Making routines the same

Making Routines the Same: Crafting Similarity and Singularity in Routines Transfer

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Abstract

Building on theoretical advances in Routine Dynamics, complemented by insights from Science and Technology Studies, we conduct an in-depth, longitudinal inquiry into how organizations are able to (re)create the 'same' routine not despite but within a pervasive background of difference and multiplicity. We draw on a three-year ethnographic study of the exact transfer of a high-end computer and production facility at a leading US organization to show how routines are enacted into being the same. In contrast with the literature, which sees replication as the one-directional implementation of an accessible and available origin template at destination, we theorize transfer as the simultaneous co-creation of routines across multiple sites. In so doing, we show how routines similarity and singularity are the (emergent, skilful, effortful and always temporary) outcomes of repairing and distributing practices, and their sociomaterial assemblages, which coordinate multiple enactments of the routine within and across locations. These micro-level practices underpin routines emergence and persistence as well as acting as the basis for the emergence of dynamic capabilities.

Keywords

Routines, Transfer, Replication, Similarity, Singularity, Multiplicity, Sociomateriality.

Introduction

The question of transfer, especially in its more disciplined form of replication, is an important topic not only in itself but also because it provides a "relatively

transparent window" (Winter and Szulanski, 2001, p.741) on routines and routine dynamics. Replication, a widespread means for organizations to multiply the advantages of their own innovation through reproducing the underlying 'golden formula' - and related repertoire of routines - at different geographic locations (Nelson and Winter, 1982; Winter and Szulanski 2001; Winter et al. 2012), provides in fact valuable opportunities to explore some of the fundamental questions about the nature of routines and their role in performing organization(s).

Despite the innovation and organizational scholars' increasingly attention towards the limits to transferring "reliable routines" (Nelson and Winter 1982, p.131), including the obstacles to reproducing "imperfectly understood, and partly tacit" routines at new locales (Winter and Szulanski 2001, p.731), however, we are still short of a full account of the deeper organizational mechanisms that support the dependable transfer of routines in the presence of substantial organizational complexity and environmental uncertainty.

To fill this gap, we depart from the extant literature's prevailing focus on simple organizations such as food and fashion franchises (Winter and Szulanski 2001, Winter et al. 2012), to build on the premise that simple cases represent only one extreme end of the replication spectrum. In more complex cases, as the one analysed here, environmental uncertainty combined with template complexity may be so substantial that they may call into question the very assumption that routines could be replicated successfully, or indeed at all. How might it be possible for organizations to accomplish this seemingly impossible exploit?

In our quest to explain replication in cases where similarity matters but is difficult to achieve, we begin by asking two pressing questions. First, how are organizations able to replicate routines reliably in conditions of high uncertainty and complexity? And, second, what does that tell us about the organizational dynamics that underpin routines' emergence and persistence?

To answer these questions we build on recent work in Routines Dynamics (Feldman et al., 2016), which has highlighted the value of taking a performative approach to transfer and replication (D'Adderio 2011 and 2014; Aroles and McLean, 2016; Blanche and Cohendet 2019, Boe Lillegraven 2019). We adopt

Feldman and Pentland's established definition of routines (2003, p.96), but modify it to account for both human and material agencies. We therefore define a *routine as* a *repetitive, recognizable pattern of interdependent actions, involving multiple actants* (instead of simply *actors*). As dynamic, generative systems routines are constituted and reconstituted through the interaction of a 'performative' and an 'ostensive' aspect which we refer to respectively as 'performing' and 'patterning' (D'Adderio 2014, Feldman et al. 2016) to underscore the inseparability of a routine's ostensive definition from its enactment.

In so doing, we characterise transfer as the effortful reproduction (Winter and Szulanski 2001) and dynamic recreation (D'Adderio 2014, Blanche and Cohendet 2019) of routines at new locales. This involves the re-creation of a template ("a relatively successful outlet that could be regarded as the guiding example", Winter and Szulanski 2001:734) and the underlying sociomaterial (Orlikowski and Scott 2008) practices and arrangements that sustain it, at new organizational locations. Studying replication in this manner requires a methodological approach which favours deep and extended forms of empirical investigation.

To capture the micro-level dynamics underpinning routines replication we therefore draw from the longitudinal, ethnographic study of the exact transfer of a high-end supercomputer, including its entire manufacturing facility and all the associated routines, at a leading US technology organization. Here we have captured the depth and variety of routinized performances and their emerging patterns as enacted by different routine participants through a wide range of observations and interviews. These were conducted at multiple organizational sites, levels of the organizational hierarchy and transfer stages, resulting in an in-depth and longitudinal study of routines transfer and replication.

In response to our challenging context, we start from the theoretical premise that, in the presence of complexity, it is not *difference* across routines that needs to be explained but *sameness* (Latour, 1986). This calls for focusing on how routines and their underlying patterns might be recreated (precisely) within a background of difference and multiplicity. Building on insights from

the field of Social Studies of Science (Law, 2004; Mol, 2002), we therefore attend to the actions and action patterns which help coordinate the transferred routine's difference and multiplicity into a similar and singular pattern.

Our findings show how a routine's similarity (across site enactments) and singularity (the 'same' routine) are the constantly emergent outcomes of the effortful and dynamic processes through which sustaining practices - and their sociomaterial assemblages – are coordinated, across contexts and over time. These findings allow us to theorize how organizations are able to replicate routines closely in conditions of high uncertainty and complexity - where even the template itself may not be fully accessible and available - thus adding to the mainstream Replication literature. Findings also contribute to Routine Dynamics by capturing and theorizing the sociomaterial practices that create and modify routines, thus underpinning the emergence and persistence of routines similarity and singularity.

Transferring routines: from replication to transformation

Routines transfer as replication

The issue of routines transfer and replication has developed over the past decades into a key topic that has been attracting increasing attention in the fields of Routines, Innovation and Organizational Theory (Argote and Darr, 2000; Bartlett and Ghoshal, 1989; Williams, 2007; Winter and Szulanski, 2001; Winter et al., 2012). A well-known and -documented strategy (Winter and Szulanski, ibid), and an important means for organizations to reap the scale benefits of their innovation by reproducing it at multiple locations (Winter 2010), replication has been implemented widely, and with substantial success, across an increasing number of organizations, including retail franchises, banking and financial services.

Despite its widespread adoption and demonstrated effectiveness, however, replication has proven much more challenging for organizations than initially assumed. While early approaches to transfer based on Diffusion Theory (Rogers, 1995) have in fact postulated the uncomplicated replication of an innovation across geographic sites, scholars in Innovation, Organizational and

Routines Theory have progressively emphasized the uncertainties and ambiguities involved in replicating a successful template.

Nelson and Winter (1982), for example, address this issue by highlighting the potential sources of unreliability in the imitation of routines, including the "potential for variation found in routines as they spread across different sites and types of activities" (in March 2008:157). The root of the problem had been initially captured by Winter (1971 and 1975), who, building on Alchian (1950, in Becker et al., 2006) had emphasised the 'reproduction via imitation' of rules of behaviour, while calling for "[…] consideration of the imperfections of search and imitation" (360).

Similarly, Nelson and Winter (1982) highlight how organizational routines are opaque, rather than transparent, due to the largely tacit character of the procedural knowledge enacted in routines. Thus practitioners might be enacting a routine proficiently, despite being unable to explain the rules they are following as part of their performance. Routines opacity means that transfer is "*not* [simply] a matter of implementing fully explicit blueprints" (ibid, p.119, *emphasis in original*). For this reason, the "close (let alone perfect) replication" of routines across organizational boundaries is often "quite problematic" (ibid, p.118). The "[…] template provided by the existing routine may not yield a good copy" (p.121) and we should expect some 'mutation' as a result of transfer.

The issue of template opacity is later developed in Winter and Szulanski (2001, p.731) where the formula is described as "a complex set of interdependent routines" in which at least "some of the knowledge may be tacit". Since transferring the routine is not the same thing as "copying the how-to manual" (734), a certain amount of exploration is required upfront in order to unearth the 'reliable formula' to be transferred: the routine's pattern is - at least partially - unknown and must be discovered before the effective exploitation of the template can take place.

While presenting issues for franchises, uncertainties become even more substantial in more complex cases, where innovation happens so deep and fast that there is a high chance of the template being immature and fluctuating, and therefore unreliable. This, for example, is the case of high-end computers,

whereby an entirely new architecture is typically introduced every four years, and substantial incremental improvements every two. In these cases, the lack of "reproductive reliability" (March 1999, p.137) could easily mean that capturing and replicating routines closely becomes difficult, if not downright impossible.

In more complex contexts, the loss of replication accuracy is in fact particularly problematic, due to the template's instability and, at best, partial availability. In these cases, even a small modification can precipitate an avalanche of unintended changes which may affect performance in ways that it is impossible to fully predict and understand (Winter and Szulanski, 2001). The act of capturing and closely reproducing the template in these circumstances becomes more difficult (the threats against achieving similarity are substantial) but also more important (even small changes can imply vast performance variations).

This raises a conundrum for scholars of routines and replication. The logical consequence of acknowledging the combined and distorting effects of uncertainty and complexity is the inability to explain how the close replication of a template and its underlying routines could ever be possible. In some cases, there may not even be such a thing as a reliable template which is ready to copy and transfer, despite the full availability of codified manuals and rulebooks. Given that, in complex contexts, any modifications - no matter how small - may have large scale consequences, going back to our research questions, we ask: how can organizations ever manage to replicate routines reliably? And what are the consequences of this for how we understand and theorize routines? To answer these questions we require a theory able to explain how organizations might manage to squeeze a deeply unreliable world into a (at least partially and temporarily) reliable replica.

