Fabricating an S&OP Process

Accounting as Matters of Concern and a Poincaré Disk

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Fabricating an S&OP process: accounting as matters of concern and a Poincaré Disk

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Abstract

Inspired by Latour's (2005a) notion of matters of concern and M.C. Escher's Circle Limit III as a re-presentation of the Poincaré Disk, this study follows how an S&OP process was fabricated in a large Swedish manufacturing company. The study claims that when actors are fabricating the S&OP process, local actors create emergent, ongoing and multiple matters of concern around it. The group demand chain, the actor who is responsible for guiding the implementation of the process, delegates the attempts to close these matters of concern to local actors located in separate times and spaces. As a result, constituents of the S&OP process are dispersed in diverse local times and spaces rather than being coordinated in a single time and space by the group demand chain. Accounting is a set of matters of concern.

The S&OP process and its purpose of integration come from an "absolute nothingness" – its minimal configuration - because actors refer to them in their absences. They need to be re-presented. The minimal configuration of the S&OP process creates a working time/space where diverse actors are engaged to create emergent properties of the S&OP process and new possibilities of integration. Consequently, as new matters of concern are constantly created by actors, integration on the demand chain becomes uncertain because actors are always creating new possibilities to move towards integration but will never arrive at the destination of integration. The S&OP process and integration thus go back to the "absolute nothingness" because as matters of concern they have no edge. To integrate is thus to postpone integration. In-between stands the constituents of the S&OP process and possibilities of integration dispersed in diverse times and spaces. This means from this "absolute nothingness" lays the "geometry exactitude" of the managerial technology. Accounting is a Poincaré Disk. Therefore accounting not only creates a presence what are absent but also initiates a working time/space where actors can bring heterogeneous problematisation upon itself. The impossibility of representation brings about possibility of heterogeneous representational practices. Accounting makes the transition possible by artificially blurring the distinction between absence and presence.

Keywords: the S&OP process, actor-network theory, matters of concern, the Poincaré Disk, representation, absence/presence

1. Introduction

In recent years, the conventional view of accounting as a mere representationalist practice has been questioned by alternative streams of accounting research (Miller and Rose, 1990; Robson, 1992; Preston et al. 1992; Chua, 1995; Mouritsen, 1999; Mouritsen et al., 2001; 2009; Quattrone and Hopper, 2001; 2005; 2006; Quattrone, 2009). These studies have gone beyond accounting representations and explored the various management spaces accounting has created, whether they are related to general governing economic life (Miller and Rose, 1990) or specific firm level innovation (Mouritsen et al. 2009). The claim is that neither accounting nor management has inherent characteristics unless it is placed in a network of

relations to other actors. Mouritsen et al. (2010) refers to this as relationality, which means that actors have no essence unless they are in a network of relations with *others*. These theoretical insights are largely based on the sociology of translation, or the actor-network theory (ANT) (Latour, 1987; 1999a; 2004; 2005a) and have explored how a variety of management spaces are constructed where accounting plays a performative role. This study follows this stream of research by using ANT as an ontological foundation thus follows relationality which implies that accounting itself is constructed because of *others*. In other words, this paper explores how accounting is fabricated. This will add to extant ANT inspired accounting research on how accounting itself is fabricated and how accounting and *other* management spaces are mutually conditioned. The argument is that since accounting and management spaces are relational, studying the fabrication of the latter without a thorough exploration on the fabrication of the former tends to under-account for the properties of the latter. In ANT language, it doesn't travel slowly enough (Latour, 2005a).

The context of this study is in a large Swedish manufacturing company who has been implementing the sales and operations planning (S&OP) process (Grimson and Pyke, 2007) to foster integration in demand chain management (DCM) where calculation of a sales forecast is the obligatory passage point. The S&OP process is defined as a cross-functional process linking strategic plans to daily operational plans and enabling organisations to balance demand and supply for their products and services (Lapide, 2005). This context offers an opportunity to offer new insights on what roles accounting plays in DCM as extant accounting research on inter-organisational relationships (IORs) has been emphasising on supply chains and sub-contractual relationships (Mouritsen, 1999; Mouritsen et al., 2001; 2009; Mouritsen and Thrane, 2006; Chua and Mahama, 2007; Dekker, 2003; 2004; Anderson et al., 2000; Wouters et al., 2005; Carr and Ng, 1995; Cooper and Slagmulder, 2004; Kajuter and Kulmala, 2005; Seal et al., 1999; 2004; Baimen and Rajan, 2002; Thrane and Hald, 2006; Coad and Cullen, 2006). Albeit the term DCM has been existing for more than one decade, accounting research has been rather silent in this space. More importantly, studying how an S&OP process is fabricated offers new insights to the DCM literature on how integration is pursued and what integration in DCM is about. As Mouritsen et al. (2009) cogently point out, innovation management is about creating relations between calculations, inter-organisational relationships and artefacts instead of dealing with innovation itself as innovation has no inherent essence. In a similar vein, this study claims that DCM is about creating relations between constituents of the S&OP process, intra- and inter-organisational spaces, and integration rather than problematising DCM alone as DCM has no inherent essence. This means that mainstream DCM literature which largely draws attention on technical aspects of DCM provides an incomprehensive picture on DCM.

The notion of *matters of concern* in ANT is used to analyse and theorise empirical material. In contrast with seeing objects as *matters of fact,* scholars of Science and Technology Studies (STS) regard them as sets of *matters of concern* to follow disputes and controversies that fabricate the objects before they are closed to *matters of facts*. Latour (2005a) indicates that matters of concern mean gatherings, "a thing, an issue, inside a Thing, an arena" (p. 246). In this milieu, studying managerial technologies such as the S&OP process as matters of concern is in concert with the research question of how such a technology is fabricated, for matters of concern allows disputes and controversies be incorporated into the ontology of the S&OP process. It is these disputes and controversies that attract *others* to perform in order to make an S&OP process. According to Quattrone and Hopper (2006), every movement of de-*finition* is also a *de*-finition because matters of concern attract *other* actors into the fabrication of the technology.

The other theoretical lens this study is inspired is the Poincaré Disk (Rouse Ball and Coxeter, 2010) from the field of mathematics and some compositions by the Dutch graphic artist Maurits Cornelis Escher, known as M.C. Escher. The Poincaré Disk is a hyperbolic geometry model illustrated by the French mathematician Jules Henri Poincaré where the whole of an infinite flat plane is shown as being within a large finite circle (Ernst, 2005, p. 112). Escher was inspired by an illustration of the Poincaré Disk so that he found a way to recognise new possibilities of describing infinity. This recognition is shown in his series of *Circle Limit*. In the

most comprehensive version of this series, *Circle Limit III* (1959), the central theme indicates that a complex world with geometric exactitude is built from the out-there "nothingness" and that constituents of this world comes from such nothingness and goes back to such nothingness. This is consistent with Quattrone (2011) who argues that impossibility of representation makes accounting a practice. It is because things are irrepresentable that they need to be *re*-presented in their absence (Latour, 1987). Therefore accounting always *re*-presents organisational phenomena in their absence. The emptiness implied by the Poincaré Disk motivates this study to take a slightly different angle of problematising the notion of representation. Instead of adding to the debate of representation between positivism and constructivism, this study aims to add just a little bit nuances on how accounting interacts with representation and *absence/presence* as a collective instead of *absence* and *presence*.

Matters of concern allows accounting scholars to follow how a calculation in the S&OP process is fabricated from disputes and controversies brought about by *others* and how they impact on the S&OP process. The Poincaré Disk model can be used to assist STS to trace where the S&OP process comes from and where it goes. Based on these two theoretical inspirations, this study finds out that as diverse local actors keep constructing emergent matters of concern around the S&OP process, new properties of the managerial technology will be continuously added although its constituents are dispersed in diverse times and spaces. Attempts to close matters of concern around the S&OP process are delegated by the process proposer, the group demand chain, to local actors who separate them into different local settings. The S&OP process comes from nothingness. Although it aims at representing future market demands and integrating the demand chain, the S&OP process *re*-presents the market in its absence, not to mention that customers are not even physically present in calculating the sales forecast. The purpose of the S&OP process, integration across the demand chain, is also referred to when actors are fabricating the S&OP process. It exists only in normative framework of the S&OP process but its figuration is built from a network of actors who fabricate the S&OP process. However, it is exactly this nothingness that constituents of the S&OP process and calculative spaces of integration are created and dispersed in diverse times and spaces. Yet again as the S&OP process and integration are fabrics of matters of concern that generate infinite new properties and new management possibilities around them, the S&OP process and its purpose of integration do not have boundaries. They come from nothingness and go to nothingness. Actors are always moving towards integration but will never get there. Accounting is a set of matters of concern and a Poincaré Disk. Therefore accounting not only creates a presence what are absent but also initiates a working time/ space where actors can bring heterogeneous problematisation upon itself. The impossibility of representation brings about possibility of heterogeneous representational practices. Accounting makes the transition possible by artificially blurring the distinction between absence and presence.

The paper is structured as follows. The next section will discuss matters of concern and how it can add value to ANT inspired accounting research on fabrication of accounting. Section 3 introduces the Poincaré Disk with Escher's series of *Circle Limit* and how it can add value to literature of demand chain management (DCM). Section 4 describes the research strategies, followed by a detailed empirical narrative of fabricating the S&OP process in Section 5. Section 6 presents the findings of this study.

2. Accounting as matters of concern

In his evolving development on the actor-network theory (ANT) including *Reassembling the Social,* Latour (2005a) illustrates the notion of *matters of concern* in contrast with *matters of fact*. He has been criticising *"Social Constructivism"* that attempts to give "social explanations" to science studies. Latour's consideration on *"society"* is to differentiate the associations between multiple entities of multiple identities from *"a substance made of social stuff"* (Latour 2005a, p. 115). In this setting, "Society's" symmetric twin, "Nature", from an ANT lens, should also been analysed to *"keep the deployment of reality and reject its premature unification into matters of fact"* (*Ibid*).

If it was a mistake to jump from the idea of association to the conclusion that they are phenomena made of social stuff, it's a symmetric error to conclude from an interest in non-humans that they will look like matters of facts – which are nothing more than a dumbed-down version of matters of concern as any reading in science studies will show. (*Ibid*)

This means that just as much as opposing the social constructivism that reduces objects and things into some "social stuff", *matters of concern* "*free matters of fact from their reduction by 'Nature'"* (*Ibid,* p. 109). Before objects are closed as such, attempts to close *matters of concern* must be followed. Objects are thus not cold and natural but disputable. Latour (1991) describes these objects that are not fully blackboxed as *quasi*-object. This prefix means how an object is closed or defined is not independent of its network of relations and it requires *others* in the network to be defined (Quattrone and Hopper, 2006). To make this closure possible, ANT scholars have to show the gatherings of all matters of concern pertaining to the so called "Nature". Such gathering, according to Latour (2004b, p. 246), is *"a thing, an issue, inside a Thing, an arena, can be very sturdy, too, on the condition that the number of its participants, its ingredients, nonhumans as well as humans, not be limited in advance".* The divisional belt between the "society" and the "nature" should be erased and only then will *"non-human entities were able to appear under an unexpected guise"* (*Ibid*, p. 111). This means a journey to follow how *matters of concern* are translated via a symmetry of humans and non-humans in order to define a *quasi-object* as an object is inevitable. Speaking of accounting, the following paragraph shows a few examples of why accounting cannot be closed into a cold object, i.e. a *matter of fact*, pre-maturely.

Accounting technologies are thus not mere technical matters of fact serving functional needs. The price of greenhouse gas emissions may be just a price to be bought and sold, but the framing of economic calculations making it becoming such an object require vast institutions in which scientists and accountants partake in order to respectively calculate the "exchange rates" rendering various sorts of greenhouse gases commensurable and make these new economic entitles visible, which facilitates decisions – not merely political decisions – to create an emerging market (MacKenzie, 2009). Self-regulating and orchestrating mechanisms may be just mechanisms in bringing focal firms and subcontractors together, but both technologies require considerable actions and interactions between partners so that the debate on the distribution of proceeds becomes an insignificant one and creation a network enterprise becomes possible respectively (Mouritsen and Thrane, 2006). The roadmap may be just a representation for the future trend for faster chip technologies, but it requires cost engineers, technological experts, which in this case would include Gordon E. Moore[1], extreme-ultraviolet lithographic tool suppliers, accountants and investors, through a series translations, to make the progression of the power of technology possible and to make the future markets for microprocessors stable (Miller and O'Leary, 2007). Contribution accounting system (CAS) and Activity Based Costing (ABC) may be "neutral" technologies representing profitability and costing status of companies, but CAS transformed the worrying fixed costs into variable thus proposing to reduce the factory capacity via outsourcing. This proposal, however, was challenged by the factory manager with ABC backing him rendering fixed overhead costs visible hence proposing to make the factory larger via producing in house. Accounting calculations not only determines organisational boundaries, but also support competing interests of different participants (Mouritsen, 1999).

Matters of fact are cold and indisputable but *matters of concern* are multiple and controversial because *"everywhere, the empirical multiplicity of former 'natural' agencies overflows the narrow boundary of matters of fact. There exist no direct relation between being real and being indisputable* (Latour, 2005a, p. 111). *Matters of concern* do not move away from facts, but get closer to them *"render(ing) justice to objective facts"* (*Ibid*, p. 112). ANT, being a constructivism and anti-essentialism, advocates the view that

[1] At the 35th anniversary issue of *Electronics* magazine, published on the 19th of April, 1965, Moore published an article titled "Cramming more components onto integrated circuits", which later became the Moore's Law in the semi-conductor industry. For detailed description, see Miller and O'Leary (2007).

facts are fabricated. Writing an account of *matters of concern* problematises the singular, cold and routine matters of fact, and suddenly, objects become disputed, but real and objective. In other words, *matters of concern* draw attention to controversies unveiled by multiple agencies coloured by the "social" but as associations that all fabricate an object. Because the twins, "Society" and "Nature", "subjects" and "objects", are treated as collectives, *matters of concern* allows the network to ally a vast number of linked entities making the network difficult to be objected thus more objective. "*There is no direct relation between being real and being indisputable* (*Ibid*, p. 112), but there are some relations between being real and being disputable.

