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Abstract:

This research questions what is known about the processes that utilise management controls. It has as a starting point the recognition that when managers utilise these artefacts they do so to influence the actions of others. However, it is these others that act and as such they may do so in many differing ways, only some of which align with the programmes of the managers. Hence, the use of management controls can assist in providing a simplification of the world but they can never tame it. These issues are explored within a case study that examines an inter-organisational project. This project was set up by an organisation with four of its suppliers to focus on a specific management control whose technical attributes promised separate and collective benefits for all those involved. However, rather than the project constructing 'matters of fact' it produced a whole stream of 'matters of concern'. These resulted in many unforeseen tensions and outcomes that highlighted that not all of the actors involved were aligned with the programme of the managers who set the project up. While the project lasted a considerable amount of time, many unforeseen tensions and outcomes resulted in its eventual abandonment without the original programme being realised. These findings illustrate that much may be gained from refocusing from studying management controls to examining the processes of management controlling. However, this kind of research requires a shift away from traditional methods, such as statistical analysis and interviews, to a more engaged research approach.

Keywords: Management control, Management controlling, Inter-organisational control, Power, Practice Theory

Article classification: Research paper

1. Introduction

The aim of this research is to investigate what is really known about the practices of management control. There is an extensive literature that examines various aspects of these artefacts. This literature often takes for granted what is meant by the notion of 'control'. Here, control is thought of as a specific type of the use of power that managers exert in order to influence the actions of others, where those others are quite often employees. As outlined by Latour (1986), those that are said to exert power do not undertake any actions and therefore only have it *in potentia*. Thus Latour (1986) notes that power is never absolute and those that are said to possess it never really seem to. Whereas, those that are said to undertake the actions as a result of the management controls utilised are the ones that hold the power *in actu* as they always have a choice to act otherwise. Hence, when management controls are utilised to control others it is those others that act. In other words management controls are the actors enrolled (Jollands, Akroyd, & Sawabe, 2015) by those that have control *in potentia* in their efforts to influence the actions of those that have control *in actu*. In line with Chua's (2007) discussion of strategy and strategising, this paper aims to examine whether, in the light of what is already known about management controls, the extant knowledge would benefit from a focus on management controlling. That is, it questions whether it is better to examine the processes of control, the enactment of controlling, rather than solely examining the artefacts that are enrolled into these processes.

In examining the processes of control it is recognised that much of the literature is dominated by knowledge derived from the statistical analysis and interpretive understandings of these practices. This research departs from these approaches through advocating for the examination of "witnessable practices" that are part of actors' everyday activities rather than on a "cognitive or conceptual understanding of the individual" (Rawls, 2002, p. 7). This will typically involve the need for participant observations where the researcher(s) become as taken for granted within the setting as possible (P. A. Adler & Adler, 1987). It is this approach that will allow development of knowledge about the witnessable practices that constitute the enactment of controlling.

Within this research a case study is utilised where two of the authors undertook this approach. Specifically examined were the attempts of actors within an organisation, AssembleCo[1], as they try to utilise a specific management control, material flow cost accounting (MFCA), to influence the practices of a

selected group of four of its suppliers. MFCA is a calculative device (Callon & Law, 2005; Callon & Muniesa, 2005; Jollands & Quinn, 2017) that aims to provide visibility over volume and cost of waste (material loss) produced within the production process (International Standard Organization, 2011). The actors within AssembleCo mobilised MFCA due to its technical aspects having the potential to provide benefits beyond the organisation to the broader supply chain. These potential benefits are both in terms of reductions in cost of production and also material efficiency leading to a reduced environmental burden (Kimura & Nakajima, 2014) [2].

The examination of processes of control, the enactment of controlling, in an inter-organisational setting is selected as it has the potential to highlight the difficulties and specifics (Mouritsen, Mahama, & Chua, 2010) of controlling that will enable knowledge to develop in line with the stated aim of this research. It has been established that the use of inter-organisational management controls have both inter- and intra-organisational effects (Cuganesan & Lee, 2006; Mouritsen, Hansen, & Hansen, 2001). However, less is known about the effects of these management controls on the broader network of organisations that participate in a given supply chain.

A project was entered into by actors from AssembleCo and representatives from their suppliers, which focused on the calculative device of MFCA. This project was an attempt by the actors from AssembleCo to try to influence and change (control) the practices of their suppliers. The project was deployed by the actors from AssembleCo in an attempt at controlling that would not be perceived as them overtly using power. However, the findings highlight that the technical attributes of MFCA were not sufficient in themselves to attain all of the predicted benefits from the project. Here, rather than the MFCA calculation producing matters of fact it opened up a whole stream of matters of concern (Latour, 2005). Unexpected tensions resulted in a reordering of relationships between all the parties and the programmes of specific actors resulted in the eventual abandonment of the project. This demonstrates that the use of management controls, which hold out the potential for win-win situations within a supply chain, will not automatically result in a linear progression to these promised benefits. Rather it is important to acknowledge that controlling is always a precarious process that will not automatically result in the implementation of the desired programme. Specifically the increasing inclusion of many, disparate actors will increase the potential number of competing objectives, which in turn may result in many unintended or

unexpected actions being undertaken by those that are the object of control. This means the power of those that are attempting controlling are always only *in potentia* with the many actors being the target of this power holding it *in actu*. Thus, this research suggests there are benefits to the extant literature from an ongoing examination of management controlling.

The rest of the paper is organised as follows: In the next section we overview the relevant literature that assisted us to develop the focus of the research. The theoretical lens employed and how this assisted to focus the analysis is then outlined. This is followed by an overview of the methods employed and providing a summary of the organisations that were involved in the project. Then an overview of the MFCA project of AssembleCo is provided prior to presenting the analysis, discussion and concluding.

2. Literature Review

What do we really know about the practices that surround management controls? There is extensive research and literature about them. They have been defined in a multitude of ways (see for example: Bisbe & Otley, 2004; Ferreira & Otley, 2009; Jollands et al., 2015; Otley, 1999; Simons, 1995; Tessier & Otley, 2012). They have been investigated using many differing perspectives including positivism (see for example Kober, Ng, & Paul, 2003; Widener, 2007), contingency theory (see for example Chenhall, 2003; Otley, 1980, Forthcoming), transaction cost economics (see for example Dekker, 2004; Speklé, 2001), institutional theories (see for example Abernethy & Chua, 1996; Scapens, 1994; Seal, Berry, & Cullen, 2004) and actor network theory (see for example Dechow & Mouritsen, 2005; Quattrone & Hopper, 2005). Further, they have been conceptualised in many different ways including as levers (Simons, 1995), inscriptions (Robson, 1992), packages (Malmi & Brown, 2008), and enabling or coercive (P. S. Adler & Borys, 1996). This research can usefully be divided into 'content' and 'process' approaches (Chenhall, 2005). Here "'content' studies seek to identify 'effective' strategic practices and/ or managing strategic change" whereas "'process' studies, by contrast, investigate the 'steps'/processes of making and implementing strategy" (Chua, 2007, p. 488). Despite all the knowledge that has been generated there is no consensus as to even what constitutes these artefacts and as a result the extant knowledge currently has many weaknesses.

One such weakness is that much of this literature has its foundation in the perspective that management controls are utilised in rational processes of enacting a desired state. From this perspective management controls are utilised in rationally thought out processes, involving consciously designed decisions, to either maintain a specific state of action or to change the actions of a given set of actors in a linear progression from one state to another (Andon, Baxter, & Chua, 2007; Quattrone & Hopper, 2001, 2005). An example of this is provided by Andon et al. (2007, p. 274) when they note "an organisation moves from being an 'Organisation without an ABC system' (State A) to an 'Organisation with an ABC system' (State B)". This perspective, therefore, rest on there being an optimal system of management controls that will maximise the benefits for the organisation, with bad performance being the result of poor implementation or usage of these artefacts (Chua & Mahama, 2007; Dambrin & Robson, 2011). However, such perspectives take many things for granted, such as what constitutes change and the processes through which it occurs (Hopwood, 1987; Quattrone & Hopper, 2001). Further, this perspective does not acknowledge that issues may exist with the ability of management controls to measure what it is they are designed to (Dambrin & Robson, 2011). After all these management controls "are not the world: they are only representing it in its absence" (Latour, 1987, p. 247). Most strikingly, however, is that what can be considered 'rational' is merely a construction and, therefore, may change in different spaces and times (Quattrone & Hopper, 2001).