Routines transfer as transformation

In parallel with the Replication debate, another strand of Organizational Theory begun to experiment with the idea of a 'performative' perspective, which sees transfer as more akin to creative transformation than mechanical reproduction (Czarniawska and Joerges, 1996). Borrowing from Latour (1986), these authors question the validity of the early theories' (e.g. Rogers 1995) assumption of transfer as the one-directional, self-propelled diffusion of a solid, singular entity

(e.g. a given technology or innovation) across organizations. According to Latour (ibid), the diffusion assumption sees the feature to be imitated as "a *given* phenomenon, something that is objectified [and] immutable born with some impetus that propels it across a social area or space with various degrees of resistance" (50, *emphasis in original*). Imitation as performatively defined, he argues in contrast, is a process in which something is *created* and *transformed* across a chain of 'translators' which help adapting the object or idea to fit the new context and therefore support its materialization. In Latour's model of translation, thus, "the spread in time and space of anything – claims, orders, artefacts, goods – is in the hands of people; each of these people may act in many different ways, letting the token [routine] drop, or modifying it, or deflecting it, or betraying it, or adding to it, or appropriating it" (1986, p.267). For this reason, an object, idea [or routine]'s "faithful transmission […] is a *rarity* […] and if it occurs it *requires explanation* [ibid, *emphasis added*].

Building on this line of thought, Routine Dynamics scholars have more recently begun to theorize transfer as a form of recreation, involving the simultaneous (albeit selective) performation of contrasting goals, such as replication (the close reproduction of a template at a new site) and innovation (the adaptation of a template to a new locale). In her ethnography of transfer, for example, D'Adderio (2014) shows how replication, even in the most demanding form of 'copy exactly', always involves the *dynamic recreation* of the template at the new site. In this case, replication is achieved by enacting the template and associated routines through heterogeneous socio-technical or sociomaterial assemblages (Suchman 2007, Orlikowski and Scott 2008, D'Adderio 2008), which are heterogeneous agentic arrangements including material artifacts and organizational communities. This work highlights how the reliable replication of routines to a new site, especially in conditions of high complexity and fast innovation, can never be taken for granted, but must be instead constantly sustained through enactment. The emergent notion of enactment implies "the claim that relations, and so realities and representations […] are being endlessly or chronically brought into being in a continuing process of production and reproduction" (Law 2004: 159).

Aroles and McLean (2016) add to this argument by showing how the repetition of even the most highly standardized routine always involves recreation. In their analysis of ink quality in newspaper printing, they show how even simple processes of repetition - which underlies the production of quality standards - rely on complex acts of translation. In so doing, they build on Latour (1999)'s notion of translation which is "displacement, drift, invention, mediation, the creation of a link that did not exist before" (179) to show how the production of ratings and marks into numerical data can be understood as the product of many different repetitions and translations (Aroles and McLean, ibid).

Recent studies in Routine Dynamics (Blanche and Cohendet, 2019; Boe Lillegraven 2019, Aroles and McLean, 2016; D'Adderio, 2014), have therefore highlighted how replication always involves continuous and effortful recreation, even in the most exact transfer conditions and simple, controllable environments. In so doing, however, they have left a gap in the theorization of the actual practices enacted by organizations for the purpose of creating and sustaining similarity in the presence of substantial difference.

In this paper we aim to fill this gap by drawing on research in Science and Technology Studies which has addressed the topic of similarity and difference from an alternate perspective. Building on Latour and Woolgar's classic study of laboratory life (1986 in Law 2004), reframed through a realist lens, Dutch philosopher Anne Marie Mol has argued for a shift from a static, *representational* view of 'objects', which takes similarity and singularity as givens, to the *performative* emergence of the object itself, through organizing difference and multiplicity (2002). Her work is particularly apt at capturing how different practices create, perform, or are constitutive of (Orlikowski and Scott, 2014) different objects. It is through practices that objects, or realities, are enacted into being the same (similar and singular) despite their intrinsic difference and multiplicity. Mol reflects on the substance of objects, which are not seen as solid entities whose identity proceeds action, but as realities enacted (constituted in and through action). Thus atherosclerosis, the focus of Mol's study, despite manifesting as a singular object (disease), is instead made up of a number of objects (blood vessels, limbs, tissue under the microscope) produced at different enactment sites or locations.

In Mol's framework, a 'site' or 'location' is where a specific version of atherosclerosis is being enacted, or brought to life, by specific sociomaterial assemblages. Sites, therefore, are not physical locations, although they might occur within specific organizational settings. For example, a consulting room (Mol, ibid) is one of those sites, where the surgeon uses her skills to identify similarity relationships between a patient's symptoms and physical manifestations of atherosclerosis. The assemblage enacting or performing atherosclerosis here includes the patient and the consultant's bodies, the consultant's experience, and the patient's story of her symptoms. Another site is the pathology laboratory, where the atherosclerosis is measured in terms of the artery vessel's thickness. The assemblage enacting this version of atherosclerosis includes the pathologist, the fridge containing an amputated foot, the microscope, and the thickened vessel. The multiple enactments of atherosclerosis at the various sites are similar, Mol argues, but only partially overlapping and therefore need to be coordinated in order to produce 'the same' disease, a single atherosclerosis. This framework, we posit, affords new ways to examine the problem of routines similarity and singularity, in the context of transfer, and beyond.

Similarity and singularity are two key concepts in Mol's analysis. Similarity is a process which involves "find[ing] or mak[ing] a pattern against an endless background of noise" (Law, 2004:109). The process of enacting similarity therefore is a form of ordering whereby similar(ity-sustaining) patterns are separated from those implying difference. In Mol's example, the body of a patient in the surgeon's consulting room may not present typical evidence of atherosclerosis, but the surgeon is able to use her experience to establish similarity with other patients who had the disease, which enables her to diagnose the patient with atherosclerosis (Law, ibid). This suggests that similarity patterning is a skilful and dynamic process.

The related notion of singularity (Mol 2002) also involves a dynamic process, one through which similar - and only partially overlapping - enactments of reality (routine) may be coordinated into being the same. In advancing her view of practices, bodies and diseases as multiple, and of singularity as emergent, Mol criticizes the widespread representational ontology which assumes that

there is one single, solid version of reality 'out there' (one routine), over which actors in different places have different views or perspectives. Translating to routines, this means that we are not dealing with a single routine, but with a number of similar routines which can be ultimately made into 'the same' routine through coordinated enactment.

Bringing Mol's insights into routines transfer, this means starting from the assumption that a transferred routine is not (automatically) the same as the origin routine from which it is copied. It might become 'the same' (ontologically singular) only if similarity-patterning practices at various sites are established which (re)enact it into being the same. This, in our case, involves capturing and theorizing the mechanisms organizations develop in order to ensure that 'the same' routine may be recreated. This is particularly important in complex cases, where even very small deviations from the template can risk generating an entirely different routine (with significant implications for performance).

This calls for the need to investigate what these mechanisms may consist of, and how they may help achieve and sustain routines similarity and singularity, an endeavour which is important beyond transfer, as it can shed new light over the heart of routines and routine dynamics. While the extant literature has in fact theorized the existence of 'dynamic routines' (Nelson and Winter 1982), 'dynamic capabilities' (Teece et al. 1997) or 'routines that change routines' (Dosi et al. 2000), we still know little to date about what these routines might look like and how they operate (Wenzel et al. 2020).

In our quest to explain (the emergence of) similarity and singularity, we are now able to reframe our main research question as follows: how can we explain the close replication of routines - and their underlying patterns - in conditions of complexity, where similarity matters, but is strongly challenged? In other words, what are the deeper organizational mechanisms through which routines are made – and remain - the same? And what do these say about how we theorize routines? This endeavour, we suggest, implies shifting our attention to the practices, actors and materials that support the emergence and persistence of similarity and singularity across routines during transfer and beyond.

Methods

Context

To gain new insights into the reliable transfer of routines within a complex and fast changing context we are going to focus on three 'enactment locations' which are drawn from the long-term ethnographic study of the exact transfer of a supercomputer at a contemporary high technology organization. The company is a world-leading innovator operating in high-end electronics. Its products include software, hardware and storage solutions aimed at corporate, mission critical clients ranging from banks to hospitals. The transfer project involved the replication of the computer and related manufacturing facilities from the US manufacturing site to their newly built UK factory.

Servers are high-performance and high-reliability machines used to provide a range of services across a network of computers (e.g. they can host databases, files and web email). They are individually configured to contain several printed circuit boards (in our case up to thirty-six), based on their performance and customer specification. The work of building and testing a computer server involves many different layers of procedures which typically range from high level (e.g. the 'testing routine', or 'shipping routine') to micro level (e.g. how to insert a pin on a circuit board in a clean chamber). Complexity in this case was also related to the need to replicate precisely a highly standardized, high reliability production facility to a new geographic location.

Due to the complexity of the transfer, the organization chose to undertake a 'copy exactly' approach originally devised by microchip manufacturer Intel (Winter and Szulanski, 2001; Winter et al., 2012), involving the close reproduction of the template, and all related routines, to a new locale. The motivation behind this choice was a previous transfer, which had relied on a much more flexible methodology, ending in failure and causing loss of reputation and revenue. Implementing a copy exactly methodology meant that everything had to be kept the same across transfer locations, including product, process, facilities and people (their roles and training).

Data collection

The data was collected as part of an in-depth, longitudinal study of the transfer which lasted for a period of three years. During this time we were resident academic researchers at the UK production location. Throughout this period we spent several days per week on site, where we had been given full access to people, activities, tools, facilities and archives. Observation and participation mostly involved day shifts, occasionally continuing into evening shifts to allow us to cover some of the US and UK meetings and those shop floor activities which took place beyond standard UK working hours. The academic project enjoyed full support at the Directors level, and the data collection was facilitated in every way possible, including free access to premises on an unrestricted basis, enabled by the provision of a microchipped company ID card and a corporate email account. Safety clothing including especially designed boots and coats were provided for visits to the production area. US shop floor activities were directly observed with weekly regularity by means of teleconferencing technologies. These allowed us to observe routines as they were enacted in real time at the US location. Direct observations were complemented by video materials recorded by UK techs while visiting the US premises, as well as the notes technicians compiled as part of their own data collection work.