Fabrication

The term *fabricating* titling this paper is inspired by Latour (2005a), and borrowed from Preston et al. (1992) whose study was tilted "Fabricating Budgets …". In provoking the use of *matters of concern,* Latour (2005a) mentions that scholar of STS should turn to focus the *gathering* and *fabrication* of a thing. In Preston et al. (1992), fabrication is "an attempt to examine the chains of reasoning and mechanisms of influence between structured forces in the determination of the direction of change and human agency in the determination of the pace of that change" (p. 565). They further elaborate that *fabrication* conveys three dimensions: the first concerns the construction of the technology; the second points to the fragility of the technology; and the third refers to the selling of the technology, that is to say, the attempt to close the technology into a matter of fact. This indicates that although *matters of concern* were introduced (perhaps highlighted) in Latour (2004) and Latour (2005a) to criticise that social science tends to close disputable matters into cold objects, i.e. matters of fact prematurely, ANT inspired accounting research seems to have embraced this ontological premise on objects in the early 1990s. Preston et al.'s (1992) *fabrication* thus motivates this study to follow the construction of a managerial technology namely the S&OP process to show how attempts to close the S&OP sales forecast into a blackbox bring about fragility and multiplicity to the technology.

Quattrone and Hopper (2006) in their study of the construction of IT also criticise the closure of IT into a 'fact'. However, rather than going into a debate from epistemology, they trace a 'fact' in its Latin etymology. One source of the word 'fact' in Latin is the verb *facere*, which means 'to make' (*Ibid,* p. 241). "The word 'fact' also interestingly shares the etymology of the word 'effect' (from *ex facere*) and highlights the power of fact in affecting and influencing (from *ad facere*) the Other…" (*Ibid*), that is to say, to fabricate. The Latin etymology of the word 'fact' interestingly coincides with the ontology premise of ANT, which Mouritsen et al. (2001) label as *relationality* and *performativity*. *Relationality* means entities do not possess any inherent characteristics until they reside in a set of relations with *others*. Thus it is the networking with *others* that defines what an entity is. An entity in this sense is also fragile and fluid for movements in the network transform its essence. *Performativity* means entities gain their properties via performing upon *others*. Accounting, for instance, is not only a passive technical tool but also frames *other* entities such as SAP implementation (Quattrone and Hopper, 2006), strategies (Mouritsen et al., 2001) and supply relationships (Chua and Mahama, 2007).

In concert with Latin etymology of the word "fact", ANT thus sees any entity as an effect of a fabrication process for to become a fact means to enact, to engage with, and to affect *others*. By doing so, the entity also becomes something/someone else. If we follow ontologies from a gaze of fabrication, a *"fact"* is an *attractor* because to become a seemingly unified "fact", an entity must attract *others* to accord herself properties. But to attract *others* also means to attract difference and diversity which in turns transform the entity. Such binding of *homogeneity* and *heterogeneity* leads to what Quattrone and Hopper (2006) term *heteromogeneity*. Stability means changes. An *object* means it is already many things (*Ibid*).

Heteromogeneity arises from the Latin etymology of definition. "Every de-*finition* (a closure) is also a *de*-finition (an incomplete order)" (Quattrone and Hopper, 2006p. 234). Thus every attempt to close a quasi-object into an object, i.e. to de-*fine*, is to attract diversity that is different from itself, i.e. to *de*-fine.

"…incompleteness and its constitution enabled to engage different constituencies simultaneously" (*Ibid*, p. 236). This is consistent with the Latin etymology of the word "fact" just mentioned. To become a "fact", a quasi-object is also an attractor. Although actors oftentimes refer to an object in its minimal configuration, its homogeneous form, for instance, the BSC is referred to as a multidimensional performance measurement system with four perspectives, fabrication of an object enacts diverse new actors that, while attempting to close the object into a matter of fact (to de-*fine*), create new matters of concern that in turn attract new entities (to *de*-fine). This makes the object more heterogeneous.

Quattrone (2009) offers a historical analysis on how accounting is diffused successfully across economies and societies. In order for accounting to succeed, i.e. to happen[2], it needs a "good method" that is capable of "coping with and handling a theoretically infinite number of situation" (*Ibid,* p. 95). A good accounting method is the one that provides practitioner accountants with a manner in order to invent new accounts and relationships between them (*Ibid,* p. 96). This is consistent with the steam of ANT inspired accounting research that argues that accounting does not represent truth but make use of a specific set of practices, for accounting provides "a method which could be flexible enough to be adapted to all types of circumstances, thanks to the infinite combinatory possibilities given by the segmentation and re-composition of accounts" (*Ibid*). These methods of segmentation and classification help accounting practices succeed (happen) because they see things better. The Latin etymology of the word "division" suggests that to see things better, one needs to break them down. This is also in concert with seeing objects as matters of concern as opposed of matters of fact because matters of concern move closer to objects whilst matters of fact moves away from them. This study thus recognises the link between homogeneity/heterogeneity, de-*finition*/*de*-finition and *matters of concern/matters of fact* in studying the fabrication of accounting. In order for the S&OP process to succeed i.e. to happen, the minimal configuration of the technology i.e. the homogeneity, forms a method that helps actors to see the technology better, but engaging with such homogeneity allows actors to create matters of concern around the technology in order to make it to be used as a matter of fact. Paradoxically attempts to close these matters of concern i.e. to de-*fine* attract new entities i.e. to *de*-fine and create new matters of concern around the technology. This increases the heterogeneity of the technology. There is thus a gap between the minimal configuration, the homogeneous part, of a technology and its heterogeneity when diverse actors are enacted. This gap is what Quattrone (2009) calls a working time/space, a time/space which can be performed and practiced. In this working time/space, the minimal configuration makes a technology appear homogeneous so that it becomes an object that people can easily refer to (p.112). While the form appears clear, the content is evanescent. Quattrone (2009) uses the BSC an example to show that although the core of the BSC is constant, users are free to enact that working time/space "provided by the typology of the ordered method" (p. 112). The S&OP process is of no difference. As will be shown in later sections, the S&OP process has an ordered method – a cross functional process that uses an unconstrained demand forecast to integrate product line planning and supplier capacity planning on the demand chain – that actors refer to it as a technology to foster integration in DCM, but users do not engage with the technology in a homogeneous manner because different actors have different interests in the proposed technology therefore creating matters of concern around the S&OP process. Attempts to close these matters of concern generate new matters of concern when new entities are attracted. Accounting technologies have homogeneous prescriptions, but this homogeneity is empty and thus offers a working time/space to attract a process of filling this emptiness (*Ibid,* p. 113). The focus of this study is on this working time/space where the minimal configuration of the S&OP process enacts diverse actors creating emergent, ongoing and multiple matters of concern around the technology.

[2] In Italian, to happen is *'succedere'*, from the Latin *'succedo'*. This is the origin of the word *'success'* in English. To happen is thus to succeed (Quattrone, 2009, p. 90).

In studying how accounting is fabricated, Chua (1995), Chua and Mahama (2007), Briers and Chua (2001) and Qu and Cooper (2011) show that networks are not only the effects of accounting images but also contributors of accounting fabrications. Attending the scene of fabrication of accounting will allow more controversies to unfold for accounting inscriptions will bring order somewhere and disorder somewhere else. The above four papers allege that accounting creates meanings and institutions and show that diverging efforts of converging meanings and institutions have to be allied in order to make an accounting technology *happen*. They show that an accounting technology is a vast network where interests of diverse actors are to be allied, but they tend to overlook the importance of competing calculative practices in the process of fabrication albeit there disputes between competing groups of actors. In this study, focus is placed on how competing accounting calculations (sales and factory forecasts in the S&OP process) contribute to constructing meanings and properties of the S&OP process. Following competing calculations allows a more slow and comprehensive picture showing how disputes and controversies are translated because competition may create new matters of concern around the managerial technology. This adds great value to the literature of fabricating accounting by slowly following the fluidity, complexity and multiplicity of accounting in its making (Hopwood, 1976).

Finally, fabricating an accounting technology does not stop after different interests are once allied. Relations between actors are not fixed and when they change, actors and their interests are also transformed anew. This means new efforts are to be put in place to ally these new interests to make the technology work because the any network is fragile and leaking (Latour, 2005a). Therefore it is misleading to theorise an accounting technology in terms of success or failure. A technology is debunked not because it is insufficient but because new relations between actors create new tensions, which require the technology to be transformed again. Existing ANT inspired accounting on fabricating accounting technologies tends to emphasise on how a technology allies diverse interests of actors but tends to overlook the fluidity of relations between actors and their interests. This study follows the emergent, ongoing and multiple matters of concern on the S&OP process and actors' continuous attempts to close them in order to make the technology a matter of fact. This helps theorise the complexity, fluidity and multiplicity of accounting in action. When relations between actors change, their interests will change accordingly. This may create new matters of concern on the technology. To close these matters of concern is to attract more entities into the network.

This section has discussed the development of ANT inspired accounting research in its endeavour to study fabrications of accounting using matters of concern. The aforementioned studies have highlighted the importance of *matters of concern* in unfolding multiplicities of accounting. These studies have thus moved closer to accounting rather than turning away from it. My claim after discussing matters of concern in this study is that by following a series continuous translations of *matters of concern* in the working time/space provided by the homogenous prescriptions of the S&OP process, we can better theorise the complexity, fluidity and multiplicity of accounting in action.

3. Accounting as a Poincaré Disk

Poincaré Disk

"In order to demonstrate hyperbolic geometry the French mathematician Jules Henri Poincaré used a model in which the whole of an infinite flat plane was shown as being within a large finite circle." (Ernst, 2012, p. 112).

Insert a brief description of the Poincaré Disk

Escher's Circle Limit

The Dutch graphic artist M.C. Escher, who was inspired by an illustration (shown in Figure 1 below) of the Poincaré Disk in a book by Professor H.S.M. Coxeter recognised new possibilities in describing infinity.

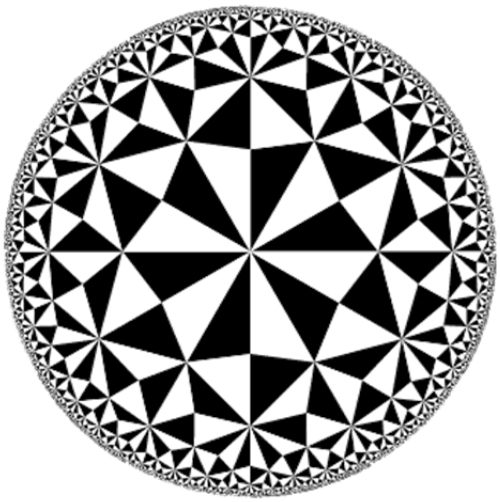

Figure 1 The Coxeter Illustration

In Figure 1, the size of the triangles approaching the edge of the disk is the same as the ones located in the centre of the disk. Those triangles approaching the edge of the circle look big in size because the weight increases as you move away from the centre. Mostly important, although the disk looks like a finite circle, it does not have a boundary because there are an infinite number of small triangles "at" the edge. The Poincaré Disk does not have an edge. These new possibilities of showing infiniteness were first shown in Escher's *Circle Limit I* in 1958 (see Figure 2 below), which Escher described as a not successful try:

This woodcut *Circle Limit I*, being a first attempt, displays all sorts of shortcomings. Not only the shape of the fish, still developed from rectilinear abstractions into rudimentary creatures, but also their position vis-à-vis one another leave much to be desired. It is true that three different series be discerned, accentuated by the way in which axes of their bodies run on from one to the other, but these consist of alternating pairs of white fish with their heads together and black ones with their tails touching. Thus there is no continuity, no "traffic flow", nor unity of colour in each row.

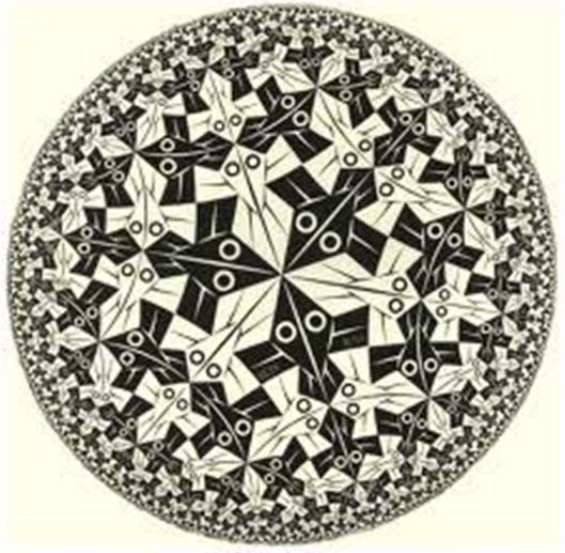

Figure 2 *Circle Limit I,* woodcut, 1958

Figure 3 *Circle Limit III,* woodcut, 1959

Inspired by the Poincaré Disk, Escher created the *Circle Limit I.* As is shown in Figure 2, the composition is a Poincaré Disk as there are an infinite number of fishes approaching the edge of the disk. Artistically, however, Escher was not quite satisfied with the work because there is no continuity, no "traffic flow", nor

unity of colour in each row or column. In the same row or column, sometimes fishes are head to head (or tail to tail) and sometimes the tail is touching the next fish's head, and also there are both black and white fishes.

Amongst the series of *Circle Limit Circle Limit III* (see Figure 3 above) has been considered the best. The woodcut is a variation on *Circle Limit I* and has solved its aforementioned imperfection. Escher also described this print as such:

> In the coloured woodcut *Circle Limit III* the shortcomings of the *Circle Limit I* are largely eliminated. We now have none but "through traffic" series, and all the fish belonging to one series have the same colour and swim after each other head to hail along a circular route from edge to edge. The nearer they get to the centre the larger they become. Four colours are needed so that each row can be in complete contrast to its surroundings. As all these strings of fish shoot up like rockets from the infinite distance at right angles from the boundary and fall back again whence they came, not one single component ever reaches the edge. For beyond that there is "absolute nothingness". And yet this round world cannot exist without the emptiness around it, not simply because "within" presupposes "without", but also because it is out there in the "nothingness" that the centre points of the arcs that go to build up the framework are fixed with such geometric exactitude.

As is shown in Figure 3, the imperfections in *Circle Limit I* were avoided. In *Circle Limit III,* in each row or column, there is a string of fishes of same colour with each head is touching the tail of the other. As there is no edge of the Poincaré Disk, in each row or column, the fish comes from an "absolute nothingness" (as there is no edge), grows in size (it becomes bigger to the viewer but in fact each fish size is the same), and goes back to the "absolute nothingness" (again the edge). However, it is because of this nothingness that the geometric exactitude is created.

