Managing earth system complexity: on the edge of project, line and program management

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1. Introduction

Earth system governance is a complex issue. Dynamics originate from continuously occurring change events, instigated by the self-organizing ability of subsystems (social, governmental and physical). Within these, people give meaning to shared issues and approaches. Subsequently, new subsystems are created to cope with complexity.

Accordingly, an interesting research question arises: how do individual public managers (try to) cope with the observed (non-linear) dynamics and complexity in earth system projects? Managing complex earth systems proves not to be easy task, because it is difficult to grasp or even understand the full complexity of many projects (Wagenaar, 2004). This paper aims to gain insight in how managers cope with the complexity of systems in their daily professional lives.

1.1 Management in the complex system

In scientific literature, different management styles are distinguished in order to cope with complexity: project, line and program management approaches. In these approaches, different boundary judgments are being made each time. In short, project managers clearly outline the project they work on, and approach the environment from the ambitions and goals set for that specific project. Subsequently, line managers are focused on hierarchical internal organization structures of accountability. They cope with complexity by scoping it within political-strategic ambitions and expectations. Conversely, program managers have a programmatic perspective on complexity. They

are less internal organizational focused, and put their efforts to spanning project boundaries in order to cope with complexity. In the paper we will use our observations of the actions of individual managers coping with complexity in an effort to elaborate on theories of public management and complexity (on self-organization, co-evolution and non-linear dynamics).

1.2 Research approach

In our effort to understand the how public managers cope with the complexity of systems in their daily professional lives, we are interested in further exploring the different management styles and attitudes of individual public managers dealing with earth system governance complexity. In this paper we concentrate on public managers who are directly and indirectly involved the development of an exemplary complex system, namely the Dutch metropolitan Randstad region. This region is faced with issues of spatial quality and troublesome decision-making with regard to infrastructure, urbanization and natural facilities. In the area, several self-organizing subsystems such as the South Wing and the Association Deltametropolis are at play. In these subsystems, governmental institutions have agreed upon a joint approach to regional spatial issues, aiming at strengthening the economic viability of the southern Randstad region in the Netherlands.

Aiming to provide with a strongly empirical addition to the existing insights into management and complexity, an inductive approach has been applied for our analysis of public managers in the Randstad region. Applying the Straussian constant comparative analysis (Glaser and Strauss, 1967; Corbin and Strauss, 2008; Charmaz, 2006: 11), two series of (semi)open interviews with 22 public managers involved, observations at five occasions and an extensive empirical literature analysis have been analyzed. The variety of data was analyzed through alternately coding, analyzing and comparing the variety of data throughout the analytical process. The aim of this approach was to develop an empirically based, theoretical understanding of how public managers cope with complexity. In this attempt, the analysis was guided by theoretical sensitizing concepts (Blumer, 1954; Strauss, 1987; Corbin and Strauss, 2008) which will be clarified in the next paragraph.

2. Theoretical departure: sensitizing concepts on complexity management

There are several theoretical insights that go into management in complex systems. These functioned as sensitizing concepts for the empirical analysis we have done. This implies that they have guided the empirical analysis.

The literature on complex systems that focuses on management characterizes managerial activities as sense-making and recursive thinking (Tsoukas and Hatch, 2001), learning (Stacey, 2003), and takes into account "the essential local nature of human interaction" (Stacey and Griffin, 2006: 40). These insights fit into some of the ideas from public management theory, which also stress the emergent, context-specific and unpredictable character of public administration (Mintzberg, 1994).

2.1 Managerial activities

Although the literature that focuses on the characteristics of managerial behavior from the perspective of complex systems is limited when it comes to empirical analysis, one thing that stands out is that managers must be flexible and resilient. Managers have to take the complex characteristics and non-linear dynamics of systems into account (Griffin et al, 1998; Stacey, 2003; Stacey et al, 2000).

