Self-optimizing systems are pervasive in contemporary global manufacturing. Many have an experimentalist character. In the process of experimentalist self-optimization stakeholder deliberation defines joint problems and establishes goals. Local actors are accorded discretion in the way in which they seek to achieve joint goals, but local deviations from agreed upon procedure must be defended and justified to central stakeholders. Successful local deviations can in this way filter back and redefine the range of possibilities that central stakeholder deliberations take into account in discussions of future problems and goals.

The best corporations in the world today apply this logic throughout their organizations, from headquarters to off-shore subsidiary and from top management suite to production level shop floor teams. A central mechanism for the diffusion of these practices throughout corporate organizations is the Corporate Production System (CPS) (Netland 2013, Netland & Aspelund 2010, Netland & Sanchez 2013, Netland & Ferdows 2014). Inspired by the original Toyota Manufacturing System, such team/stakeholder driven systems of formal procedures have transformed corporate culture today. Their experimentalist character enhances the capability of companies to negotiate uncertainty in their market and technological environments by encouraging organizational recomposition in response to challenges. When they are working properly, experimentalist systems foster and diffuse both organizational and technological innovation within companies and across supply chains (Helper et, al 2001; Sabel 2005, Spear 2009, Herrigel 2010, Herrigel et al 2013). As such, they enhance the competitiveness of manufactures in advanced political economies and induce continuous upgrading of producers and regions in emerging economies (Herrigel et al 2013)

The new recursive and transnational experimentalist systems have theoretically distinctive characteristics that are not captured in much of the existing literature on MNC governance1. In particular, Experimentalism involves a self-conscious departure from traditional principal-agent based governance systems (Nohria & Ghosal 1994, Birkinshaw 1997, 1999, Birkinshaw et al 1998). But the formal and recursive systems also are not captured by arguments that characterize MNC governance and innovation practices as the contingent political outcomes of intra-organizational clashes between different institutionally embedded players (e.g. Headquarters and subsidiary) (Dörrenbächer & Geppert 2011). Instead, we claim that the formal experimentalist governance systems create trans-nationally coherent, self-recomposing systems in which

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1 Although we have learned much from that literature: cf in particular Kogut & Zander 1992, 1993, Havila et al 2002, Kristensen and Zeitlin 2004)
neither center nor locality “controls” or “directs” either its own actions or those of the other. Experimentalism foregrounds mutual dependence and moves beyond theoretical debates about hierarchy and autonomy in the MNC. The new, formal and experimentalist governance arrangements are designed to manage (and optimize) growing global interconnectedness.

Movement towards experimentalism in corporate production systems is neither seamless nor uncomplicated (Netland & Federow 2014). Indeed, there are characteristic obstacles to the diffusion in practice of experimentalism’s recursive learning dynamics and the destabilization mechanisms that firms put in place in an effort to overcome these obstacles. Three sorts of obstacles are most common—hierarchical insulation, stakeholder exclusion and inadequate empowerment resources for participants. Interesting about these obstacles is that they exist not only ex ante, as firms attempt to construct corporate production systems and implement them throughout their global operations, but they also are continually regenerated by the experimentalist dynamics of the CPS’s themselves. The revision of commonly agreed upon frameworks frequently redefines power relations and stakeholders, creating new possibilities for insulation and exclusion. In order to prevent such obstacles from paralyzing the global process of recursive learning, the chapter shows that MNCs have developed an array of destabilization mechanisms that systematically undermine insulation and exclusion strategies within the global firm and reconstitute the deliberative experimentalist learning process. Interestingly, CPSs often contain penalty default mechanisms as part of the standard operating procedure which systematically monitor widespread deliberation processes for possible paralysis and, when finding it, impose a redefinition of the deliberative terrain in a way that re-starts deliberation (and learning) on a new basis.

