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Accounting ambiguity and structural change

Hans Englund, Jonas Gerdin and Gun Abrahamsson

Örebro University School of Business, Örebro, Sweden

Abstract

Purpose – The purpose of this paper is to present an emergent model showing the change potential inherent in the mirroring of time-space bound metrics and numbers in management accounting (MA) and other cognitive frames.

Design/methodology/approach – An observation-based qualitative field study of a change project in a large manufacturing company is used as the basis for the analysis.

Findings – The empirical study shows that as actors recurrently mirror time-space bound metrics/numbers in MA and other cognitive frames, three forms of ambiguity may occur. Definitional ambiguities occur as actors' extant MA frame cannot fully account for the metric as such, while representational ambiguities occur as actors perceive uncertainties as to what a particular number stands for "in reality". Operational ambiguities, finally, occur as actors perceive uncertainties as to how time-space bound numbers can be "causally" explained. In the emergent model, the paper shows how these different forms of ambiguity constitute important sources of critical and collective reflection of, and subsequent change in, both metrics and MA and other cognitive frames.

Originality/value – Through identifying and elaborating on the change potential inherent in the interplay between cognitive frames and time-space bound metrics and numbers, the study adds a partial, yet previously largely unexplored answer to the paradox of embedded agency in a MA context (i.e. how actors may change existing cognitive (MA) frames when their interpretations and actions are largely constrained and shaped by these very frames). Also, the study shows that it may not necessarily be the content of MA information *per se* that triggers critical reflection and structural MA change, but also the perceived ambiguities that such information use may engender.

Keywords Management accounting change, Metrics, Numbers, Ambiguity, Social structure, Cognitive frames, Accounting, Management accounting

Paper type Research paper

Introduction

> It's always easy to blame "the others", and to say that the problems are all related to the suppliers. But I think we've realized now that we need to shoulder some of the blame too.

The above quote expresses a retrospective account of an intense change project in a large manufacturing company, where a small project group was entrusted with the task of making more effective the existing material sourcing operations and thereby to reduce capital employed. As management accounting (MA) researchers, we originally monitored this project with the ambition to tease out how actors used performance metrics when they discussed and took measures to achieve this capital reduction

target. Interestingly, however, a preliminary analysis of the emergent material made us attentive to an interesting and somewhat unexpected development. The premise is as follows. During the whole period of study we find that MA worked as a largely "constraining perceptual lens" which heavily informed actors' interpretations, (inter)actions and construction of MA metrics (cf. Kilfoyle and Richardson, 2011; Tillmann and Goddard, 2008). Notwithstanding this highly structuring role, however, we also find strong evidence of a gradual, yet distinct reconstruction of this governing and highly taken-for-granted MA structure as such. Specifically, we find a shift from an outward to an inward focus on how capital efficiency can and should be achieved (as indicated by the introductory quote above), and related to this, a shift from a functional/vertical orientation to a more processual/horizontal one.

In trying to better understand these emergent findings, we positioned our empirical material against various parts of the literature that have taken an interest in how MA may constitute both a means for, as well as an outcome of, organisational change processes. More precisely, we entered more deeply into those parts of the literature that have addressed the paradox of embedded agency in a MA context, which alludes to the question of how actors can come to change the existing (MA) cognitive structures, when their beliefs and (inter)actions are largely constrained and shaped by these very structures.

In the extant literature, this paradox has been addressed (at least implicitly) through the lens of various theoretical concepts, including social structures (e.g. Macintosh and Scapens, 1990), institutional logics (e.g. Lounsbury, 2008), rules and routines (Burns and Scapens, 2000), and cognitive frames (e.g. Boland and Pondy, 1986). A common denominator in this literature is that endogenously sparked change is typically traced to the inherent properties of social structure as such (for an overview, see, e.g. Kilfoyle and Richardson, 2011; Englund *et al.*, 2011). More to the point, researchers have typically assumed that social structures are heterogeneous in their character (see Ahrens and Chapman, 2002; Englund and Gerdin, 2011), and consequently, that change may emerge as actors recurrently (re)interpret ambiguous elements of these structures (e.g. Kilfoyle and Richardson, 2011; Lounsbury, 2008; van der Steen, 2011), move back and forth between various structural elements (e.g. Boland and Pondy, 1983, 1986; Jönsson, 1987), or experience and act upon structural contradictions (e.g. Burns and Baldvinsdottir, 2005; Abrahamsson and Gerdin, 2006; Seal *et al.*, 2004; van der Steen, 2011)[1].

The overall purpose of our study is to add to these important insights through proposing a model suggesting that there is not only a change potential inherent in the interplay between (ambiguous and potentially contradictory) structural elements, but also in the interplay between these structural elements and particular time-space bound metrics and numbers. Indeed, a number of researchers have already acknowledged that the situated use of metrics/numbers may result in structural (MA) change (see, e.g. Abrahamsson *et al.*, 2011; Ahrens and Chapman, 2002; Busco *et al.*, 2006; Roberts, 1990; Seal *et al.*, 2004). However, our emergent model takes their findings one step further through showing that it may not only be the content of the MA information *per se* that sparks critical reflection and structural change, but also the ambiguities that the use of MA information more generally may engender. More precisely, our model suggests that embedded agency can come about as actors experience, and (re)act upon, one or more of three distinct forms of ambiguity that may

occur as actors recurrently mirror time-space bound metrics/numbers in MA and other cognitive structures.

In the following sections, we first clarify our theoretical approach and position our work in the extant MA literature that has addressed the paradox of embedded agency, and then outline our research design and the procedures used for data analysis. After that, we introduce the case company and present the empirical evidence upon which our emergent model is based. In a concluding section, we outline our key conclusions and some implications for the MA literature in this area.

The paradox of embedded agency in the MA literature

Below, we will provide a picture against which our empirical results and contributions can be mirrored and valued. We begin by outlining how we approach and define the structural elements of interest in our study, which will be referred to as a frame-based perspective. After that, we present extant understandings of how actors may come to change such frames when their thoughts and actions are largely conditioned by these frames.

Frames and the embedded agent

As hinted above, a commonly occurring way of conceptualizing how MA is implicated in day-to-day social (inter)action has been to deploy various cognitively oriented notions, such as "institutions" and "social structures". In this paper, we will deploy the notion of frames – sometimes also referred to in terms of cognitive scripts (Gioia and Poole, 1984; Louis, 1980) or schemas (DiMaggio, 1997; Harris, 1994; Weber and Manning, 2001) – which means that we focus on the different types of "logics" which shape individuals' thoughts and actions (cf. Lounsbury, 2008).

Indeed, the frame concept is by no means unambiguous, and it has been used in different ways and in an array of settings, also in the accounting literature (see, e.g. Boland and Pondy, 1986; Fauré *et al.*, 2010; Jönsson, 1987; Vollmer, 2007). In our study, however, we specifically adopt this concept to denote the knowledge structures which actors draw upon in their interactions to make sense of, and act upon, incoming information about the activities of daily organisational life. A key characteristic of frames is thus that they refer to generalizable and generative social structures which inform individuals' interpretations of the past, present and expected future, and how they (should) (inter-)act in daily organisational practices (cf. Harris, 1994). That is, they refer to typified templates for daily (inter)action which allow for the binding of time-space, yet are themselves out of time-space, with only a virtual existence in the form of memory traces in the human mind (cf. Giddens, 1984; Sewell, 1992).