The existing literature on complex systems indicates how managerial strategies have to be organized and implemented in order to cope with complexity (Griffin et al, 1998; Senge, 1990; Stacey, 2003; Stacey et al, 2000):

- *flexible*; if systems are characterized by complex dynamics, managerial strategies must be flexible so that they are able to cope with a myriad of different interactions, actors and unexpected consequences and effects;
- *adaptive*; if complex systems are characterized by emergent properties, then managerial strategies have to be adaptive in order to fit the changing properties. In that sense, much emphasis is placed on learning capacities of systems but also of managers;
- *specific*; if agents in social systems are adaptive and thus themselves complex, managerial strategies have to address (local) actor dynamics in order to be able to influence dynamic patterns that arise out of the interactions of separate agents.

Literature is growing on the issue of 'complexity management' which stress that management is not an *individual act*, but as an *interact of different managers* (formal and informal) leading to directions in complex projects (Uhl-Bien et al, 2007; Teisman, 2005). This stream of literature looks at how different managerial behaviors to cope with complex situations, stating that it is a mixture of administrative leadership, focused on formal structures, rules and control mechanisms, adaptive leadership, focused on informal structures, learning and flexibility, and enabling leadership, which is focused on the dynamic interaction between the former two types of leadership (Uhl-Bien et al, 2007). This framework is very interesting because it is oriented on the interrelationship between formal and informal structures and processes, and has a specific focus on dealing with complexity in organization and management of private as well as public organization and inter-organizational cooperation. However, this framework has little empirical illustration and ground this far. Moreover, this stream of literature has little embedding with management theories within public administration. In the next section we pay attention to this.

2.2 Management styles

In this paper we are interested in how public managers cope with the complex character of metropolitan projects. In public administration literature a distinction is made between three forms of management: project, line and program management (see also: Gage and Mandell, 1990; Kickert et al., 1997; Mandell, 2001; Agranoff and McGuire, 2003; Meredith and Mantel, 2000; Mantel, 2005; Süsskind & Cruikshank, 1987; Teisman, 2005; Edelenbos and Teisman, 2008). In the case of project management, the process of a project is divided into successive phases. Project management focuses strongly on managing the phases based on five aspects: quality of contents, costs, time, organization and information (Meredith & Mantel, 2000; Mantel, 2005). Each phase transition is marked by a foundation document containing the results of the previous phase and describing the requirements and approach for the following phase. The results of each phase are tested against the foundation document. Project management focuses mainly on internal project management and less on continuing interaction with the environment. In a project approach, the assumption is that problems and solutions (within certain limits)

are reasonably stable. This makes it possible to use project managerial techniques: a clear objective, a fixed schedule, clear preconditions and an end product agreed at the start.

In literature the rise of project management approaches and failure in rather complex and process oriented situations has been discussed widely (see e.g. Turner and Keegan 1999; Crawford *et al*. 2003; Maylor *et al*. 2006). If we look at the current practice of public management in the Netherlands, we tend to agree with the reasoning of Maylor *et al*. (2006) that this decade shows a trend from *projectification* to *programmification*. A key characteristic of programmatic work is that it goes beyond studying the internal functions of a public organization (Hall and O'Toole, 2000; Mandell, 1994; O'Toole *et al*. 1997). Programs are oriented at improving relations between governmental organizations and a diversity of stakeholders or specific actors in their dynamic environment. However in public management theory that discusses these reforms very little attention has been paid to the rising organizational logic of project and program management in public management practice. Management attention is paid to continually adapting the program during the execution of activities. Adaptation does not occur only in response to the internal operations, but also in reaction to the impact of the context in which it is situated (Browne and Wildavsky 1984: 208).