The larger picture of manufacturing MNCs that emerges here is one of extraordinarily dynamic organizations (embedded in equally dynamic supply chains) characterized by recursive learning and chronic organizational disruption and recomposition. A snap shot picture of these organizations at any instant in time reveals complex admixtures of joint problem solving, team-based goal setting, hierarchical insulation strategies, and patterns of stakeholder in/exclusion.2 Viewed as a constantly self disrupting process over time, however, manufacturing multinationals emerge as dynamically recursive learning systems focused on permanent organizational and technological optimization and innovation.

The paper proceeds in three sections. The first outlines the global competitive and strategic conditions that have given rise to the construction of experimentalist governance architectures within manufacturing multinationals and their supply chains. Section two outlines the theoretical distinctiveness of contemporary corporate experimentalist

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2 This heterogeneity is reflected in the critical literature on corporate production systems. Critics point to the continued existence of hierarchical and exclusionary aspects of the system and conclude therefore that the deliberative and joint problem solving practices are superficial. CPSs are really new forms of hierarchical control rather than bottom up generated learning. As we will show below, this static perspective underestimates the recompositional fluidity of governance arrangements over time that the destabilizing mechanisms within CPSs generates.
architectures and describes how they work. In section three, characteristic obstacles are discussed along with a range of strategies and mechanisms that firms deploy to overcome those obstacles.

1.) Changing global demand and production location: The rise of emerging economies and the shift to “produce where you sell”

From a developed country manufacturing MNC point view, global opportunities for growth and expansion have shifted notably in the new century. For most of the twentieth century, the largest markets for manufactured goods were also the fastest growing ones. For US, German and Japanese manufacturers, this meant that the bulk of their exports and FDI efforts targeted the developed (western) European, North American and North Asian economies. This situation began to change in the last decade, however, and most forecasting agencies suggest that the new trends are likely to accelerate in the next several decades (cf Bergheim 2005, Trinh 2004, 2006, Dyck et Al 2009, Walter 2007).

For example, the Economist Intelligence Unit (2011) expects world real GDP growth to increase approximately 4% yearly between 2010 and 2015, but OECD country growth rates are expected to be only roughly 2% yearly, while non-OECD annual growth is expected to exceed 7% for the same time period. A different measure by the same institution shows that Asia (including Japan) is expected to grow twice as fast as the rest of the world over the same time period (Table 1). In the same vein, the German Chamber of Commerce estimates that China will go from having a third the number of potential middle class consumers as the United States (70 million to 236 million) in 2001 to having well over twice as many of those potential consumers in 2015 (700 million to 284 million) (Reinhardt 2009). The later number shows that while current trends represent a relative shift in the expansion of demand, rather than an absolute shift in its location, the quantitative levels separating the two markets are narrowing rapidly as well.

In many specific industrial product areas, from consumer electronics items and automobiles to hydro-electric turbines, the contrasting demand situations are quite dramatic. Developed markets have reached points of saturation where demand is primarily driven by replacement of existing product (when demand expands at all it is doing so in the low single digits), while demand for the same products in developing Asia or other Brics is growing in double digits. In the global electronic and electromechanical products, for example, Deutsche Bank Research shows that between 1998 and 2007 demand grew at a less than 2% rate in the US and Germany, while demand for the same products in developing Asia or other Brics is growing in double digits. In the global electronic and electromechanical products, for example, Deutsche Bank Research shows that between 1998 and 2007 demand grew at a less than 2% rate in the US and Germany, while demand for the same products in China, Russia, Indonesia and Malaysia exceeded 10% (Table 2). Similar imbalances can be observed in global machinery and automobile markets. In 2000, for example, the German Automobile Association (VDA) notes that developing countries accounted for just 22.3% of global automobile demand, but this percentage is expected to increase to 48% by 2020 (table 3). The picture is very similar in the machinery industry. The German Machinery Association (VDMA) shows that by 2011 China had emerged as the world’s single largest machinery producing country, selling nearly twice as many machines (of all types) — 230 billion Euros to 563 billion Euros — as Germany (Table 4). Our interviews with a German manufacturer of hydro-electric turbines revealed that the
company currently only sells replacement parts and components in Europe and North America. All of new global demand for turn-key hydro-electric generating complexes comes from Latin America, Asia and Africa.