The idea that MA may be conceptualised as one among several such cognitive frames which both enable and constrain daily (inter)action is by no means new (see, e.g. Boland and Pondy, 1986; Jönsson, 1987; Roberts and Scapens, 1985). However, there is considerate variation in the literature, where MA has been conceptualised all the way from a domination structure (e.g. Jones and Dugdale, 2001) to a language of business (e.g. Fauré *et al.*, 2010; Roberts and Scapens, 1985). In this study, the notion of MA frame is used to denote the largely shared, typified set of rules and norms that defines MA concepts, their relationships, desired values (targets), and accountable actors. That is, irrespective of whether MA refers to financial notions such as profits or stock values, or non-financial, including lead times and defect rates, they all represent

quantified, decontextualized and efficiency-focused constructions of a particular piece of "underlying reality" for which particular (categories of) actors are held accountable.

As suggested in the literature, such MA frames are typically drawn upon by organisational actors in "a taken-for-granted, largely unconscious manner" (Ahrens and Chapman, 2002, p. 170; see also Burns and Scapens, 2000; Cruz *et al.*, 2009; Jack, 2005; Siti-Nabiha and Scapens, 2005). Importantly, however, they should neither be viewed as fixed and stable structures that determine human activity, nor as external to or beyond the reach of human reflexivity. On the contrary, as suggested by Giddens (1976, 1979, 1984), the relationship between frames as such (which are virtual, non-observable, subject-less and non-situated) and the daily (inter)actions (which are observable, conducted by a subject, and always temporally and spatially located) should be treated as one of duality. That is, frames and (inter)actions are viewed as mutually constitutive, implying that neither can exist independent of the other. Or as Giddens (1984, p. 25) puts it, cognitive frames (or "structures" as he calls them) "are both the medium and outcome of the practices they recursively organize."

Based on such a duality view, we will below present the main conclusions that have been reached in the extant literature regarding how endogenously sparked change may come about in (MA) frames.

Embedded agents and (MA) frame change

Based on the duality relationship proposed above, endogenous change is feasible due to the non-deterministic relationship between cognitive (MA) frames and social (inter)actions (Dillard *et al.*, 2004). More interestingly, however, and as suggested in the introduction, MA researchers have also identified and elaborated on a number of sources of such change, including the role of ambiguous structures, frame-shifts between structural elements, and structural contradictions.

The first line of reasoning departs from the common assumption that frames are inherently heterogeneous in their character. That is, the literature has both identified a number of different frames, such as where researchers have contrasted a MA frame against other ways of understanding an organisation (see, e.g. Ahrens, 1997; Scapens and Roberts, 1993; Siti-Nabiha and Scapens, 2005), and also concluded that the accounting frame as such consists of a multiplicity of elements, including multifaceted rules and norms on budget authorisations, bonus payments, performance objectives, and systems of accountability (cf. Ahrens and Chapman, 2002; Englund *et al.*, 2011; Seal *et al.*, 2004).

Moreover, it has also been proposed that each such set of rules is often ambiguous and subject to multiple interpretations, which means that the relationship between a frame and a particular (inter)action is seldom of a one-to-one character (Kilfoyle and Richardson, 2011; Lounsbury, 2008; van der Steen, 2011). As Ahrens and Chapman (2002, p. 169) found; "in the practice of accounting, its functions cannot purely be derived through the application of logic. [Rather, accounting] is creatively drawn upon, and subtly changed, through practice." Hence, in social (inter)actions people draw upon their knowledge of how to go on in social life, but they do so through skilfully interpreting and combining a multiplicity of structural elements. And such ongoing interpretation and combining opens up for varieties in action and modifications of structural elements over time, which makes endogenous change an integral part of the ongoing reproduction of frames[2].

The second suggestion of how frames may change draws upon the idea that actors engage in frame-shifting (e.g. Boland and Pondy, 1983, 1986; Jönsson, 1987; Vollmer, 2007) between MA frames and other cognitive frames. More precisely, change may come about as MA notions, relations and norms are recurrently related to, and contrasted with, other ways of knowing and understanding the organisation in a dialectical manner (Ahrens, 1997; Hall, 2010). As Boland and Pondy (1983, 1986) observed, for example, the MA frame was filled with meaning as actors forayed out from it into other cognitive frames and then later returned to the MA frame with new meaning (see also Jönsson, 1987).

A third suggestion relates to the idea that various elements of a frame may be incompatible or contravening, and that change may occur as actors experience and (re)act upon such structural contradictions (e.g. Burns and Baldvinsdottir, 2005; Abrahamsson and Gerdin, 2006; Lawrence *et al.*, 1997; Seal *et al.*, 2004; van der Steen, 2011)[3]. As argued by Cruz *et al.* (2009, p. 95) "social structures [...], are composed of loosely coupled elements, which are neither complete nor entirely coherent. Such incompatibilities provide a continuous source of tension and conflict, which are experienced by the actors, and which can lead them to transform those social structures".

Overall then, these three strands have primarily focused on how actors interpret and contrast heterogeneous, ambiguous and (potentially) contradictory structural elements in order to understand how endogenously sparked structural change may come about. This paper adds to these insights by introducing the role of specific MA information as such. More to the point, we argue that there is not only a change potential inherent in the ongoing comparison between, and reflection on, structural elements *per se*, but also in the interplay between these structural elements (which, again, allow for the binding of time-space, yet are themselves out of time-space) and particular time-space bound metrics and numbers.

Indeed and again, the idea that structural change may come about as actors interpret, reflect and (re)act upon MA information/systems is by no means new. For example, Ahrens and Chapman (2002, p. 169) showed how formal accounting systems both shaped and were shaped by actors' understandings of issues of signification, legitimation and domination (see also Roberts, 1990), while Busco *et al.* (2006, p. 38) showed how MA systems "may be used intentionally to challenge existing ways of thinking; to unfreeze old cognitive schemes, and to enact a new set of roles, rules and routines". Also, Seal *et al.* (2004, p. 77) submitted that "institutional reflexivity" – which refers to how actors in the modern world are constantly triggered to reflect upon, and also change, social practices – is typically sparked by the ever-increasing incoming information (including MA information) about those very practices.

Again, however, based on our in-depth analysis of face-to-face interactions between project members in our case company, we will below add to, and further develop, these previous understandings through developing a model of the change potential that is inherent in three general and distinct categories of ambiguity that may arise as actors mirror time-space bound metrics/numbers in different cognitive frames. In other words (and in contrast to previous studies), we will show that it may not only be the content of the MA information as such that may spark emergent structural change, but also the perceived uncertainties that such information use may engender. Before so doing,

however, we will give further details about the choice of case company, and also go through how the empirical data were collected and analysed.

Research method
Choice of case
As hinted above, this paper is based on a case study of a project group situated in a large manufacturing company here referred to as "Alpha" (a subsidiary of a multinational group). Alpha is a high-tech company with a long history of developing, manufacturing, and marketing a wide range of complex and customized machines. In total, they employ some 2,300 people worldwide, of which about 750 belong to the site studied here. This context was chosen for two main reasons.

First, based on our general interest in exploring how people interpret, and (re)act upon MA metrics and numbers, we needed access to an empirical setting where we could observe "accounting in action" (cf. Baxter and Chua, 2009; Boland, 1993; Burchell et al., 1980; Hall, 2010). Alpha provided such an arena in the form of the so-called REDCAPE (REDuce CAPital Employed) project, which was launched with the aim of radically reducing working capital in Alpha. Through the project, we had access to weekly meetings where members of the project developed and used various types of MA numbers and metrics to discuss issues of material sourcing.