2.3 Managerial coping with complexity

Line management focused on functional hierarchical structuring was the main management paradigm in as well management theory and practice for a long time (Turner and Keegan 1999). Line management concerns with hierarchical structuring and steering of an organization (Mintzberg, 1994). Line managers are focused on strategy formulation and controlling the implementation of prior developed strategies (Mintzberg 1994). Line management features top-down target-setting, dividing up the activities to be implemented and a formal embedding of these activities in budgetary and strategic planning procedures. Line managers are thus very much oriented on decomposition of overall strategies in decentralized parts of the organization, and looking ways to coordinate and integrate those parts on a higher level (middle management and top management). Coordination and integration is approached as a formal, top-down approach, whereby strategic planning was decomposed into clearly articulated steps

(Lundin and Soderholm 1995; Turner and Muller 2003). Moreover, in public organizations strategies find their origin in political agenda-setting. Top managers are guided by political negotiation and contestation. The political world is often complex leading to often-times unexpected results that have to be picked up in a way by top managers in public organizations (Lehtonen and Martinsuo 2008; Lundin and Soderholm 1995; Turner and Muller 2003). The main differences between project, line and program management are summarized in the next table:

Table 1. Overview of management styles

Dimension	**Project management**	**Program management**	**Line management**
Nature of complexity	Internal organizational dynamics due to coordination between clusters/sectors within the organization	Dynamics in the coordination between projects and complex external environment of different stakeholders	Dynamics in political sphere, due to negotiations between politicians and unexpected outcome from those negotiations
Main management focus	Internal organization and coordination with line and segments	External environment and inter-organizational cooperation	Serving the political principals in dealing with complex issues
Main management activity	Creating a well-defined and demarcated project: clear project goals and time path	Realizing a coherent set of interconnected projects	Realizing well-defined procedures and a clear accountability structure

3. The case of the Dutch Randstad region

The Dutch economy is an open one, relying heavily on international trade through Schiphol airport and the Port of Rotterdam which are both situated in the western part of the country. This part of the country is characterized by its dense urbanity, being a conglomeration of the four large cities of Amsterdam, Rotterdam, The Hague and Utrecht and their surrounding number of smaller cities. Of the 17 million people living in the Netherlands, 7 million live in this region. Hall (1966: 95-121) was one of the first to refer to this area as the 'greenheart metropolis', referring to its horseshoe-shaped build-up and its agricultural, green core (Hohenberg and Lees, 1985; Meijers, 2005). The Randstad area, as this metropolitan region is known as, has undergone a speedy growth during the last decade. The governance practice of the region has also undergone many changes in this period.

3.1 Randstad metropolitan governmental context

In the Randstad region, a variety of governmental institutions are responsible for its spatial development. The national government has a variety of sectoral interests in the area, concerning its quality, its build-up and its economic development. In that light, it's departments of Spatial Development (VROM), Transport, Public Works and Water management (V&W), Agriculture (LNV) and Economic Affairs (EZ) each make policies for the Randstad region. On the other hand, there are four provinces active in the Randstad region, which have a responsibility to guide spatial development for the long term and for a high level of aggregation. These provinces are that of Flevoland, North-Holland, South-Holland and Utrecht. Subsequently, more than 138 municipalities are actively developing their constituencies in the region. Their attention is for instance directed at developing built environment, securing local infrastructural connectivity and ensuring the recreational and natural quality of their constituencies.

Similar to other metropolitan regions, governance in the Randstad is faced with difficulties. The need to be internationally competitive causes each governmental organization to acknowledge the need for sizeable developments in the region. In practice however, public management is faced with extensive delays in the realization of these interventions. Infrastructural interventions take up an average of 14 years in preparation

(Feenstra, 2009). Also, the interventions that are developed reflect a debated quality and coherence in the area, threatening the economic success of the country (Ministry of Economic Affairs, 2004: 26-29; The Economist, 2009; Institute for Management Development, 2009).

3.2 Tackling metropolitan issues in the Randstad

In reaction to these issues, three public management approaches are observed in the Randstad region. The first of these approaches concern adapting the governmental structure in the region. In that light, a lengthy debate continues to be held on the establishment of a so-called Randstad-province. This new to be established governmental institution would replace the authorities of the current provinces and is considered to guarantee coherency for the metropolitan region as a whole. On a more local level, discussions have been held on the establishment of city-provinces that would replace municipalities in areas where they are densely present. After much debate, so-called wgr-regions were brought into being, taking over some of the regionally oriented tasks of municipalities such as child-care and public transport. These governmental organizations however are lead by politicians from the different municipalities involved. The second public management approach discriminated is adapting regulations in the region. In order to realize spatial interventions, a variety of regulatory processes are required attention. These also include processes to streamline public participation. By adapting regulations such as the Dutch Law for Spatial Development and the infrastructural Tracélaw and by establishing the Crisis and Recovery law, public management aims to reduce the moments in which public participation is put in. The third approach to dealing with the issues of lacking quality and extensive delays consists of improving interaction in the Randstad region. This is reflected in the establishment of alliances between governmental institutions in the area such as ‘Regio Randstad’, the North Wing and the South-Wing collaboration and the ‘Association Deltametropolis’.