There is, therefore, a need to understand that management controls are utilised in a complex and messy reality making it problematic as to how well the rational perspective holds in practice (Justesen & Mouritsen, 2011; Robson, 1991). Perspectives that rely on rational underpinnings assume that changes in states are easily identifiable, including clearly being able to identify those involved, the nature of the consciously designed decision and every step in the process undertaken (Andon et al., 2007; Quattrone, 2015; Quattrone & Hopper, 2005). Rather it is best to understand the use of management controls within a context of poly-rationality and a-centred organisations (Quattrone & Hopper, 2001). That is, within a complex and messy reality, changes in state, including the decisions and actions taken, can unfold reactively as well as proactively, through negotiation, conflict or struggles, with no guarantee or *a priori* understanding of how 'successful' their deployment will be (Briers & Chua, 2001; Mouritsen, 1999; Mouritsen & Thrane, 2006; Preston, Cooper, & Coombs, 1992; Quattrone, 2015). Further it may involve incompleteness, experimentation, serendipity, drift and chance (Andon et

al., 2007; Quattrone & Hopper, 2001). This means that the use of management controls as well as the effects that they produce can be unpredictable, unintended and surprising (Christensen & Skærbæk, 2007; Hopwood, 1987; Mouritsen et al., 2010). Importantly these unpredictable, unintended and surprising effects may construct order and control and/or ambiguity and disorder (Chua & Mahama, 2007). These effects may then be constructed by relevant actors as the 'successful' result of 'rationale' decision making and actions or the 'unsuccessful' result of 'poor implementation' (Dambrin & Robson, 2011; Quattrone & Hopper, 2005). As Quattrone and Hopper (2005, p. 761) note:

"Understanding multiple attempts to create order, spaces, and times is the uneasy task facing managers and management control scholars alike. It requires substituting linear and unique depictions of control with ones that recognise how actors with divergent expectations and beliefs define organisational spaces and times to exert their own views of order."

Within these attempts to 'create order, spaces and time' management controls are useful to actors in that they help to produce a simplification of reality (Mouritsen, 1999; Quattrone & Hopper, 2005). They allow for the reduction of the complexity and messiness through the construction of specific depictions of that reality, including the imposing of specific identities (Miller, 1991; Mouritsen, 1999; Mouritsen et al., 2001). However, while they assist in simplifying the complexity and messiness, they can never tame it (Andon et al., 2007; Quattrone & Hopper, 2001). Again this is as a result of the management controls being inscriptions that represent the world in its absence (Latour, 1987). This may be further complicated by the management controls themselves. If, for instance, competing management controls construct the world differently this will have implications for how the managers who utilise them understand specific concepts, such as flexibility, innovation, and productivity (Mouritsen, 1999). Thus, in helping to simplify reality, management controls acts upon how reality is constructed. In other words, as noted above, they produce effects (Chua & Mahama, 2007; Jollands et al., 2015). For example, they construct new possibilities for management intervention (Mouritsen et al., 2001) and who are 'those in control' compared to who are 'those being controlled' (Quattrone & Hopper, 2005).

This separation of controller and controlled equates to these artefacts being utilised as a means to influence the behaviours of others (Jollands et al., 2015) or

in other words controlling is a way of deploying power. In recognising this it is necessary to examine what the programme of those enrolling these artefacts is. In trying to discern this analysis should go beyond just the 'action at a distance' explanation (Robson, 1992). For example, in Law's (1986) analysis of the Portuguese attempts to control their outposts in India in the fifteenth and sixteenth century he notes that it was the aim of Lisbon (the centre) to change the notion of distance through improved technology. They undertook this not only to gain knowledge of what is occurring half way around the world at the periphery but also to act upon the actions being undertaken there. But wherever power is at play political manoeuvring follows, which creates the uncertainty discussed above (Quattrone & Hopper, 2005). So it would seem that research would benefit from this recognition of controlling in relation to power (Justesen & Mouritsen, 2011; Kraus & Strömsten, 2016; Mouritsen & Thrane, 2006).

However, in understanding controlling in these terms it must be recognised that power is never absolute. For example, most governments in the world mobilise their power through laws, police forces, prisons, etc. only to find that people do not act in accordance with their programme and continue to commit crimes such as murder. Thus, control, even in the most tight and important areas, is never absolute due to the inability to ever totally enrol every actor into a given programme (Andon et al., 2007; Jollands et al., 2015; Latour, 1991). Hence this research aims to examine the process of controlling and thereby open up future research to the prospects that it can and often does fail (Callon, 1986). Research to date, with a few notable exceptions (see for example Andon et al., 2007; Briers & Chua, 2001; Chua & Mahama, 2007; Jollands et al., 2015), present, to a degree, sanitised results where the effects produced by these artefacts result in some form of 'success' or 'control'. The analogy that may be utilised to elaborate on this is that it is much like how statistical based positivistic accounting research never presents and discusses where their hypothesis has not been supported by significant results. If the extant knowledge over the processes of management controlling is to progress then understandings need to be developed of their use in a multitude of different outcomes.

Moving from researching management controls to management controlling, with its relation to power, is a shift, as advocated by Chua (2007), from focusing on nouns to verbs. As also discussed below, implementing a study focusing on verbs requires getting as close as possible to the actual practices to witness how they are undertaken rather than just actor's impressions of them. It is only through these

means that understandings of the witnessable practices of management controlling will be able to develop (Garfinkel, 2002; Rawls, 2002).

An ideal setting for such an investigation is provided by inter-organisational relations, where partnering organisations see each other's operations as objects to be managed and controlled (Chua & Mahama, 2007; Miller & O'Leary, 2007; Mouritsen et al., 2001). Structuring in order to take advantage of the potential benefits of inter-organisational relationships is becoming increasingly more common (Mouritsen et al., 2010). As Cuganesan and Lee (2006, p. 141) note, "networks continue to be promoted as a means of: responding to heightened competition; sharing costs and risks; keeping apace of constantly renewed information." However, in this setting management controlling becomes more problematic as the complexity, risks, complicatedness, instability, fragility and messiness increases from that of just within one organisation (Chua & Mahama, 2007; Dekker, 2004; Mouritsen & Thrane, 2006). This setting provides many more question to the actors involved. For example, how are the expected benefits to be distributed among the participants in a way that at least gives a sense of equity and in doing so enabling the collaboration to continue? For instance Coad and Cullen (2006, p360) overview the use of an inter-organisational control to identify non-value adding practices at the suppliers, that when removed resulted in cost savings for both parties involved. However, they do not outline how it was negotiated for those benefits to be shared. With the justification for the setting in place, the next section overviews the theoretical perspective taken in this research.

3. Theoretical Perspective

The theoretical perspective mobilised within this research reflects the understanding of a messy and complex reality but can still place management controls at the centre of the research (Justesen & Mouritsen, 2011). Specifically, it is grounded in the practices of the actors rather than in relating social theories to these practices (Garfinkel, 2002). In this way it maintains the focus on developing understandings of the processes and enactment of management controlling. Further it opens up, through taking a no *a priori* stance, the potential for any outcome, intended or surprising, including those that may deemed to be 'successful' or 'failures' (Callon, 1986; Latour, 2005; Munro, 1999).

This perspective allows the examination of, within the processes of controlling, how the artefacts and actors are mobilised to construct the world around them. In turn it enables an understanding to develop of what is surprising, unintended and the effects that are created (Mouritsen et al., 2010). Thus, as heterogeneous elements are combined in the efforts to implement a programme the analysis can follow what develops to discern the enactment of controlling (Latour, 1987, 2005). In so doing it allows for the potential for the management controls to assist in processes of controlling as well as simultaneously acting against them (Chua & Mahama, 2007).

With the emphasis on action (Chua, 2007) the focus becomes on the witnessable practices (Rawls, 2002) that constitute the enactment of controlling. This enables the analysis of methods, or the procedures, that actors use for accomplishing what they do (Garfinkel, 2002). Hence this perspective examines the things commonly done to create and recreate practices that others will recognise (Rawls, 2002). In this way it enables an understanding of how people make themselves accountable, or understood, by others (Garfinkel, 1967, 2002, 2006). Actors will often utilise management controls, including within inter-organisational settings, to assist them in this process of making themselves accountable and thereby the enactment of controlling (Akroyd & Maguire, 2011). The important feature is the "setting" not the actors as they may change but the "setting" will endure (Garfinkel, 2002).

In short, therefore, this perspective provides a focus on the witnessable practices rather than the interpretations of those practices (Rawls, 2002). It is through being able to witness actual practice (Preston et al., 1992) that something concrete may be said about what actors do and how within that they make themselves understood by others. For this very reason abstract notions, such as trust (see for example Minnaar, Vosselman, van Veen-Dirks, & Zahir-ul-Hassan, 2017), while they may 'exist', do not form part of the knowledge derived. Only if the abstract concept can be discerned in the practices that have been observed will it become part of the account of these actions. But then it is only as a concept that is mobilised through witnessable practices (such as speaking) rather than an abstract notions that somehow 'exists'. For example, it is a concept that is labelled 'trust' that has a concrete existence and acts rather than there being an object 'out there' of trust that has an existence of its own. However, no actor is dismissed without seeing how they act and what effects they produce (Latour, 2005). The aim of such a perspective of practice is, unlike interpretive social science which stresses the

validity of accounts (Ahrens & Chapman, 2006), the utility of the accounts produced (Garfinkel, 2002), here on the enactment of controlling.

As mentioned above, this requires an acknowledgement that controlling is in relation to power. Here power is thought of as the consequences of those that act rather than what makes them act (Latour, 1986). However, those that can assemble materials, including management controls, and deploy methods, such as management controlling, to entice others to act may generate themselves in line with their desired programme – but importantly this can never be assumed to be the case (Law, 1992). This is, as discussed above, especially the case as power is never absolute. Rather those that utilise management controls to assist in their attempts of controlling only wield power *in potentia*. It is those that act as a result of the effects of these artefacts that have power *in actu* as they always have the option to do otherwise (Latour, 1986).