Second, the research group had extensive experiences of "the Alpha context", mainly through two previous longitudinal case studies in the organisation (1999 and 2000-2001, respectively). During these studies, one of the researchers observed some 60 meetings and conducted a large number of interviews with organisational members representing various functions and hierarchical levels. And, as argued by Ahrens and Chapman (2006) such experiences may be essential when studying the micro-practices of "experts in action", since they mostly act without anticipating the underlying order, and when they do express their diagnosis, it is often done in a technical and context-specific terminology.

On these grounds, we followed the project group internally referred to as "material sourcing". This group consisted of nine middle managers, of which three belonged to the "strategic purchasing department" while the others represented the "production department". Importantly, however, none of the group members were actually involved in the daily "sourcing" of materials, which meant that MA information constituted an important means for their sensemaking about the operations (cf. Hall, 2010).

Data collection
From March through June 2006 we attended 14 meetings in the material sourcing group as direct, non-participant observers (Silverman, 2001). We also attended four so-called "milestone-meetings" where the group-leader (the purchasing manager) briefed the top-management group of Alpha on their "progress" in the project. During all meetings, we wrote down whatever occurred (Eisenhardt, 1989; Silverman, 2001), in as much detail as possible (i.e. expressions used and turn-taking during conversations), including emotional reactions such as "laughter", "accentuation", or "irritation". Furthermore, we noted gestures such as "pointing on the whiteboard" and "showing a MA report". The notes were then compared between researchers and transcribed.

Whenever we visited Alpha (for observations or interviews), we also took the opportunity to get background information and actors' views on the project. For

example, through informal conversations before and after the meetings and through other openings such as coffee breaks and lunches, we asked the actors involved to elaborate on certain aspects of their project or to fill in "gaps" that we experienced in our material. Furthermore, we also had a large number of informal conversations with our primary contact person at Alpha – the purchasing manager – during the whole data collection period. All such conversations were subsequently written down, either in summarised form or in terms of specific quotations when judged as relevant.

As a complement to our detailed observational data, we also conducted ten formal interviews. All interviews but two (which were done initially to provide background information about the project) were conducted after having observed their meetings for four months. During these, project group members (and also the MD and the CFO) were asked to elaborate on the project and their retrospective understandings of the meetings and their development over time. All interviews were done by two researchers at a time, tape-recorded and then transcribed.

Finally, we collected large amounts of written data in order to provide further insights into the context in which the focal project group was situated. These included all "official" material of the company-wide capital reduction project, such as the monthly newsletters in which project targets and results were communicated, an early consultant report, and "project kick-off" material. We also had access to the focal group's internal meeting minutes, and also the MA reports used, which facilitated our analysis of their readings and interpretations of these reports during meetings.

Data analysis
As we collected the data, we simultaneously analysed it, working back and forth between the extant literature, the empirical observations and an emerging model (Ahrens and Chapman, 2006; Eisenhardt, 1989). However, after having reached a preliminary understanding of the material, we also used NVivo 8 (a computer-based program for qualitative data analysis) to conduct the following more systematic codings of the material.

To begin with, we sorted out all strips of interactions where specific MA numbers or metrics were discussed, and marked the particular topics and issues related to each metric. Based on the frame concept (see theory section above), we then conducted a preliminary coding of each strip. Specifically, utterances which expressed how actors constructed a number/metric as such were coded as representing a MA frame, while utterances that referred to some sort of underpinning "reality" in operations were coded as representing an operational frame (see also Figure 1). Accordingly, an utterance like "things look good as we have 96 per cent materials availability and we're getting closer to the target line" was coded as a perception based on a MA frame, while a response to such an utterance saying "sure, but we still lack critical articles in production so several customer orders are at stand still" was coded as grounded in an operational frame.

Overall, this initial coding confirmed our "feeling" that MA metrics and numbers were being heavily invoked in their interactions, and also, that the MA frame constituted an important perceptual lens. However, at this stage, the most striking impression from the interactions was that their use of metrics/numbers seemed so marked by various forms of uncertainties. This somewhat unexpected finding made us attentive to (and wanting to further explore), why they experienced this uncertainty,

and what effects it had on the ongoing (re)production of their MA and operational frames. Guided by these questions, we singled out and compared all instances where actors seemed uncertain or hesitant as to how to understand a particular metric or number. And, based on their own "wordings", in terms of recurrent expressions, phrases, and lines of reasoning in the interactions (so called "first-order expressions", see Van Maanen, 1979), we derived second-order concepts through an inductive grouping of their statements (see Table I). As will be evident in the next section, this analysis suggested that their uncertainties could be divided into three perceptions of ambiguity, each referring to different qualities of the metric/number (see Figure 1).

In a next step, we then focused on the effects of each such form of ambiguity, in terms of how actors tried to handle these in their interactions (and also in-between meetings). Also in this case, we used their own "wordings" as a basis for the generation of second-order categories, suggesting that their "responses" could be categorised as various forms of critical reflection and (suggestions for) change (see Table II). And, seen over the whole period of study, we could link these critical reflections to various forms of change, such as changes in the particular metrics used, how metrics and numbers were understood, and importantly, in the frames shaping these understandings (see Table III).

In order to confirm the emerging picture of a gradual and largely unintended change in frames – as manifested in a changing interaction-order over time – we also conducted complementary "word counts" and qualitative analyses of these (see Figure 2). Furthermore, we used our other sources of data to validate the interpretations made. In particular, we used Alpha's extensive internal material on the REDCAPE project, but also interviews and informal conversations, to confirm and extend the picture obtained from attending meetings on a weekly basis.

Emergent findings
As suggested in the theory section above, quite a few institutionally oriented studies have, at least implicitly, addressed the question of how endogenously sparked MA change may come about, i.e. have addressed the "paradox of embedded agency". In short, it has been insightfully argued that actors' daily enactment and reproduction of heterogeneous, ambiguous and even contradictory social structures is an important source of change in these very structures (see, e.g. Ahrens and Chapman, 2002; Burns and Baldvinsdottir, 2005; van der Steen, 2011). As suggested in Figure 1, however, we will below take these findings one step further by showing that not only is there a change potential in the comparison between, and reflection on, different frames (i.e. different elements of social structure, cf. relation 1), but also in the recurrent mirroring of particular time-space bound metrics and numbers in these frames (relations 2 and 3, respectively). More precisely, we find that such mirroring in MA frames and other ways of knowing the organisation (subsumed as operational frames) may result in the perception of three distinct types of ambiguities. These emanate from the collective sensemaking about definitional (relation 2), representational (relation 3a), and operational (Relation 3b) qualities of the metric/number. And interestingly, we find that such perceived ambiguities may not only trigger critical reflection on and change in operational activities as actors draw and act upon the extant MA rules and norms, but also in the governing MA frame as such (see Section Change in management accounting frame, below).