During this time, in addition to the observations, we conducted a total of 36 in-depth, semi-structured interviews with both UK and US employees. Interviews were conducted for the purpose of recovering information about activities and decisions which had taken place outside the period of observation (e.g. before the start of transfer, or after). The sample of informants was selected to cover most organizational functions (i.e., project management, product engineering, test engineering, analysis, training, production, manufacturing) and levels (directors; product, process, and project managers; engineering, manufacturing and test managers; information technology managers; failure analysts; test and shop floor technicians) (Table I - Interview Protocol Sample). Interviews lasted from half an hour to three hours and were fully recorded and transcribed and supplemented by additional evidence including paper and online notes and documents, diagrams, sketches, flowcharts and presentation slides. Copious notes were taken during formal and informal interviews and were all duly typed

and filed. The large amount of data collected (occupying four drawers in our office filing cabinet, and amounting to about 10,000 pages) provided the basis for an unprecedented ethnographic study of replication, in its most demanding form of 'Copy Exactly'.

The motivation for this writing project came from the finding that the transfer had been a success, despite the substantial complexities involved in capturing the template and reproducing it precisely at the new location. The destination product, according to the tests conducted at the end of transfer, had in fact shown the same performance as the machine at origin. This result had been mostly unexpected. Despite the extremely regimented nature of the transfer, the widespread impression across the teams and the sites had in fact been one of substantial drift. Targets had been so complex and local circumstances so variable that - until that point - there had been little confidence in the reliability of the transferred template. Let's examine the reasons behind this perception.

The template at origin had been difficult to capture due to the extraordinary complexity of the interactions it entailed, some of which were not readily available for inspection (first source of ambiguity). For this reason, the routines capture process had yielded ambiguous results which, despite the exacting efforts and sophisticated tools involved, were only partially codified into the shared online corporate database (second source of ambiguity). Moreover, participants had been aware of some adaptations which had occurred in the process of reconstructing transferred routines at destination (third source of ambiguity). All in all, our practitioners appeared to have reproduced an adapted copy (once removed), of a partial representation (twice removed) of an ambiguously specified template (three times removed).

Given the complexity involved in the transfer, the organization and the product being replicated, the outcome of the test (measured in terms of machine performance, see also Donmez et al. 2016) had therefore surprised the transfer teams, so much so, that it had prompted an investigation into the validity and credibility of the results. How could such a complex transfer have resulted in a copy that was so similar to, if not exactly the same as, the original? How had

they managed to (re)create a reliable replica, and all associated routines, despite the vast extent of complexity and uncertainty involved?

The fieldwork strategy we adopted entailed following closely the unfolding actions in the field. Specifically, this involved tracking the management and engineering investigation that followed the counterintuitive result. For this purpose, we opted for a 'detective' approach which consisted in following the investigation as it unravelled. This entailed 'following the problem' as practitioners went about trying to find the reasons for the unexpected result.

The investigative approach led us to identify three main organizational 'enactment locations', identified by our data, where routines were being performed and tested against similarity to the template. These heterogeneous 'sites' (Mol 2002, Law 2004) were the loci of routinized enactments taking place in a number of physical and virtual (technology-mediated) settings. After having identified the three key enactment locations which were the focus of the investigation, we proceeded to scrutinize closely all data related to the enactments of routines at those locations.

Data analysis

The analysis of the data was conducted inductively in accordance with the principles of 'grounded theorizing' (Glaser and Strauss, 1967). We began by analysing the data and inductively compiling it into a longitudinal and in-depth case study (Eisenhardt, 1989; Miles and Huberman, 1994). We were initially driven by the striking empirical narrative and begun by focusing on the relevant quotes, starting from the meeting described above and the ensuing investigation. After that, we started pulling quotes out of the data which belonged to the three enactment locations covered by the investigation (Table II – first order quotes and observations). We started by analysing the first-level field quotations (Van Maanen, 1979) in an iterative manner, scanning the data for recurrent concepts and themes, and consolidating these into emergent categories (Orlikowski, 2002, Gioia et al. 2013). The analysis uncovered some important dynamics as yet unreported in the routines literature.

The unfolding patterns in the field data progressively indicated the emergence of sets of actions corresponding to specific ways in which practitioners were addressing similarity and difference at the selected locations. In the process of developing our theorization, we proceeded to evolve and label these emergent patterns through notions borrowed from Routine Dynamics (Feldman et al. 2016) complemented by theoretical sensitivities from the field of Science and Technology Studies (Mol, 2002, Law 2004).

In particular, we adopted and extended Mol's own methodological approach, *praxiography*, which she devised to capture the enactments which produce - or craft - her object of study (atherosclerosis). Praxiography, in Mol's definition, involves exploring how similarity and singularity are constituted in practice within a background of difference and multiplicity. This involves, first, focusing on the various sites at which an object of study is enacted, to identify the practices that perform similarity and singularity; and, second, capturing how the versions of the object produced at each sites are coordinated to produce a single object (in her case, a single atherosclerosis). In this paper, we develop Mol's approach to study the emergence of similarity and singularity at specific enactment locations by extending it to the context of routines and transfer.

We thus proceeded by evolving our emergent first order codes through the above-mentioned theoretical framework. We were able to identify two main patterns in our data (Figure I – Data Structure) which, using labels derived from our field, we named *repairing* and *distributing*. The first emergent pattern (*repairing*) consisted in a dedicated set of activities which practitioners (and the wider sociomaterial assemblage including their tools, instruments, goals and beliefs) performed with the aim of closing down any gaps and reducing or - wherever possible - eliminating dissimilarity between routines at different locations. The second pattern to emerge from the data (*distributing*) alerted us to the presence of a set of activities which practitioners (and the wider sociomaterial assemblage) performed with the aim of embracing and distributing difference and multiplicity.

A first set of field quotes and observations (first order, Figure I) pointed to three kinds of activities and patterns aimed at repairing differences across locations.

Coevolving - and further refining - our original field labels through Mol's theory (see also Law 2004) we labelled these *layering* (reducing difference by adding new – formal - layers of information), *translating* (reducing difference through migrating idiosyncratic ways of working to match the original example), and *narrating and storytelling* (reducing difference through sharing informal knowledge about differences across locations).

A second set of field quotes and observations (first order, Figure I) highlighted three further kinds of patterns and activities which practitioners performed with the aim of acknowledging but distributing differences which could not be aligned. Building on Mol (2002, see also Law 2004) we labelled these *creating exceptions* (accommodating difference through categorizing); *creating different objects* (deferring difference in time); and *locating in different places* (distributing difference across space).

We therefore proceeded to aggregate these labels into two distinctive sets of practices, *repairing practices* and *distributing practices* (second level codes in Figure I) which captured the actions and action patterns routines participants were enacting in order to address difference and multiplicity and produce similarity and singularity. More specifically, we named *repairing* those practices enacted with the aim of supporting similarity and singularity by reducing difference and multiplicity; and we named *distributing* those practices enacted to support similarity and singularity by embracing and distributing difference and multiplicity. The combination of the two sets of practices of repairing and distributing, and their underlying sociomaterial enactments, allowed us to capture and theorize the nuanced mechanisms developed by routines participants to support similarity and singularity through simultaneously embracing and renouncing difference and multiplicity.

Findings

In this section we proceed to illustrate how routines were made 'the same' not despite but within a substantial background of difference and multiplicity. We do this by showing how similarity was achieved through enacting a range of sociomaterial similarity-creating and -sustaining practices within and across

locations. To this end, we are going to, first, zoom in on the key organizational enactment locations where routines were being dynamically (re)created and (re)aligned. The three main locations where similarity and singularity were being simultaneously produced were the US shop floor, the Computer Model, and the UK shop floor (Table II). Second, we are going to focus on the sociomaterial practices enacted within and across each of these locations to highlight the dynamics by which similarity and singularity were enacted.

Enactment locations

A first key enactment of similarity and singularity was performed on the US shop floor. During the course of transfer, teams of UK technicians were regularly sent over to the US to learn in detail about all the relevant routines involved in building the computer server. Whilst on US premises, UK techs spent their time observing their US counterparts as they performed all production routines and subroutines involved in constructing the machine (assembling, testing, building, packing, shipping, etc.). The purpose of the observations was for UK engineers to learn how the various steps of the production process were executed directly from their US counterparts, and then copy and reproduce those performances precisely at their location. Performance variability here was related to the lack of formal technical training, the frequent alternation of the workforce, and a reliance on tacit/verbal knowledge transmission over procedural codification.

A second key enactment location, the computer model, saw US and UK technicians and engineers writing down all the performances that had been captured at origin through observation and then transcribing them into an online database. The computer model thus created was subsequently shared across sites thus acting as a common reference point which helped ensure that everyone was working at the same time on the same product/process definition. The online database ordered the step-by-step procedural knowledge by progressively breaking down the complex technical server specification from a high-level system description to increasingly detailed sub-system levels. Performance variability at this site was related to the lack of detail in lower-level process definition which created gaps that were filled by UK techs through experience and experimentation.

A third enactment location was the UK Shop Floor. This enactment saw UK engineers and technicians accessing on a regular basis the multi-level configuration of the new machine and the surrounding infrastructure from the online model which was available simultaneously on multiple screens scattered throughout the production floor. The prompt availability of the server specification, together with the ability to zoom into increasingly detailed layers of information were meant to facilitate the exact reproduction of this advanced supercomputer. Despite this, performance variations were also observed here, this time linked to the lack of fit with UK local conditions and constrains, as well as to different ways of working and solving problems by the local communities.