Inspired by Coxeter's illustration of the Poincaré Disk and Escher's *Circle Limit I,* this study argues that accounting does not have a boundary because it is a set of matters of concern. In contrast to technology determinism which claims that technologies are inherently well designed and that any failure is to be attributed to their implementation, accounting as matters of concern implies that the dichotomy between design and implementation of technologies is misleading (Justesen and Mouritsen, 2011). When actors are engaging with the technology, there are disputes and controversies that continuously reshape the technology. Quattrone and Hopper (2006) find that the ERP system to foster integration is many things and will continue to be many new things because there are always insufficiencies created by actors. Chua (1995) states that the ontology of a DRG based accounting information system is subject to disputes created by debunking parties and that as new disputes emerge, the accounting system is not likely to be closed to a blackbox. Chua and Mahama (2007) also point out that the performance measurement system in the supply alliance constantly fails because there are always new disputes created by suppliers. Accounting thus has a property that is consistent with the Poincaré Disk that there is no edge surrounding it. As actors continuously create disputes and controversies when they are engaging with accounting practices, accounting incorporates more matters of concern into itself. Therefore, accounting is constantly transformed anew. Actor-network leaks (Latour, 2004; 2005a). Maybe accounting can be stabilised for a while, but there will always be new disputes and controversies brought about by *others* that will make accounting different from what it is. Callon (1998) describes such a movement as an overflow which may construct a further movement of re-framing.

If Coxeter's illustration of the Poincaré Disk and Escher's *Circle Limit I* inspired the study that fabricating accounting does not lead to a finite destination, an end, Escher's *Circle Limit III* offers a new analytical space where ANT inspired accounting research may consider offering a more comprehensive narrative at the start, the in-between and the end, actually directions towards the end, of the fabrication process. The reflection upon the *Circle Limit III* contradicts with the positivist view of accounting as a representationalist practice. Quattrone (2011) argues that "if things are representable they would not need to be represented" (p. 2). Rather they need to be *re*-presented when they are absent (Latour, 1987), and therefore accounting *re*-

presents “things which are never visible (a cost) (Quattrone, 2012, p. 3). The claim is that impossibility of representation makes accounting a practice. . This is consistent with the Poincaré Disk where there is “absolute nothing” beyond the infinite properties of the managerial technology and possibilities of its purpose. Those fishes come from such nothingness but a geometric exactitude is exactly built from this nothingness. The notion of ‘nothingness’ is an artistic notion used to interpret Escher’s work. In philosophical terms nothingness may differ from emptiness hence absence. For the purpose of this study, I choose to skip such philosophical discussion and to deploy the word emptiness or absence. Actors refer to technologies in their absences, and such absences oftentimes create the minimal configuration of the proposed technology. In Quattrone and Hopper (2006), participants refer to SAP not only as an abstract technology because it lacks functionality, but it’s exactly this absence that establishes its presence for users wish to establish its presence “by precipitating enactment of a simple three letter acronym – common, global, [and] simple” (Woolgar, 1981). Because of this emptiness, the minimal configuration of SAP, the lack of its functionality, the SAP is constructed to enrol actors and incorporate properties (the geometric exactitude).

The Poincaré Disk and its artistic illustration in the *Circle Limit III* also motivates this study to drift back to the discussion on representation, but instead of arguing whether it is faithful, this study aims to add some new insights on how accounting mobilises the notion of absence/presence in order to *re*-present something. Friedrich’s (2011) study of representation, memory and pedagogy in the Museo de la Memoria (Museum of Memory) and the Parque de la Memoria (Memory Park) in Buenos Aires has provided a new possibility of exploring accounting representations. The purpose of both constructions in the city is for the remembrance of what has happened during the period of dictatorship of Argentina. The first episode of the study narrates a tour in the former Navy’s School of Mechanical Engineering (ESMA) where the Museo de la Memoria is located. The human rights NGOs in charge of setting up the institute finally decided to run the museum without any representations of the terror. Thus the whole former concentration camp was left empty. However, as the tour started, the guide brought back anecdotes in relation to prisoners in order to enlighten a pedagogical discourse of resistance. Friedrich (2011) sees such endeavour of filling the void/emptiness as a paradox. Although the empty rooms in the ESMA do not represent anything from the outset, the modernisation of destabilisation of moral certainties produces “The Homeless Mind” in search of a sense of reassuring home (Berger et al., 1974).This calls for a moralising process to fill the empty space, which in the case of ESMA is using anecdotes to represent prisoners’ resistance, which resonates with González (2005) who states that to avoid representation cannot escape the play of representation. In ANT words, human actors’ searching for a moral home brings presence of something into the absence. Going back to accounting representation, this study therefore argues that the impossibility of representation *re*-present objects of representation in their absences (Quattrone, 2012), but according to González (2005), the absence of a representational space calls for a presence that “moralises” humans. This indicates that the performativity of accounting inscriptions resides on their endeavour to revert actors’ minds to costs, profits, customers and so on, albeit these entities are never visible (Quattrone, 2012). In this sense, the classic notion of representation relying on merely presence (García, 2008) does not seem to offer a sufficient explanation. We don’t need an abruption of presence and absence because any absence cannot escape from the play of representation that brings about presence of something (González, 2005).

The second episode in Friedrich (2011) narrates the representational practice of the construction of artworks and monuments in the Parque de la Memoria. It also rejected clear representations of what has happened but the difference is that there was no motivation to guide “The Homeless Mind”. The emptiness leaves visitors innumerable possible narratives and meanings. Therefore the impossibility of representation cannot escape the innumerable possibilities of individualised engagement. This is in

concert with Quattrone (2009) who believes accounting such as the BSC offers a working time/space so that actors can engage with it heterogeneously. In this sense, this perfectly resonates with Escher's *Circle Limit III* where it is because of this nothingness – emptiness - that the geometric exactitude is created. The aim of this study is to offer a narrative by showing how accounting mobilises this absence/presence in its trials of constructing itself towards some "geometric exactitude".

This study will also use Escher's *Circle Limit III* to study the fabrication of an S&OP process. This will offer alternative insights of DCM on integration. Most mainstream DCM research (eg. (Van Landeghem and Vanmaele, 2002; Heikkila, 2002) either discusses the technical perspective on technologies or proposes normative framework on integration in DCM, but it has not explored the intricate relationships between a managerial technology to foster integration and integration itself. Studies have recommended a cross functional team (Lapide, 2005; Grimson and Pyke, 2007) to implement the S&OP process but have not paid attention to the impacts of having a cross functional team and frictions that are created by such a team. Moreover, these studies do not account for the destination this cross-functional S&OP team leads to. Although these studies consider the S&OP process as a technology to foster integration on demand chains, they tend to overlook to what extent the S&OP process leads to integration. As ANT draws attention on *relationality,* fabrication of the S&OP process and integration mutually condition each other. If the S&OP process does not have a boundary, so may its purpose – integration. In this sense, both the S&OP process and integration may never stop because they are sets of matters of concern. Rexhausen et al. (2012) find that implementing the S&OP process is difficult. Matters of concern and the Poincaré Disk suggest that perhaps it is problematic to judge whether the level of implementation is high or low, or successful or unsuccessful. Using whether or not integration is achieved as a judgment criterion is problematic because integration may not have a finite edge. So the question becomes where the S&OP process lead managers in DCM to? *Circle Limit III* suggests that integration may exist in a remote infiniteness, but it will be interesting to see how the S&OP process is fabricated after disputes and controversies brought about by actors are closed, that is to say, how the managerial technology reaches its "geometric exactitude", and how this "geometric exactitude" shape the progress of S&OP's purpose, integration.

In summary, following accounting as matters of concern and the Poincaré Disk, this study aims at offering a more comprehensive narrative on how the S&OP process is created from its absences and fabricated to a status of "geometric exactitude", how accounting mobilise the absence/presence in order to represent customer demands and where the fabrication of the S&OP process leads to progress of integration. These will add value to ANT inspired accounting research on what accounting is and how it lives a life and to DCM literature on what integration is, how it is pursued and whether it is achievable.

4. Research strategies and contexts of using the S&OP process

This paper utilises Law's (2004) and Latour and Woolgar's (1986) reflection upon the mediation of research methods on theorisation and knowledge production. Law's (2004) reflection on knowledge production in social science starts with a discussion on *inscription building* in laboratories. According to Latour and Woolgar (1986), a laboratory is a system of material/text translation where material resources are transformed into texts and that more or less stable similarities are transformed into *substances, facts*. Realities are thus *constructed* by inscriptions devices.

Law (2004) then takes a journey around metaphysics of realities as *out-therenesses* and reflects upon how Latour and Woolgar (1986) problematise the *out-therenesses* of realities differently from Euro-Americans[3]. Properties discussed include *independence,* whether the external reality is independent of our actions and perceptions, *anteriority,* whether the external reality exists before us, *definiteness,* whether the external

[3] Law (2004) uses this term as an index for those "more or less hegemonic set of claims about method, notwithstanding the divergences in practices" (p. 165).

reality is composed of a set of definite relations, and *singularity,* whether the external reality is the same everywhere. Law (2004) states that on *independence* and *anteriority,* ANT sees realities are associated with the apparatus of *inscription producing*. On *definiteness* and *singularity,* ANT also sees realties as effects of the apparatus of *inscription building*. Producing inscriptions therefore are vital in generating scientific power/knowledge thus cannot be separated from the *out-there* realities. Law (2004) describes those inscriptions produced yesterday as hinterland of today's statements, modalities. "It is not a matter of words representing things. Words and worlds go together"[4] (*Ibid,* p. 33).

If the hinterland of inscriptions is central in transforming modalities into unqualified statements about reality that have the potential of becoming routinised *facts*, the conventional take on research methods becomes an object subject to scrutiny.

> *"But this means that as the modalities disappear, so too do almost all of the processes in which statements and realities are produced. The largest part of the work that has gone into their production is deleted. In the end, the inscriptions devices themselves disappear, though those that are most novel are likely to retain a foothold in the 'method section' of scientific papers. But it is the 'subjective' and the 'personal' that disappears first. The traces and the statements in the laboratory are used 'in such a way that all the statements were seen to relate to something outside of, or beyond, the reader's or author's subjectivity' (Latour and Woolgar, 1986,* p. 84)*." (Law, 2004,* p. 36)

This reflection on *inscription building* points to a fallacy of the conventional main stream Euro-Americans, to whom realities come first and inscriptions come later as representation of the former. It is the other way round! It is "the processes of comparing, contrasting, and weighing up inscriptions that *produce* realty…It is arguments, debates, discussions or controversies that *produce* reality" (Law, 2004, p. 37). It is not reality that settles any disagreements via setting rigid methodological rules. Methods where *inscription building* plays a vital role *construct* realities.

This reflection upon research methods is consistent with Quattrone and Hopper (2005; 2006) who build upon Latour (1988) alleging that scientific methods are bundled with theorising but are not neutral representational tools and Woolgar (1988) viewing scientific methods as mediating the connection between the object of the study and its representations. As researchers need reflect upon a concept as part of the object they wish to represent (Woolgar, 1988), and the perception of ontology shapes a particular epistemological underpinning, which in turn points to the character of the methods hence the nature of representation (Woolgar, 1988; Chua, 1986), "scientific methods become the problem rather than the means for investigation" (Quattrone and Hopper, 2005, p. 743).

ANT is well known for its methodological slogan, "follow the actors". Field based case study research is in principle coupled with research deploying ANT as its method theory for its orientation towards the locals and particularity. Its theorisation, however, differs from conventional case based research that implies the modern separation of the researcher and the researched objects that searches for abstraction and generalisation. This typical kind of case study research thus becomes both the means and object of the investigation (Quattrone and Hopper, 2005). Some would argue that ANT's approach that looking at "things out there" and reporting back and representing those same things "in here" that enable *action at distance* (Latour, 1999a) is also replicated in other empirical studies. There is, however, a vast difference. ANT inspired case study research sees methods as an object instead of as a means of investigation (Calas and Smircich, 1999). The ideology is not to discover a theory that can be generalised, either statistically and analytically, across settings but to look for surprising explanations which challenge the taken-for-granted as is mentioned in prior discussions.

[4] This is also Latour's (1999a) argument for studying social science as circulating references.

This research was based on a longitudinal case study in a large Swedish manufacturing organisation implementing a sales and operational planning (S&OP) process throughout their operations in response to poor availability problems. The choice of conducting a longitudinal case study complies with ANT's re-habitation of the detailed descriptions and actions at the empirical level (Justesen and Mouritsen, 2011), which is the approach that Latour (2005a) refers to as "slowciology" (p. 165). Conducting interviews, observing habitants' behaviour, participating in meetings and reading internal documents are common means to "go slow", "keep everything flat", and "don't jump", which are typical slogans representing ANT's methodological advices (*Ibid,* p. 190).

The case study was conducted in a Swedish based large bearing producing company, namely SWEDTECH (a pseudonym). Its product range comprises five platforms including bearings, seals, lubrication systems, mechatronics and services. Its customers encompass a wide range of industries including aerospace, agriculture, cars, compressors, construction, electric motors and generators, electric power tools, food and beverage, home appliance, oil and gas, industrial fans, pumps and transmission, racing, solar energy, and so on. The company's annual turnover amounted to 56, 227 SEKm, 61, 029 SEKm and 66, 216 SEKm in 2009, 2010 and 2011 respectively. Operating profit for the same periods were 3, 203SEKm, 8, 452 SEKm and 9, 612 SEKm.

In 2007, the group demand chain of the SWEDTECH realised that although the products the company was offering are of cutting-edge, it had to decline a lot of customer orders because of capacity constraints. Significant revenue would have been generated had factories and suppliers got sufficient capacity. In order to balance demand and supply, the group demand chain decided to implement the Sales and Operations Planning (S&OP) process to make the company demand driven. Also during the same period consultants deployed by the company indicated that the company hadn't had structured information processing and methodologies of using data. Disparate sub-organisations were using different information systems producing different structure of data which makes it impossible to integrate. The group demand chain also wanted the S&OP process to provide a space where these information and methodology problems could be solved. From 2009 the group demand chain started to delineate the S&OP agenda because the 2008 credit crunch drove the organisation's attention to other urgent problems. It was not until September 2010 did it start its first pilot S&OP product group planning (PGP) meeting. I entered the organisation in June 2010 when the group demand chain considered rolling out the pilot process in some of the product groups, for instance, SRB/CARB in the industrial division. When I completed the field research in September 2011, the pilot S&OP process was still implemented due to those many controversies that are going to be discussed in the next section. The S&OP sales forecasts were calculated by the sales organisation and were then sent to factories and product line planning management (PLP). In PGP meetings, discussions should be centred on how to make up the shortage of capacity identified. However, in those pilot PGP meetings, debates were proliferating on the reasonableness of the sales forecasts because factories believed that the sales forecasts were of low quality. The majority of the efforts spent in the pilot S&OP process were thus focusing on how to generate a reasonable sales forecast.