Type of ambiguity	Definition	First order (informant) expressions
1. Definitional ambiguity	Uncertainty as to the definitional meaning of a MA metric, triggered by a mirroring of that particular metric in a MA frame	But what do we mean by lead-time? Is it when the suppliers say that they can deliver or when we want them to deliver? Yes, but what lies behind the metric? Are all materials included [in the metric]? We have some [materials availability] data on certain [types of] articles, but we don't know why a particular article ends up on the list [i.e. it is unclear as to how articles are classified in the system]
2. Representational ambiguity	Uncertainty as to the representational qualities of a MA number, triggered by a mirroring of that particular number in an operational frame	It seems as if 25 per cent of all purchasing orders are put within the suppliers' lead-time I would like to see a specification on that... I'm not sure that the figure is correct How about assembly stock of articles [NN]? We have a lot of them, in fact, a stock of [X] millions, but we consume everything we get But how come the stock increases? Don't know. It's really strange It's 52 [planned machines in assembly] in May and 42 in June [Reading on the graph] Can 52 be correct? Not sure
3. Operational ambiguity	Uncertainty as to the causes of a MA number, triggered by a mirroring of that particular number in an operational frame	I'm still very puzzled. Why is it that we buy so late? After all, it's a significant share of total purchases. I mean if it would have been, say, 7-8 per cent that would have been understandable, but I honestly don't understand this number As the graph suggests, we lack materials [at assembly start]. The stock level does not correspond to our needs, but we don't know why... whether it's because of late deliveries from suppliers [i.e. the suppliers' fault] or because we buy too late But I can't understand why our procurements vary so much when our production volume is rather constant. [One of our suppliers] has received orders of 20, 27, 20, 44, and 19 components this year [i.e. for the first five months], and that's not what our assembly looks like [i.e. their own production does not vary that much]. Especially May [i.e. the order of 19 components] looks peculiar. If we look back four years, it's the same [i.e. they can see a similar pattern in their ordering for the last four years]

Table I.
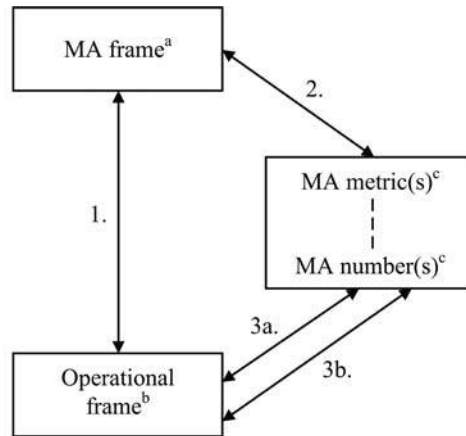Emergent categories of management accounting ambiguity

Figure 1.
Overview of different ways in which MA and other frames can be related to each other and to particular metrics and numbers in daily accounting talk

Notes: a: MA frame is used to denote the virtual, largely shared and non-situated set of efficiency-focused rules and norms that defines MA concepts, their relationships, desired values (targets), and accountable actors, based on a quantitative logic; b: Operational frame is used to denote the virtual, largely shared and non-situated knowledge structure that defines categories of actors, operational activities and their (appropriate) relationships; c: MA metrics and numbers refer to particular time-space bound pieces of MA information. The double headed arrows denote principal ways in which frames can be related to each other, and/or to particular MA metrics/numbers, in situated accounting talk

However, before entering into details about the exact meanings of these different types, how they were empirically manifested, and how they may spark structural MA change, we will provide a short account of the context in which this change came about. This description also serves to give a sense of what the pre-existing MA frame looked like, and how it initially worked as a largely "constraining" perceptual lens which heavily informed actors' interpretations, (inter)actions and constructions of MA metrics.

The content and role of MA frames in the early phases of the project
The backdrop to the REDCAPE project was a sudden cash-flow problem, resulting in a perceived need to improve Alpha's capital efficiency. Based on this, the project was launched with an overall objective to "radically reduce working capital", which was to be reached through working "with all addressable capital elements and [through setting] ambitious reduction targets" (internal document). Moreover, based on such an accounting focus, the overall project was organised around ten parallel subprojects, all but two focusing on a specific capital element in the balance sheet. Each subproject-leader was also to report on activities taken to a project database on a weekly basis, and was then followed up by top management based on their respective improvements in capital turns.

As mentioned above, we followed one of these sub-projects, namely the "material sourcing project". Actors within this project were specifically held accountable for improving capital turns in assembly stock. However, in order to avoid the potentially negative side effects of radical reductions in stock level (as suggested by one respondent, "reducing inventory levels is a simple task [...] you simply stop buying"),

Type of ambiguity	Type of reflexivity	First order(informant) expressions
1. Definitional ambiguity	Reflections on how to enhance the meaning of a particular MA metric, either through further exploration, or adjustments, of the existing metric	It would be good to have a definition [of the metric] in the system,... So let's define it in the system, and then we can change it later on [if necessary]. Could you do that, [NN]? Maybe we should keep on digging in the system [i.e. trying to find out what is actually included in the metric] But who does that? It's really hard! Can you do that, [NN]? Yeah, but what am I supposed to look for? I could check [X], but that won't help us ... Can we somehow have the different articles weighted in the [materials availability] metric? Yes, what is most important? Nuts or motors?
2. Representational ambiguity	Reflections on how to validate the representational qualities of a MA number, either through reliability checks or through complementary measurements	Yeah, we simply have to investigate further what underlies these numbers Maybe we should change the metric then, or at least have a separate follow-up of critical parts [measured in terms of number of parts] Yes, perhaps should we measure in terms of [stock] value as well [i.e. measured in financial terms] Not sure [whether the number is correct], but we really need to look into this
3. Operational ambiguity	Reflections on how to better understand the causes of a MA number, either through providing, or suggesting further exploration/quantification of, plausible causes of a particular number	We must somehow measure the influence this has Alright, but this is very difficult to trace [in our system] Okay, but it's worth trying But it couldn't be just [X] that causes this No, it can't be Hmm... [X] millions increase in two months, it's too much. We must analyze this. Who can do it? I've looked at this before. I can do it again Good, we really have to look into this, and see if we can find any patterns I believe we are on to something big here. Can you [NN] search into this? We need more facts. Try to find variables for explaining what causes this

Table II.
Emergent categories of reflexivity sparked by definitional, representational and operational ambiguities, respectively

they were also entrusted with the target of increasing materials availability at the time of assembly start. Two key metrics were established for measuring and following up assembly stock ("total inventory days in assembly stock" and "capital tied up in assembly stock"), and two for measuring materials availability ("material availability in production at picking" and "number of requisitions and returns"). Judging from our observations of meetings, and interviews, this strictly marked accounting orientation

Transformations in cognitive frames	First order (informant) expressions
1. Shift from outward to inward focus	This has been a very useful exercise [i.e. to follow up the materials availability metric on a weekly basis]. This made us realize that we cause a lot of the problems ourselves. I mean, it's always easy to point finger outwards, externally, and to say that the problem lies with the suppliers. But an important lesson learned is that we have to point at ourselves as well . . . and start to deal with the problems caused in-house I think the most important thing was that we really understood what the problem was. I mean, in this company, people have always had their "theories and hypotheses" implying that it's the suppliers' fault. And indeed, as a purchaser, I still think that the suppliers cause some of our problems. However, we've also realized that we need to improve our internal processes. And instead of only attributing the problem to "someone else", we now work much more internally I believe we've had the tendency to blame others [i.e. the suppliers] . . . [That is to say] we've considered ourselves as "the good guys" and always criticized the suppliers because they don't deliver on time. But during the project, it has become clear that we have shortcomings as well. [. . .] And we really need to work on our internal routines in order to make this work
2. Shift from functional/vertical to processual/horizontal focus	[Previously] we've looked at the subparts [of the sourcing issues]. But we've never really taken this holistic view and approached [material] sourcing as a process. That's the new thing with REDCAPE, and the new set of [performance] measures that we've developed We've done things the wrong way! We haven't had any clear routines, and we haven't really had an understanding of our processes. But that's exactly what we've been working with now [in the REDCAPE project]. I mean, the planners haven't always understood how changes in an order affect the work of the purchasers, which in turn, affects the suppliers. [. . .] It's all about understanding the processes REDCAPE and Sourcing [i.e. the Material Sourcing subproject] came about as an effect of the liquidity problems that we had, and they [i.e. Top management] wanted us to reduce the capital employed in stocks. However, instead of just cutting down on stocks, we reoriented the project so that it became a question of how to improve our processes. We wanted to make sure that the planning procedures worked properly in order for purchasing to work, in order to reduce the stock amounts, and so on. That's the main result from REDCAPE, I would say