These very significant relative shifts in manufacturing demand growth have resulted in a massive strategic shift in the relative weight of export vs FDI and in MNC strategies in developing economies. In short, emerging market demand growth has been so rapid, technologically challenging and quantitatively massive that it cannot be serviced through exports alone. Instead, firms have been forced to expand FDI and service demand in those emerging markets by “producing where they sell”. The shift has been very rapid: US non-financial FDI in China, for example, grew by more than 40% between 1984-2004, but off a very small base (Branstetter & Foley 2007 p 3). Given the growth of income and internal demand in China, however, NBER analysts estimate that levels of US non-financial FDI affiliate sales in China is likely to triple in the next decade (Branstetter & Foley 2007 p 9). Japanese, German, South Korean and Taiwanese non-financial FDI has followed a similar pattern (Japanese levels of China investment are slightly higher than those in the US; German, Taiwanese and S. Korean slightly less). Manufacturing has been the dominant form of FDI into China, and though rising Chinese wage costs have tempered FDI, most believe that China will remain a strong destination for manufacturing FDI for quite a long time.

Crucially, this shift toward producing where they sell involves significant offshore production operation upgrading. Competition for market share in growing markets such as China is intense and the sophistication of customers is developing rapidly. In order to be competitive, FDI manufacturers must pay attention to manufacturing economies and product quality. Moreover, the MNC affiliates must be able to offer products that appeal specifically to the needs and preferences of local customers and that are designed according to host country regulatory norms and standards. This presses manufacturers to upgrade local operations in three areas: production worker skill levels, supply base sophistication, and local R&D, design and engineering capability (Herrigel et Al 2013).

Foreign manufacturing MNCs have invested significant resources and have received remarkable support from, in particular, Chinese regional governments for vocational training. Initially, low wages made it possible for MNCs to deploy less automation in their production and assembly processes, but as skilled wages increase, so are levels of capital intensity and technical sophistication in production equipment. Local facilities have significant discretion regarding how labor and production is organized (and there are often significant differences between products made in home countries and those made in offshore locations.

Analogous processes of upgrading are occurring in emerging market supply chains. The key change here is that both MNC supplier firms, as well as indigenous emerging market suppliers active in transnational supply chains, are shifting their attention away from transnational activity and seeking, instead, to embed themselves in emerging market production networks oriented toward domestic rather than foreign markets (Herrigel et Al 2013). MNC supplier firms, such as Robert Bosch or Magna, follow their customer’s FDI
activities to exploit their familiarity with the customer’s production systems and benefit from new business in emerging markets. At the same time, such firms assume a teaching role for their customer’s by developing the capabilities of indigenous suppliers. In China (or in Central Europe), there are many quite capable indigenous suppliers, with considerable experience in continuous improvement, lean practices, and collaboration with customers from many years of participation in transnational supply chains. These indigenous customers are normally process specialists without the ability to deliver a proprietary component of their own (i.e., second tier or below in the supply chain), so they must only be socialized in the particular practices of customer corporate production systems. It is a matter of learning the language and practices of customer interface.\footnote{First tier MNC suppliers specialize in this kind of socialization. At the same time that they attempt to develop the indigenous supply networks for their MNC customer subsidiaries, they also seek to insert themselves into the supply networks of their customers competitors—e.g., Magna tries to get business in China with Geely or Hyundai and in that way provide diverse (less dependent) business for its China operations.}

R&D, product design and engineering capabilities upgrading in offshore locations is an extremely dynamic and important aspect of the overall upgrading process. The key here is the need to adapt existing products, developed in the home market, to the specific conditions of the emerging market. Increasingly important, especially in big Bric markets, is the need to develop original products tailored specifically for that home market (Brandt & Thun 2010). In both cases, pressure to improve the local engineering competence of subsidiary operations intensifies. Home country engineers do not understand intricate foreign customer desires or product usage idiosyncrasies. Nor can they easily identify or understand the constraints on product design generated by host country regulations and standards, which apply not only to the product being designed, but also to the materials that are used to make the product. Use of local engineers for these tasks is increasingly inescapable. Firms in the automobile supply chain as well as in the machinery industry are all developing R&D capacity in large emerging markets, in particular China, to enable them to cope with these challenges.