Repairing and distributing practices

The high extent of within- and cross-site variation turned copying the server precisely into a highly problematic endeavour. And yet, as by this point we all know, our practitioners ultimately succeeded in building what was – for all intents and purposes - a practically identical machine. How did they manage to copy exactly in the presence of such pervasive complexity and diversity? In the sections below we discuss the emergence of the two key sets practices – 'repairing' and 'distributing' – which were performed at each site with the aim of supporting routines similarity and singularity. In so doing, we highlight how those practices - and their sociomaterial enactments –helped make routines more similar and singular, therefore enacting routines into 'being the same'.

Repairing practices

The first set of practices, referred to in the field as 'repairing', included: layering, translating, and narrating & storytelling. *Layering* was about reconciling and negotiating any inconsistent or conflicting actions and action patterns which might undermine (a belief in) the singularity of the manufacturing process across locations, and therefore of the underlying routines. The practice of layering thus ensured that any instances of dissonance which might indicate that the process was not 'the same' had to be renegotiated until singularity was restored ('until there is only one process'). Under layering, any differences and variations detected were thus addressed as temporary failures or limitations

which could - and indeed should - be remedied in order to support (a belief in) a single process (or the 'same' routine).

An example of *layering* could be found on the US production floor. Here practitioners addressed the variability stemming from the lack of detail in routines description by intensifying their observations and producing new layers of knowledge which would help closing any leftover gaps in process definition. Such was the case of the 'board inspection' routine. The routine consisted in visually and manually checking materials - such as computer boards - for defects before scanning them into the production line. Here we observed how one technician might check a component for damage before testing, whereas another might skip the inspection, prompting UK techs to complain about the "lack of process repeatability" (internal document). For example, every time UK techs went across to the US, they discovered different portions of the process which had not been fully identified and mapped before. Layering in this case involved closing gaps in the process mapping documentation through the increasingly detailed observation of US practitioners, their bodies, their tools, and their stories, and by carefully annotating any new or discrepant details. As argued by the UK site training manager: "There have been some gaps in terms of the documentation. We have had to go back and drive people to write these down and maybe add something to each as they go forward".

Through *translating*, the second 'repairing' practice, diverging features of process were coordinated across locations by converting one into the other. This helped deal with controversies which arose out of idiosyncratic practices being enacted within individual transfer locations. Translating involved, for example, migrating one location's distinctive practice to match the practice at another location (e.g., changing the UK process to match the US template). There was also a hierarchical version of translating which concerned the subordination of a particular aspect of practice to another that supported singularity. Hierarchical orderings could change over time, as happened here in the case of the UK techs first submitting their knowledge to support the US template and 'gold standard' and later on being able to impose their view of the process.

An example of *translating* was identified at the Computer Model location. The Model indicated that different software testing tools were being used across production sites causing different 'virtual testing' routines to be executed in the US and the UK. In this case, supporting copy exactly required "[…] a conversion from [the UK] Virtual Online Testing System to the American Testing System, [a] *translation"* (UK test manager, *emphasis in the original*). The process of data translation across testing systems, however, created

opportunities for additional differences to be generated. In reaction, a new set of software scripts were formulated which helped 'translate across' (ibid) the two test environments thus preventing further drift amongst different software versions of the process.

Another example of translational practices, this time a hierarchical one, involved changing UK software tools to match US tools. An interesting issue, for example, was that the UK tools were state-of-the-art and already aligned with the global organization, whereas US tools were idiosyncratic and specific to the US: "[in the UK] we don't have [the same tools], […] so now we have to revert to those environments […] and integrate their practices into our own" (UK software manager). In the 'software testing' routine, for example, UK techs had to run the data through older tools used by the US team, instead of their own (more advanced) technology. In other words, the UK had no choice but to adopt the US tools for the sake of being the same, even though that meant effectively going backwards in terms of technology adoption maturity.

Yet another example of translation through submission was how the UK had been - from the outset and throughout the transfer process- subjected to the US machine performance standards, even though both sites thought it needed urgent improvement. In other words, the US performance as the 'golden standard' was not perfect, but nevertheless it provided the parameters against which practitioners could judge similarity and difference.

The third and final repairing practice, *narrating & storytelling* involved constructing and enacting coherent narratives about the singularity of the template and the similarity of the underlying routines. Through narrating, practitioners joined up all the different stories about the origin, online, and destination processes into one consistent account that supported (a belief in) similarity and singularity or 'sameness'. Narrating could also involve building argumentations to explain apparent contradictions which would have otherwise undermined similarity and singularity.

An example of a *narrating & storytelling* practice was how stories about machine repair were being shared at the UK location. Here narratives helped building relationships and overcoming differences across routines, sites and cultures. Some of the stories, for example, captured the perceived reasons underlying differences across locations. An example of this was how a US engineering manager - seconded to the UK – related a story about the 'political discussions' surrounding precisely how to detect and close differences: "There has been a lot of internal politics, [we found out that] we hadn't had acceptance in the way that we thought we had" (US project manager).

Another narrative captured how cultural differences across sites could be used to explain differences in process definition: 'There is a hidden element of the culture [...] at this factory [UK], there is no universal openness between functions [and this generates] cross purposes. Usually [in the US] it's out in the open, so there will be open conflict. Here it seems like it's very hidden" (US project manager). Thus, for example, during the course of the quarterly 'face to face meeting' routine, US managers would not hesitate to confront peers about a discrepancy. UK managers usually chose instead not to address potentially contentious issues in the open, preferring to deal with those before or after the actual meeting. Telling stories about cultural differences thus helped create reciprocal recognition and acceptance, leading to greater trust and willingness by UK practitioners to come forward in the open to discuss the rationales behind local decisions.

Distributing practices

In addition to 'repairing', we have identified a second set of practices which focused not so much on eliminating or reducing, but rather on accepting and embracing – and therefore learning to live with - differences. We named these 'distributing practices' as they helped harnessing clashes and inconsistencies through separating incompatible evidence of misalignment across space and in time. The additional set of practices, referred to in the field as 'distributing', encompassed: creating exceptions, creating different objects (in time), and locating in different places.

Creating exceptions involved dealing with differences which were deemed irreconcilable and could not – or indeed should not - be reduced or eliminated. This entailed identifying multiple, parallel and alternative versions of the process that could not be brought into alignment and treating them as exceptions.

At the UK location, for example, there were aspects relating to the localised supply chain which necessarily had to be retained, as well as Health & Safety rules. One such example of creating exceptions can be found in the 'machine lifting' routine, which entailed lifting, moving and lowering the server from one spot of the shop floor to another. In the US, this was done manually by technicians. In the UK this practice could not apply, as it was in conflict with local health and safety regulations: "[...] the weight of the individual components that go into [the server] exceed the UK weight legislation. It is designed over in the States, where this is not a consideration, they can have people lifting heavy weight. So [we had to] take on geographical legislation considerations, local constraints" (UK shop

floor manager). The solution here entailed using an especially designed lift which afforded legislative compliance with UK Health and Safety regulations.

Despite the unrelenting dedication with which practitioners tackled the 'process repair' tasks, a transition of this complexity was always going to raise challenges which prevented closing in on differences. For example, issues emerged due to clashes with other sections of the UK facility which pre-existed the transfer and were devoted to different product lines. In some cases, the interactions between the tools in the newly constituted UK replica factory, and those being used in other portion of the UK facility meant that fusing the US and UK systems was harder than predicted. This meant that exceptions had to be devised. In the example of the 'software testing' routine described above (Computer Model Location) testing engineers noted how: "[it is recommended that we] implement a separate instance of [test log software] in the new factory [...] I am not merging – no chance [...] it would jeopardize the system" (software test manager).

A second device enacted to address multiplicity by distributing was through the practice of *creating different objects*. In this case a single entity (process, product, facility) was separated and distributed over time into a number of different, standalone entities.

An example of this was the substantial pressure for improvements felt at the US location which stemmed from the perceived immaturity of the product and subsequent need to push for continuous innovation. This would have required implementing changes to the server performance specification which the US counterparts felt were urgently needed. Changes, however, would have required modifying the product and all production routines at source (the template), something which would never be allowed in a 'copy exactly' regimen. In a copy exactly context, improvement must in fact be avoided at all costs as it would inevitably cause drift across sites, ultimately making the transferred routines less like the template. This particular conundrum was resolved by delaying (much needed) improvements until after the completion of the transfer: "*now* we copy exactly, *later* we can improve" (UK process manager). The teams in this case agreed that any changes to the origin template should be delayed until after the end of transfer.

Another device used at the Computer Model location to address differences that could not be reconciled consisted in postponing the introduction of changes to the software testing environment. In the 'software testing' routine described above, for example, the decision was taken to delay the necessary introduction of a new, state-of-the-art and company-global virtual online environment until after transfer completion. For example, one of the managers explained that, while it might have been desirable to introduce local variations to the online environment in the present, they were not going to allow it to interfere with UK-

US alignment: “Over the years […] we can start marrying some of these [virtual testing tools], one at a time, just to get more synergy [but not right now].

A third and final distributing practice involved *locating in different places*. This consisted in placing contradictory actions in different places thus preventing differences from spilling over one another. For example, conflicting versions of process were placed in different locations so that the work could carry on simultaneously while avoiding the conflict that their coexistence would have generated.