This otherwise may be motivated by any number of factors (Munro, 1999). Further, as many actors are often involved with any given programme the outcome is never certain given the multitude of motivations that could be at play (Latour, 1986). Thus, actors may have any number of motivations for acting in any specific way that may / may not be influenced by a management control and therefore may / may not relate to the underlying programme of those deploying these artefacts. It is this ability to act in many divergent ways with a multitude of differing motivations that makes controlling never a guaranteed outcome. A specific actor may become interested in a specific programme of action through the enticement of a management control. However, becoming interested does not prohibit the actor from removing their support and acting in a contradictory way (to whatever degree) at any moment (Callon, 1986). Hence, controlling involves many complexities that make an outcome where the desired programme is achieved far from certain (Latour, 1986). As such, understanding why and how (Latour, 1999) the result of controlling is otherwise also needs attention. This is why a focus on the process and enactment of controlling is a compelling proposition. The next section now provides an explanation of how data was collected and the case organisations that this collection focused on.

4. Method

In order to investigate the aim of developing knowledge of and the case for researching the processes and enactment of controlling a longitudinal case study was undertaken. The focus of this case study was on an organisation, AssembleCo, which undertook a project focusing on encouraging four of their suppliers; AlphaCo, BetaCo, CignaCo, and DeltaCo; to utilise the calculative device Material Flow Cost Accounting (MFCA). The project was undertaken in an effort to minimise waste being produced across the supply chain and thereby forge closer relations with specific suppliers from the plastic injection moulding industry. The project was seen as being able to benefit all parties involved financially through cost reductions. As discussed above, this setting was selected as it allowed for the examining of controlling in a context (inter-organisational relations) where the associations are long and more easily observable (Garfinkel, 2002).

Further details of each of these organisations are provided below. Briefly, however, each is based in Japan and each, including AssembleCo, utilise plastic injection technology to produce component parts that are included in the assembling and production of other products. While AssembleCo primarily assembles components into products that it supplies to other manufacturers within the electronic and automotive industries, it has a strategy of splitting the production of the components it needs between its own factories and outsourcing to its suppliers. It is with four of these suppliers of components that AssembleCo set up an inter-organisational project that focused on gaining benefits from the common use of the MFCA calculations. It is this project that forms the basis of data collection for this research.

In collecting data from the case study it is acknowledged that the researchers, like all actors, are part of the world around them and add to the theorisation of it like every other actor (P. A. Adler & Adler, 1987; Latour, 1986). Further, the theoretical perspective mobilised in this research typically involves the need for participant observations where the researcher(s) become as taken for granted within the setting as possible (P. A. Adler & Adler, 1987). Validity for this perspective is gained through a researcher attaining "unique adequacy" (Garfinkel, 2002). That is, "unique adequacy" enables a researcher to understand practice in very much the same ways as practitioners do (P. A. Adler & Adler, 1987). Further, these types of participant observations have many strengths over interview techniques (Alvesson, 2009), especially as the aim of the research does not involve

the actors interpretive understandings of their practices. As such, two of the authors fully participated in the project as experts enrolled by AssembleCo due to their knowledge in the technical aspects of MFCA. The ability to gain this level of access was as a result of an established relationship that one of the authors held with AssembleCo that went back to 2008.

The specific project that is focused on lasted between January 2011 and November 2013. Through participating in the project, the two authors observed roughly 133 hours and 25 minutes of the meetings that constituted the project and gained an in depth understanding of events as they unfolded over this time. A summary of the observations is provided in Table One below. We now turn, in the next section, to providing the details of the MFCA project initiated by MFCA, including an overview of all the organisations that were involved.

Table 1 – Summary of data collection activities

Time span of project	January 2011 to November 2013
Total time of participant observations	133 hours 20 minutes
Number of participant observations	39
Average time of participant observations	3 hours and 25 minutes
Meetings attended by actors from:	
AssembleCo	25
AlphaCo	16
BetaCo	14
CignaCo	16
DeltaCo	13
ParentCo	2
Meetings held at the premises of:	
AssembleCo	20
AlphaCo	6
BetaCo	3
CignaCo	3
DeltaCo	5
ParentCo	2
Meetings held in the country of:	
Japan	31
China	3
Thailand	2
Malaysia	2
Indonesia	1

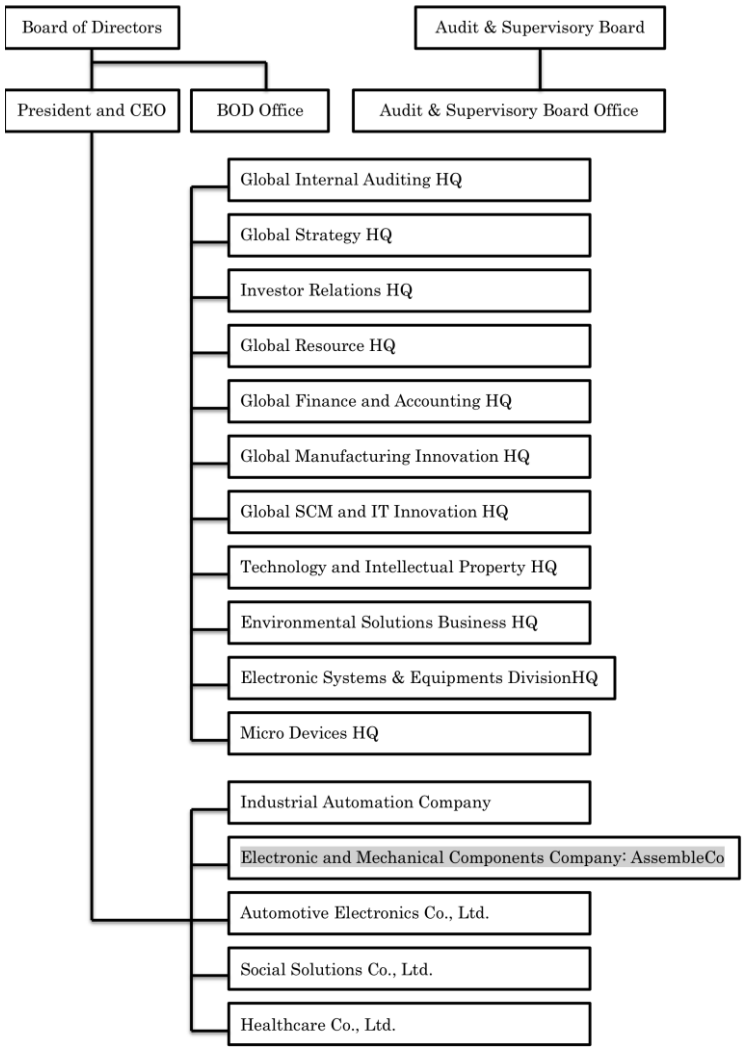
5. AssembleCo's inter-organisational MFCA project

This section provides details of the inter-organisational project that AssembleCo initiated, which utilised MFCA as its focal point. This starts with an overview of the organisations involved before proceeding to giving details of how the project unfolded over time. As will become apparent from the overview of the organisations, the actors from AssembleCo had a multiplicity of objectives for this project that goes well beyond the efficiency promised by the technical aspects of MFCA.

5.1 Overview of case organisations

AssembleCo is a multinational Japanese company that has its headquarters in the southwest part of Japan. It is capitalised at around three hundred million yen (which is approximately 1.75 million pounds Stirling[3]). In 2013 it had approximately one thousand employees in Japan and a further five thousand globally. Their production is spread across factories located in Japan, China, Korea, Malaysia, Indonesia, the USA and Italy. AssembleCo is a sub-business unit of a holding company, ParentCo, which has further sub-business units as outlined in Figure 1 below.

Figure 1: The organizational chart of ParentCo



ParentCo is a company that specialises in producing electronic and mechanical parts, and mainly focuses on supplying automobile companies. As such, AssembleCo assembles components together into parts that are then on-sold to electronic and automobile companies, who in turn install these parts into their own products. Specifically AssembleCo utilises the technology of plastic injection moulding[4] as part of this process. In turn, AssembleCo relies upon approximately forty eight suppliers to provide components for use within its production process. Twenty two of these suppliers operate within the plastic injection moulding industry, with the others supplying the metal press components that are required in the process of assembling components into parts. Prior to the commencement of the MFCA project five of these twenty two supplied more than seventy percent of AssembleCo's requirements. However, none of these five were selected to take part

in the project. Rather the four suppliers that took part were selected on the basis of either being the up and coming challengers or having a reputation as being companies that used advanced technology.

In a sense, AssembleCo uses its suppliers for capacity management. As demand increases beyond what its' factories can produce it outsources the excess amount of production to the suppliers. AssembleCo does not, however, share with its suppliers the advanced technology that it uses in its own production process. It also keeps a standard amount of production for its own factories at all times. This creates stability for its own operations and in so doing creates issues for the suppliers, which are typically smaller companies. This project had the potential to alleviate these issues for the suppliers. That is, through a focus on reducing cost, AssembleCo would then be able to sell the parts it produced at a lower price. This would then create more stable demand and thereby stabilise the amount outsourced to the suppliers. The two main components of labour and material were seen as the only means for reducing the cost of a part. Labour costs were determined mainly through economic conditions and it was unlikely these could be significantly reduced. Therefore, MFCA was seen to be able to assist as it focused on reducing the waste of material and thereby reducing the cost of producing each part.