I was present in the company interviewing and observing during the period from June 2010 to December 2010. Then I went to the company to do a number of follow up interviews when new concerns emerged. This discontinuous presence occurred throughout the Year 2011 up to October. The empirical domain largely involves the headquarter and the production channels located in the adjacent factories of the company. 41 semi-structured interviews (including 6 telephone interviews due to inability to conduct face to face interviews) with 16 managers across functional groups were conducted during the period June to November 2010 and December 2011. Each interview lasted between 0.5 and 3 hours. Most of the interviewees were key participants in the group demand chain because the group demand chain is in charge of the pilot process and the S&OP process was intended to be fully rolled out to local functions later. Most of these persons were repeatedly interviewed in order to trace ongoing tensions. This allows in-depth

analysis of ongoing attempts to close multiple *matters of concern* around the S&OP process. Some key players in the sales organisations, factories and product line planning management were also interviewed.

I explained to the managers that I was interested in their efforts to calculate, to control and to account for the impacts of using the S&OP. Semi-structured interviews were preferred for their reflexive (Alvesson, 2003) and analytical (Kreiner and Mouritsen, 2005) nature enables the researcher to follow the translations between accounting calculations and integration in DCM. This means a questionnaire was prepared but the dialogue was quickly stimulated to develop its own momentum for entities unfolded unexpectedly to compete for a voice. Reflexive and analytical semi-structured interviews also place the researchers to the same level as the lay actors so that lay actors' interests, actions and interactions can be followed to allow surprises to unfold.

Six pilot S&OP meetings were followed (September 2010, February, May, June, August and September 2011). Real time debates on the construction of the S&OP sales forecast, for instance, the disagreements on the sales forecast from the factories, were followed to trace the fabrication of a company-wide S&OP forecast. These debates will then be translated into different time and space where local actions are enabled.

A vast range of internal materials were studied including S&OP charter, 6 Sigma charter, business cycle forecasts (F18), financial forecasts, S&OP instruction manual, data in the pipeline and Demand Solution, factory daily planning inscriptions, factory stock levels, safety stock levels, shipment histories, and meeting minutes. A summary of the interviews, meeting observations and documents inspected is provided in Table 1.

Interviews		
Positions	Face to face	Telephone
Sales manager of bearings and units	1	0
Demand chain manager for large bearings	5	2
ID manager on manufacturing & supply	5	1
S&OP manger	4	0
Business process analyst A	1	0
Business process analyst B	3	0
Business process analyst C	2	1
Regional sales director	1	0
Sales manager in SD	2	0
Product line manager for medium bearings	1	0
S&OP PLP manager	3	0
S&OP SCP manager	2	0
Sales manager in ID	1	0

Purchasing manager	1	0
Direct of demand chain - ID	1	0
Product line manager for group demand chain	2	2
Total	**35**	**6**
Meetings		Attendance
Pilot S&OP meeting Sept. 2010, Feb., May, Jun., Aug., and Sept. 2011		6
Total		**6**
Internal documents		
S&OP charter 6 Sigma charter Business cycle forecasts (F18) ABC analysis Financial forecasts S&OP instruction manual Pipeline Demand solution Factory daily plans Factory plan, stock levels & safety target levels Shipment histories Meeting minutes		

Table 1: A summary of interviews conducted, meetings attended and documents studied

Following Latour and Woolgar (1986), for a statement to be transformed from a mere modality into a fact, it needs to ally a hinterland of other statements. Therefore, this paper shares the principle of triangulation with conventional case study approaches, but the difference is that in ANT studies, disagreements between participants and evidence are not intermediaries to test reliability of the data collected. Instead they open a space for more controversies allowing actors to show longer translations that construct a collective once the controversies are more or less closed. Triangulation tests reliability but more importantly it allows more tensions to unfold. In this study, quotes are cross checked with multiple interviewees and meeting minutes and graphs analysed accordingly. In most cases, when a disagreement is found, questions in the follow up interviews will be developed in a way that unfolds debates. For instance, when the demand chain manager for the large bearings mentioned the importance of calculating forecasts in the warehouses, which has been skipped in the current S&OP process, his argument was then brought by to the manager of the S&OP, who in turn challenged this inclusion of forecasting in warehouses. The result is that such a disagreement will not point to any data unreliability, but a collective that both arguments were addressed in the end via the enrolment of another mediator, a translation of the sales forecasts into a shipment forecast.

Interviews were transcribed at the earliest possible time. Qualitative data was coded in NVIVO by matters of concern around the S&OP process, forms, sales forecast, factory forecast, debate, uncertainty in customer demand and integration in DCM, multiple voices for customers and intra- and inter-organisational relationships, but not in a conventional manner. Data was first organised chronologically and then by episodes and in each episode an attempt to close a *matters of concern* on the technology is narrated. There were no categories assigned to data from the outset because ANT looks at the processes rather than structures of empirical events. Episodes include, for instance, an episode of closing a matter of concern on primary keys and an episode of closing a matter of concern on forecasting accuracy. This is inspired by Latour's documentation means in *Pandora's Hope* in his scientific inquiry of clarifying whether the rainforest in Amazon is retreating or intruding upon the savannah. He documents his empirical material through a set of inscriptions building processes "from mapping, tagging and sectioning of an area of rainforest and savannah to the many holes dug in the ground and to the transfer of soil samples to a gridded, wooden box, each coded by colour, type, depth and location" (Dambrin and Robson, 2011, p. 5). Narrative organised by episodes helps readers go along the reversible chain of circulating reference to see how an attempt to close a particular matter of concern around the S&OP process is translated into a particular inscription. Readers know which inscription refers to which matter of concern on the technology.

5. Empirical analysis

As the original study (my PhD thesis) describes the whole fabrication process in a series of 9 episodes where some episodes even comprises sub-episodes, this paper only describes some of those episodes due to the scope limitation of a paper.

Episodes 1 & 2: Constructing the minimal configuration of the S&OP process

In the case company, SWEDTECH, there are automotive (AD), industrial (ID) and service (SD) divisions, each of which has both a sales and a manufacturing organisation. The consultants found that sales and operational planning had been working "pretty well" when sales and manufacturing are in the hand of the same organisational unit, that is, the same division. However, problems occurred when sales and productions were cross-divisional, which forms the starting point of the S&OP process. The S&OP manager explained,

> If you have a product that is produced in a car and sell it to industrial division, that it's not that good communication flow. And this is the starting point of the S&OP project...because in SWEDTECH we produce, for example, a bearing which is mainly for car customers, but there is always a certain part which goes to either service division or industrial division, so it's very seldom that one product only goes to one segment. So factories produce for different customers, SWEDTECH customer segments. That's why it's so important to get the whole demand right for all our customers… We had different solutions, pieces here, pieces there.

The above quotes indicate that managers at SWEDTECH interpreted consultants' findings in terms of a matter of concern on demand chain management with regard to a lack of communication between divisions and departments. It also points out that disparate organisations had different information structure and different degrees of updates on their information. Information was also processed differently. These make it difficult for management to consolidate. This constructed another matter of concern that was to be incorporated into the boundary of the S&OP process, namely a lack of structured and consistent methodology and information across the demand chain. Moreover, the above quotes also indicated that the diversity in product offerings was in recent years translated into a platform concept with a purpose to foster one of the company's visions, namely to be knowledge based. The platform concept was used to offer combined products as a package of solutions to customers. This would require cooperation especially information integration between divisions. The platform concept wasn't intentionally developed to foster the closure of the aforementioned two matters of concern into an S&OP agenda. It existed before the S&OP but made such closure more convincing. The platform concept was never connected to consultants and the S&OP network before. There interests were now allied. The manager of the S&OP also indicated,

> In SWEDTECH we produce, for example, a bearing which is mainly for car customers, but there is always a certain part which goes to either service division or industrial division, so it's very seldom that one product only goes to one segment. So factories produce for different customers, SWEDTECH customer segments. That's why it's so important to get the whole demand right for all our customers.

This means that the company was short of a technology that was capable of domesticating uncertainty in future customer demands attributed from a platform concept combining multiple product groups. Cross divisional cooperation and consistent information and methodology were crucial to address this uncertainty. It is therefore under these relations between actors a delineation of a "company-wide" process was constructed.

The next question to the group demand chain (the S&OP process guide) became what calculations would be the obligatory passage point (OPP) of the S&OP process. The consultants advocated that the process should start with a sales forecast to balance demand and supply, which was also suggestion by the S&OP literature. In SWEDTECH, a sales forecast was initiated to be the OPP of the S&OP process, but instead of referring to the consultants directly, an accounting inscription showing availability failure was the actor to enact the sales forecast. In fact, in SWEDTECH availability was the most frequent word during the interviews that had been mentioned by a number of interviewees especially those from the factories and the purchasing. These comments all pointed to serious availability problems.

> We have poor figures on more or less all channels…this is the actual situation when it comes to deliveries right now, so that is not good picture now…I just give you a hint on our availability. Here you see the H channels that we have, you see who is the planner, here we have the availability on the stock items, 81% for the H2, 9, 35, 51, 53 and so on.– by the purchasing manager of medium bearings.

An availability failure of 19% as indicated above was considered high at SWEDTECH, but some channels were even worse.

> In 2008 we had a delivery time of 2 years in Channel 77, and one year ago, we had a…one month, delivery time. The trend is that we are getting longer and longer delivery time. If you look at C2, availability 9%...we have a factory in India now which has availability failure of 50%, I mean it's just ridiculous, I mean it doesn't matter because the sales guy, they don't talk any more to customers…I mean you should have already taken the decisions to either build a new factory or get support production, or get rid of customers before. Now you are absolutely in crazy situation.– by the process analyst of the group demand chain

These quotes indicated the performativity of accounting inscriptions that visualise availability failures and delivery time. Customers had to wait for longer delivery time due to capacity constrained in either factories or suppliers. When the economy was in its upturn in 2009, SWEDTECH failed to translate the upturning market business volume into increased returns because of the imbalance of demand and supply.

> It came from the last upturn. We had very big sales issues. We couldn't sell…because of constraints in our factory and suppliers as much as the customer wants to have…That is the main reason why they start this process to have enough or to get the right capacity to supply the market needs. It's also the opposite in the downturn…The main driver was that we to have the right capacity. It came from last upturn when they have what they called availability problems. – by the manager of the product line planning stream of S&OP

This quote indicated that an inscription showing availability was connected to the matter that the company had lost some of the business volume because of capacity constraints. Re-capturing the lost market demand in turn generated a form of the S&OP agenda to create a company-wide "unconstrained" sales forecast. This form of the S&OP agenda was created in early 2010 when the group demand chain decided to implement the process later during the year. The performativity of this inscription lies in the displacement of time so that the whole future market demand was calculated to identify any potential capacity shortage at present. The uncertainty in an imbalance between demand and supply was translated

into capacity management that would enact actions of making up for such shortage by, for example, increasing shifts, investments in machines and additions of factories.

Accounting inscriptions showed that the poor availability and long delivery time had become proliferating throughout the whole demand chain. To avoid the problem of a 1.5-year-delivery time, there needs to be a satisfying level of finished stock, which in turn requires sufficient capacity at least 1.5 years before customer orders come. This delineated the original minimal configuration of the S&OP, to have a company-wide sales forecast for the next 36 months to foster tactic and strategic time horizon capacity planning. The 36 month, however, was just an ad hoc decision. The intention was to cover both tactic and strategic horizon of capacity improvement.

> I think that must be the purpose, using it in a strategic way, and also put sources to where sources should be. So for this material family, SRB, we have production in China, Luten, USA, so it's also where are the needs. The strategy is to produce as close to the customer, so in the long term, to use this tool, it must be very good. – by the purchasing manager for medium bearings

The long term was defined as 36 months in the S&OP process. It was believed by the group demand chain that the company can become *proactive, agile, and faster* by using such an unconstrained sales forecast covering the strategic planning horizon to guide product line planning (PLP) and supplier capacity planning (SCP), which was the minimal configuration of the S&OP process. Fabrication of the minimal configuration of the S&OP process was shown in the following figure.

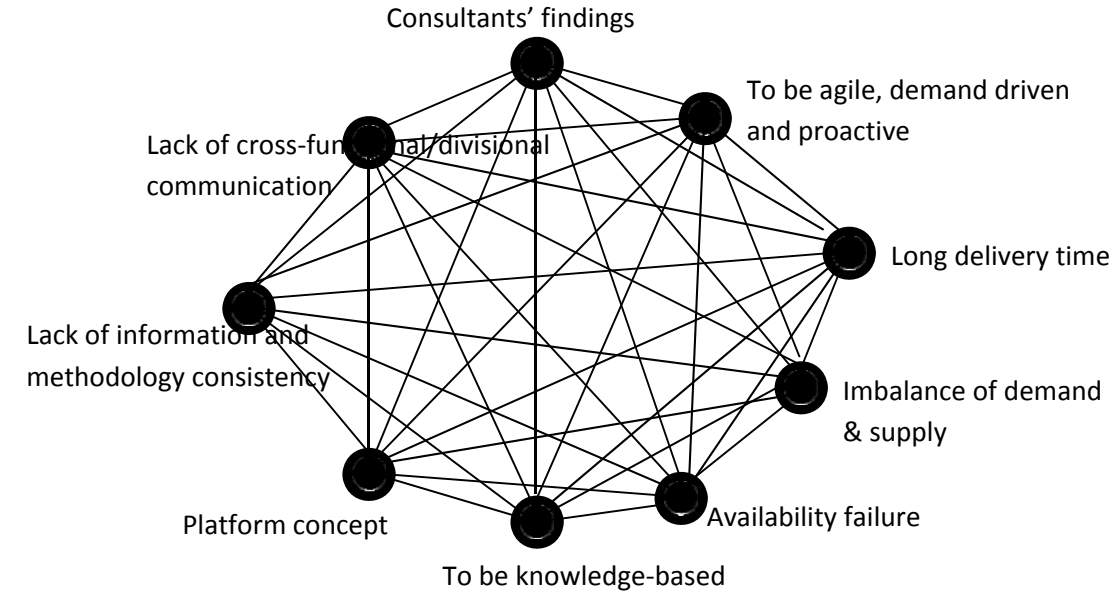

Figure 4: Delineation of a company-wide unconstrained S&OP forecast for the next 36 months

According to Figure 4, the S&OP is process incorporates a new matter of concern, to balance demand and supply, mentioned by the consultants. This matter of concern was connected with intra-organisational problems on communication and information processing that was related to revenue generation. An imbalance between demand and supply was visualised by an inscription showing availability failure. This made the group demand chain realise that significant business volume was lost because of capacity shortage. To re-capture these lost business, "an unconstrained sales forecast" was to be calculated to translate future market demand into current production plans. Another inscription showing delivery time made up the final property in the S&OP agenda, a forecast to cover the next 36 months. Although the S&OP was intended to be a strategic oriented technology, it also had implications on operational activities. A gap between expected capacity and actual capacity would enact operational activities such as adding shifts and

manpower, and providing supports between factories as well as strategic activities such as adding a new factory somewhere in the world. This would in turn help the company to be agile, demand-driven and proactive because current activities preceded future risks.