Within the new UK facility (UK shop floor location), for example, there could have been opportunities for clashes generated by activities which might employ people working across all manufacturing units, such as the in-house supplier base, material delivery and packaging. Here, to avoid what they referred to as cross-factory ‘contamination’, a solution was found which involved partitioning people and facilities. Practitioners, drawing on the software vocabulary, named this ‘firewalling’: “Most people will be firewalled into this programme […] they won’t be working on to two different programmes and they won’t be affected by other programmes” (UK project manager). Separating activities, in this case, was achieved by clearly demarcating the shop floor space dedicated exclusively to the newly transferred facility with industrial yellow tape: “It helps to rope the area off, doing something psychological to separate, [something] that says ‘these are different areas’” (UK manufacturing director). An example is the ‘board rework’ routine which had to be moved outside the factory area, to a specific zone dedicated to supplier representatives. A failed board would therefore be extracted from the production flow, then carried out ‘outside’ the new factory area to the supplier area, and then would be brought back to the stack of fresh material once repaired.

Placing contradictory actions in different places allowed to prevent differences from spilling over one another. In another example (US location), we saw how engineers - who were known for improvisation and tinkering - had felt frustrated by the need to keep their performances unchanged in order to allow the UK to copy. In order to keep US engineers onboard, some micro adaptation work incompatible with copying exactly, was (temporarily) allowed to take place, as long as the different parties did not seem to occupy the same spot: “Engineers like to play in their sandbox. This means we cannot expect them to be always perfectly aligned [at least] in that space” (UK manufacturing manager).

Discussion and framework

Performing and patterning similarity and singularity through repairing and distributing

Our findings thus suggest that routines similarity and singularity did not exist before, outside of, or independently from the sociomaterial practices that produced them, but were repeatedly (re)constituted and (re)enacted in and through practices. Perhaps even more importantly, we found that similarity and singularity did not consist in the complete absence of, but instead productively encompassed, difference and multiplicity. At each of the three enactment sites, we have thus identified two sets of practices which helped maintain similarity and singularity at the expense of difference and multiplicity; and practices which addressed difference and multiplicity, while however not trying to eliminate them. The first set acts by reducing difference and multiplicity in favour of similarity and singularity, while the second operates by embracing difference and multiplicity but separating and distributing them across objects, space and time. This shows how, creating and sustaining practices which supported similarity and singularity, performed an essential coordinating role in allowing routines participants the discretion to take different actions and support different patterns while still referring to 'the same routine'. These practices, we have shown, were intrinsically sociomaterial.

Sociomaterial assemblages performing and patterning similarity and singularity

A range of sociomaterial features (e.g. artifacts, bodies, instruments, goals, knowledge and beliefs) performed key roles in 'repairing' the process at each location while helping establish and maintain similarity and singularity across locations. For example, recording assembly sequences on the US shop floor through textual description and (photo)graphic illustration of detailed actions such as manual assembly helped reconstruct the process by patching up leftover gaps in the computer model. Sociomaterial features were also crucial in enacting similarity and singularity through 'distributing practices'. For example, the bright yellow tape on the production floor helped separate neatly the two production facilities (the existing UK facility and the new factory) by

establishing clear physical boundaries which separated the existing UK factory, its people, objects and practices.

Amongst those features, a key role was played by the US 'performance standard'. Acting as a 'performative engine' (MacKenzie 2006), the standard supported similarity/singularity patterning through 'materializing' (Orlikowski and Scott 2015) the alignment goal into a highly visible and operationalizable form thus providing it with "a facticity [it] would otherwise lack" (Power 2019). In so doing, it acted as a critical feature in the translation or, more precisely, submission of the UK to the US standard. Through repeated enactment, the standard thus performed as an ordering mechanism supporting similarity and singularity from the very start of the replication process (acting as the ultimate target for the replication effort) to the end (helping to reach temporary closure in the replication process). Despite this, differences remained which overflowed the standard, leaving the process of alignment open-ended and potentially challenged by competing standards.

Enacting routines similarity and singularity through repairing and distributing

Finally, our overarching theme, obtained by evolving our emergent themes through Routine Dynamics, highlights how sociomaterial assemblages helped orienting routines (their patterns and performances) towards similarity and singularity through performing and patterning repairing and distributing.

A first observation here is that different and multiple performances and patterns coexisted across organizational sites throughout transfer. Close investigation of the emergent and unfolding dynamics revealed a plethora of sociomaterial 'repairing' and 'distributing' performances through which the copy exactly mandate was being enacted. Rather than undermining or invalidating copy exactly, counterintuitively, those performances and patterns provided the essential mechanisms for transfer to succeed. In other words, it was the sociomaterial enactment of repairing and distributing which ultimately helped turn an unreliable copy into a reliable replica of the original template.

A second observation is that similarity (across locations) and therefore singularity (the 'same routine') was constantly challenged. It emerged out of

multiple, and often only partially overlapping, sociomaterial enactments of the same routine at different (physical and virtual) localities. For example, we have seen how opportunities for continuous process, product and technology improvement were constantly challenging the quest for similarity and singularity. Despite our practitioners' widely held belief in the singularity of the production process (the painstakingly sought after, but deeply elusive, 'gold standard', Mol 2002), these qualities were always effortful, creative and highly precarious achievements. The multiple and diverse sociomaterial enactments of repairing and distributing, in other words, coordinated site performances of similarity and singularity, helping make routines 'the same', across locations and over time. Obtaining these results required a somewhat original and perhaps counterintuitive approach to studying routines transfer and replication.

Framework: towards a performative view of similarity and singularity

Our detailed ethnographic observation of a complex routines transfer project shows how organizations may be able to replicate routines closely, even in challenging circumstances. According to the extant theory (Nelson and Winter 1982; Winter and Szulanski 2001; Winter et al. 2012), the progressive accumulation of uncertainties and ambiguities, and the ensuing 'reproduction unreliabilities' (March, 1997 and 1999) which inevitably accrue as a template is copied and reproduced could have – or perhaps should have - seriously undermined any possibility of achieving its accurate reproduction.

First, the initial template was complex, opaque and unstable, and therefore difficult to articulate and capture. Second, the procedures and tools used to copy the template were less than infallible, and tended to produce an unreliable copy. Third, the processes through which routines were reconstructed at destination added another layer of unwanted distortion to the original template. All these sources of unreliability combined were likely to produce a highly inaccurate set of routines at destination, despite substantial efforts to copy exactly.

The progressive 'loss in translation' which occurred during the course of the transfer ought to have resulted in a flawed reproduction (once removed), of a weak imitation (twice removed), of an uncertain original template (three times

removed). This should have been as far from the goal of accurate reproduction as could be. But that is not what we observed. In our case, accurate replication was achieved right in the midst of high levels of uncertainty, complexity and ambiguity. By drawing on Routine Dynamics (Feldman et al. 2016), as sensitized by an STS-inspired (Mol, 2002; Law, 2004) view of routines, we are now able to theorize how our practitioners managed to address and resolve this apparent contradiction.

Our framework (figure II) illustrates the emergent and dynamic process through which this outstanding organization was able to 'make routines the same' through assembling, at multiple locations, arrangements of sociomaterial features which supported a range of repairing and distributing practices. These, in turn, enacted the performing and patterning of similarity and singularity within and across sites, leading to the emergence of similarity and singularity patterns and performances, and therefore routines. Our framework schematically illustrates how our practitioners were able to turn multiple and divergent actions and action pattern into 'the same' routine.

Contributions to theory

Based on the above evidence, we can now argue that theorizing the close reproduction of routines across diverse contexts can benefit from a deeper characterization of transfer. This entails going beyond simply acknowledging the presence of ambiguity and diversity, as it is the case in the replication literature, to examining the actual practices that (re)produce similarity and singularity. Zooming in on the ways in which a reliable replica is (re)created at a new location involves focusing on the actions and action patterns that repeat a routine into being (the same).

This is an endeavour which resonates closely with Latour's observation that, if or when similarity exists, it is a rarity which must be explained. Explaining similarity and singularity, in our case, meant that "…instead of looking for common patterns [we] look[ed] for differences and disjunctions" (Law, 2010, p.183). Once we chose to attend closely to the practices that underpinned

routines replication, we were able to identify how similarity and singularity were being performed over time and across different locations.

With our study we have therefore captured how routines participants, acting within wider sociomaterial assemblages, drew upon their knowledge and experience of similar versions of the routine to actively modify the routine and its patterns through the practices of repairing and distributing. In so doing, they were making routines at their enactment location more similar to the corresponding routines at other locations, therefore at the same time enacting connections across locations. This explains how routinized actions and patterns at each location were (re)configured through being continuously enacted and adjusted to similar routines at other locations. This in turn supports the emergence of a single, 'reliably similar' routine across locations. It was these simultaneous performations, and subsequent mutual adjustments enabled by the practices of repairing and distributing, which - ultimately – made routines 'reliably similar'. This suggests that routines similarity and singularity are not stable properties which exists before or outside enactment but are instead created and recreated *in and through* action. They are the constantly emerging outcomes of the simultaneous sociomaterial enactment of similarity- and singularity-patterning practices within and across locations.

On the basis of the above discussion, we are therefore now in a position to answer our main research question: the reliable transfer of routines can be usefully theorized by capturing the situated and distributed sociomaterial practices of 'repairing' and 'distributing' which address difference and multiplicity over time and across locations, ultimately ensuring that routines are made similar (across sites) and singular (the 'same' routine). Drawing on Routine Dynamics (Feldman et al., 2016), complemented by a range of STS sensitivities (Law, 2004; Mol, 2002), our theory adds to Routines Theory and Routine Dynamics by providing a more advanced and nuanced conceptualization of routines transfer and replication.