For the most part, the R&D competence being developed in emerging market locations is focused on applied operations: testing locally generated designs, exploring the possibilities of local materials, re-engineering components or manufacturing techniques developed in the home market for use under the different emerging market cost and material conditions. MNC machinery producers and automobile suppliers, above all, develop local R&D capacity with this character. One German drive train technology MNC created a central R&D center in Shanghai (with over 200, mostly Chinese, engineers), which worked on the issues outlined above, always in intimate contact with engineers in the firm’s local Chinese production facilities. Engineers in the Shanghai R&D center, in turn, were in continuous contact with the R&D staff located back in the MNC central operations in southern Germany. Central R&D provided more foundational design input and also served as a clearinghouse for design information that the firm’s other global R&D operations and production subsidiaries generated.

We found similar R&D arrangements at firms manufacturing computer numerical
controllers, stationary drives, hydro-electric turbines, high speed rail drives, construction equipment and a wide array of automobile components. This general division of labor between central and local R&D, moreover, appears to be characteristic of both German and US manufacturing MNCs. Japanese (and Korean) firms tend to centralize R&D far more in the home market and rely on expatriate engineers in offshore locations to achieve adaptations (Speed 2009).  

Expenditures by developed country overseas facilities have expanded very significantly in the last decade. The US has been the global leader in industrial R&D since WWII. The amount of R&D that US MNC manufacturers perform outside of the US has been steadily increasing. In 1999, US MNCs spent 12.6% of total R&D expenditures outside the US. By 2008, that percentage of offshore R&D had increased to 15.7% (about $37.0 billion) (US Bureau of Economic Activity, 2012 p 4-26). Within that shift toward offshore R&D, there has also been a pronounced shift away from developed to developing market R&D investment. According to the US Bureau of Economic Activity’s Science and Engineering Indicators report from 2012:

“The combined share of Europe, Canada, and Japan as hosts of R&D by U.S.-owned foreign affiliates declined from about 90% in the mid- and late 1990s to around 80% since 2006. On the other hand, the share of R&D performed by Asia-located affiliates (other than in Japan) increased from about 5% to 14% from 1997 to 2008. In particular, the share of U.S.-owned affiliates’ R&D performed in China, South Korea, Singapore, and India rose from a half percentage point or less in 1997 to 4% for China, just under 3% for South Korea, and just under 2% each for Singapore and India in 2008.” (US Bureau of Economic Activity, 2012 p 4-27)

Growth in offshore German MNC R&D has been similarly recomposed. Between 1995 and 2005, German MNCs opened as many offshore R&D sites as they had in the last 50 years combined (Ambos, 2005 p. 401). While offshore growth was most strong in North America and Europe (including central Europe), the growth of R&D units in Asia increased steeply as well. 10.3% of all overseas R&D units established in the Machinery industry between 1995 and 2005 were in Asia. Growth since then has accelerated. By 2009, overseas affiliates of all German MNCs had spent €11.2 billion on R&D activities overseas, about 27.2% of total R&D outlays. The Machinery industry invested 19.6% of total outlays in 2009 overseas, while the Motor vehicle industry invested 18.2% abroad in that year. (Neukirchner 2012; Kladroba 2011 Tabelle 24)

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4 but see also Buckley & Horn 2009 for a differentiated account
2.) A recursive experimentalist learning architecture within MNCs and across supply chains governs new global strategies.