Episode 3: Separating primary keys

The next matter of concern around the S&OP process was the primary key of the sales forecast, or the starting level of the calculation. The object on which the sales forecast is based forms the starting point of the calculation for SWEDTECH produces a variety of end products to a wide range of customers. This is reflected in the divisionalisation of AD, ID and SD. The manager of the S&OP described the embeddedness of the sales forecast in a variety of business types,

> The sales forecast is depending on what business we are talking. We are following the sales organisation on the forecasting side…And this is the level we do the forecasting. And for each those units, we have defined what we call the primary key, so the level we are doing forecasting. In AD, we do it on the lowest possible level, which is item customer, whilst in ID and SD, we do it on product line. The lower you go in the primary key, the more details you can put in, but obviously the more records you get. Therefore it's very much depending on which business you are in. If you are on the typical automotive business, then you need to enter data on that low level because you talk about a limited number of links, item customer, but every individual link, you sell a lot of items, volume of each, record is very big. If you look at service division, business is completely opposite. We sell to one dealer a huge amount of records, and we sell to a huge amount of dealers, so if we look on a typical service division business, you will not be able to forecast on item customer level.

The above quote says that an attempt to close a matter of concern on which detailed level that the forecast should start with are mediated by business characteristics that are shaped by the divisional structure of SWEDTECH. In AD, the S&OP forecast is done to the item customer level or the final variant level, for instance, a certain type of bearing sold to Volkswagen (VW) for SWEDTECH normally sells a large volume of bearings to a limited number of customers in this division. The ID/SD, on the other hand, serves a huge number of customers each with a tiny proportion of the business volume. Therefore, sales forecast is done on a higher aggregated product line level, for instance SRBs. This is confirmed by a forecasting manager in SD,

> We do forecasts at an aggregate level, not on final variant. Basically the lowest level we do in the sales forecast in the pure front end is what we call product lines or a sub-group of product lines. A product line could be a TRB (tapered roller bearings), and a sub-group level could be medium size TRBs.

AD's primary key referring to the forecasts is detailed down to customer items on final variant levels also because they have a good quality order book. According to another process analyst in the group demand chain,

> For the automotive business, I guess they are really focusing on the order book. They have a good quality order book, reliable, and customers give SWEDTECH the forecast of 12 months in general, so for the automotive business, the order book is pretty much fixed for the 6 months, of course it's getting a little bit weak, but information is in that respect quite reliable.

In ID/SD, a short order book existed. In this setting, it was not sufficient to forecast on the final variant level for the medium- to long-term horizon. Also, in contrast with AD where its customers have sound supply chain management, ID and SD customers were summarised in terms of long lead time and investment centres. According to one of the business process analyst of S&OP,

> In the ID, for example, lead time is much longer, we have sometimes 6 months lead time of a bearing. This is one problem. This ID is more an investment centre, you know that the customer is ordering a machine, or a huge machine for the consumer industry, that's a pretty big and complex project for SWEDTECH, a big business, they are ordering 6 machines with several bearings, this is much more investing in the machine, but compared to AD, it is little bit more how the… for example, a newspaper press manufacture is going to invest in the future, there is

more like customer relationships between SWEDTECH and the customer. So it's much more soft effects, which are important, and also little bit more on the experiences of sales persons…for AD, their customers have good supply chain management, so their order book is quite reliable.

This means that future business volume for ID/SD in this setting is constructed by customer relationship management between SWEDTECH's sales persons and customers, which is uncertain, so the association between the business characteristic in ID/SD, i.e. small business volume sold to huge number of customers and uncertain customer relationships produces a short order book that cannot be relied upon for forecasting, which translates the primary key into the one that refers to the higher product line level. To close the matter of concern on primary keys of the sales forecast, local actors separated the attempt to close it into two different local times and spaces, different divisions. The process of separation is shown in Figure 5 below.

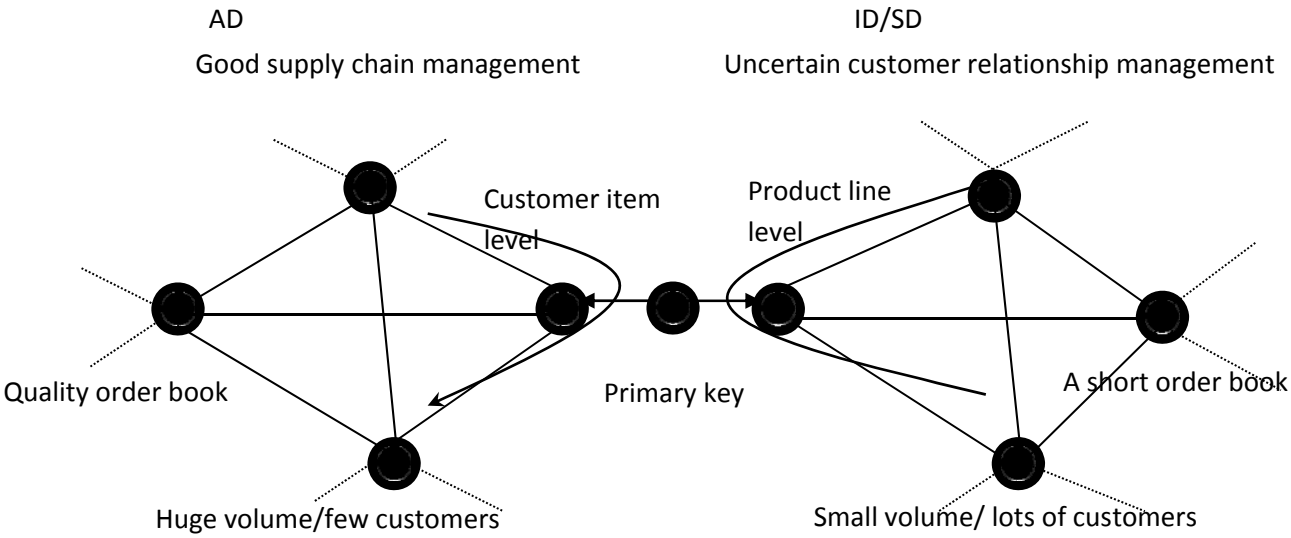

Figure 5: Translation into a primary key for AD and ID/SD

It shows that even a short translation that attempt to close a matter of concern on the primary keys of the S&OP sales forecast was separated into two co-existing actor-networks. The association between AD's business characteristics and sound supply chain management of its customers constructs a good quality order book, which in turn constructs a very detailed level primary key on the customer item level. In ID/SD, the order book is short, and relationships with customers are uncertain because each customer only buys a small volume of the many SWEDTECH products, the primary key could only be set on a higher product line level.

Episode 5: Forecasting accuracy

Episode 4 describes the separation of the work of calculating the sales forecast between the computer software namely Demand Solutions (the system forecast) and sales persons (collaborators) manual input (market intelligence). The separation was also initiated by a number of human (eg. forecasting managers) and non-human (eg. different inscriptions visualising different representations of products sold) actors. As the process was similar to the one in Episode 3 it is not describe here. In Episode 5, both the group demand chain and local actors created a matter of concern on forecasting accuracy, which was derived from another matter of concern on selecting the criterion for computing the system forecast.

The system forecast calculated sales forecast for every month. There are 21 formulas available in the Demand Solutions, but since there can only be only forecast, a criterion had to be chosen to decide which

formula to use. The Demand Solutions only use absolute (net) error (or sometimes if is referred to as the average error) comparing past forecasted and actual sales and select the one with the lowest error, but this was considered by the group demand chain as being contradicting with the S&OP's purpose to smooth forecasts across months because the purpose is to ensure sufficiency of long-term capacity. The reason was that the absolute error will generate fluctuating forecasts across months. The formula with the lowest average error is still selected as the forecasting formula for the next time. This rule cannot be changed because it is built in Demand Solutions.

> This is the standard from Demand Solution, you cannot change it. We ask them requesting them to give us the possibility to select according to that error or that error. Because I believe when we talk about understanding the correct level, this may be more important to have this formula and select it with the lowest mean error compared to do it having the lowest absolute error (average error)…If you looked at there, we only have a mean error of 3%, the absolutely error is 40%, it's quite bad. You can also see the difference, this formula will come up with 112, if you select this formula, it will be 160, so it (the difference) is quite significant. That one is a very stable formula not going too much into + and -, we have one 120 and one 180. So it's also a little but tough. It's a small decision criterion, which formula to select, but it can have huge impacts. – by the manager of the S&OP

This quote shows that using mean error will yield smooth forecasts across months and that different formulas will produce significantly different forecasts. Although in later interviews this manager kept mentioning that the forecast managers should be given the option to select the decision criterion i.e. mean error % or aboslute (net) error %, the system forecast today still starts with the one with the lowest absolute error. This is shown in Figure 6 below.

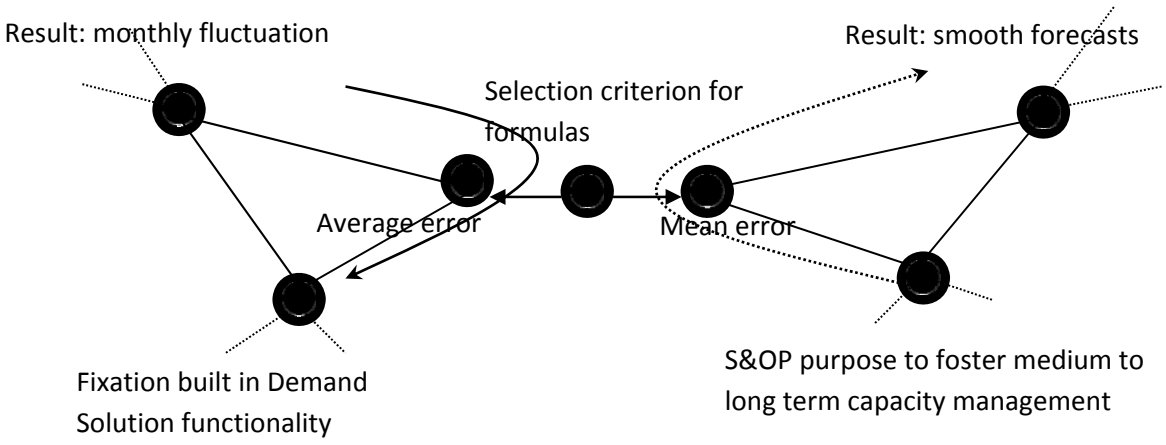

Figure 6: Matters of concern of measurement of forecasting accuracy between average error and mean error

Figure 6 shows that the form of average net error calculation is allied with Demand Solution's functionalities that will transform the market demand into a forecast that is fluctuating significantly across months whilst the form of mean error calculation is in line with S&OP's purpose to foster medium to long term capacity management, and this association will translate future business volume into smooth forecasts across months. However, the network initiated by mean error had to be disregarded by actors because it is not built within Demand Solutions (this is why the arrow pointing to the network on the right is dotted). Separation in this sense could not happen.

The resulting network, however, was not stable when adjustments other than changing the selection criteria were available to forecasting managers. One of the process analysts of the group demand chain gave me the following example,

> Because where the history is bad, then of course the forecast will also be bad. There is something is the system which is called the adjusted history, what is adjusted history? That sounds cheating you know. But if you have a strange history, we have for example for large bearings, we had a situation a couple of years ago where you can wait for 1.5 years for your orders, that means you get no supply, no sales, no sales, no sales, then suddenly there is a production, and you produce all sales in one goal, 20 large bearings in July, then there is a long period of no sales, no sales. Then of course we use that input to plan the forecast. That is not really good. So in those kind of cases, it is very valuable to adjust the history to smooth it out what was the really one.

The example illustrated above refers to an adjustment to smooth out erratic historical sales. It means when the criterion of average error is used to select the forecasting formula, and this in most cases will lead to monthly fluctuation in forecasts that contradicts with S&OP's purpose to manage medium to long term capacity management. According to the human actors, forecast smoothing is preferred. The key actor making this possible is the forecast manager who has the opportunity to override the computerised system forecast. She can also input other adjustments if she believes the system forecast is not reasonable.

Because other means such as de-select the formula and manual adjustments were enrolled in the network as an "interessement device" (Callon, 1986), the form of average net error becomes stronger in the network of generating a sales forecast. On the other hand, the form of mean error, though not amplified in creating a forecast for it lost its mobility in Demand Solutions, may regain its mobility in evaluating forecasting accuracy for the sales organisation. This had been proposed since the attempt to close a matter of concern on the competition between average error and mean error emerged, but hasn't been officially activated. When asked how the SD used mean error calculation to measure forecasting accuracy, one of the forecasting managers in this division answered,

> We export data out of the forecasting tool (Demand Solutions), and we do it manually in excel sheets because the functionality is not really rich in Demand Solutions, so we store the forecast accuracy here.

Unofficial forecasting accuracy measurements were hence manually done outside the functionality of Demand Solutions. Even though this evaluation has never been made official throughout the S&OP process, the mobility of mean error was indeed transported into another time and space where measuring forecasting accuracy was enacted. An absence in an official world triggered a presence of an unofficial world. This indicated that although a matter of concern on evaluating forecasting accuracy hasn't been closed, the mobility of mean error in this setting extends not only to a space of forecasting evaluation for the sales persons but also to a space that attempts to modify the reward system for the current compensation system which, at that time, only concerns with achieving the financial forecasts. This attempt, however, hasn't been closed to date either. The enrollment of other adjustments in Demand Solutions on one hand stabilises the form of average error in creating the system forecast in S&OP by dissolving a problem of the fixation of selection criteria for formulas in Demand Solutions, and on the other hand, translates another form, mean error, in bringing about spaces of forecasting evaluation and modifying compensation systems that were present in the unofficial world. This is illustrated in Figure 7 below.