Replicating reliably where similarity matters

The early work on replication (Winter and Szulanski, 2001) has afforded pioneering insights into routines transfer. It has fallen short, however, of

explaining close replication in the presence of high uncertainty and complexity. In particular, we find that the first wave of replication studies (see Winter et al., 2012 for a review) - despite highlighting potential difficulties involved in routines transfer – does not stretch as far as explaining how imperfect, distorted and/or partial copies of the origin template might be able to generate the required "reliable routines of well understood scope" (Nelson and Winter, 1982, p.131) at destination. This is particularly significant once we consider how, in more complex and uncertain circumstances, not only the arrow core will be opaque (Szulanski and Winter 2001), but the template itself may be unstable and less than readily available, as in the case discussed here.

In this paper, instead, we started from the question of how organizations might be able to capture and transfer routines precisely, despite the inevitable and pervasive 'reproduction unreliabilities' (Becker et al., 2006; Levinthal and Marino, 2015; March, 1997 and 1999; Winter and Szulanski, 2001) inevitably involved. Our theory explains how this seemingly impossible task was made possible. In so doing, we were able to capture and theorize a routine's similarity and singularity as the constantly challenged and emergent outcomes of multiple coordinated sociomaterial enactments at various organizational locations.

Enactment locations include the transfer destination, the computer model, and the origin template, which is not simply 'discovered' (Winter and Szulaski 2001) but (re)created as it is being transferred. In contrast therefore with the current literature which sees replication as a one directional transfer of a template to destination we show how it is instead the outcome of simultaneous multi-site performations through which difference and multiplicity (at least in the short term) are coordinated and similarity and singularity created and sustained.

This finding also adds to the wider 'innovation diffusion' (Rogers 1995) and 'transfer of best practice' literature (Bartlett and Ghoshal 1989) by capturing the micro-level processes through which organizations manage the tension between maintaining the practice's integrity and allowing for (controlled) variation, an important gap in the extant transfer literature (Ansari et al. 2014). In our case we have seen how, while adaptation may be - in the long term - inevitable, and to a varied extent indeed desirable, organizations might go to great lengths to

preserve routines similarity in the form of alignment to the original formula, even when that means temporarily degrading to 'worse practice' (as in our case of de-standardization). This is because the hazards of modifying an imperfectly understood formula in complex cases might overwhelm the benefits of early adaptation.

Routines that change routines

A second important contribution of this paper consists in theorizing and capturing empirically the deeper micro level dynamics underpinning routines similarity and singularity, and, ultimately, routines emergence and persistence. Routines Theory has dealt with this topic under the heading of dynamic capabilities (Teece et al. 1997), an important construct which, however, has been so far mostly theorized as a high-level mechanism, assessed as an ex-post measure of performance.

Routine Dynamics has addressed the issue from the opposite perspective, namely by focusing on the enactment of those micro level practices which contribute to creating and modifying routines. For example, in the replication context, RD scholars have made progress by identifying the material instruments and distributed agencies that might contribute to supporting similarity through promoting stronger alignment to the template (D'Adderio 2014). However, we were still missing a theorization of the deeper dynamics by which similarity and singularity can be achieved.

In our quest to theorize routines similarity and singularity, we have uncovered the micro level practices that generate and sustain them, helping make routines 'the same'. Starting from the assumption that similarity and singularity – *if* and *when* they occur – must be explained, we have captured and theorized the practices organizations enact to address any gaps and inconsistencies and turn an unreliable copy into a reliable replica. In so doing, we have shown that what makes a pattern 'the same routine' is the continuous, effortful and dynamic work (Feldman et al., 2016) of repairing and distributing, involving continuously smoothing down differences and distributing multiplicity in the relentless quest for similarity and singularity.

An important implication to stem from this finding is that replication, even in the strictest form of 'copy exactly', involves not simply reducing but also accepting - and dealing constructively with - difference. Embracing difference is in fact not only *not* opposed to, but an intrinsic - if counterintuitive - part of the success of copy exactly. In confirming recent advances in Routine Dynamics concerning the simultaneous production of difference and similarity (D'Adderio 2014, Aroles and McLean 2016), this finding offers a deeper and more nuanced understanding of replication which points to sophisticated ways of organizing difference and multiplicity.

We can therefore conclude that the practices of repairing and distributing, acting as the micro-level organizational mechanisms that are responsible for creating and sustaining routines similarity and singularity, constitute the basis of dynamic capabilities. While these have been variously identified as 'change routines', 'dynamic routines' (Nelson and Winter 1982), and 'dynamic capabilities' (Teece et al. 1997, Dosi et al.2000) they have not so far been fully theorized or captured empirically. Our findings, based on routine dynamics, therefore usefully complement the capability view of routines (Parmigiani and Howard-Grenville 2011, Davies et al. 2018) by helping 'unravel the dynamics of dynamic capabilities' (Wenzel et al. 2020).

The sociomaterial assemblage as agentic unit

Another objective of this paper was to capture and theorize the specific agentic mechanisms which contribute to making routines 'the same'. Here we add to more recent contributions which, in their quest to remedy for the prevailing emphasis in RT/RD on human agency and interaction, have begun to address the central role of physical and digital artifacts in routine dynamics (D'Adderio 2011 and 2014, Sele and Grand 2016, Aroles and McLean 2016, Glaser 2017). In mapping the sociomaterial dynamics involved in replicating routines, we have thus theorized here the heterogeneous agentic assemblages (Suchman 2007, D'Adderio 2008 and 2011, Orilkowski and Scott 2008, D'Adderio and Pollock 2014, Glaser 2017) which are responsible for constantly tuning and retuning the routines' similarity and singularity across different locations and over time.

Specifically, we have observed how different assemblages may enact different, partially overlapping versions of the routine at different locations, versions which might be complementary or conflicting and need to be coordinated (in this case into being 'the same') and brought into alignment. This finding thus allows us to theorize "how different sociomaterial assemblages may perform the same routine", a gap in our understanding of routine dynamics (Feldman et al 2016, p. 511). Heterogeneous - and constantly shifting - sociomaterial assemblages are the agentic drivers which lie at the very basis of routines emergence and persistence, helping explain how these may be successfully enacted and re-enacted into being the same.

A particularly novel finding here concerns the central role played by the 'performance standard' within the sociomaterial assemblages. In addition to reinforcing the notion of the endogeneity of artifacts to routines, this finding allows to theorize the role of routines performance (their outputs, not simply their patterns) in replication. This adds to the Replication debate (Winter et al. 2012) which has so far neglected to incorporate the role of a routine's output as indicator of performance and measure of transfer success. It also adds to the Routine Dynamics literature (Feldman et al. 2016) by theorizing the sociomaterial mechanisms through which similarity and singularity enactments may be temporarily stabilized.

Routine dynamics and multiplicity

A final, but no less important implication of our theory is - to paraphrase Mol – that a routine is better understood as being 'ontologically multiple': fluid, made up of multiple, distributed, emergent, sociomaterial enactments producing a number of similar but only partially overlapping patterns, which need to be coordinated to generate 'a single routine'. This captures our final core contribution.

To say that the routine is multiple entails more than allowing for multiple ostensives (how participants view the routine) or performances (how they perform the routine) (Feldman et al. 2016). It is also more than allowing for the existence of multiple routines clusters (Kremser and Schreyögg 2016), or ecologies (Sele and Grand 2016). This is because these implicitly assume that we

are either talking about different ostensive views/performances of the 'same routine', or about entirely different routines. The routine in both cases is treated as being ontologically singular.

In our theorization, in contrast, we build on the notion of 'replication as recreation' (D'Adderio 2014) to theorize the routine as being ontologically multiple. Not unlike Mol's Zimbabwe bush pump, we characterize routines as ontologically fluid and only coming together as 'one routine' with great effort and as a temporary, challenged achievement. Studying routines as fluid patterns implies going a fundamental step further in unpacking routines dynamics. Now we can ask new questions such as: when is the same routine? How much can a routine change before it becomes another routine? And if it does change that far, how can it be re-stabilized, or brought back into being the same routine? And through which agential devices or mechanisms?

Conclusions and avenues for future research

In this paper we have theorized routines transfer and replication in a highly demanding context where similarity matters, but uncertainty and complexity are substantial and pervasive. In so doing, we have developed a framework which theorizes how routines are repeated into being similar and singular ("the same routine") through simultaneously enacting a set of repairing and distributing practices, which reduce and embrace difference and multiplicity. Similarity and singularity are the (temporary and challenged) outcomes of the coordinated, sociomaterial performation of repairing and distributing within and across different organizational sites and locations. The theoretical framework developed here may extend to supporting other scholarly endeavours aimed at capturing routines transfer and (re)creation in various, more or less demanding, and more or less uncertain contexts. Our novel approach to capturing the practices that create and sustain similarity and singularity through multiple sociomaterial enactment can open up entirely new avenues for future research within the field of routines transfer and beyond.

A topic of immediate significance for transfer, for example, is how (the need for) singularity and similarity may shift over time. This calls for further longitudinal studies which go beyond the early transfer and adaptation stages, the prevalent

focus of the extant literature. Another transfer-related topic of inquiry is how singularity and similarity can be achieved and maintained across different organizational structures and cultures. This would be particularly of interest, for example, in the case of organizational mergers and acquisitions.

Another topic similarly worthy of exploration would be how routines participants design and maintain similar and singular routines in contexts more dispersed and distributed than the one in our study. This for example could be the case of routine replication in project-based or virtual organizations. The question of the role of artifacts and materiality in routines transfer and replication also deserves further exploration, including the performance standard as objects of contention and organizational struggle, whose outcomes will inevitably shape routinized actions and patterns. A final - but not less important - object for future inquiry is how we may study a 'fluid' routine. In our case, it was the act of unveiling the UK performance results that made fluidity visible, prompting the engineers' investigation and our parallel academic inquiry, but there may be other methodological devices.