Table III.
Emergent categories of transformations in cognitive frames

of the project not only made actors highly focused on their particular capital element (e.g. expressed in terms of "we're worried that the large deliveries of material will show up as an increase in capital tied up in March"), but also, provided them with clear boundaries within which their attentions should be directed (e.g. expressed in terms of "that's not in the hands of this project").
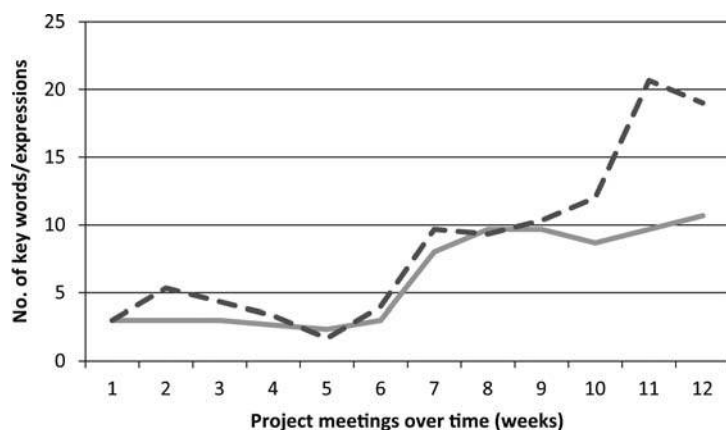
Notes: The continuous line shows the number of times key words/expressions
related to purchasers and the problem of late procurements are used in
interactions. The broken line shows the number of times key words/expressions
related to the construction department and to the problem of late changes in
machine orders are used in interactions

Figure 2.
Development of key
words/expressions used in
interactions related to late
procurements and late
machine order changes,
respectively (rolling
average)

Based on their current understanding of how their overall targets could be reached,
they also early on concluded that the suppliers' "delivery precision affects safety stock
and material availability and is a key measurement" (internal document). Accordingly,
they defined two "drivers" (leading indicators) of the more outcome-oriented metrics,
namely "Supplier delivery precision" and "Lead-time alignment – actual and in
system" (referring to the suppliers' lead-times). Based on our empirical data, it is clear
that this supplier-focused working version of how economic efficiency can and should
be achieved (i.e. MA frame), worked as an important way of setting the agenda for their
discussions and efforts. For example, actors would typically respond to outcome
reports in terms of "The statistics show that supplier X is way below average. They
should really be investigated further", or "The US suppliers [...] nothing is more
prioritised right now". In fact, both qualitative and quantitative analyses of the
interaction data collected and interviews made (including analyses of foci/contents,
and the counting of words/expressions used) suggest that the issue of suppliers'
delivery performance largely dominated (inter)actions in the early phases of the
project. More specifically, we find that the continuous updating and presentation of
measurements of these metrics worked to direct actors' attention (not least towards
numbers deviating from the expected and/or desired state), and as a means of
suggesting, and also taking, a large number of supplier-oriented actions.

Put in theoretical terms, our study thus largely confirms previous research
suggesting that MA models and norms work as important "ordering instruments"
(Fauré *et al.*, 2010; Jönsson, 1987) which bring structure to organisational life (Tillmann
and Goddard, 2008). In this case, the extant MA frame narrowed down their focus of
attention in two main ways. First, and in line with the highly functionally oriented
financial focus in the REDCAPE project, the Materials Sourcing group felt highly
accountable for assembly stock, and assembly stock only. While this meant that the

scope of the subproject largely concerned their functional area of expertise, it also had the effect that actors became highly focused on taking measures, and achieving targets, specifically marked off by this capital element. Second, the extant MA frame also provided actors with a largely shared view that it was through turning outwards, towards the suppliers, that organisational efficiency could and should be achieved. That is, the suppliers were pointed out as a, if not the, major cause to their perceived capital efficiency problems. Taken together then, the extant MA frame worked as a highly influential perceptual lens, which narrowed down what interpretations and (inter)actions were deemed available and appropriate during the project. Importantly, however, although the matters of assembly stock and suppliers' delivery performance were deemed very important during the whole period of study, we also find that actors, step by step, reconstructed this MA frame as manifested in a significant change of focus and emphasis in their daily (inter)actions, and in the development of a revised set of "leading indicators" (see more descriptions below). Next, we will show that different perceptions of ambiguity that oftentimes arise as time-space bound metrics and numbers are used, may be an important "driver" of such endogenously sparked MA change.

Forms of accounting ambiguity

As illustrated in Figure 1 above, actors' efforts to collectively make sense of time-space bound metrics and numbers can be described as a type of mirroring process where the metrics/numbers as such are related to, or perhaps more correctly put, interpreted by means of MA or other more operationally oriented frames (cf. Boland and Pondy, 1983, 1986; Vollmer, 2007). Overall, our data suggest that such comparisons resulted in three principal impressions/perceptions. First, the particular metric and its corresponding measurements largely confirmed their expectations and understandings of the ongoing operations, e.g. expressed as "[i]t's nice that our measurements mirror reality [in production]!". Second, we identify evidence of perceived conflict, i.e. of cases where the metric/number in question was believed to stand in stark contrast to the existing MA and operational frames. These instances were typically manifested in terms of "that number can't be right", or "the feeling among people is that [X] underperforms, but the measurement shows something else". Third, we find that the use of MA metrics/numbers triggered a lot of ambiguity. That is, the metrics and/or numbers as such invoked feelings of equivocality, either because the metric/number seemed to have no clear meaning, or that it had multiple meanings (typically expressed in terms of "what is actually measured?" or "what lies behind this number?".

Below, we will focus specifically on the third type of perception, i.e. on the cases where actors' encounters with metrics and numbers resulted in feelings of ambiguity. The reason is that our coding of the empirical data strongly suggested that perceptions of confirmation and conflict were less interesting considering our purpose to address the paradox of embedded agency. More to the point, we found that these perceptions primarily led to incremental changes/improvements of operations and/or of the measurements. Perceived ambiguities, in contrast, oftentimes sparked deliberate and critical reflection of the governing structure as such. That is, through their overt questioning of the current (MA) understandings, the interpretative schemas as such were gradually altered. Before we enter more deeply into how and why such structural

change may come about, we shall first present the emergent results of the observed occurrences of accounting ambiguity.

As illustrated by relations 2, 3a and 3b in Figure 1 above, our empirical data indicate that three different forms of ambiguity were prevalent in the discussions about metrics and numbers. A first form, henceforth termed definitional ambiguity, refers to situations where actors perceived that the existing MA frame could not adequately account for the metric as such (cf. relation 1 in Figure 1). That is, the actors had no clear understanding of the "arithmetical" qualities of the metric, i.e. how the metric was constructed. Part 1 in Table I shows a number of representative first-order informant expressions, based on which this form of ambiguity was derived.