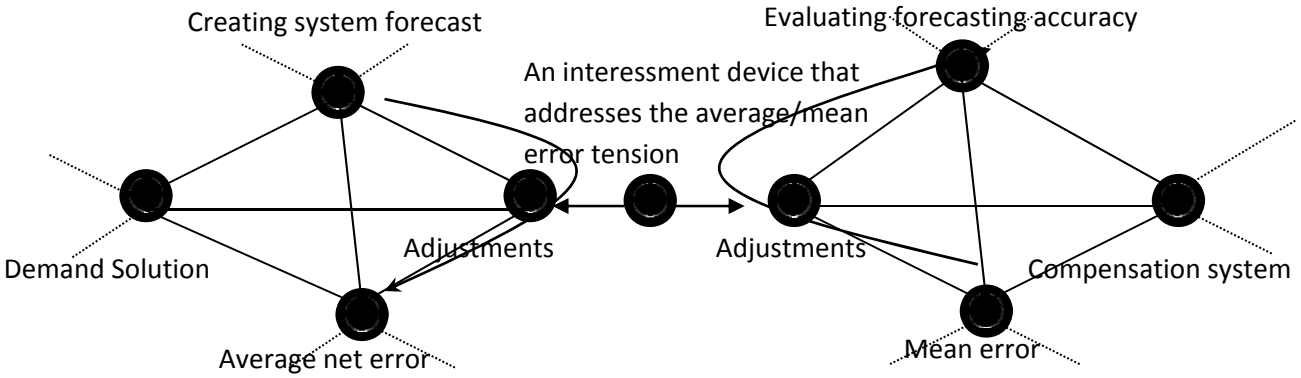

Figure 7: An enrolment of other adjustments in translating the matters of concern for the choice between average and mean errors

The figure indicates that average and mean errors are no longer in competition for they are now settled in separate times and spaces. A non-human actor, Demand Solution adjustment, and a human actor, forecasting managers' manual adjustment, are inseparable from the matters of creating a calculation and evaluating its implications. Separation finally took place so that two times and spaces became co-existing.

Episode 9C: Forecasting accuracy: incentives to under-forecast

Episodes 6 to 8 are not discussed here as they describe how a factory forecast has been constructed. The factory forecast was not enrolled in the S&OP's minimal configuration. However, when the pilot S&OP process started, the factory forecast was enrolled and became the OPP in the S&OP process. The sales forecast was under most circumstances disregarded by local actors albeit it was proposed by the group demand chain because its accuracy was challenged by factories. The interesting phenomenon discovered in the series of pilot S&OP meetings was that although the sales forecast was supposed to be an unconstrained market based forecast, it was in most cases lower than the constrained factory forecast that took into account their capacity situation. The series of Episode 9 is describing how matter of concern on forecasting accuracy was closed and how they affect the fabrication of the S&OP process and where it leads integration to. Because the series was based on the competition between sales and factory forecasts, attempts to close the matter of concern were separated to two local spaces, sales and factories, who in turn during their competition, enacted other times and spaces. Episodes 9A and 9B are not discussed because they are outside the scope of this study.

When I traced the reason why sales forecasts were lower than their factory counterpart, one of the managers responsible for manufacturing and supply in the ID kindly explained,

> There was no alignment for sales. ID sales, they have decided that the forecast should be the same as the financial forecast. There was no change in business thinking.

The reflection was that participants in the sales were still sticking to the old business thinking of the financial forecast. They weren't really thinking of S&OP forecast as the one representing the unconstrained market demand. In this setting, their S&OP forecasts were nothing more than a target that they committed to achieve at the end of each month, as they had always been doing. The above manager in ID elaborated,

> There is always an alignment on the aggregated level, but this is group management making that, not the individual unit, they are not aligned. You know sales, they have a financial forecast, so they keep it low because they want to have a bonus. Factories don't have that, they are more trying to determine what kind of demand they should supply for.

The financial forecast mentioned in the above quote is a top-down forecast. Each sales director collects financial forecasts from its local sales forces in each region, and then the group management makes a decision on an aggregated financial forecast. The rewarding system however, is tied to such financial

forecasts, which then raised the concern of under-forecasting by the sales. In this setting, although the attempt to close the matter of concern on forecasting accuracy was delegated by the group demand chain to local actors in sales and factories, in this episode separation involves an investigation of possibilities to under-forecasting in these separated spaces.

At the inception of the S&OP process, the sales did under-forecast because there was lack of training guiding them so that they would not confuse the S&OP sales forecast with the financial forecast. Sales under-forecasted also because their financial forecasts were linked to their performance evaluation and to their rewarding. All these actors kept the supposed S&OP sales forecasting practice at bay. This can be depicted in the following figure.

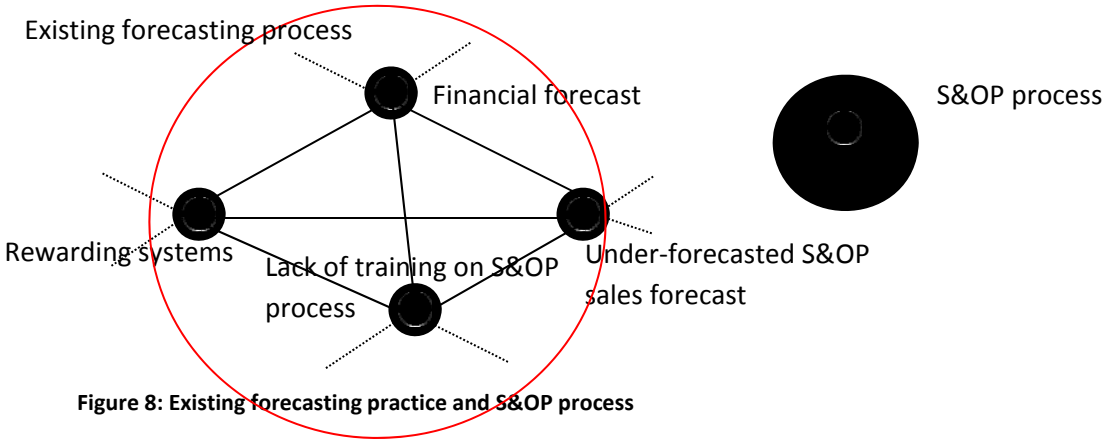

Figure 8: Existing forecasting practice and S&OP process

The investigation revealed that sales did under-forecast because of the above reasoning. This investigation, however, was not to disregard the sales forecast. Instead it created new management possibilities to reinstall the original supposed S&OP sales forecast into the S&OP process. These possibilities included provision of more training to forecasting staff in sales, challenges of the top level management on forecasting numbers and using mean error to evaluate forecasting accuracy. Integration thus means creating new management problems and possibilities in separate local times and spaces.

The forecasts carried forward to be used in PLP in the pilot S&OP process were the factory forecasts, but did factories under-forecast? Performance measures in factories also were actors in shaping the calculative space in factories. The manager in charge of the product line planning stream of S&OP mentioned a variety of KPIs that measure the performance of factory channel planners and product line planners.

> ATP, which is availability to promise. If they ask us to deliver on the 1st of July, if we have certain quantities that we can promise availability, what we have in stock and what we plan to produce before that. When we are doing that today, we are taking customers. In that warehouse, we have stocks, we can promise customers on that base. ATP is linked to our product hierarchy, the M, D and E decisions. So in this example, they have a 100 pieces of pack variants, that is the customer order, belonging to material family B. So in this example, they have a 100 pieces of pack variants, that is the customer order, belonging to material family B. This one is a make to order. It's nothing that we have in stock, we only produce this we have the customer order. Since we don't have anything on stock, then we need to check our production schedule, when do we produce this the next time, and in that case, you found that material family B is out here. Then we can give the customer answer at real time, and we will say that…the only thing that we have decided in this case is we have to produce 1000 pieces of that size of that bearing, nothing else…This is also that if you have during this time, they want to keep this as flexibly as possible.

As is indicated in the above quote, one of the customer-oriented service based KPIs is the ATP. Factory planners then translated their responsibilities to ensure availability into a set of product hierarchy decisions. By making M decisions first, that is, to decide which material families (MF) to produce, the translation of

ATP into product hierarchy decisions creates flexibility in availability by postponing D and E decisions. For such a translation to be possible, the factory forecasts mobilise the daily operational planning of product line planners. Those planners hence will be able to decide which MFs to produce. Importance of forecasting accuracy in higher MF level therefore precedes the accuracy in lower final variant levels due to the mobilisation of time via the product hierarchy decisions. These translations are ultimately linked to ATP in the factory BSCs for which factory staffs are responsible. Forecasting aims at improving ATP but it does not ensure its happening. Neither do product hierarchy decisions, but they postpone the time of making decision on final variants so that ATP will be higher compared to situation where there are no such product hierarchy decisions, but factory forecasts are crucial because the M decisions are to be made from the outset. In this vein, the S&OP forecast is allied with the factory and product line planning network because all the factory based interviewees agree that medium to long-term capacity management will certainly foster short-term planning. Factories have longer experiences in forecasting than sales, but they challenged sales forecasts in the pilot S&OP meetings not because they wanted to claim their calculations were superior per se but because the S&OP process was linked to their KPIs.

Actually forecasts become vital to the channel planners because they are responsible for free availability on a daily basis. According to the product line planning manager for medium bearings, the translation of the responsibilities for the ATP into product hierarchy decisions also transforms the notion of time for the channel planners.

> Daily planning! I would say the objective or the goal of the daily planning, to maintain free availability. Free availability means you should have the right products on stock all the time. So we can service the market…Also the daily includes you should book the dispatch order every day, you should order material every day, yes, you have made your M decision what to produce, so we do this, we have a loop of tasks that we do each day…Here says core tasks for the supply chain manager, to daily or rather continuously maintain free availability, so it's every second, it's not reasonable, optimal free availability per product at every moment.

This quote means that channel planners think of ATP on daily intervals. They are responsible for availability on an everyday basis. In addition, the factory forecasts are also crucial for the channel planners for they are also responsible for the availability for the warehouses.

> The manager in the warehouse is responsible for planning of the warehouse and the stock level in that warehouse. If the service is bad, he claims that it depends on supplies from the factories, then it's the factory responsible for the service level because if he has a bad planning, but not his fault. It's the factory and the channel responsible for that performance in the warehouses.

Therefore the performance measure in the factory BSC, ATP, enrolls the S&OP sales forecast, factory forecast, channel planners, product line planners and warehouses through the mobilisation of time by product hierarchy decisions (see Figure 9 below). Debating the S&OP sales forecast in this case assists the improvement in the KPIs thus making the associations in the network tighter.

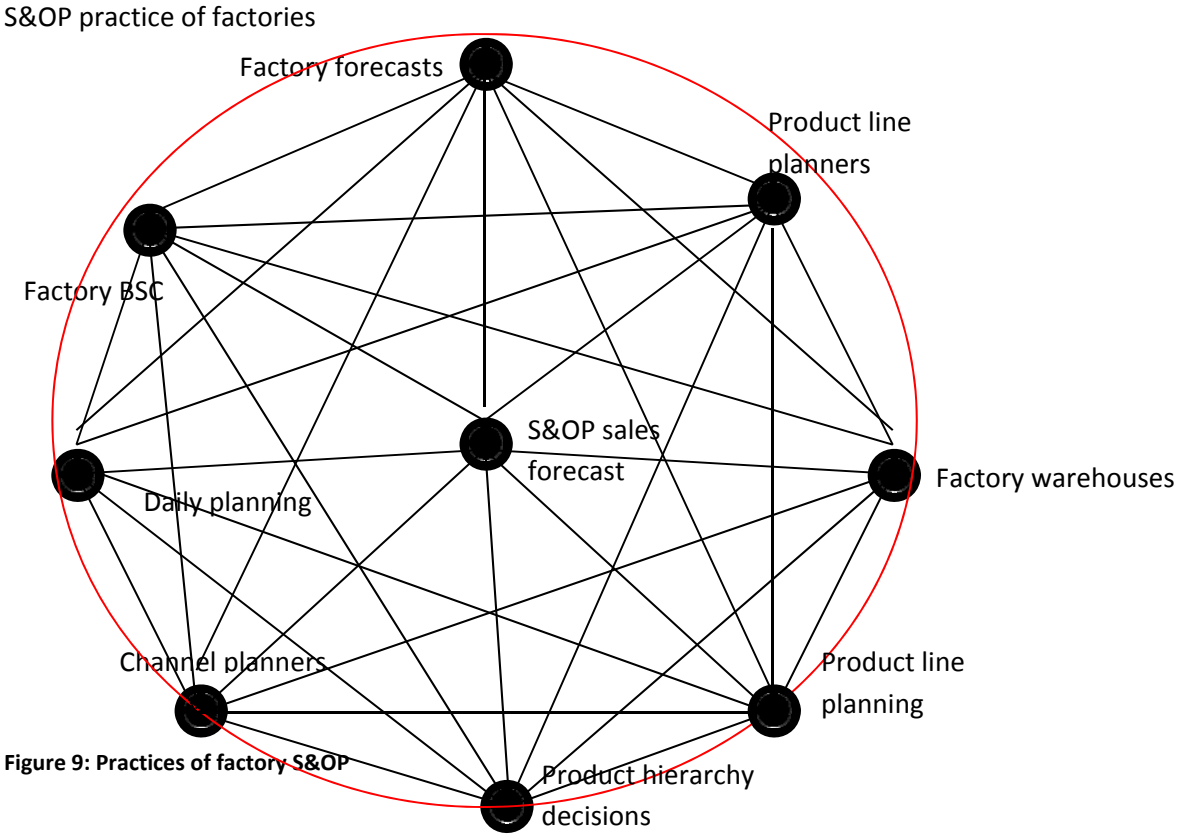

Figure 9: Practices of factory S&OP

Figure 9 shows a detailed translation. The factory S&OP practice is now an intricate network of heterogeneous actors including humans and non-humans. The S&OP sales forecast and factory forecast are tightly coupled to ally interests of channel planners, product line planners and factory warehouses who are responsible for KPIs in the factory BSC. They also have impacts on product line planning and daily planning based on product hierarchy decisions. This explains why factory forecasts have been considered as a stronger voice in the S&OP process than the sales and the S&OP sales forecasts were later transformed into shipment forecasts, the language that is used by factories. It will be difficult to object against such a network for to do so all links and associations in the figure have to be broken.