All of these topics promise to substantially and meaningfully deepen our theoretical and empirical understanding of routines transfer and replication, in complex contexts and much further beyond. They also warrant further investigation into the ontology of routines, a question which lies somewhat beyond the scope of this manuscript, but which identifies an entirely new and exciting agenda for the field of Routine Dynamics.

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Table I – Interview Protocol Sample

Interviews with Project Manager (destination site organization)

Name, position, role, department, division, site organization

Transfer

What are the drivers behind the transfer?
Why "copy exactly"? How do you plan to implement it?
What is the project structure? What is the timing for each phase?
What will need to be done with respect to product, processes, tools and facilities?
What are the success criteria for the project, for each phase?
How far should it be alignment? How important is it to be aligned? How feasible?
What are the criteria to establish whether and how far the sites are aligned?
Which are the processes to identify and deal with differences and exceptions?
What are the main characteristics of each site?
What are the differences and similarities across sites?
What are the potential obstacles you foresee (people, processes, product, tools, infrastructures)?
What are the potential benefits (financial, learning, etc.)?
Which tools, methods and resources are being put in place to facilitate the transfer?

Post-transfer

How far are you aligned?
What are the weak areas or obstacles? What is being done to remedy this?
What in your view has succeeded; what has failed?
Which tools, methods and resources are being put into place for this stage?
Have relationships/structures/cultures/ motivations changed and if so, how have they changed?
In the future should it be alignment or drift?
How important is it to stay aligned? How feasible?

Interviews with Lead Engineer (origin site organization)

Name, position, role, department, division, site organization

Transfer

How would you describe your organization/your product?
Can you describe how the decision to copy exactly was communicated/received?
What do you think about [destination]/copying / [origin]/ adopting your product/process?
How important is alignment with the other site?
How would you describe the status of your product? Process? Procedures? Tools? Facilities?
How do you identify/capture the processes to be transferred?
What kind of obstacles to transfer do you foresee? What kind of opportunities?

Post-transfer

How do you identifying differences in practices between [origin] and [destination]?
Are there still differences? Where are the differences located (which processes/process levels)?
Can we go through some examples of procedures that appear not to be aligned.
Can you describe these procedures to me in detail?
Can you explain how they are interpreted/executed at [origin] vs. [destination]?
What are the differences due to? How/when were the differences detected?
How far would you say that you are aligned at this point in time?
What is alignment going to look like in the future?

Figure I– Data structure

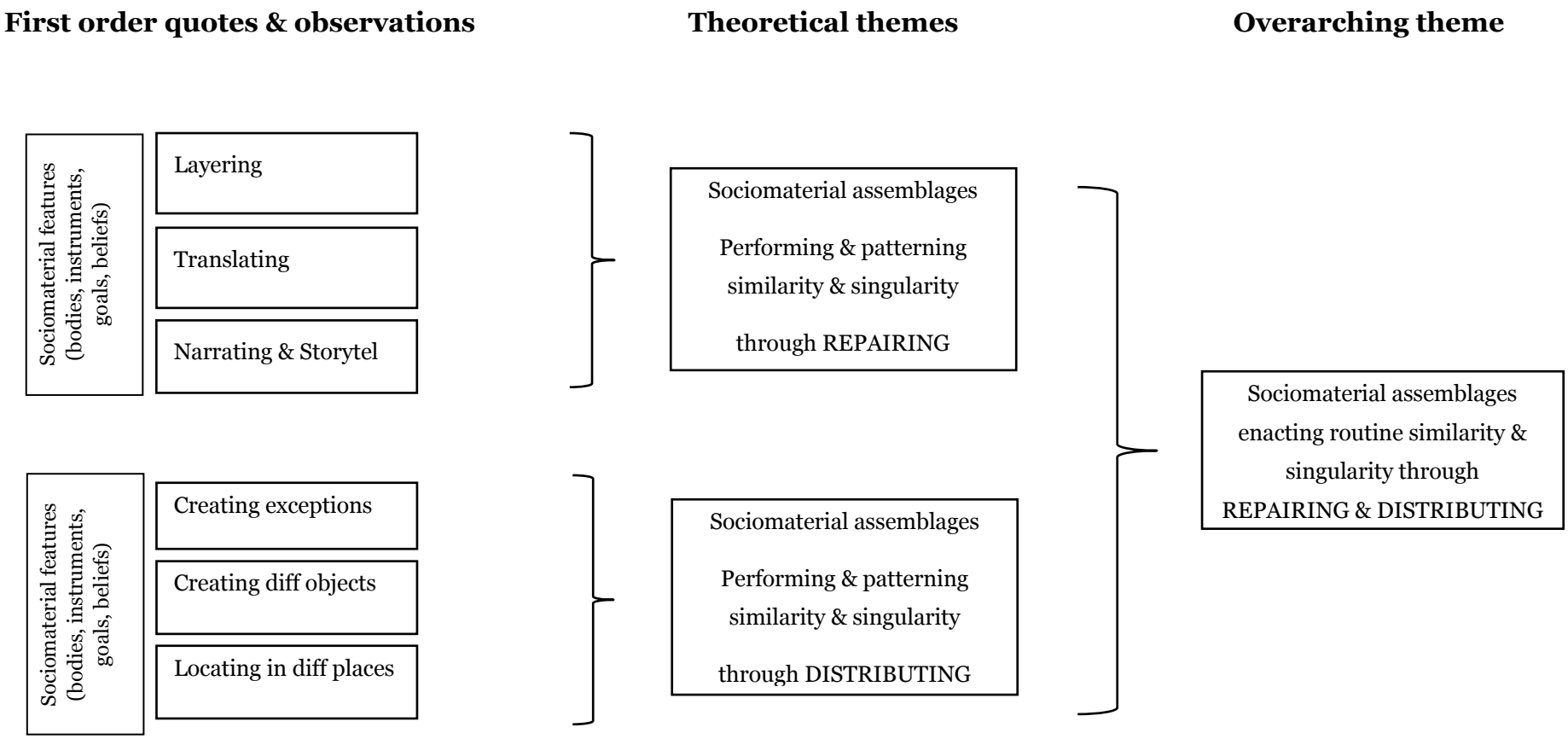

Table II – First order quotes (patterning) and observations (patterns)

LOCATION	US SHOP FLOOR
Theoretical themes	**First order quotes & observations**
REPAIRING	**Layering: adding layers of knowledge that help close gaps across locations** Practices enacted to find gaps in product/process definition and fill those gaps through acquiring new knowledge UK techs intensify their observations of US practices in order to gather new information to help identifying and closing gaps. Variability found in the 'board inspection routine' description. UK techs complaining about the "lack of process repeatability" (UK internal document). "There have been some gaps in terms of the documentation. We have had to go back and drive people to write these down and maybe add something to each as they go forward" (UK site training manager)
	Translating: turning one thing into another to support alignment Practices enacted to convert UK processes and labour structures into US processes and structures Differences between the 'assembly routine' as enacted in the UK as opposed to the US: "[In the UK] We have experienced techs who are able to do the whole assembly on their own and understand all the details of the machine…in their case [US] instead they have different guys to do bits of the process and this makes a big difference in how we do it" (UK technician) UK change their assembly routine to match the US. This entails reconfiguring the division of assembly labour in the UK to match that in the US. UK facility not aligned to US because the UK is ISO 9001 certified (whereas the US is not compliant). UK process de-standardized and migrated towards the (uncertified, and therefore inferior) US process: "We agreed that […] we will copy exactly what [US] are doing, [even though] that is not ISO approved (UK project manager). Initial resistance from UK counterparts against this move pacified by "…the realisation that [the discussion] had to be at a higher level. That it should be based on what is really important about consistency and inconsistency" (UK engineering manager). US capability performance output upheld as the 'gold standard' "[our company] has to work as one company. One process/one standard" (UK process manager)
	Narrating and storytelling: sharing knowledge to produce an overarching narrative Practices enacted to integrate partial and divergent accounts into a smooth, common narrative. Lack of process repeatability in the 'apprenticeship routine' as enacted on the US shop floor: "We have had a number of people out there. They have been working alongside somebody […] The issue that arises […] is that […] if there isn't a good relationship […] then the next person that goes to stay with that individual isn't getting the same instructions, […] the same exposure" (UK training manager). "Every time UK techs went to visit, they "[found] a different person and a different process" (US manager). "I've had two of my trainers up there for two months' stretches. They have been working alongside someone. That's probably another issue out there, that they rely on a 'people on the line' culture" (UK training manager). Techs comparing and contrasting stories about individual working styles through 'narrating' helps identify and reduce differences: "The […] instruction that we have received was working along with somebody else and asking them about those activities and the problems that come with the nature of the process…and then recording the answers"