A second form of ambiguity expressed in their interactions concerns the perceived correspondence between the number and the underlying operations to which it refers (cf. relation 2a in Figure 1). That is, based on their current understanding of the operations (cf. the operational frame), actors would sometimes question whether a particular MA number mirrored the actual operations (see part 2 in Table I for representative first-order informant expressions). In these cases, which will henceforth be referred to as representational ambiguity, it is thus not the actual scope or content of the metric as such that is the subject of sensemaking, but rather, what piece of reality the number refers to.

Finally, we found a large number of instances where actors discussed neither the metric as such, nor the representational meaning(s) of the number, but were unable to make sense of the causes of a particular trend or level of a number. This third form of perceptions, which also relates to a comparison between a number and the operations to which it refers (cf. relation 3b in Figure 1), will be referred to as operational ambiguity (see part 3 in Table I for representative expressions based on which this form was derived).

Next, we will show how these three forms of ambiguity may trigger different types of critical reflection among actors which, in turn, may result in emergent structural MA change.

Ambiguity as a source of emergent accounting change
Our evidence clearly suggests that the various forms of ambiguity identified were important sources of critical reflection. Importantly, however, they not only triggered a more deliberate form of sensemaking, but also a form of reflection that went beyond that made when the MA frame worked purely as a structuring device. The argument is as follows. When the MA frame largely constrained actors interpretations and (inter)actions, as was generally the case in the early parts of the studied project (see description above), actors typically reflected upon how to adjust the existing operations based on the current rules and norms that constituted the MA frame as such. That is, actors were primarily engaged in first-order reflections, i.e. (re)considerations within the boundaries of the existing way of thinking (cf. Broadbent, 1992; Ligouri and Steccolini, 2012). Specifically, MA was drawn upon to set targets, keep scores, and identify and attend to deviations, with a particular focus on how suppliers' delivery performance affected materials availability and capital efficiency. As time goes by, however, we also find a great deal of evidence suggesting that the perceived ambiguities may spark critical reflection of the governing MA frame as such, so called second-order reflections (cf. Broadbent, 1992; Ligouri and Steccolini,

2012). That is, the very structural element that actors drew upon in their collective sensemaking of particular metrics/numbers was called into question, and became the subject of reconsideration and reconstruction.

Starting out with cases where actors experienced definitional ambiguity, we find that they tended to raise questions regarding the scope and/or content of a particular metric (cf. relation 2 in Figure 1). More precisely, when they perceived such ambiguity, they typically engaged in a type of exploration process where they collectively tried to make sense of the metric (see part 1 in Table II for representative first-order informant expressions based on which this type of reflexivity was derived). And, if the feeling of ambiguity persisted despite intense efforts, someone in the group was usually given the task to "look more deeply into the matter". Their argument was that it was important to clarify how the metric was constructed, and oftentimes also to improve it, in order to take the next step and try to understand what piece of operational reality the metric referred to, i.e. to be able to establish the representational qualities of the metric. As the project leader in the material sourcing group argued retrospectively:

[A major advantage with this project was that] we had the time to ask ourselves whether these [i.e. the current definitions] are the correct definitions. Before, we just made a lot of measurements. Now we started out with the formula [...] what shall we measure? Then we ran several tests until we felt that this is okay.

Generally speaking then, a first form of MA change that emerged during the project thus involves changes in MA metrics, which refers to those instances where actors strive to reduce definitional ambiguities through re-defining or adjusting already existing MA metrics.

As suggested above, however, also mirroring in operational frames may give rise to perceptions of ambiguity (cf. relation 2a in Figure 1). In contrast to definitional ambiguities where the MA metric as such is perceived to be unclear, however, representational ambiguity arises because the actual measurement (i.e. the number) is vague in some respect(s). In these situations, actors typically began to reflect upon the representational qualities of a particular number which, in turn, tended to result in efforts to validate or explore the number in question. Our analyses of their interactions suggest that this may either be done through "reliability-checks" (i.e. where someone is asked to check whether the number is correct), or through suggesting "complementing measures/measurements" (see part 2 in Table II for representative expressions). In particular the latter type of reaction is interesting from a MA change perspective, not only because it meant that actors developed the extant set of metrics, but also because these new measurements provided alternative ways of depicting and understanding particular pieces of reality.

In general then, a second form of MA change sparked by perceived ambiguities refers to change *of* accounting metrics, which refers to those instances where new MA metrics are added to the set of existing metrics.

Finally, and as suggested above, a third form of ambiguity that triggered actors' reflexivity emanates from situations where actors neither questioned the metric as such, nor the representational qualities of the number, but were simply unable to make sense of why a particular trend or level of a particular number had emerged. In these cases, which we above referred to as situations of operational ambiguity, actors typically suggested a quantitative exploration of plausible causes to the number, through the development of new "causally linked" metrics (see part 3 in Table II for

representative expressions). Interestingly, however, even though actors drew upon extant MA understandings and norms as to how capital efficiency can and should be achieved in producing this change of accounting metrics, this explorative process also led to a gradual change in the MA frame as such.

Change in management accounting frame
As shown above, actors were initially highly convinced that the suppliers' performance was a key to understanding the outcomes of the materials availability and capital efficiency metrics. And guided (constrained) by this pre-existing MA frame – i.e. this cognitive "map" of how to improve capital efficiency – their (inter)actions focused intensively and mainly on improving suppliers' delivery precision. They also developed a number of new tools, including new MA metrics, to "monitor the effects" of their endeavours (e.g. in terms of measuring the number of order acknowledgements from suppliers, and developing an "early warning system" to detect potentially problematic suppliers in an early stage).

Interestingly, however, after having tried to induce the suppliers to increase their delivery precision in a number of ways, yet facing little or no improvement in key performance indicators, they started to critically reflect upon to what extent they produced some of the suppliers' problems themselves. In fact, through the development of new MA metrics (e.g. "procurements-within-suppliers"-lead-time'), they found out that a surprisingly large number of purchasing orders were put too late, implying that many of their suppliers did not stand a chance of delivering according to the agreed upon (standard) lead-times. That is, although it was generally known that late procurements could negatively affect materials availability, they were not aware of the significance of the problem, let alone how it could be solved (cf. the notion of operational ambiguity). To illustrate, consider the following interaction that took place when facing figures suggesting that no less than 23 per cent of the total number of procurements were done too late:

- A total of 23 per cent are bought too late [i.e. within the supplier's lead-time].
- Why is that so? What kind of articles are we talking about?
- It seems as if it concerns a range of articles and suppliers.
- Is it due to the changes that are made when we convert forecasted orders into sharp ones? Maybe that's done too late?
- Perhaps. I believe we are on to something big here. Can you [NN] search into this? We need more facts. Try to find variables for explaining what causes this.
- Yes, I honestly do not understand this number. Why do we order so late?

In order to explore the potential causes to this perceived problem they conducted a number of new measurements, e.g. involving different suppliers, purchasers and types of articles. However, one factor that was constructed as considerably more important than others was the influence of the engineers at the construction department. More precisely, it was argued that the engineers made a lot of late changes in machine orders, which made it difficult to order materials in time (e.g. expressed in terms of "the construction department does a lot of late changes, so it's not strange at all [that materials are procured too late]"). And in order to explore and quantify the magnitude

of this new perceived cause to their efficiency problems, they developed yet a new metric referred to as "number of late machine order changes".