The above global manufacturing MNC strategic shifts have generated quite distinctive governance dynamics. Firms need to optimize exports with global production capacity while simultaneously reconciling constant imperatives for process and product optimization, innovation, cost reduction and learning, not only within individual plants, but also centrally and locally across vast global organizations. This is not easy: innovation can increase costs; optimization and cost reduction can undermine learning; too much local autonomy can generate centrifugal pressures weakening the various forms of leverage (learning, knowledge, purchasing) that comes with global concern membership; too much central direction can undermine local innovation and organizational capabilities crucial for competitive advantage in foreign markets. Not only that, global competition is so dynamic that there is never a natural sweet-spot in which all of these competing goals and pressures can be stably reconciled or in which a happy equilibrium can be found. New products, technical innovation, competition among suppliers, new local regulations, currency value shifts, organizational learning induced possibility --and much more-- all constantly destabilize the ordered practices that firms develop and generate new adjustment and governance challenges. Innovation, cost reduction and learning are imperatives for all actors throughout MNC operations, yet environmental uncertainty is so great that at any given moment players have no clear sense of what strategy would be most optimal for them to achieve those goals.

In this context, we believe that it is not analytically helpful (nor empirically accurate) to view successful manufacturing MNC governance efforts as “reactions” seeking to “cope” with continuously uncertain and recombinatory practices in their organizations and the environment. Rather, we claim that the best manufacturing MNCs, are creating (transnational) governance architectures that systematically induce organizational destabilization and recompositional experimentation as a mechanism to foster innovation and learning. This proactive destabilization, we argue, is accomplished through the workings of formalized “experimentalist” systems, such as corporate production systems (CPSs), six sigma programs and other formal systems of open standards (eg. ISO certifications). Such systems impose regimes of collective self-analysis through joint goal setting, systematic performance review, prompt problem solving and organized destabilization of insulation and exclusion strategies. They are experimentalist in the pragmatist sense that roles and social arrangements within MNCs and across their supply chains are seen as provisional and subject to virtually permanent revision and rearticulation (recomposition). Formal experimentalist governance strategically fosters innovation and learning by forcing organizational players to reflect on the effectiveness of their collective practices and experiment with ways to improve them. Such strategies do not eliminate or overcome competitive and environmental uncertainty; they leverage it for learning, innovation and competitive advantage.
In this section, we will discuss the mechanisms and architecture for the generation of experimentation and learning; the following section will discuss characteristic obstacles to the achievement or reproduction of experimentalism and the way that the architecture itself seeks to destabilize these obstacles. Before we begin, however, it will be helpful to show how the existing literature on MNC governance is not in a position to adequately characterize what firms are doing. In the broadest sense, the MNC governance literature’s dominant school conceives MNCs as knowledge (or resource) networks (Kogut & Zander 1992, 1993). It places great emphasis on managerial capacity to control and direct knowledge (resource) flows to and from central MNC locations and among far-flung subsidiaries. Much of this literature works within a principle-agent framework in which the key to effective governance is the appropriate incentive alignment between headquarters (HQ) and subsidiaries (Nohria & Ghoshal 1994). The best of this literature allows for considerable flexibility and variety in subsidiary-HQ arrangements by relativizing notions of organizational power and transforming hierarchical organizations into interactive networks and heterarchies (Birkinshaw 1997, 1999, Birkenshaw et Al 1998, Havila et Al 2002).

The strength of this literature is that it relativizes claims made in other disciplines, above all industrial sociology (eg Sauer 2013, Dörre 2014, Pfeiffer 2008 a-c), which reduce the governance of the modern corporation to an increasingly intricate array of market incentives and shareholder concerns that impinge arbitrarily on the local production level. Not only do MNCs govern themselves with a broader set of concerns in mind beyond the needs of the stockmarket, bankers and their finance departments, their struggles, under uncertainty, to manage knowledge flows, resources and personnel, generates a profoundly strategic and flexible orientation toward the market. In their efforts to leverage resources and know-how for competitive innovation, MNCs define the market signals they respond to much more than signals from the market define them.