Episode 9D: Forecasting accuracy: transforming the minimal configuration of S&OP I

In the pilot S&OP meeting held in February 2011, it was revealed that the forecast carried forward to PLP and SCP was the sales forecast. However, it didn't mean that factories and sales had formed a consensus. Sales forecast was discussed because factories did not present their forecasts. Factories thought it would be unreasonable to discuss with sales as there was serious capacity constraints in the factory. Capacity constraints became a critical actor in this episode as it initiated a transformation of the original minimal configuration of the S&OP process. The S&OP sales forecast was transformed to be constrained within the 12 months if there are capacity constraints but to remain unconstrained thereafter. The cut-off of 12 months was later confirmed by the manager in the ID responsible for manufacturing and supply,

> That is decided, yes. Outside 12 months, forecasts need to be unconstrained, but within 12 months, if we have considered that I cannot guarantee, the decision is that the process should be, if we have any constraints, (in) short-term we should consider it in the forecast. The ideal is that in 12 months, we should be able to fix those constraints with our own manufacturing with all possible supplies. Actually now we should have been able to see quite some product lines because they are so in shortage that for 12 months the forecast should be constrained, and then in 3 years, everything is available, just produce what they forecast.

This change of the minimal configuration of S&OP, was not made from the outset but constructed during its "implementation" when factory challenged the sales. The January 2011 battle between sales and factories became a mediator transforming the S&OP's minimal configuration. This is shown in Figure 10 below.

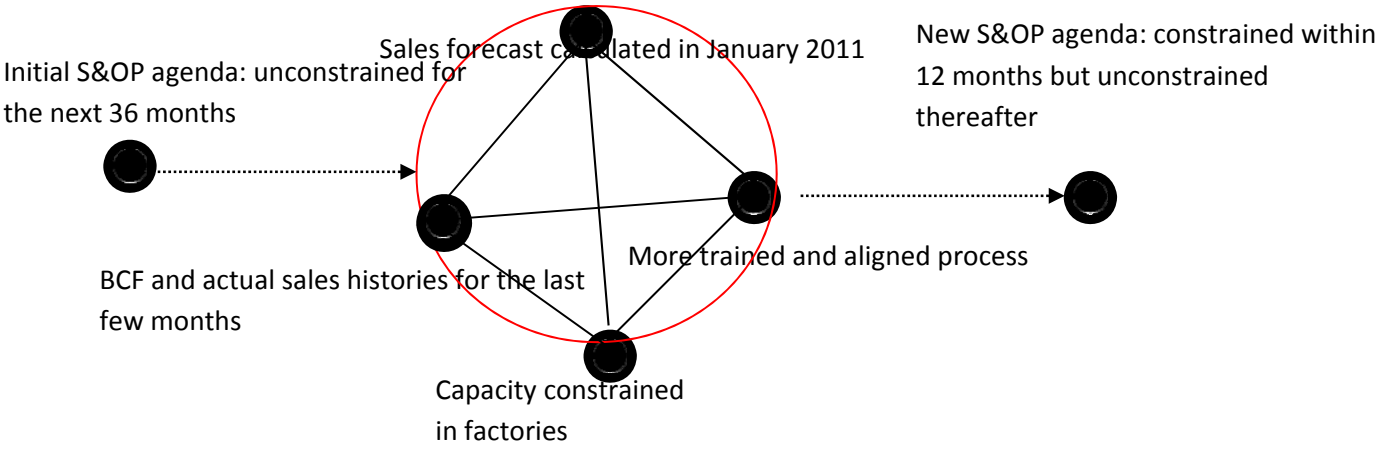

Figure 10: January 2011 battle at the arena and the re-shaping of the S&OP agenda

Figure 10 shows that if factory has capacity constraints, a universal unconstrained forecast for the next 36 months is transformed into the one that constrains the forecast within the 12 month-period. After 12 months forecasts are unconstrained for factories are believed to be able to address their capacity shortage within the 12 month-period. Although sales and factories were battling against each other, the network of the new minimal configuration of the S&OP process wouldn't be constructed if there was no such a battle. Intra-organisational competition constructs a new minimal configuration of the S&OP process.

Episode 9E &9F: Forecasting accuracy: transforming the minimal configuration of S&OP II

Starting from the series of pilot S&OP meetings held in May 2011, sales and factories were still struggling with creating a consensus forecasting to integrate the demand chain. Therefore, actors started looking for new fabricating problems. A product line manager from the group demand chain cogently pointed out that,

> More or less all factories now realize their forecasts refer to the shipment out of factories. During this period (February 2011 to May 2011), there was a huge up-stocking in regional warehouses for example Singapore and a number of factory warehouses. As a consequence, factories put sales forecast aside as they speak a different language. Sales always consider the volume sold to customers but the factories always think in terms of shipment to the warehouses or directly to customers.

He pointed out a critical matter of concern regarding the objects based on which forecasts are calculated. Sales forecasts refer to the total demand expected to be sold to external customers. Factory forecasts refer to the total shipments out of factories to both warehouses and customers. This was a turning point in the implementation of the S&OP. Factory warehouses ship to regional warehouses, local warehouses and directly to customers. This was considered as a reason underneath why sales forecasts had been consistently lower than factory forecasts. In September 2010, sales tended to under-forecast, but as the S&OP process was claimed to have streamlined during the pilot phase, sales had increased their forecast significantly as was showed in the forecasts in February, May and June of 2011. The struggle to close the gap between sales and factories forced the group demand chain to consider if there are problematic logics in creating the sales forecast. From February to June 2011 factories with over-capacity was supporting others with under-capacity in order to enhance capacity situation. This supporting action, unexpectedly, became a mediator that enabled the group demand chain to realise the different languages sales and factories were expressing. Sales forecasts only considered the inter-organisational sales to "external"

customers whilst factories taken into account both “internal” warehouses and “external” customers. Sales forecasts were lower than factories’ because sales didn’t include shipments to “internal” warehouses. In addition, sales forecasts didn’t take into consideration the supporting actions undertaken by, for instance, the Hanover factory. This means that if the factory continues supporting other factories, its forecast will be increasing, and if the sales don’t see this, the forecast will be lower than what it actually should be. This translation is displayed below in Figure 11.

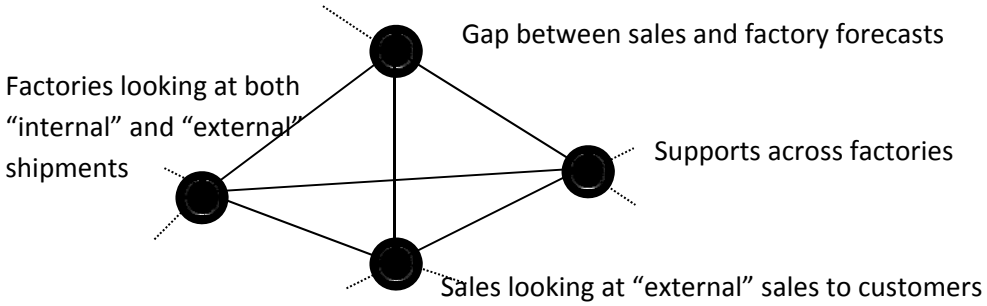

Figure 11: The transformation from a competition into a coalition for management intervention in May & June 2011, pilot S&OP

Starting in the September 2011 meeting, the group demand chain had been concentrating on the construction of a new sales forecast that is meaningful to the factories. It was then a delineation of the lead time adjusted shipment based (LTASB) forecast that was constructed. Sales need to produce a forecast in the language of the shipment that is understandable to factories.

For the substitution of a LTASB forecast for a sales forecast to be acceptable, factories brought a new entity, namely the lead time between geographically different warehouses. The manager in charge of the PLP stream of the S&OP process explained,

> In general we have four geographical areas, North America, South America, Europe and Asia. The rule is that there is no lead time between the shipping factory and the “receiver” if they are in the same geographical area. When they are in different areas, there is a 1 to 2 months lead time.

Hence a LTASB forecast is a forecast that is transformed from a sales forecast taking into consideration the lead time if factories ship to a warehouse or support a factory that is located in a different geographical area. A product line manager showed me a numerical example showed below,

Shipment Forecast	111	118	114	106	106	110	105	107	108	104	107	110	107	103	104	103	106	108	109	106
S&OP forecast	105	111	107	107	109	105	111	105	109	107	103	109	111	100	105	107	101	110	104	110

Figure 12: A numerical example of LTASB forecasts transformed from sales forecasts

The figure shows that, for instance, if the sales forecast of the volume to external customer is 105, but considering there is a lead time of 2 months of shipment from Gothenburg to the Dalian factory warehouse, the Gothenburg factory also needs to ship 6 more today, the LTASB forecast will therefore become 111.

The translation induced by the lead time between factories and warehouses in different geographical regions is depicted below in Figure 13. This proposal of using the LTASB forecast prepared by the sales is to be implemented in December 2011 where a substituting forecast will battle against the factory forecast.

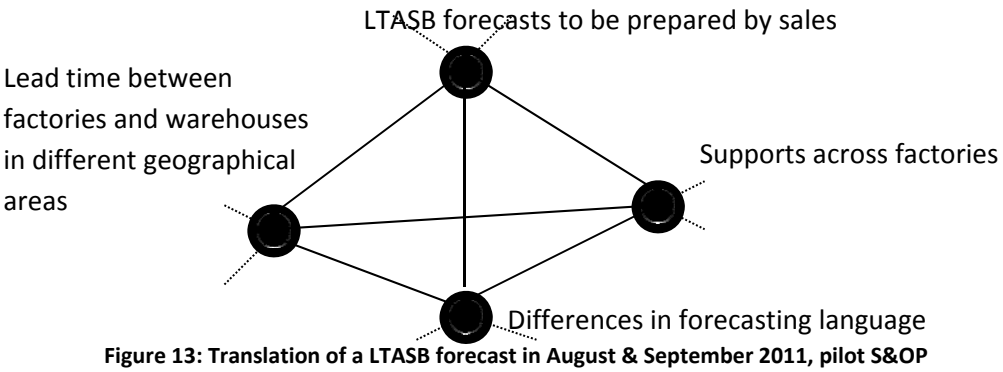

Figure 13: Translation of a LTASB forecast in August & September 2011, pilot S&OP

Figures 13 shows that although the competition between sales and factory forecasts has unfolded diverse matters of concerns surrounding forecasting accuracy that all point to an integration between the sales and factory forecasts throughout the period from September 2010 to September 2011 when a series of pilot S&OP PGP meetings were held, the enrolment of the local and regional warehouses and the transportation lead time between factories and warehouses in different geographical areas suddenly constructed a delineation of a substituting calculation, LTASB forecasts, thus transforming the minimal configuration of the S&OP process anew.

Although attempts to moving towards integration are still separating in two spaces, sales and factories, interactions between local actors in these two spaces keep re-shaping the calculative practice. In this episode sales have been trained, and factories with under-capacity have been supported by those with over-capacity, yet the competition between sales and factory forecasts transformed OPP of the S&OP process, the sales forecast. We still do not know whether the LTASB forecast will be used by factories, but we can conclude that integration is brought by separation, and separation creates new possibilities for integration.

6. Discussion and conclusion

Accounting as matters of concern

The claim on processes of the fabrication of an S&OP process is that, in order to fabricate an S&OP process to foster integration on the demand chain, diverse local actors are attracted and create a set of matters of concern around the S&OP process thereby constructing new problems on the S&OP process. Although attempts to close these matters of concerns and dissolve these problems are initiated by the group demand chain, it is the local actors that undertake these closing and dissolving actions. I therefore conclude that fabricating an S&OP process to foster integration involves delegating matters of concern around the S&OP process into separate local times and spaces.

During the fabrication process, diverse human actors such as managers in the group demand chain, business analysts, consultants, product line planners, customers in their absences, forecasting managers and sales, and non-human actors such as BCF, inscriptions showing availability failure, Demand Solutions, financial forecasts, supporting activities across factories and geographical locations of warehouses, create matters of concern and management problems around the S&OP process. These matters of concern and problems constructed a series of dilemmas involving, for instance, a trade-off between forecasting accuracy and business reality (see Episode 3A), logics of setting primary keys in the forecast (see Episode 3B), data organisation (see Episode 4), a conflict between computing forecasts and evaluating forecasting accuracy (see Episode 5), organisational structure (see Episode 9B), incentive problems (see Episode 9C), and coordination problems in sales, factories, and warehouses (see Episodes 9D, 9E and 9F). Although the S&OP process was initially proposed by the group demand chain, most problems and matters of concerns were

created by local human and non-human actors attracted to the fabrication process. For instance, the S&OP process was proposed by the group demand chain because of existing organisational problems pinpointed by consultants and inscriptions showing availability failure (a local actor), and the problem of setting primary keys was created by local actors namely differences in business volume and customer distribution across divisions, and order books. These findings show that although the group demand chain proposed and was responsible for guiding the implementation of the S&OP process, it was the local actors who created and separated matters of concern around the S&OP process into diverse times and spaces. When local actors created emergent matters of concern around the S&OP process, attempts to close them were delegated by the group demand chain into separated local times and spaces instead of being coordinated in a single time and space by the group demand chain. As a result, the group demand chain and vast local actors form a collective in fabricating the S&OP process. Delegation by the former leads to separation of different local networks. There are four types of translations that lead to such separation.

The first type of translation took place in Episode 3 where local actors, namely customers spoken of by business volume, order books and inter-organisational relationship with customers, closed the matter of concern on primary keys on the S&OP sales forecast. In this the attempt to closing this matter of concern was delegated into two separate spaces, namely different divisions. The aforementioned local actors in these spaces (divisions) translated a problem on constructing primary keys into a separation where problematisation of primary keys led to two networks. Separation means that the two (or more) spaces now co-exist in the S&OP process.

The second type of translation is similar with the first type of translation abovementioned, but the difference is that in the second type of translation, separation occurs after a moment of tension where separation is in the first place impossible. An example is where the attempt to close the matter of concern on selecting criteria for computing system forecasts was delegated by the group demand chain to local actors in Episode 5. In this episode the problem of selecting formulas in the S&OP sales forecast was first translated into a tension rather than directly into a separation. Tension here means it is impossible to settle the dilemma in two separate spaces, implying that one space has to be disregarded for the existence of the other. Here the network comprising the mean error was disregarded by both the group demand chain and local actors because it could not be used due to software constraints in Demand Solutions, although both the group demand chain and local actors wanted to use mean error as it is consistent with S&OP process' purpose to smooth forecasts across months. This tension, however, was then transformed into a separation by enrolling a local actor namely other available adjustments in forecasting. These adjustments overcome the limitation of the software and created a new space of evaluating forecasting accuracy. Consequently there was a separation that led to co-existence of both spaces of creating system forecasts and evaluating forecasting accuracy.