In terms of structure, three of the four suppliers involved with this project have some similarities: AlphaCo, BetaCo and CignaCo are family owned and managed businesses with each having a president who is a second-generation owner. In contrast DeltaCo is a subsidiary of a much larger chemical company. As a result the president of DeltaCo has less autonomy in comparison to the presidents of the other three suppliers.

AlphaCo is the smallest of the four suppliers with roughly one hundred employees. AlphaCo's headquarter is located within the mid-west part of Japan with all its factories being domestically located. In 2013 AlphaCo had a capitalisation of approximately ten million yen (approximately fifty-seven thousand pounds Stirling). AlphaCo specialise in providing AssembleCo with components made out of thermosetting plastic[5]. AlphaCo has a long established relationship with AssembleCo of more than 10 years.

The second supplier, BetaCo, is also a relatively small company with around two hundred employees. Its headquarters and one of its factories are located in the northeast of Japan. Of all the suppliers, BetaCo is geographically located the furthest from AssembleCo. BetaCo has overseas operations in Thailand, the

Philippines and China[6]. In 2013 BetaCo had an approximate capitalisation of sixty million yen (approximately three hundred and forty three thousand pounds Stirling). BetaCo specialises in producing micro-sized plastic components. At the start of the project, unlike the other three suppliers, they had no existing relationship with AssembleCo. Rather AssembleCo utilised the invitation to participate in the project as a means to establish such a relationship, with the aim of gaining a new supplier with a reputation for high quality production.

The third supplier is CignaCo, who has approximately two hundred and forty employees in Japan. CignaCo is also located in the mid-west of Japan and has overseas operations in Thailand, Indonesia and the USA. In 2013 CignaCo had an approximate capitalisation of six hundred million yen (just under three and a half million pounds Stirling). CignaCo specialises in producing thermoplastic[7] parts for AssembleCo. In the past the relationship between CignaCo and AssembleCo was very good, with a reasonable volume of parts being ordered. This ended when the purchasing manager for AssembleCo made a decision, for no apparent reason, to scale back the amount purchased to a bare minimum. However, this manager relocated within ParentCo to another sub-business unit and hence this project was seen as a way to re-establish the previously strong relationship.

The final supplier invited to participate in the project, DeltaCo, had around two hundred and twenty employees and has three factories, all located within Japan. DeltaCo's headquarters and manufacturing sites are all located in the mid-west part of Japan. In 2013 they had an approximate capitalisation of forty million yen (approximately two hundred and twenty eight thousand pounds Stirling). As with CignaCo, they specialise in thermoplastic parts. However, DeltaCo utilises significantly different technology from CignaCo in the production of the components it supplies to AssembleCo. Unlike all the other three suppliers, because DeltaCo is a subsidiary of a much larger organisation, it could use its size and position to gain an advantage through purchasing customised raw material, plastic pellets, specifically designed to maximise their production process. As the other three suppliers were all independently owned companies of a relatively small size they only had access to purchasing standard plastic pellets from the raw materials suppliers.

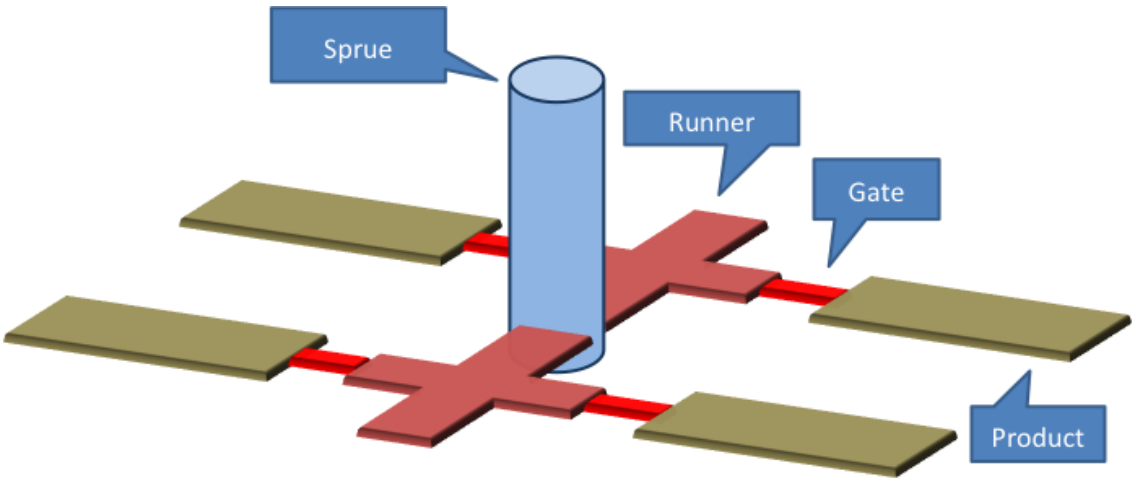
5.2 On the importance of moulds

To understand the significance of what happens within the project it is important to know that while all five companies use the process of plastic injection

moulding to produce the same kind of components they all do this in slightly different ways. That is, while they all use similar machines and are confronted with similar issues within the production process, each of the companies has a different approach to overcoming these issues. Specifically, the different approaches revolve around the technical specifications of the mould that is used, with each company designing, developing and utilising their own unique version. The way in which the mould is designed will affect the rest of the production process. For example if the mould only produces one component then the production process can be conducted at a faster rate than if the mould produces ten components where more care must be taken to ensure that the plastic is injected to all the spaces within the mould. This is specifically why Delta utilises customised plastic pellets as they enable a more consistent flow into the mould. Another important element that differs between the suppliers as a result of the specific mould used is the temperature that the plastic is injected at. The other machines used within the production process are the same across all the companies and the output of the process is standardised among them as well. This makes the mould the most important component in the process as it how each company derives its competitive advantage.

Figure 2 is an illustrative example of the inside of a mould and shows where the plastic is injected to in order to produce parts. How the mould is designed, in terms of the sprue, runner and gate, will dictate how much material waste is produced. The sprue is "[t]he opening in an injection mould through which the melted plastic is fed from the nozzle of the injection machine to the runner" where the runner is "the channel through which the melted plastic flows to the cavity" (Sapene, 2007, p. 174). The gate is "the area through which the melted plastic enters into the cavity and core section of the mould where the plastic part is shaped" (Sapene, 2007, p. 172). This example demonstrates that the material waste may be reduced by redesigning the mould in terms of the sprue, runner and gate.

Figure 2: Conceptualisation of a representative mould



Redesigning the mould can be problematic in that many unexpected issues can arise. To start with it is very difficult to alter the design of existing moulds. This, therefore, requires them to redesign and develop new moulds from scratch. Redesigning new moulds from scratch is a costly and time consuming process. The benefits of doing so are that it can enable the shortening of the sprue, runner and gate and thereby reduce the material loss. Also redesigning the mould provides the opportunity to increase the number of parts that are produced by each mould. However, increasing the number produced by each mould may cause issues within the production process as it requires the workers to simultaneously manage more parts. Another issue is that the re-designing of moulds is a very technically challenging process with not all suppliers having the required skill set within their organisations to do this. All of the suppliers selected to participate in this project did have this skill set available within their organisation[8]. We now in the next section overview the events that occurred during the project.

5.3 The origins of the inter-organisational project

AssembleCo introduced MFCA to their production process in 2008. This was as a result of the Special Production Improvement Department from ParentCo sponsoring this project within AssembleCo. Based upon a presentation made about MFCA at AssembleCo the Production Manager agreed to become the project leader. This was an important enrolment to the project as the Production Manager was also a member of AssembleCo's board and had responsibility for domestic procurement. A team was formed shortly after that consisted of the Production Manager, outside consultants, the two managers of the production lines involved,

and representatives from the Production Improvement Department. The Project Manager had the purpose for this project of addressing issues related to resource in-efficiency within the production process.

The analysis performed by MFCA focuses on where material loss is generated in the production process. The initial analysis suggested that the material loss was related to three different types of issues: internal technical issues, internal capital investment issues and external issues[9]. The internal technical issues relate to how material was being lost within the production process and hence the initial efforts that resulted targeted these to be reduced through the use of Kaizen[10]. However, the benefits that can be derived from these types of activities have their limits and hence the other two areas soon became the focus of discussion in terms of how best to keep reducing material loss.

The internal capital investment issues proved to be more problematic as these need to be addressed through the use of reengineering of existing machines or through the purchase of new equipment. This required the development of new technologies with corresponding long-term capital investment. It proved to be problematic as it also required cooperation from the Department of Production Engineering and the R&D Department. The Department of Production Engineering was located within the AssembleCo factory to assist with production related issues. However, while direct communication between the Production Department and the Department of Production Engineering occurred on a daily basis, different priorities and practices resulted in difficulties with enrolling their support for the MFCA project. In relation to the R&D department other issues were encountered, such as it was not physically located within the factory but rather attached to the operations of ParentCo. This meant that little face to face communication between the Production Department and the R&D Department existed. As AssembleCo is a financially independent sub-business unit there would be implications for their budget in using the R&D Department's services. This was further complicated by the R&D Department having a one year project plan with little time or budget left for undertaking new projects. As a result it was hard to convince the R&D Department that cost reductions from MFCA should be a priority. The final complication was that, as mentioned above, the suppliers were being utilised for capacity management. As production levels were stable, this meant that AssembleCo had a relatively fixed budget. As such there was no extra money available to be spent on initiatives that arose from the MFCA project.