Figure 2 shows how the two above identified issues emerged over the period of study, measured as the frequency of key words/expressions in their interactions related to purchasers and late procurements, and the construction department and late machine order changes, respectively. As the graph illustrates, these issues were indeed present in the discussions during the whole period of study, but became significantly more important throughout the project.

Hence, our observations of meetings (and retrospective interviews with key actors), strongly suggest that the critical reflection that emanated from perceived operational ambiguities is an important source of MA change. Specifically, we find a gradual, yet distinct change in their MA frame which was not only manifested in terms of a new set of "causally linked" MA metrics, but also in the metrics-related discussions. More to the point, our qualitative and quantitative coding of the interaction data clearly show that the actors' "causal map" of how economic efficiency can and should be achieved (i.e. MA frame) was gradually changed from focusing more or less solely on suppliers and their delivery performance, to including also the impact of internal actors within Alpha (including purchasers and engineers).

In similarity with the changes triggered by definitional and representational ambiguities, however, such change in the MA frame was not sparked by single occasions of sensemaking of any particular piece of MA information. Rather, we find an ongoing process in which specific metrics and numbers are recurrently mirrored in, and interpreted through, extant MA and operational frames, leading to a gradual co-development of these very frames. Interestingly, however, although this process was indeed incremental and largely unplanned, our interviews with actors clearly showed that they had no problems to retrospectively "see" that a significant shift in mindset had taken place. As one member of the Materials Sourcing group expressed:

> [We finally realized] that the problem is internal. We've always blamed the suppliers when something is delivered too late, but we're the ones that order [materials] too late and make [machine order] changes too late.

More precisely, our empirical evidence strongly suggests that this shift involved two principal changes of their extant MA frame. First, and as illustrated by the quote above (see also further representative expressions in part 1 of Table III), the largely taken-for-granted assumption that the suppliers were the ones to blame for low materials availability was gradually substituted with the assumption that a substantial part of the capital efficiency problem related to their own behaviour. In other words, we thus observed a significant shift in focus, from a primarily outward-looking to a more inward-looking one. And related to this change, we observe a gradual, yet distinct transformation of internal accountability relations. In particular, we find that the prioritized position of the Construction department in this engineering driven company started to erode[4]. That is, it became commonly held that they too had to take responsibility for the problems of low materials availability. As argued by one informant with emphasis:

> The construction department should be viewed like any production department. I mean, they deliver machine structures and drawings. We should measure their "on-time-delivery".

And sanctioned by the top management of Alpha, such measurement and periodic evaluation of "delivery performance" became part of the company's standing key performance indicators soon after the REDCAPE project was ended.

Second, and related to this shift in focus and accountability relations, their interpretative scheme of how efficiency can and should be achieved was changed from a largely functional/vertical perspective to a more process-oriented/horizontal one. More precisely, and as suggested above, in the beginning of the project they were highly focused on improving the capital element related to their particular functional responsibility as such (i.e. assembly stock), primarily through putting pressure on suppliers to improve their delivery performance. However, in the ongoing process of reducing perceived ambiguities of different kinds through the development of a new set of causally linked accounting metrics, the functional interdependencies within the company emerge as the central issue that needed to be addressed. For example, one informant retrospectively argued that "[t]here was a lack of process perspective. Each and everybody sat in their silo, but when we got together, we saw the problems" while another said that "[t]his is a new way of working. We didn't meet like this before [i.e. cross-functionally]; we all focused on our own areas. [...] This gives us the broader picture" (see also the representative first-order expressions in Part 2 of Table III).

Overall then, it can thus be argued that the transformation process, fuelled by the different forms of accounting ambiguity, should not be seen as a "minor extension" of their causal understandings of company operations. Rather, we observe more fundamental MA frame shifts in terms of focus and accountability relations (outward vs inward), and way of thinking about how capital efficiency can and should be improved (a functional vs processual view).

Conclusions

In this article we address the paradox of embedded agency, which alludes to the question of how actors can change the existing cognitive (MA) frames, when their beliefs and actions are largely constrained and shaped by these very frames (see, e.g. Battilana *et al.*, 2009; Holm, 1995; Seo and Creed, 2002). Or more precisely, the purpose is to develop an empirically derived model that helps us understand how and why endogenously sparked change of (MA) frames may come about, also in situations where these frames are deeply embedded and largely unquestioned. Indeed, and as suggested in the theory section, a number of studies have argued that social structures are typically heterogeneous in their character (see Ahrens and Chapman, 2002; Englund *et al.*, 2011), and that structural change may come about as actors enact these ambiguous and potentially contradictory structures in different ways over time (cf. Abrahamsson and Gerdin, 2006; Boland and Pondy, 1983, 1986; Burns and Baldvinsdottir, 2005; Kilfoyle and Richardson, 2011; Lounsbury, 2008; van der Steen, 2011).

Arguably, though, our study goes beyond these ideas through showing that structural MA change may not only stem from skilled actors drawing upon and contrasting different frames *per se* (cf. relation 1 in Figure 1), but also from actors' ongoing interpretation of, and (re)action upon, particular time-space bound metrics and numbers. In contrast to many previous studies that have explored this interplay (Ahrens and Chapman, 2002; Busco *et al.*, 2006; Seal *et al.*, 2004), however, our emergent model suggests that it may not only be the MA information/system as such that sparks

reflexivity and structural change, but also, the various forms of ambiguities surrounding this information. Below, we will elaborate in more detail the central tenets of this emergent model, the conclusions that it suggests, and based on these, some suggestions for further scholarly effort.

Overall, the emergent model shows that there is an inherent change potential in the three general and distinct categories of ambiguity that may occur as actors mirror time-space bound metrics/numbers in MA and operational frames. Starting out from relation 2 in Figure 1, we identify one type of mirroring where the metric as such is related to the group's extant MA frame. Oftentimes this mirroring is implicit, unverbalized and "automatic" (cf. DiMaggio, 1997). That is, the actors' collective interpretation of the metric relies heavily and uncritically on a taken-for-granted MA frame, resulting in largely shared perceptions of MA metrics as meaningful as such (cf. Ahrens and Chapman, 2002). Importantly, however, this mirroring may also invoke a feeling that the metric has no clear or multiple interpretations, above referred to as definitional ambiguity. This perception, in turn, typically triggers a more deliberate mode of sensemaking which is explicit and verbalized. That is, actors start to discuss and ask themselves questions like "how can this metric be understood?", "what's included in the metric?" and "how can the metric be improved?". And importantly, our data suggest that such perceived definitional ambiguity may lead to critical reflection of, and sometimes even change in, the metric as such (see the representative interactions/expressions in Table II). We also find that these conceptual clarifications of and/or changes in the metrics were deemed necessary by actors for them to restore confidence in the metrics and view them as a meaningful source of information about the underlying operations in the first place. A first conclusion that our study suggests thus is:

> 1. Definitional ambiguities – i.e. where actors' extant MA frame cannot fully account for the time-space bound metrics – are important sources of critical reflection of and, potentially, of subsequent change in, the metrics as such.