Working within this context of alliances, laws and organizational structures are thousands of public managers working for municipalities, wgr-regions, provinces and ministries. As will become clear, these public managers have different ways of coping with the complexity they encounter.

4. Managerial coping in metropolitan governance

When reflecting on the different public managers who are active in the various governmental institutions in the Randstad region, the three types of public managers distinguished in theory are subscribed. Project, program and line-managers are working alongside each other in governmental organizations in the metropolitan region. Their understanding of their complex context, their main managing focus and their management activities however diverge from theoretical assumptions referred to earlier.

4.1 Complexity according to public managers

In theory of public management in complex systems such as metropolitan regions, assume the complexity faced to be caused by a high degree of dynamics. Line-management is proposed to deal with political dynamics, program-management with the program and accompanying projects, and project-managers are interpreted to deal with dynamics within their organizations. The analysis of public management in the Randstad region supports the assumption of a dynamic complex context. It has uncovered that the complexity experienced by public managers is predominantly based in the way they interpret their surroundings: as a threat. This exert reflects this interpretation of a line-manager in his attempt to realize an organizational ambition: *"The social-support approach, that's always a difficult story. […] Our friends of 'economy' will start, in our own joint right? 'You shouldn't do that'. And we don't give civilians too much say in it, because then it won't succeed."*

Public managers are embedded differently for each task and for each project they are working on. Their social surroundings are built up of unique combinations of horizontal and vertical relations. While the first type of embeddedness is mostly concerned with exchange, the second type is more related to power and hierarchical relationships between the public managers and other actors. Studying the interpretations of embeddedness by public managers, it becomes clear that they consider their surroundings as predominantly threatening. This is true for line-, program- and project-managers alike. This interpretation can be exemplified in a project concerning the realization of a regional strategy by an alliance. A line-manager involved stresses that the hierarchical context he faces is resentful. This resentment is reflected in their effort to push through their own

ambitions and block the realization of the interest of the line-managers' organization. A program-manager indicates especially being confronted with the vertical context being uncomfortable with the regional wishes. This is experienced by their reluctance to pass through the regional agreements in their organizational policies and ignorance of the wishes among those people putting the agreements to practice. Subsequently, a project-manager involved claims to be confronted with a hesitant vertical context in which actors are not dedicated to realizing the project. Also, he is faced with an unavailable horizontal context, characterized by people avoiding the program or trying to realize their organizational aims in stead of the projects' aims.

Public managers dedicate most of their attention not to directly work on the task at hand, but to deal with the threatening factors. This is experienced as the most important part of their work, dealing with complexity.

4.2 Demarcating the working area

Public managers are not flexible in adapting their aims. In practice, public managers strive for a large variety of sub-aims for each task they are working on, such as trying to realize home-relocation in a protected area, making inner-city development economically successful and safeguarding the constituency from undesired developments. When reviewing the great variety of sub-aims, it becomes clear that public managers have different general aims. Line-managers aim for the success of the organization or sector they work for, project-managers aim for project-realization and program-managers for regional development. The different aims are reflected in this exert of a program-manager: *"Everything was organized in the line. And I was suddenly pulled out of that line by my director, saying 'you're sitting next to me, because I want that integration taking place'. Well, everyone was startled, 'he's going to do our job'. Well no! Imagine I could do that, you'd be able to fire a lot of people. No, it's just keeping the overall view, coordinating, having the big picture, and from that big picture communicating internally."*

In the attempts to realize their aims, public managers find themselves embedded in a social context that continuously threatens their work. As a result, their efforts are not – as implied by much literature – directed at their tasks themselves.