The problems with addressing the internal capital investment issues meant that attention turned to investigating the external issues. The MFCA analysis of AssembleCo's production process suggested that the level of material loss at their suppliers was significant and concentrating on this may provide considerable cost reduction. This was further reinforced through AssembleCo having already experimented in redesigning their own moulds, with success achieved for some of the products. A decision was made to focus efforts on reducing material loss through forming collaborations with suppliers. It was also decided that this would take the form of a project focusing on the use of MFCA at specific suppliers.

Addressing the external issues meant enrolling the support of the suppliers. As explained above, four specific suppliers were selected and invited to participate in the MFCA project. As all four suppliers' production processes varied slightly, and specifically in respect to the moulds used, MFCA was put forward as a means that could be used by all to minimise the material waste despite these critical differences. As shown in Figure 2 above, how the mould is configured will determine how much material waste is produced. It was proposed that through the use of MFCA material loss could be reduced at the suppliers, thereby reducing the cost for all.

In effect AssembleCo put the calculative device of MFCA analysis forward as a means to enable reducing the material loss it was responsible for, even if that material loss occurred within their suppliers' production processes. In this way the cost of production would be reduced across the supply chain. The upper management at AssembleCo were in effect using this calculative device to assist in efforts to manage and control the costs of these selected suppliers in an effort to address issues related to their own strategic imperatives. However, as will be discussed below, enacting this controlling would prove to be problematic.

5.4 Project start-up and initial stages

The initial steps focused on selecting who from within AssembleCo would be involved in the project. The team that was assembled were typically senior managers from the Production Department and staff members of the Procurement Department. All of the participants had in common that their roles involved responsibility in relation to the outsourcing of production of the components to the suppliers. Given his previous support for the use of MFCA in AssembleCo, the Production Manager was selected to lead this project.

In making the selection of who would be invited to participate, the project team researched a wide range of their suppliers. This included senior managers from AssembleCo visiting the factories of twenty different suppliers. Many criteria for supplier selection were considered, including competencies and quality of output. Given their importance the main criteria for selecting the suppliers settled on their abilities to design and produce their own moulds. The criteria aligned the capabilities of the selected suppliers, ability in relation to moulds, with the focus of the project, waste reduction and cost savings. With the criteria in place four suppliers were selected and invited to join the project.

The project team set up an initial meeting with these suppliers at AssembleCo's headquarter on the 18th and 19th of December 2011. This meeting constituted and facilitated the formal invitation for these suppliers to join the MFCA project. In essence this meeting was used to start interesting the actors into the use of MFCA and, thereby, enrolment into the project. On the 18th the Production Manager gave a presentation that outlined AssembleCo's intended procurement policy and how the targets of this project fed into implementing this. The intended procurement policy was based upon a reorganization of AssembleCo's global supply chain. Like many Japanese manufacturers, AssembleCo's strategy focused increasingly on growth in sales through expansion in overseas markets. As a result issues around their global supply chain also became increasingly important. To address these issues, at least in part, AssembleCo had established new factories within these overseas markets and had plans to move more of its production capabilities overseas in the future. Part of the stated rationale for this, along with shortening the physical distances within the supply chain, was to lower the risks associated with foreign exchange fluctuations. This also had implications for the supply chain within Japan and, therefore, the four suppliers invited to attend this meeting. As AssembleCo moved more of its production capabilities overseas it would no longer need to maintain so many suppliers within Japan. This implied that AssembleCo would in the near future reselect and renew the relationship with the suppliers it felt it needed in Japan. The Production Manager explained that the suppliers who AssembleCo would maintain doing business with would be those that helped them increase productivity and in doing so established a Kaizen between the organisations. It is precisely these outcomes that the MFCA project promised to produce.

The Production Manager also gave a presentation about MFCA. As the suppliers had not heard of MFCA before it was explained in detail. This included

overviewing how MFCA could deliver benefits beyond cost reductions, such as reductions in fail rates and cost. After the Production Managers presentation there were further presentations made by project team members that outlined the technical aspects of MFCA, including how it is implemented. These presentations included case study examples of the implementation of MFCA at organisations, including a discussion of the use of it at AssembleCo. Outlined were the 'typical' issues encountered during its implementation and use. Also discussed were the issues within production that MFCA would bring visibility to and thereby enable solutions to be implemented. It was explained that these were issues and benefits that were likely to be common across all five companies.

The second day of this meeting focused on the suppliers. The representatives from each of the suppliers took it in turns to introduce their organisation. While there were some existing relations between the suppliers, on the whole this did not exist, with the level of familiarity typically being at recognising the other organisation's name. For example, the representatives from AlphaCo and BetaCo previous to this meeting didn't have any existing relationship. This is not surprising given that there were significant differences in the features of their respective products and their operations were geographically distant from each other.

After these introductions the discussion moved to how the project should progress, including what the steps and stages should be. At this point none of the suppliers had formally committed to the project. The outcome of these discussions was that all of the representatives from the four suppliers agreed in principle, but not formally, to AssmbleCo's proposal for this project. Further the representatives agreed to introduce MFCA on a trial basis to their factories and to meet again to keep the discussions between the five organisations going. It was also agreed that any resulting findings from the joint project would exclusively be kept between the organisations that participated. However no decision was made as to when or where the next meeting would occur.

With no agreement over where or when the next meeting would be held, it fell to the Production Manager and the other project members from AssembleCo to follow up on what had been decided. They held informal meetings and negotiations with each of the four suppliers. These included discussions over what were the critical issues that should be discussed when the next meeting is held. The critical issue that developed out of this was the offshoring of production, with China seen as the key location. All four suppliers had in common that they wanted to know

how to succeed in setting up and running production facilities in China. Across the four was the common acknowledgement of a paradox that related to operating in China. This related to how could the cost of production be lower in China: the cost per employee is lower in China but more employees are required than in Japan and hence there is a higher total labour costs. Further, the defect rates are higher in China compared with Japan. The paradox related to reconciling these issues with still being able to maintain a lower total cost of production in China in comparison to Japan. Based on the common interests in the issues of offshoring production to China, AssembleCo arranged for the next meeting with the four suppliers to occur at their factory in China. With its focus on the complexities of successfully conducting production in China, this trip demonstrates that the motives of the representatives of the suppliers were not necessarily aligned with the purpose that the Production Manager had for this project.

5.5 Solidification of the MFCA project

The meeting at AssembleCo's factory in China took place on the 6th and 7th of June, 2012. In discussions with two of the authors who also attended this meeting, representatives of each of the four suppliers stated that they attended this meeting in efforts to forge ever closer relations with AssembleCo. The representatives from BetaCo also stated that the potential benefits of this ever closer relation were the reestablishment of receiving orders from AssembleCo. The representatives from the other three suppliers also stated that the benefits for their organisations of the ever closer relations were the increase in the levels of orders that AssembleCo placed with them.

The purpose of this meeting was to examine the processes within this factory in order that all the participants of this project could come to a common understanding of the variety of issue these operations faced. While each of the suppliers is different and had its own unique challenges, the ideal outcome was stated as finding a specific issue common between all five organisations asend setting, for all five, concrete targets in relation to it. The starting point for this was a presentation made by the Manager of AssembleCo's Chinese factory. This presentation covered such topics as the present condition of the factory, issues related to operating in China, the impacts of movements within the Chinese economy and many other current issues. In brief, while the factory's orders were increasing it faced increased labour costs due to the Chinese government raising the minimum wage. Competition as a whole in China was fierce given a saturated

market with many competing organisations and as such it was not easy to secure a consistent level of orders. In relation to the factory's supply chain they mainly used the Chinese operations of Japanese companies as suppliers. Even though Chinese suppliers could deliver at a lower cost, the corresponding quality was poor necessitating using the Japanese subsidiaries.

In discussions with the two authors who attended this meeting, representatives from AssembleCo stated that they wanted to share this overview of issues with the suppliers so as to emphasise the impact of the suppliers operations on their activities. After the presentation was made a general discussion was held in which the representatives of the four suppliers discussed these issues related to the Chinese factory. This included discussing what they could do as a collective to assist with the improvement of the operations and outcomes for all five organisations. From this they developed a document which outlined an agreement that had the aim of bringing focus to and solidify the project. This agreement included the significance, purpose and target of this project. According to the agreement, they aimed to make a collective with the purpose to accomplish higher resource efficiency through focusing on the elements of EQCD (environment, quality, cost, delivery). Through this collective alliance, with the focus on efficiency, they aimed to gain a global competitive advantage for all five organisations. Further the representatives of the five organisations set the first level of targets for improved resource efficiency and agreed that this should be achieved through the use of MFCA. Specifically the agreement focused on three targets as reflected in the following, which is quoted from the original document (translated from Japanese into English by the authors):

1.Visualising the resource efficiency in the company's own processes.

- Visualisation of and reduction activities in relation to material loss, both in regards to that caused by the design of the mould and that caused by other production factors.
- Prior to taking action on material loss in regards to mould redesign a complete cost / benefit analysis should be conducted.
- The formation of links between the project participants, their R&D departments and material suppliers.

2.Analysis of manufacturing costs inside Japan with costs of manufacturing globally.