The third type of translation also occurs when delegation by the group demand chain leads to separation of times and spaces, but this time the focus is on investigating local actors in these separate networks in order to help the weak calculation more convincing in the future. This occurred in Episode 9C where a matter of concern around the S&OP process was related to incentives of both sales and factories to under-forecast.

The attempt to close this matter of concern was delegated by the group demand chain to local actors in two spaces, namely sales' and factories' existing forecasting practices. It, however, turned out that the group demand chain was not trying to close the matter of concern but to unveil why the unconstrained S&OP sales forecasts were lower than the constrained factory forecasts. Therefore delegation in this episode was more like an investigation by the group demand chain of forecasting practices undertaken by sales and factories. The investigation concluded that sales did under-forecast but factories did not. The investigation unveiled new local non-human actors, namely financial forecasts and rewarding systems in sales, the BSC in factories, channel planners, product hierarchy decisions and warehouses. These local actors indicated to the group demand chain that sales under-forecasted because their existing financial

forecasting and rewarding practices kept the S&OP sales forecast at bay. Factories did not under-forecast because their existing forecasting practice allied a number of actors including the S&OP process. Investigation in this case clarified why one calculation dominated the other but it also constructed new management intervention to strengthen the weak calculation. Management intervention was initiated by the group demand chain not to withdraw the S&OP sales forecast but to disconnect financial forecasts from the S&OP process by offering more training to the sales and letting them understand that the S&OP sales forecast is to be different from the financial forecast. Although it could not be concluded that whether such disconnection occurred at the end of the study, it created more management actions (eg. trainings) to increase the magnitude of sales forecast. In short, delegation here led to investigation by the group demand chain, which unveiled new local actors. Investigation on one hand created a winning calculation and on the other hand constructed new management actions to save the losing calculation. Separation is still the outcome of delegation, but delegation in this case initiates an investigation in relation to the calculations in separated local settings.

The final type of translation is that delegation leads to separation, but separation also has impacts on the minimal configuration of the S&OP process. This took place in Episodes 9D, 9E and 9F where the the group demand chain delegated the attempt to close the matter of concern on forecasting accuracy into different times and spaces, namely factories capacity planning, factories' customers (internal warehouses and external customers) and long lead time due to different geographically located warehouses. The impacts of delegation in these three episodes, however, differed from previous episodes. In previous episodes, each matter of concern was closed by delegating the attempt to closing it into separate times and spaces. In other words matters of concern around the S&OP process were translated into a set of separations where separate networks co-exist, either directly or indirectly through translating problems into tensions first. In Episodes 9D, 9E and 9F, this is also the case but in addition the translations did not stop after the group demand chain delegated a matter of concern on forecasting accuracy into separate local times and spaces. In Episode 9D, after delegation by the group demand chain to sales and factories, the minimal configuration of the S&OP process was transformed anew by both the group demand chain and local actors including factories' capacity, channel planers and sales. The S&OP sales forecast was transformed to be constrained within the 12 months instead of being unconstrained when factories had capacity constraints. In Episodes 9E and 9F, after group demand chain's delegation of the attempt to close the matter of concern on forecasting accuracy to sales and factories, the minimal configuration of the S&OP process was transformed by both the group demand chain and local actors including sales, factories, warehouses located in different regions around the globe and lead time from a sales forecast into a LTASB forecast. Although separate times and spaces still co-exist, their impacts have arrived at the same time and space namely the minimal configuration of the S&OP process.

Because these aforementioned translations were taking place in diverse separate local settings, the outcome of the S&OP process was that its constituents are located in diverse times and spaces instead of being coordinating in a single and space. Its primary keys reside in different divisions, its logic is set within the S&OP team, its computation is realised in Demand Solutions and collaborators' intelligence, selections of calculative criteria are dealt with in spaces of computing system forecasts and evaluating forecasting accuracy respectively, its organisational structure of implementation is determined by two potential times and spaces of standardising decision making processes and proactively serving customers, and its new minimal configuration is built from relationship between sales, factories, warehouses and customers. The S&OP process is thus separated into different times and spaces instead of being coordinated in a single time and space.

In summary, the claim on the processes of fabricating the S&OP process is that diverse human and non-human actors participating in the S&OP process create emergent, ongoing and multiple matters of concern around the S&OP process and that the attempts to close these matters of concerns to foster integration are

delegated into separate local times and spaces instead of a single time and space coordinated by the group demand chain (the process proposer and guide). Although delegation is predominantly proposed by the group demand chain, it is the networking of local human actors such as managers in sales, factories and product line management, and local non-human actors including computers, different forecasts and the BSC that creates separate co-existing times and spaces that tame these matters of concern. There are four types of such delegating translations that close matters of concern. First, a problem is directly translated into a separation that leads to co-existence of different times and spaces. Second, a problem is translated into a tension that creates a time and space by disregarding the other, but enrolling a new local actor translates the tension into a separation. Third, delegation leads to an investigation by the group demand chain on the constituents making up forecasting calculations in separate local settings. The investigation produces a winning and a losing calculation but the purpose is to create new management intervention to help the losing calculation become acceptable to debunkers. Finally, delegation leads to co-existence of spaces (separation), but sometimes these co-existing spaces also transform the minimal configuration of the S&OP process. As a result, the outcome of the S&OP process is that its constituents are located in diverse times and spaces instead of being coordinating in a single and space. Accounting is a set of matters of concern as actors continuously create disputes and controversies around it. As these actors are located in diverse local times and spaces, constituents of accounting are dispersed across times and spaces instead of being coordinated in a single time and space. Accounting does not have a boundary because disputes and controversies are constantly brought about by new actors.

Accounting as a Poincaré Disk

The S&OP process and its purpose integration are always referred to in their absences. Its minimal configuration of creating an unconstrained sales forecast to integrate capacity planning across the demand chain in order to balance supply and demand is nothing more than a set of normative principles mentioned by consultants and S&OP literature. At this stage, the S&OP process does not have any functionality. In this sense, these principles, ideas and prescriptions whatsoever are not representable because they are empty spaces. Therefore the S&OP process and its purpose of integrating the demand chain starts from an "absolute nothingness". Actors in the demand chain have to create visualisations to *re*-present them in their absences. However, it is exactly this "nothingness" that constituents of the S&OP process and integration are created and dispersed in diverse times and spaces. It is exactly this absence that creates a working time/space (Quattrone, 2009) that engages actors to construct properties of the S&OP process and possibilities of integration. Like the fishes in *Circle Limit III* are fixed with "geometric exactitude" which is surrounded by the outside emptiness, the grand structure of the S&OP process built thus far (see Figure 14 below) is built from the "absolute nothingness".

Although new matters of concern will be created, and thus new properties will be added and new possibilities of integration created, they will never reach the edge. It is because the S&OP process and the idea of integration are *re*-presented in their absences that there will be infinite properties of the S&OP process and infinite management possibilities of integration. Paradoxically attempts to integrate DCM through a consensus forecast leads to separating problems of DCM and the S&OP process into diverse times and spaces. In short, to integrate is not to integrate, but to separate problems of integration. There will be no end, no edge, for from the start there is nothing. The fishes, the S&OP constituents, and the possibilities for integration come from nothing – an emptiness - and reach the nothingness – an infinite borderless, and yet they are dispersed in times and spaces. Like the geometric locations of the fishes are precise, the architecture of the S&OP process is grand. From its absences was accounting constructed and its fabrication reaches an infinite borderless. This is why the S&OP process is always in its making and actors are always moving towards integration. To integrate is to postpone achieving integration by creating new problems and possibilities of integration. There will be no fixed S&OP process and a final destination of integration. And yet interests of diverse actors are allied, constituents of the S&OP process dispersed, and management possibilities of integration created. Accounting is a Poincaré Disk.

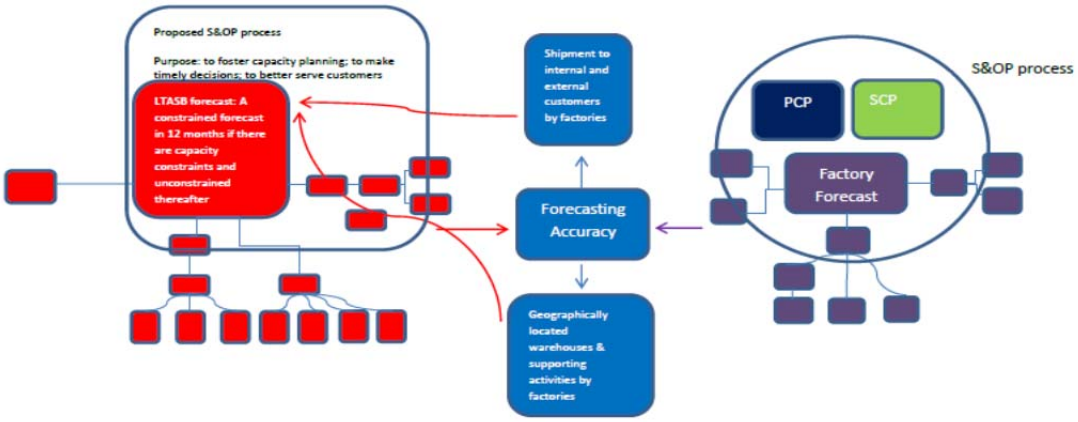

Figure 14 The S&OP process

Comparing accounting to a Poincaré Disk allows a further problemtisation on the representation practice it enables. This problematisation poses two ontological questions: *what is accounting* and *what does it do*? Built upon my early theorisation, the discussion now turns to enrol the classic notion of representation resting upon presence. Whist classic notion of representation rests upon a presence of a remembrance of an original matter and a plenitude that strives for reconciliation through representation (Garcia, 2008), modern notion of representation calls upon an absence instead of a presence such that things are represented in their absences because if things are present they do not need to be represented (Latour, 1999a). Whether representation is premised upon absence or presence is outside the scope of this study, but this paper still attempts to theorise on a local level how accounting interacts with such absence/presence.

The intention of the human actors in ESMA is to avoid any representation of horror paradoxically attracts a representation (those stories about prisoners) to motivate a pedagogical thinking of resistance (Friedrich, 2011). The starting point of the journey, that is to say, to delineate the objects of representation of the S&OP process, however, does intentionally create a need of a representation of future customer demands. The paradox of the S&OP process, however, is that future customer demands are not present until they are inscribed in the S&OP process through forecasts. Therefore accounting, at least from the outset of the representational practice, creates a presence of the objects of representation where they are actually absent. The difference between the S&OP process and the ESMA cases is that in the former, the sense of 'home' (Berger et al., 1974) is installed in human actors' minds and accounting is their hope to come back home, and in the latter, 'the homeless mind' finds its way through an absence of representation. Accounting, even though its actantiality is yet to be enacted, creates a sense of presence when actors enact the representational practice. Although it represents things in their absences, it instils in the minds of human actors that the absences are present. In the Poincaré Disk metaphor, the construction of "geometric exactitude" of accounting becomes possible by creating a sense of presence of the absent objects of representation.

The fact that the Poincaré Disk does not have a boundary implies that accounting as matters of concern do not have a fixed finite boundary. In this setting, the narrative of the S&OP process resembles the construction of the Monumento a las Víctimas del Terrorismo de Estado where visitors are provided an empty space to bring their individual aesthetic experiences. This resonates with Quattrone (2009) who

states that accounting provides a working time/space that engages heterogeneous interactions amongst enrolled actors. Therefore accounting not only creates a presence what are absent but also initiates a working time/space where actors can bring heterogeneous problematisation upon itself. The impossibility of representation brings about possibility of heterogeneous representational practices. Accounting makes the transition possible by artificially blurring the distinction between absence and presence.

Conclusion

Inspired by Latour's (2005a) notion of *matters of concern* and M.C. Escher's *Circle Limit III* as a *re*-presentation of the Poincaré Disk, this study follows how an S&OP process was fabricated in a large Swedish manufacturing company. The study claims that when actors are fabricating the S&OP process, local actors create emergent, ongoing and multiple matters of concern around the S&OP process. The group demand chain, the actor who is responsible for guiding the implementation of the process, delegates the attempts to close these matters of concern to local actors located in separate times and spaces. As a result, constituents of the S&OP process are dispersed in diverse local times and spaces rather than being coordinated in a single time and space by the group demand chain. When local actors are closing these matters of concern, they create new properties on the S&OP process and new management possibilities in relation to integration. Because constituents of the S&OP process are separated in diverse times and spaces, to integrate is also to separate problems of integration. Accounting is a set of matters of concern.

The S&OP process and its purpose of integration come from an "absolute nothingness" – its minimal configuration - because actors refer to them in their absences. They need to be *re*-presented. The minimal configuration of the S&OP process creates a working time/space where diverse actors are engaged to create emergent properties of the S&OP process and new possibilities of integration. Consequently, as new matters of concern are constantly created by actors, integration on the demand chain becomes uncertain because actors are always creating new possibilities to move towards integration but will never arrive at the destination of integration. The S&OP process and integration thus go back the "absolute nothingness" because as matters of concern they have no edge. To integrate is thus to postpone integration by creating new problems of possibilities of integration. In-between stands the constituents of the S&OP process and possibilities of integration dispersed in diverse times and spaces. This means from this "absolute nothingness" lies the "geometry exactitude" of the managerial technology. Accounting is a Poincaré Disk. Therefore accounting not only creates a presence what are absent but also initiates a working time/space where actors can bring heterogeneous problematisation upon itself. The impossibility of representation brings about possibility of heterogeneous representational practices. Accounting makes the transition possible by artificially blurring the distinction between absence and presence.

Future research could continue explore matters of concern of accounting and its stated purpose to follow they travel across time and space. This may offer new insights on accounting changes that have been focusing on stability. This implies accounting research may theorise accounting change prematurely when it overlooks its matters of concern to conclude stability. The Poincaré Disk model may also be referred to in order to follow the trajectory of how accounting live a life. In doing so, we are moving closer to accounting instead of moving away from it (Latour, 2005a). Last but not least, future accounting research may consider drawing attention on how accounting makes representation a practice through mobilising a collective of absence/presence instead of debating on whether accounting representations are true as Mouritsen (2011) argues 'It is true (!) that that accounting is not neutral and that accounting cheats when it proposes itself as a technical activity merely; this can be argued philosophically, but who would care?' (p. 231).

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