DISTRIBUTING	**Creating exceptions: differences that cannot be aligned are turned into exceptions**
	Practices enacted to identify and manage exceptions across locations.
	Differences relating to features which could/should not be changed such as the localised supply chain and Health & Safety regulations were identified and retained as exceptions
	'Server lifting' routine: "[…] the [server] is getting so much bigger, that the weight of the individual components that go into it exceed the UK weight legislation. It is designed over in the States, where this is not a consideration, they can have people lifting heavy weight. So [we had to] take on geographical legislation considerations, local constraints" (shop floor manager)
	UK engineers building an especially designed lift to afford legislative compliance with UK health and safety practice.
	Creation of a dedicated administrative tool (the 'exceptions list') which helped identify and record all exceptions across sites, so that their individual influence on performance could be accounted for.
	'Training development' routine: "When we first started off […] we had to say that one of the exceptions is that [the US] does not have dedicated training development. The whole process is highlighted as an exception" (UK training manager).
	Creating different objects: separating incompatible objects in time
	Practices enacted to postpone incompatible actions and action patterns.
	'Continuous improvement' planning and executing routine: need for continuous process improvement in conflict with the need to copy exactly. Solution involves delaying (much needed) improvements until after the completion of the transfer: "*now* we copy exactly, *later* we can improve" (UK process manager)
	Locating in different places: separating incompatible objects in space
	Practices enacted to place incompatible actions in different spaces. Dealing with contradictory actions which could not be reconciled
	'engineering design routine': some adaptation work, incompatible with copying exactly temporarily allowed to take place as long as the different parties do not seem to occupy the same spot.
	"Engineers like to play in their sandbox. This means we cannot expect them to be always perfectly aligned [at least] in that space" (UK manufacturing manager).
LOCATION	**COMPUTER MODEL**
Theoretical themes	**First order quotes & observations**
REPAIRING	**Layering**
	Practices enacted to address any differences and variations detected in the database to support the emergence of a single online process (the same routine).
	Substantial differences detected in online product and process definition across locations: "There is a number of websites, but it is not easy to find where the most appropriate website is, we use the websites that [the US team] has put together, but where are the websites of the design group, the developers, the engineering group? […] There are websites and also an internal training group, but where are they?" (UK training manager)
	Search instigated to capture process information and add it to the shared online repository (online computer database).
	'failure recovery' routine: online solution flowcharts appears to be incomplete and dated. UK techs working to improve definition in the online data by "trying to break down that [available] information, trying to find those channels of information [to fill in gaps]" (UK training manager).
	Translating
	Practices enacted to translate UK software testing tools to match US tools.
	Different 'virtual testing' routines being used in the US and the UK required "[…] a conversion from [Virtual Online Testing System] [to the American system] to get our test infrastructure (test manager)

	[…]. So with this particular product there has to be some kind of conversion, *translation* (UK test manager, *emphasis in the original*). A new set of software procedures formulated to help 'translate across' the different test environments thus preventing further drift amongst different software versions of the process. Different production software tools being used across UK and US. UK tools state of the art and already aligned with the global organization, whereas US tools idiosyncratic and specific to the US location "We don't have [the same tools], we dropped them two or three years ago [to align with the global organization] so now we have to revert to those environments […] and integrate their practices into our own" (UK software manager). 'software testing' routine: to avoid potential misalignment threats which two different systems would have created, the UK decides to abandon its (more advanced) tools and adopt the US tools for the sake of being the same.
	Narrating and storytelling Material discursive practices enacted around the computer database aimed at unifying actions and interpretations. Practitioners work on repairing online process definition gaps and inconsistencies by sharing rich stories about failures and their subsequent repair. 'process diagnostic' routine: "[it] would be interesting to follow all the debates around different systems. [Be]cause there is a fair amount of conflict[ual information]" (UK head of diagnostics). US techs failure to release timely information about the process leads UK techs to surreptitiously copy an old and redundant version of the database. In the end they end up "getting everything wrong and having to start again" (UK engineering manager). […]when they came in April and they were presenting to some degree advanced work and probably 80-90% of it was wasted effort because, for example, they went into a corporate database where they maintained part number drawings and they used those to start to design test fixtures. But all the drawings in the database were obsolete […] and if they had asked us we would have told them that it was worthless exercise but nobody asked (US project manager)
DISTRIBUTING	**Creating exceptions** Practices enacted to turn the UK facility into an exception. Clashes between new replica facility and other sections of the UK facility which pre-existed the transfer and were devoted to different product lines. Tools in the new UK replica factory conflicted with those being used in other portion of the UK facility so that they could not be merged and exceptions had to be devised. 'software testing' routine: "[it is recommended that we] implement a separate instance of [test log software] in the new factory […] I am not merging – no chance […] it would jeopardize the system. We do not do user interaction with automated processes. Only [this product] is trying to do that" (UK software testing manager).
	Creating different objects Practices enacted to address differences that could not be reconciled by delaying or postponing the introduction of changes. 'Software testing' routine: decision taken to delay the necessary introduction of a new virtual online environment until after transfer completion. Managers explain that, while it might have been desirable to introduce local variations to the online environment in the present, they were not going to allow it to interfere with US alignment: "Over the years […] we can start marrying some of these [virtual testing tools], one at a time, just to get more synergy [but not right now]".
	Locating in different places Practices enacted to address irreconcilable differences by maintaining two incompatible systems running in parallel but separated in space.

	To protect the alignment between the UK plant and the US, while also managing the separation of the new UK plant from the rest of the UK facility practitioners agreed to maintain two sets of shop floor data gathering databases: "So in some cases we are going to be doing the same sort of thing but in different ways [from the rest of the factory], using different [software] tools that we a currently doing [on other products] so we are going to run two separate things but in parallel" (product manager)
LOCATION	**UK SHOP FLOOR**
Theoretical themes	**First order quotes & observations**
REPAIRING	**Layering**: Practices enacted at the UK shop floor location to close gaps in process definition (that is how the UK manufacturing process description differed from the template). Shop floor 'documentation routine': practitioners seek to repair procedures by learning how to detect and close gaps in process documentation "One of the issues was when do you say that 'I have a failure'. […] The issue was that [the definition of failure] wasn't implemented in the same way […] across the two sites. […] I think the challenge is going to be to identify [things] like that and try to incorporate them into the procedure" (UK project engineering lead).
	Translating Practices enacted on the UK shop floor to repair gaps and discrepancies in the process across sites by 'translating'. "I think there are things that were missed, there are things that were not *translated* across" (US engineering manager, *emphasis added*). Shop floor 'hardware testing' routine: failures not always detected at the same specific places in the manufacturing process and therefore not always treated identically across sites. "How do we expect a failure to get captured at a particular place in the factory [when it] hasn't necessarily been translated [across] in the way it should have been by engineering" (UK Engineering Manager) Practitioners highlighting the need for "Patching up things that were not translated across" (UK engineer). Translating viewed as core mechanism for process repair. ——————————————————————————————— Translational practice involving submitting UK standards to US standards. Towards the end of the project decision was made to make the US progressively migrate towards ISO-approved processes, in order to align with the rest of the UK facility. This reversed the early transfer stage decision to have the UK abandon ISO in order to align with the US process. The end of transfer sees work being carried out at UK shop floor to help the US begin to align to ISO: "[The] US are not going [immediately] for ISO approval, but the documentation they will produce will be ISO compliant. So when we get ISO certification a year later we will not have to redo the documentation" (UK product manager) 'ISO alignment' routine involved periodic formal verification in which ISO-style checks were initiated which helped standardize the entire [US] process according to ISO standard regulation. UK 'performance standard' submitted to (must be as good as) US standard
	Narrating and storytelling Practices enacted on the UK shop floor to share stories which help building relationships and overcoming differences across routines, sites and cultures. Some of the stories capture and harmonize the perceived reasons behind differences across sites. Engineering manager's story about the 'political discussions' surrounding precisely how to detect and close differences: "There has been a lot of internal politics […] we hadn't had acceptance in the way that we thought we had" (US project manager). Story about cultural differences across sites could be used to explain differences in process definition: "There is a hidden element of the culture here […] at this factory [UK], it is that there is no universal openness between functions [and this generates] cross purposes. Usually [in the US] it's out in the open, so there will be open conflict. Here it seems like it's very hidden" (US project manager)

	Quarterly 'face to face meeting' routine: US managers confront peers about discrepancies whereas UK managers usually chose not to address potentially contentious issues in the open, preferring to deal with those in a more informal setting, before or after the actual meeting. Narratives used to rationalize the presence of differences across sites. Shop floor 'data logging' routine: differences detected might be occasionally attributed not to actual errors or deviations but to differences in how the data had been logged into shop floor databases: "The only thing that could have potentially been different [...] is the way the data was put into the database in the first place" (US engineering manager) Efforts directed towards investigating and uncovering whether differences are actual or due to lack of precision/alignment in data reporting and recording. Repairing the process involves changes not only to the data itself, but to the way it is handled by the different functions or to how it is expressed through different tools (spreadsheets, online databases, etc).
DISTRIBUTING	**Creating exceptions** Practices enacted to turn irreconcilable actions into exceptions. The simultaneous presence of multiple production programmes and facilities in the UK as an important source of potential conflict and contradiction. To avoid overlap and or 'contamination', between the new and the existing facilities, they "agreed that the [entire] new factory would be an exception" (UK project manager). Turning the new factory into an exception meant installing the unit in an entirely new and separate build.
	Creating different objects Practices enacted to temporarily separate incompatible objects for the duration of the transfer. The new facility clearly separated from the rest of the UK production site: "We are going to split [...] the UK facility to allow copy exactly for this product transition" (UK manufacturing director). "Another way to say this is that there will be [two factories]: a multiple product line (the existing factory) and a new factory with a single product line. The new factory is going to be effectively another US" (UK project manager) All 'design and building' routines had to cater for, at the same time, copying precisely from the original factory blueprints and maintaining a neat separation between the old and the new factories for the duration of transfer.
	Locating in different places Practices enacted to separate incompatible objects and activities across space. Within the new facility there were opportunities for overlap generated by activities which might employ people working across all manufacturing units (in-house supplier base, material delivery and packaging). To avoid contamination, people and facilities were physically partitioned or 'firewalled'. "Most people will be firewalled into this programme [...] they won't be working on to two different programmes and they won't be affected by other programmes" (UK project manager) Separating activities by clearly demarcating the shop floor space dedicated exclusively to the newly transferred facility with industrial yellow tape: "It helps to rope the area off, doing something psychological to separate, [something] that says 'these are different areas'" (UK manufacturing director). 'Board rework' routine moved outside the factory area to a specific zone dedicated to supplier representatives. A failed board would therefore be extracted from the production flow, then carried out 'outside' the new factory area to the supplier area, and then would be brought back to the stack of fresh material once repaired.

Figure II– Theoretical framework