- Analysis of differences in the cost structure between Japan and elsewhere.
- Developing a means for calculating the product unit cost in different contexts.

3.Development of knowledge of how to better co-operate between the five companies.

- Developing knowledge of the means to ensure that this cooperation extends beyond Japan.

As the document demonstrates, the agreement was developed in a way that it reflected, at least in part, the stated objectives of the representatives of all five organisations. For example, the first target, with its reference to efficiency and material loss, is a clear prompt to the suppliers to introduce the use of MFCA to their factories. Therefore, while the document may have had internal inconsistencies, it was constructed in an attempt to act in a way that further solidified the network that was forming. An example of the way in which this acted to enhance the inter-organisational relations can be seen in the actions of DeltaCo subsequently to this meeting. DeltaCo being part of a much bigger organisation had relations with the suppliers of plastic that enabled them to access cheaper and customised pellets. DeltaCo leveraged this arrangement to gather the other four organisations with it into a buying collective that allowed all to purchase customised raw materials at a lower price.

This agreement, however, also left many issues outstanding. Specifically while the representatives of all five organisations discussed what steps they should take in order to honour the agreement there was no discussion around important aspects related to this. For example they did not discuss and make clear how any subsequent benefits, including who would own patents, that were derived through the MFCA project would be shared across organisations. For instance, if the implementation of MFCA resulted in cost reductions within one of the four suppliers how this would be shared between the supplier and AssembleCo was not discussed – was the benefit to be retained fully by the supplier or shared with AssembleCo through a decrease in the price of the components supplied? Further,

if the project resulted in the development of new or improved technology then who would own the patent was also not discussed.

On the second day of the meeting AssembleCo allowed the representatives from the four suppliers to take a tour of their factory. For obvious reasons, such factory tours are not common between organisations within the same manufacturing industries. So for AssembleCo to allow their suppliers to take such a tour, even though they are not direct competitors with each other, is quite unusual. During the factory tour, as they were inspecting specific aspects of the production process, some of the representatives from the suppliers took out magnifying glasses and stop watches from their pockets. They utilised these tools to confirm the quality of the components being produced and to measure the time it took to complete specific aspects of the production process[11]. Further, they closely inspected failed components to ascertain the reason for the failure.

The factory tour was followed by a discussion focusing on what had just been observed. The members of the project team from AssembleCo stated that they were looking to receive suggestions on how to improve their processes from the suppliers. An example of the types of suggestions made by the suppliers was in relation to how the components were collected when being removed from the mould. Most moulds produce two or more components at a time (refer to figure 2 above). For instance, when one mould produces four components, currently they are all emptied into a single collection box. The suggestion was made that if there were four separate collection boxes then if defects started to occur it would be easier to identify what particular part of the mould was giving rise to this failure.

As part of this discussion the project team from AssemleCo asked the representatives from the suppliers to focus their attention on one of the parts that this particular factory produced. They supplied to the representatives a completed part as well as the manufacturing cost information that related to it. Some of the representatives deconstructed the part in an effort to understand its' construction. Following on from this they used calculators to estimate how much it would cost to produce the same completed part in their own factories. This resulted in many of the representatives commenting that their factories could produce the completed part for significantly less than it cost AssembleCo to make in this Chinese factory.

Giving such access to parts and costing information is very uncommon. The Production Manager of AssembleCo's closing remarks focused on that he didn't want to start competition among the four suppliers. He suggested that the suppliers should start sharing key technical aspects with each other, as

AssembleCo had just done, in their efforts of reducing material inefficiency. He noted that these key issues would be different for the four suppliers, in accordance with the unique features of their production process. His remarks focused on wanting to gather improvement opportunities in regards to these technical issues and in doing so to move the focus away from cost. He overviewed how a focus on cost could result in increased competition, either real or imagined, between the four through their differing ability to reduce price. However, a focus on technical issues, he noted, could bring a more positive atmosphere as they are different for each supplier. In turn the results of the MFCA calculation would also be different in each supplier as they use unique processes that will mean that the material loss will occur at different points in their process.

5.6 MFCA at the suppliers and unexpected effects

Before the completion of the meeting in China a rough schedule was developed as to further meetings and workshops that would include visits to each of the suppliers' factories, with DeltaCo agreeing to be the first. Before the next formal meeting a trial of MFCA was held by each of the four suppliers. Each of the four suppliers analysed their products through the use of MFCA and shared interim results in the ongoing workshops or directly just with AssembleCo.

After the China meeting unexpected events began to happen. For example, the representatives from AlphaCo visited BetaCo's operations on the 16th of July 2012 without any representatives from AssembleCo being present. This was unexpected due to the organisations not having any prior contact before joining the MFCA project. During this visit the representatives discussed the MFCA project in terms of how their specific operations related to it and what their respective expectations for the project were. As BetaCo is a relatively small organisation they focused on producing the components in large batches and through the use of mainly automated operation. As such their expectations in relation to the project were around issues in increasing productivity. After taking a tour of BetaCo's factory, the representatives from AlphaCo focused the discussions on how BetaCo managed to keep a stable quality level despite producing in such large batches. Through this discussion they gained visibility of BetaCo's techniques, such as how they had a dedicated employee group for the maintenance of the moulds. The purpose of this dedicated group was not to take corrective measures, as is the industry norm, but rather to devise preventative measures to stop defects occurring in the first place.

The most unexpected aspect of this visit was that the President of BetaCo arranged directly with the President of AlphaCo for their organisation to undertake a contract with an electronics company that their organisation could not fulfil. Specifically the electronics company had asked BetaCo to produce a new part. While BetaCo already had contracts for other parts with this electronics company it was unable to undertake this new contract as the part in question was physically too large to fit on their production line. However, as a result of the forging of this alliance in the MFCA project, BetaCo recommended to the electronics company that they use the services of AlphaCo to undertake this production.

This unexpected event was not an isolated outcome. Another example occurred on the 1st and 2nd of November 2012 when the Thailand Branch Managers of BetaCo and CignaCo visited each other's factory. The factories are located near, but on opposite sides of, Bangkok. At the time of the visits CignaCo had too many orders than it could fulfil. During the discussions between the Branch Managers they negotiated to utilise the spare capacity that the BetaCo Thailand factory currently had to cover the amount of production that was excess to the CignaCo Thailand factory's capacity.

The first formal meeting between representatives of all five organisations after all the suppliers had introduced MFCA was held at BetaCo's headquarters on the 19th of October 2012. This meeting started with a tour of BetaCo's factory and a discussion by the representatives of what they had seen on the tour. The meeting then focused on discussing specific issues relating to the outcomes of the MFCA calculations at CignaCo and DeltaCo. Specifically, the representatives from CignaCo outlined how they had disclosed the figure of material loss[12] to their workers in a weekly report. They stated that their aim in releasing the information to the workers was to impress upon them that waste meant cost was being incurred. Further the workers were set targets to aim for in relation to material loss. As noted by the representatives, this was used to act upon the workers to prompt them to find ways to reduce material loss. One of the suggestions by a worker was to switch to using an alternative material that would result in less material loss. However, in order to use this alternative material they needed to gain the agreement with the organisation they were selling the components to, which was AssembleCo.

The representative from DeltaCo outlined the issues that the MFCA analysis highlighted about efforts to reduce material cost through using recycled material. Specifically there was a tension between reducing costs through using more

recycled material and the ratio of recycled material to virgin material affecting the strength of the components being produced. That is, while the increased use of recycled material lowers the cost it also lowers the resulting strength of the component. The buyer, in this case AssembleCo, specifies the ratio of recycled material that is allowed to be utilised within a given component. The representatives of DeltaCo asked whether representatives from AssembleCo would join the new product development meetings at DeltaCo to discuss this issue relating to the ratio and, thereby, help formulate solutions that are acceptable to both organisations. Part of these proposed meetings would be to examine the related issue of the type of raw materials utilised by DeltaCo in producing the components. Issues arose as DeltaCo did not directly deal with the raw materials supplier but rather received these from AssembleCo. As stated by the representatives from DeltaCo, they are happy to get the plastic pellets from AssembleCo rather than directly from the raw materials supplier but they wanted to have more influence over the type of pellets they were expected to use and how these pellets were designed.

The final meeting of interest in this stage of the project was held at AlphaCo's factory on the 4th of February 2013. As had become the norm of these meetings, it started with and had subsequent discussions of a factory tour. AlphaCo is the smallest organisation of the four suppliers and they produce a wide variety of products using small batches. Their operational workers take responsibility for the whole production process including the checking of the quality of each component produced. This responsibility also extends to the maintenance of the moulds with every worker being trained in the skills of mould maintenance. This does not, however, extend to the maintenance of the plastic injection machines as these are maintained by the company that manufactures them. Hence, this is unlike larger companies who typically have a maintenance department for this.

The discussion that followed the tour highlighted many issues and suggestions in relation to AlphaCo's production process. For example, a representative from DeltaCo pointed out that issues may be being caused by the reliance on a conveyor belt that was old and worn. A representative from AssembleCo also highlighted issues in relation to time management. Specifically they noted how, as each worker was responsible for the whole production process of a component, this prevented the implementation of a Kanban[13] system that was suggested could bring many benefits. Further, the Procurement Manager from AssembleCo noted an issue in relation to the lack of management information

about the individual production progression. As each worker looks after the whole process, they are, therefore, not responsible for maintaining a targeted tact time[14]. The Procurement Manager suggested the introduction of such information so that the workers could better monitor their own progress.