Interestingly, however, while definitional ambiguities essentially involve a mirroring of metrics in the extant MA frame, we find massive evidence of mirroring in operational frames as well (see relations 3, in Figure 1). As was the case with the mirroring of the metric in the MA frame, also this form of mirroring may invoke a feeling of ambiguity. More to the point, actors may perceive that the "links" between a particular number and what it purports to represent are weak, because their operational knowledge suggests no or multiple interpretations of the number. In these cases, above referred to as representational ambiguities, actors typically start to critically reflect on the individual number and/or the current working version of the operational reality the number refers to. Moreover, we find that actors repeatedly took decisive steps to (non)validate the focal number through further investigations of its representational qualities, including the development of complementary metrics. Their motive was that, without such clarifications, it was difficult to understand the implications of the numbers and to know what actions to take. Overall then, this leads us to conclude the following:

> 2. Representational ambiguities, i.e. where actors perceive uncertainties as to what time-space bound numbers stand for "in reality", are important sources of critical reflection of, and, potentially, subsequent change both in and of MA metrics.

Finally, as suggested in relation 3b in Figure 1, actors' mirroring of a MA understanding of a particular number in operational frames may also invoke a feeling of operational ambiguity. That is, even when any representational ambiguities have been reduced or bracketed (i.e. when the focal number is seen as a trustworthy image of a particular piece of social reality), actors may still find it difficult to understand the level or trend of the focal number. In other words, they perceive uncertainty in terms of the underlying causes of the level or trend.

As illustrated above, such operational ambiguities constitute important triggers for collective sensemaking and structural change. Specifically, we find that this explicit and verbalized sensemaking may involve a reconstruction and co-development of both MA and operational frames as manifested in a "revised map" of causally linked MA metrics. Importantly however, and as shown above, this change in frames not only involved an "extended" working version of causal relationships in operations, but also a more fundamental cognitive change in their understandings of how capital efficiency can and should be improved, i.e. from an outward to an inward focus and from a functional/vertical orientation to a more processual/horizontal one. A third important conclusion that our study suggests thus is that:

> 3. Operational ambiguities, i.e. where actors perceive uncertainties as to how time-space bound numbers can be "causally" explained, are important sources of critical reflection of, and potentially, subsequent change in/of both MA metrics and in cognitive (MA and operational) frames.

Overall then, and compared to the extant literature, the emergent model from our study thus shows a more detailed account of how critical reflection and structural change may be triggered as cognitive frames (i.e. generalized templates for human action that are out of time and space) are continually "confronted" with specific, occasionally unique numbers (i.e. pieces of accounting information depicting particular time-space bound characteristics). That is, apart from confirming previous research suggesting that MA information is interpreted through relating it to MA and other frames (Ahrens, 1997; Boland and Pondy, 1983, 1986; Hall, 2010), our model suggests a number of principal "outcomes" that may result from these "mirroring" processes (i.e. definitional, representational, and operational ambiguity), each dependent on which frame is activated and what aspect(s) the comparison concerns. The model also suggests that the three types of ambiguity discovered are essential for understanding shifts from first-order to second-order changes, that is, from a mode where existing MA metrics and numbers are used as a means of rendering the operations more effective, to a mode where changes are directed toward the governing structure as such (cf. Broadbent, 1992; Ligouri and Steccolini, 2012). The argument is that the different forms of ambiguity worked as important "triggers" of a shift in cognitive mode from a largely implicit and unverbalized way of drawing upon a MA frame to a more explicit and deliberate one. And as shown above, this reflexive mode constituted an important prerequisite for actors' collective, critical reflection and (re)construction of both MA metrics/numbers and the cognitive frames as such[5].

Specifically, we find that definitional ambiguities tend to trigger reflections on an existing metric, typically resulting in adjustments of, and changes in, that particular MA metric (cf. Wouters and Wilderom's (2008) finding that the perceived validity and reliability of an existing metric may be enhanced through such "adjustments"). In contrast, changes of MA metrics (i.e. where new metrics are suggested and added)

seem to be triggered by the experience of representational and/or operational ambiguity. In the former case, we find that through adding a new measure/-ment, an existing focal number may be (non)validated, and hence, representational ambiguity reduced. In the latter case, we see how the development and use of new metrics constitutes an important means of recurrently exploring and mapping the plausible causes of particular outcomes. And importantly, we also find that it is in and through these processes that actors (re)shape their cognitive (MA and operational) understandings of how to render the existing operations more effective, and of who was to be held accountable for what.

As with any model emerging out of case study findings, it seems reasonable to consider the transferability of such findings. And indeed, on the one hand, it might be argued that our particular focus on a temporal project involving semi-distant managers' use of mainly non-financial information, may result in highly context specific findings that are difficult to generalise. On the other hand, however, it seems fair to say that the concepts that we launch in order to better understand the paradox of embedded agency are not necessarily linked to the particular setting studied, but rather, are likely to be applicable also in other contexts. Particularly, we argue that although the extent to which people perceive metrics and numbers as being ambiguous may differ between contexts, the prevalence of such effects *per se* is likely to be found in any "mirroring process". Arguably, the same applies to the three types of ambiguity identified. That is, while the actual extent of definitional, representational, and operational ambiguity, respectively, may be considered an empirical question, the concepts as such and their proposed effects on cognitive frames are likely to be transferable also to other contexts.

Based on this, we are confident that the emergent model not only represents a contextually linked explanation of this particular case, but also, a useful starting point for further research into endogenously sparked processes of MA change. For example, future research could more systematically explore in what respects (if at all) different forms and designs of MA information spark different types of perceptions, interpretations and (inter)actions. In particular, a promising agenda for future research would be to apply our emergent model to other MA artefacts such as accounting software and texts (cf. Briers and Chua, 2001; Dechow and Mouritsen, 2005; Jones and Dugdale, 2002).

Notes

1. For the sake of clarity, it may be noted that there is also a large body of research which relies on various forms of "exogenous shocks" as an explanation of structural change, including financial crises (e.g. Alam *et al.*, 2004) or changes in ownership (e.g. Conrad, 2005). However, as argued by Kilfoyle and Richardson (2011) and others (e.g. Englund and Gerdin, 2011), such an explanation does not really address the paradox underlying how socially embedded agents may come to reflect upon the social templates for action that they take for granted.

2. It could be noted that a similar line of argument has also been proposed by accounting researchers drawing upon the notion of "unintended consequences", who have argued that "change from previous structures may occur as individuals attempt to cope with new situations and contexts through reflexive monitoring of available rules and resources, possibly thereby producing actions with unintended consequences" (Ribeiro and Scapens, 2006, p. 100; see also Conrad, 2005; Englund *et al.*, 2011).

3. As we are interested in the paradox of embedded agency, we refer here particularly to the stream of research that has focused on contradictions within a particular frame as such (or structure/institution), rather than potential conflicts or contradictions between different frames. The latter has been extensively discussed in the NIS-oriented MA research, where it has been argued that due to contradictions or conflicts between institutional pressures from the environment and the structures governing an organization's day-to-day activities, formal structures may be de-coupled from the actual operations (see, e.g. Johansson and Siverbo, 2009; Nor-Aziah and Scapens, 2007).

4. A telling evidence of their unique position within the company is that the Construction department was the only department that did not have to participate in their efforts to significantly improve capital efficiency, i.e. take part in the REDCAPE project.

5. In contrast to the recent work of van der Steen (2009), our study thus shows that perceptions of ambiguity and contradictions may not only be dominant sources of inertia, but also important sources of MA change.

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Corresponding author
Jonas Gerdin can be contacted at: jonas.gerdin@oru.se

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