Literature stresses these activities: Line-managers are proposed to work on serving the political principals by devising procedures and structures. Program-managers are indicated to work on cooperation by realizing projects and interconnections between them. Project-managers define and demarcate their project in goals and time-paths in the attempt to coordinate and organize internally, as reflected in this exert: *"When we began, we said 'there should be an integral project group and of course that should be organized outside of the line-organizations. Well, you can imagine that gave a substantial amount of struggle from the line-organization, which felt passed over sometimes because the standard hierarchical decision lines could just be ignored. So I haven't always made friends, but that's okay."*

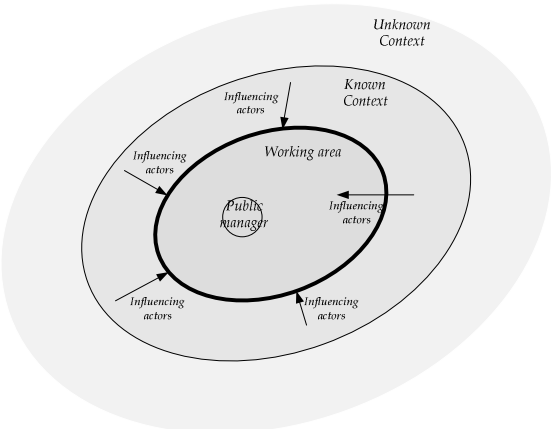

Figure 2 The strong demarcation by line-managers

In practice however, public managers dismiss these efforts as their main work. In stead, they stress their efforts of dealing with the negative, threatening influences they experience towards their aims and efforts from others. These efforts include making a careful demarcation of their working area. This process is also touched upon in literature as the practice of making boundary judgments in the action area (Flood, 1999; Teisman et al., 2009: 6; Pel, 2009: 117). The demarcation of their working area is a tacit process, based on including those actors interpreted to be important to involve in their efforts, and excluding actors who are considered threatening and unimportant in the process of aim realization.

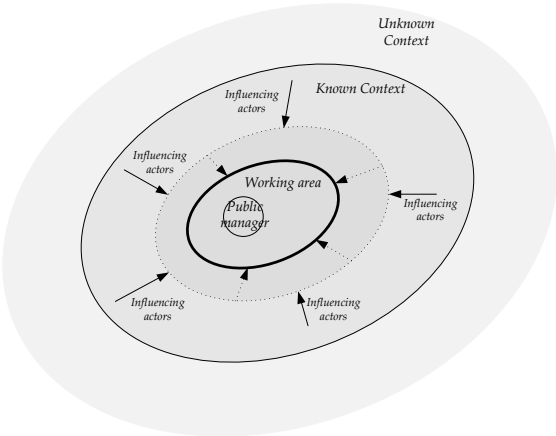

Figure 3 The strong and specific demarcation of project-managers

In figures 2, 3 and 4, the demarcation by each type of public manager is reflected. In the figure, it is stressed that the social context public managers is vast and largely unknown. Subsequently, the demarcation of the working area takes place in relation to the context that is known and is experienced as influencing the public manager in a threatening fashion. In the first figure 2, it is illustrated that line-managers make stable demarcations, clearly distinguishing those involved and those not involved. This causes certain influences from the known context to be ignored, while others are dealt with. As reflected in figure 3, project-managers also make stable demarcations, but are also inclined to be more specific in their demarcations. This implies their preference to focus on those actors directly linked to their project. Other actors in their acknowledged context, who influence the project but are not considered to aid the project are not acted upon. The third figure illustrates how program-managers make dynamic boundary judgments. This implies that they are open to adapting their inclusion when the situation requires it. When an actor from the social context is perceived to be of influence to the success of the regional agreements, he or she is involved in the working area.