Subsequent to this discussion all four suppliers presented their final results from the MFCA analysis and resulting Kaizen activities. The discussion by the various representatives around the outputs of the MFCA analysis and Kaizen activities resulted in these being deemed as 'successful' or 'unsuccessful'. One example that was deemed 'successful' was the change that DeltaCo made in the mould they used. They adopted the use of a redesigned mould that allowed them to increase the number of components produced per mould. Another similar example, but that was deemed 'unsuccessful', was CignaCo's decision to change to using a different mould. Rather than resulting in improvements to productivity, the new mould led to unexpected increases in material loss.

Based on these discussions the representatives from AssembleCo encouraged the four suppliers to continue their Kaizen activities in the search for greater efficiency. Further they set targets for the four suppliers, such as increasing mould life, increasing the automation of their operation and continuing the use of MFCA analysis. However, rather than giving common targets to all four they gave specific and different issues with related targets to each supplier to concentrate their improvement activities on. Part of the justification for these individual targets was that the representatives from AssembleCo, as part of their normal, ongoing commercial relationship, would regularly visit, independently, each of the suppliers' factories. They noted that support for these individual efforts would always be available. In response to this suggestion the President of CignaCo urged that they consider having common issues that all five organisations concentrated upon and, thereby, collectively pooled their resources towards solving. As part of this he made a direct request to the representatives of AssembleCo to share with all four of the suppliers their organisations design sheets of either the parts being produced or the mould they were using to produce the components. The senior managers from AssembleCo who were in attendance rejected this request outright. They stated that they did not want to share all the issues with all the suppliers, but rather wanted to have different issues with individual suppliers. They backed up this decision by noting that it was impossible, in their view, to have a focus on common issues between all five organisations as the moulds and production processes used differed significantly between them. This discussion was brought to

a close through the raising of the issue of patent ownership. A representative from DeltaCo asked the question of which organisation would have the ownership of a patent when the collaboration in the MFCA project resulted in an innovative solution to an issues. To this question no consensus could be reached.

At the conclusion of this meeting the Production Manager of AssembleCo announced that he was going to retire from AssembleCo at the age of sixty years old, which would occur next April. He had been a critical supporter of this project both through his leadership but also through his influence as a member of AssembleCo's board. Thus the representatives from all five organisations had a discussion about the continuation of the inter-organisational MFCA project after the retirement of the Production Manager. In announcing the retirement of the Production Manager the person to succeed him in this role was not disclosed.

5.7 The death of the MFCA project

Despite the impending retirement of the Production Manager, activities related to the project, continued. For example, on the 15th of February 2013 the President of AlphaCo made a visit to the factory of AssembleCo in Indonesia. This visit was prompted by the Senior Managers of AssembleCo suggesting that AlphaCo expand through buying and setting up their own Indonesian based factory. Hence the president of AlphaCo visited AssembleCo's factory in order to investigate whether the Indonesian economic situation favoured their expansion into manufacturing there. Based upon the visit the President of AlphaCo took the decision not to set up a factory there. The reasons given by the President included rising operating cost and poor infrastructure. Further, AssembleCo did not commit to ordering any of the components that AlphaCo would make there, despite the recommendation of setting up there made by their senior managers. As stated by the President of AlphaCo this suggestion, with no corresponding confirmed orders, created doubts towards the intentions of the senior managers of AssembleCo.

The Production Manager formally retired as a regular employee of AssembleCo in April 2013. An arrangement was made so that he became a temporary employee so that he could remain as an observer to the project. A new senior manager was appointed in his place. However, the new senior manager only had the responsibility for the procurement department. That is, the new Procurement Manager did not have the broad span of responsibilities of the old Production Manager, including not being appointed as a member of AssembleCo's board. He did take over as the leader of the MFCA project, with his first

engagement with the project being as an observer at the February 2013 meeting at AlphaCo's factory.

In April 2013 the new Procurement Manager invited the representatives from the four suppliers to a meeting where he delivered a presentation about AssembleCo's procurement policy for the fiscal year of 1 April 2013 to 31 March 2014. The presentation began with the announcement that there would be another formal meeting to discuss these plans with all existing suppliers, not just these selected four, in June. The current meeting was utilised to inform the representatives that AssembleCo would return to a policy of sourcing components from a broad range of suppliers. As part of this the new Procurement Manager signalled that there would be a reduction in the amount of resources invested in developing new moulds. Specifically they would be looking to repair existing moulds rather than developing and making new moulds. He stated that this would mean that suppliers would no longer specifically need the technical abilities to develop their own moulds.

A pivotal meeting was organised by the Production Manager and the new Procurement Manager on the 17th of May 2013 at the headquarters of AssembleCo. The Production Manager extended the invitation to this meeting beyond direct members of the project to powerful (Latour, 1986) members of AssembleCo, including board members and senior managers or other departments. The key part of this meeting was the presentation made by the Production Manager, now acting only as an observer. Specifically, he presented his argument for the importance of the MFCA project, including an explanation of the significance, purpose and target of the project. This included stating that the project did not only focus on procurement problems but rather issues that permeated across the whole company and argued that the solutions to these issues would more easily be found with cooperation from the four selected suppliers. He finished his presentation by strongly urging that the decision should be made to continue to invest time and resources into this project. Despite these arguments made by the Production Manager, subsequent to this meeting the new Procurement manager took the decision to dissolve the MFCA project. As such a few concluding meeting were held with the four suppliers to bring the project to a conclusion.

6. Analysis, discussion and conclusion

In the above section an overview of the project that formed the focus of this case study was provided. As with the case study in Coad and Cullen (2006) the inter-organisational project developed out of an intra-organisational dilemma. That is AssembleCo had identified, through the use of MFCA, three possible means of making improvements in the material loss within its processes. These were technical issues within operations that required redesigning products and procedures, internal capital investment issues that required new engineering or equipment, and issues caused by their suppliers' product or design. Out of the three the last was decided upon as it was seen as the best option in that it required the least amount of investment and change to be undertaken by AssembleCo.

In setting up the project AssembleCo selected three of its current suppliers and one other supplier whom it wished to forge a commercial relationship with. In selecting these four suppliers AssembleCo excluded a further seventeen suppliers. This was a deliberate strategy adopted by the Production Manager who had a programme that aimed to serve AssembleCo's interests by reducing the number of suppliers to just a few. In this sense the MFCA project was a means for making the suppliers understand (and thereby controlling) what their roles would be within the planned future state. However, while the suppliers went along with this it is important to note that they did so as long as it aligned with their own motivations. As Callon (1986) notes, we must be aware that it is often a fine line between support and treason.

The use of MFCA and the resulting inter-organisational project was undertaken by the Production Manager in relation to his programme for managing and controlling the suppliers operations. However, the enrolment of MFCA was to put in place a means by which the Production Manager could influence the supplier's actions without it being a direct intervention (Miller, 1991). MFCA and the project were sufficient to interest (Callon, 1986) the four suppliers who engaged with the Production Manager's programme. Further, supplier selection was based on them not being in direct competition in regards to supplying to AssembleCo. Hence the Production Manager programme was designed to provide a steady platform of suppliers who co-operated with each other in order to maximise their collective outcomes. All four suppliers, however, did have similar processes and on some occasions did compete to supply components to other companies. What the Production Manager overlooked in setting up the project and selecting suppliers is

how they interacted beyond their relations with AssembleCo. This opens up a multitude of unknown potential motivations of the representative from the four suppliers in participating in the project. This in turn did not necessarily mean that each of these representatives was motivated by the same benefits as promised by the programme of the Production Manager.

Specifically, the Production Manager utilised the benefits, such as cost savings, from the technical qualities of MFCA to interest the representatives from the suppliers to participate in the project. Further the Production Manager referred to how MFCA was known as an 'environmental management accounting' device (Kimura & Nakajima, 2014) and the utilisation of experts to make it understood that the use of this calculative device could result in a reduction in the environmental burden caused by their supply chain[15]. In the initial stages of the project the actions of the representatives from the suppliers suggested that they were participating based on these potential benefits of cost and environmental burden reduction. This can specifically be seen in the drawing up of the agreement between all of the actors involved. In effect this agreement should have provided the basis for all involved to understand what the project was aiming to achieve and how all would have benefited.

As the project progressed though the technical attributes of MFCA were not sufficient in themselves to attain all of the predicted benefits from the project. What is striking is that most of the project meetings did not seem to focus per se on the technical output of MFCA but rather broader issues of interest to those involved. Thus, rather than the MFCA calculation producing 'matters of fact' it opened up a whole stream of 'matters of concern' (Latour, 2005). For example, many of the representatives from the suppliers became interested in using this project as a means of discovery of how the other suppliers gained their competitive advantage in producing their products. This was seen, for instance, in the examination of AssembleCo's production process within China, where the representative used stop watches and magnifying glasses in their efforts to gain such knowledge. Hence the project centred on MFCA did result in learning across the supply chain but not in the intended or expected way. Hence, the introduction of the MFCA project produced multiple effects (many of which were surprising or unexpected) that created many other types of changes. Here, however, unlike in many other examinations of the introduction of a management control, the calculative device, MFCA, remained stable and constant.

