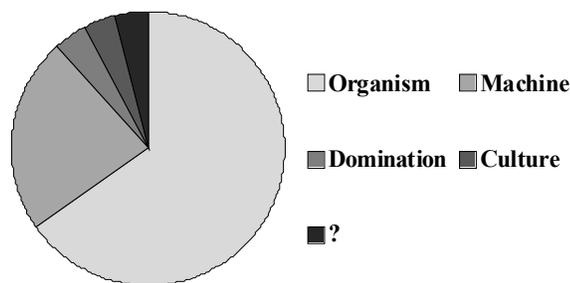


Figure 12.4: Division of metaphors (N=26)

12.4 SUMMARY AND CONCLUSIONS

In search of an organisational assessment tool for GIS and SDI, this chapter developed a method of analysis, using metaphors. This method served as a tool to analyse all the literature known and available from the last two decades on organising theory and geo-information. The theoretical perspective was based on an adapted approach, using paradigms and metaphors, as developed by Morgan (Morgan, 1986). We found that in literature on analysing and explaining organisational issues concerning GIS and SDI, most theories are based on the functionalist paradigm, either using the metaphor of organisations as machines or organisations as organisms. Theories within this realm adhere to the assumption that the organisation behind a GIS or SDI is a real object with a systemic character, and interventions should be implemented accordingly.

While during the last few decades organisational theorising is moving towards other paradigms as described by Burrell and Morgan (Burrell and Morgan, 1979; Hassard, 1993), SDI and GIS are almost exclusively studied from the functionalist paradigm. The two contributions in the interpretationist paradigm could represent the dawning of a new paradigm, but with only two publications within a ten year interval it is doubtful if that is the case. Meanwhile, in the interpretive paradigm, particular cultural approaches have gained significant attention (Alvesson, 2002; Martin, 2002).

Organising aspects of GIS and SDI deserve better theories, based on alternative metaphors and paradigms. Improvement can be achieved in two ways. First, new approaches can be developed within the functionalist paradigm, using alternative metaphors like political, cybernetic and theatrics ones. Second, research can be guided by other paradigms, using metaphors like culture, language game, psychic prison and catastrophe. In order to learn more about how geo-information and how organisations affect one another, both lines of research need to be developed.

Innovative research on GIS and SDI will generate new insights that spawn new approaches. The adventurous and uncertain way of doing research guided by other paradigms might not be an argument to refrain from blazing new trails. Inspiration can be drawn from information systems research, where terra incognita was investigated in a similar way (Walsham, 1991). That scholars from other disciplines are able to do groundbreaking research in a technical

environment is convincingly demonstrated by the anthropological study of a technical culture by Kunda (1992), and the narrative analysis of complex infrastructural projects by Berendse et al (2006).

Looking at perceived problems in GIS and SDI practice, theory advancement in organisational GIS and SDI research is needed. Still little is known about how the use of geo-information and how the implementation of GIS and SDI affect the way organisations behave. Further, the relationship with users and user groups needs to be investigated. There is a lot to be learned about the interplay between flexible organisations and rigorous data structures through focusing on people's perceptions, motives and expectations, rather than simply looking at what design of organisational structure is most effective.

The use of alternative organisational metaphors can be beneficial to both practitioners and researchers. It enlarges the palette of theories and approaches to choose from when it comes to explaining organisational behaviour and developing geo-information management strategies. Researchers may be challenged to use theories stemming from alternative metaphors and paradigms. Because researchers with a background in organising are scarce in SDI research, they have to be invited from disciplines like sociology, anthropology, psychology and public administration. Practitioners can benefit from the window of opportunity offered by a revolutionary paradigm. A given business case that has a certain problem can be analysed with theories stemming from contradicting metaphors, leading to alternative and challenging conclusions, preferably offering hints for new strategies. Consultants in charge of such processes must be able to apply different metaphors, leading to the ultimate business strategy.

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