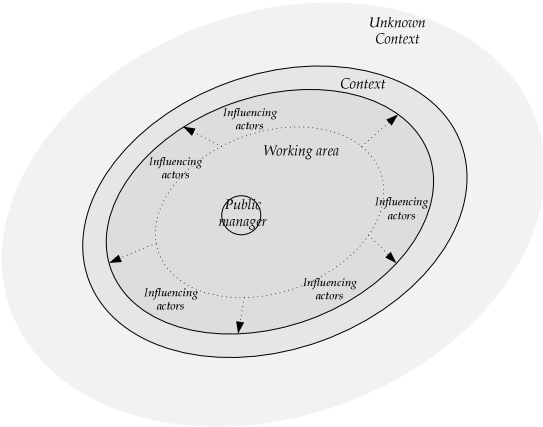

Figure 4 The changeable demarcation of program-managers

4.3 Dealing with those included in the working area

Through the process of demarcation, a sorting of actors to deal with and actors to leave out from actions is made. Subsequently, public managers devote most of their time and effort averting, mitigating and convincing threats brought on by those actors included in their working area. To that end, each public manager has a different set of actions at their disposal. Nevertheless, three strategies are identified. Line-managers mostly adhere to a hierarchical strategy. They mostly interpret actors from their hierarchical embeddedness to threaten their organizational or sectoral interest. In order to prevent threats from being realized, line-managers use their position and the position of others in the organizational

hierarchy to deal with these threats. This line-manager for instance indicated the intention to use power attributed to her organization by the installation of a new law: *"We hope that…with the new WRO [Law on Spatial Development], a lot of the provinces' authority is transposed to the municipality. So well, I'm anxious to know how that will work, because we do intend to use it."* Program-managers perform a twofold task: they work on regional coordination, as well as organizational coordination. In practice, they devote their attention to dealing with the refusal of their organizational and regional colleagues to commit to the program. They do this by an engaging strategy, involving organizing meetings, workshops and continuous networking. *"You do it with department heads through that sounding board. And sometimes you do workshops where you put together a couple of key-figures from organizations in those workshops with those market parties you also involve. And those are people that if you get the story across there, they can subsequently bring it across in their own circles. That's just about the way you try to work."* Subsequently, project-managers strive for realizing projects applying a procedural engaging strategy. They experience most of their threats from actors reverting from cooperation with the project. In practice however, they don't have a clear hierarchical position. In that light, they work on devising structures and procedures to streamline coordination among those actors involved. *"You organize a sounding board that really, from the department on the level of department heads, usually reacts as a sounding board to all of the intermediary steps and products we present to them. But the sounding board is no more than a sounding board. And they're all department heads in it, and they're used to be in their line-organization in a management team and can decide 'yes' or 'no', while now they only have an advisory role."*

5. Managing earth system complexity

In this paper, we set out to answer the question of how individual public managers (try to) cope with the observed (non-linear) dynamics and complexity in earth system projects. The study of public managers in the Randstad region uncovered that coping with complexity in complex systems such as the metropolitan region largely consists of dealing with surroundings who threaten the realization of aims of public managers. The influences faced with are dynamic as different people are included in their work and

actors change their influence continuously. This makes the work diverse: no day is the same for a public manager.

Keeping their aims as fixed as possible, public managers are more busy averting threatening influences by people they come in contact with. This is done by carefully demarcating the working area to decide which influence to act upon and which not to. Subsequently, averting, mitigating and convincing efforts are made to deal with the thwarting influence experienced.

In practice, line-, program- and project-managers work within the same organizations. This implies that they are part of the context others are embedded in. Also, this implies that they influence each other in the attempt to realize their aims. While they interpret each other as possible threats, coping with complexity implies public managers to act antagonistically. In this lies the core of the difficulty of managing earth system governance. As this program-manager indicates: *"Sometimes, you see that there's the inclination to go back to the old situation. So that's not on purpose, but than you try to go outside of the program-project. Than you don't want to share with others anymore. So they'll go back to those project-columns. And that's the danger."*

As public managers interpret the influences uttered by colleagues as potential threats to their aims and remain unwilling to revise these aims, public management in the complex system will continue to be complex and difficult.

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