These multiple surprising and unexpected effects created tensions, which in turn resulted in a reordering of relationships between all the actors involved and the programmes of specific actors resulted in the eventual abandonment of the project. That is, once the Production Manager retired, his successor made the decision to abandon the project based on the risks and potential costs in relation to his own aims, goals and purpose rather than those of AssembleCo. Thus we see that management controlling may be driven in turn by any number of motivations, only some of which will be aligned with the broader interests of the organisation concerned. So while the project may have been labelled as 'unsuccessful' by many of the actors involved, its major outcome was a reorganisation of the relationships between the organisations involved. Hence, while MFCA was promoted for its technical abilities, its enrolment produced other effects that meant the benefits of cost savings and to the environment were all but forgotten.

Perhaps most striking was that within the agreement that was written up and within the activities that occurred as part of the project there were no discussions of how any benefits that materialised would be shared. That is, if cost savings were realised there was no discussion or agreement over what portion of these benefits would be accrued to each organisation that was involved. The exception to this was the discussions around who would own any patents or intellectual property that arose from the project. However, even these discussions concluded without resolution. Again there could have been a multitude of reasons and motivations for this. For example, actors within AssembleCo know how much material it supplies to their suppliers and then how much it orders in components. Hence, just like Archimedes, behind the scenes they can calculate the material loss and savings to be gained from reducing this. Related to this is that the suppliers need to pay for the materials they source from AssembleCo up front. Therefore, if they can reduce the amount of materials used then they can gain the immediate benefit from this without the need to distribute the benefits.

This demonstrates that the use of management controls, such as MFCA, which hold out the potential for win-win situations within a supply chain, will not automatically result in a linear progression (Quattrone & Hopper, 2001) to these promised benefits. In examining the actions of the Production Manager it can be seen that he never relied upon a rational review of the costs and benefits associated with the project, including those that related to the technical aspects of MFCA. Rather the decision to start the project was as a result of the Production Manager downplaying the potential issues that may result. Instead he focused on and

promoted the project through stressing the benefits that would be derived for AssembleCo. These included the closer relations with a few key suppliers as well as the cost and environmental benefits derived from MFCA. However, upon his retirement so many aspects of the project were still not solidified or made durable. This meant that for the manager that succeeded him the potential of issues arising was still visible, particularly given the issues that had already arisen. This is best demonstrated with reference back to the suppliers visit to AssembleCo's factory in China. The learning of AssembleCo's processes that had occurred gave the potential, real or not, for the suppliers to imitate what they observed. This was compounded by the new manager being in the earlier stages of his career at AssembleCo. As such his own success was far from settled and may have been compromised by a project that had not lived up to initial expectation. He therefore took the decision to abandon it within a short time of taking on this new role.

Out of all the actions outlined above it is not possible to conclude which were motivated by the intended influence of the enrolled management control. Specifically these actions may have been motivated and influenced by other actors, things or reasons that just happened to produce effects and outcomes that may erroneously be attributed to the management control. What was definitely within the witnessable practices examined were a multitude of motivations that produced different outcomes than those that aligned with the programme of the Production Manager. This can be seen within the trip to China. The discussions of the representatives of the suppliers focused on how to do business there rather than the furtherance of exploring the technical abilities and benefits from the use of MFCA. However, it must be noted that the Production Manager did reactively engage with this as a means to interest (Callon, 1986) the representatives from the suppliers to engage with the project.

This suggests that a focus on witnesable practices (Rawls, 2002) can provide knowledge that is unable to be sourced through interviews of the actors and their interpretive understandings (Alvesson, 2009). However, the above discussion demonstrates that care should be taken in trying to derive motivations of actors even when they are stated within an interview. Regardless, the above strongly suggests that management controlling is always a precarious process that will not automatically result in the implementation of the desired programme. Hence future research must take care not to just report 'successful' use of management controls. It must also engage with the multitude of questions that arise from a focus on episodes that can be labelled as 'unsuccessful'.

In relation to this, the above demonstrates that the inclusion of many, disparate actors will increase the potential number of competing objectives and motivations at play, which in turn may result in many unintended or unexpected actions being undertaken by those that are the object of control (Justesen & Mouritsen, 2011). This can be seen in that the outcome of this project was a reorganisation of the relationships between the organisations involved. Initially this had been one of the goals that the Production Manager had set for the project. However, it had planned to utilise the project as a means of establishing durable relationships with high quality suppliers that would have long term benefits for its own operations. To a certain degree it had been 'successful' in achieving this goal as can be seen, for example, in the establishment of a commercial relationship with BetaCo. However, what had not been anticipated was that the bringing together of these four suppliers would result in their interacting together. The result of this interactions were many unexpected outcomes, such as the co-operation among these suppliers to achieve better commercial performance in respect to supplying to other organisations other than AssembleCo. This highlights the impossibility of management controlling all outcomes and demonstrates that the more actors that become involved the greater the complexities that arise in attempts to try to do so.

This example clearly illustrates that the power of those that are attempting controlling are always only *in potentia* with the many actors being the target of this power holding it *in actu* (Latour, 1986). Hence, in line with Chua's (2007) discussion of strategy and strategising, the above suggests that the extant knowledge would benefit from a move in focus from management controls to management controlling.

Notes:

1. All company names and people involved have been given a pseudonym to protect their identities as agreed by the researchers when undertaking this research.
2. In making this comment it is acknowledged that there is a large literature; (for example see Alcott, 2005; Holm & Englund, 2009); that critiques this viewpoint. Specifically it is argued that calculative devices, such as MFCA, that focus on efficiency in resource use, a relative measure, actually encourage increases in consumption, in absolute terms, of that resource. This paper does not aim to enter into this debate but rather acknowledges

this as the perspective of those that were the spokespeople for the MFCA project, which is the focus of this research.

3. The exchange rate calculation is based on ¥175 per £1.
4. Plastic injection moulding is "the process by which objects are formed when a plastic material is fed through a nozzle into a mold where it is held until removed in a solid state, duplicating the cavity of the mold." (Sapene, 2007, p. 172). Within this process the mould is "the cavity, core, and base components that comprise the tool in which a plastic part is formed or molded." (Sapene, 2007, p. 173)
5. Thermosetting plastic "differ in that they are not re-mouldable. Strong cross links are formed during the initial moulding process that give the material a stable structure. They are more likely to be used in situations where thermal stability is required. They tend to lack tensile strength and can be brittle." (from http://www.lgschemistry.org.uk/PDF/Thermosoftening_and_thermosetting_plastics.pdf accessed 9 September 2014) Parts that are used in automobiles and electronics often need this kind of property due to being close to other parts that produce significant heat, such as the engine of a car.
6. It is worth noting that at the time the project started BetaCo didn't have any factories in China or the Philippines.
7. "Thermoplastics can be made 'plastic' and malleable at high temperatures. Modern thermoplastic polymers soften anywhere between 65 ºC and 200+ ºC. In this state they can be moulded in a number of ways: They differ from thermoset plastics in that they can be returned to this plastic state by reheating. They are then fully recyclable." (from http://www.lgschemistry.org.uk/PDF/Thermosoftening_and_thermosetting_plastics.pdf accessed 9 September 2014)
8. AssembleCo often loans its moulds to their suppliers who do not have the skill set available within their organisation to make their own moulds. In these situations AssembleCo pays the supplier for the cost of the material and the cost of producing the part but not for the depreciation costs that are associated with the mould.
9. These are common issues that result from MFCA analysis (Nakajima, 2011; Nakajima & Kimura, 2012).

10. Kaizen in general is a system of continuous improvement utilised and customised within Japanese organisations. Refer to Imai (1997) and Brunet and New (2003) for further details.
11. Within this industry it is routine behaviour to carry a magnifying glass. It is used to make random checks on parts coming off the production line. These checks are necessary as buyers will inspect whether there are scratches or cracks on the parts. Hence, magnifying glasses are used in checking quality as buyers demand damage free parts.
12. Material loss is defined in ISO14051 as the following; "all material outputs generated in a quantity centre, except for intended products NOTE 1 Material losses include air emissions, wastewater and solid waste, even if these material outputs can be reworked, recycled or reused internally, or have market value. NOTE 2 By-products can be considered as either material losses or products, at the discretion of the organization." (International Standard Organization, 2011, p. 3)
13. Kanban is a technique developed by Toyota and is a means of using cards (the Kanban) within a large scale manufacturing facility to coordinate the flow of work-in-progress inventory (see Mitra & Mitrani, 1990 for further description).
14. Tact time is the time to produce one unit of a product. Tact time is calculated by "daily operation time / daily volume of production".
15. Again it is acknowledged that there is a substantial literature that demonstrates the opposite happens in practice. That is, it has been known since the industrial revolution that relative gains in efficiency in using a resource result in increases in the absolute level of use of that resource. This is known as Jevon's paradox or within modern ecological economics as the rebound effect. Hence any efficiency gains made through the use of MFCA are in practice more likely to result in increased environmental burden rather than less. However, for the purposes of this paper what is important is that the actors within these organisations utilised efficiency gains as an argument for reducing environmental burden (also see note 2 above). Further, the debate about the potential for such calculative devices to assist within supply chains (see for example Kogg & Mont, 2012) is not addressed within this research.

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