The problem with this literature, however, is that it has an equilibrium rather than a process emphasis. This orientation leads analysts to interpret recomposition processes as episodic moments that firms overcome with governance adjustments rather than as permanent features of MNC innovation and learning strategies. Moving away from this view, however, poses a theoretical challenge for the dominant paradigm because it makes its commitment to governance as principal-agent incentive alignments problematic. When the identity of the actors and the terrain upon which interest is generated is continuously changing—often through the systematic actions of MNC actors themselves—principal-agent incentive alignments are difficult to identify and hence rendered ineffective. This calls into question not only the idea of incentive alignment induced equilibrium, but also the very idea of governance as an incidence of managerial control. In the face of the reality of continuous recomposition and innovation, principal–agent governance models appear as disconnected (and not so empirically relevant) stylizations.

In an effort to overcome the first literature’s ability to identify stable interest alignments in thought but inability to discover any in practice, a newer, critical, literature has emerged focusing on the dynamism generated by MNC HQ & subsidiary embeddedness.
in relevant extra-firm institutional surrounds. This literature—which borrows heavily from the National Business Systems and Varieties of Capitalism schools in comparative political economy—argues that the recompositional turbulence and innovation observable in contemporary MNC relations and practices stem from conflicts between home and host country institutional logics embedded within MNC actor behavior. Home country managers guided by home country institutional understandings come into conflict with host country managers, whose behavior is shaped by host country institutions. Out of this conflict comes mutual disruption of routines, which in turn stimulates processes of creative joint reflection among the conflicting parties (Saka-Helmhout & Geppert 2011, Greenwood et al 2011, Greenwood et al 2002, Greenwood 1996, Kostova & Roth 2002, Edwards & Belanger 2009, Ferner et al 2006). Under favorable background conditions, the embeddedness school shows that innovation, learning, organizational and institutional change and local upgrading can take place in subsidiary locations (Dörrenberger & Geppert 2011, Geppert & Williams 2006).

This perspective is certainly an advance over the stylized disconnectedness of MNC dynamics represented in the dominant literature. Not only are MNC actors and governance struggles given the realistic flesh of institutionalist comparative political economy, the view also captures the reality of continuous organizational instability and recomposition driven by creative interaction and reflection between HQ’s and subsidiaries. There are, however, two limitations to this approach. The first is that its emphasis on local embeddedness often causes it to lose sight of genuinely transnational MNC internal operations. For the embeddedness group, the point is made when a local subsidiary is able to leverage local institutional resources and wrest autonomy from the center. What is lost in this is how the center processes this loss. Is there recursivity and learning elsewhere in the concern as a result of a specific local outcome? These questions are left un-theorized (often un-asked) by the embeddedness group (cf. Morgan 2001a-b, 2009, 2011). But it is precisely at this transnational/trans-organizational level that the formal experimentalist governance systems have their most transformative effect. Rather than passive victims of colliding institutional logics, the experimentalist systems shape the collision into a mutually transforming conversation about possibility and problem solving.

The embeddedness approach’s second limitation is that, like the literature it criticizes, it continues to view governance as a reactive, coping response to instability, rather than as a proactive driver of recomposition and change. Our own pragmatist commitments make us sympathetic to the embeddedness literature’s claim that routine disruption generates creativity and collective deliberation. But in embeddedness accounts, routine disruption induced creative reflection emerges out of contingent contextual institutional complexity and interpenetration. By contrast, we argue that the emerging experimentalist governance arrangements, such as CPSs, deliberately disrupt routines to stimulate collective self-examination and unleash creative experimentation. Creativity and joint problem solving are unshackled from contingency in order to gain competitive advantage in the marketplace. The new governance arrangements systematically link routine disruption to group self-examination to experimentation to innovation to competitiveness. And, as this sequence occurs repeatedly over time, in an MNC-wide recursive
architecture, it constitutes an organizational learning process. Regarding the limits of the embeddedness perspective, the key thing to see is that role and rule turbulence, learning and innovation do not in this way emerge episodically out of a contingent clash of differently embedded institutional logics. Instead, they emerge systematically, and recursively, out of an experimentalist governance architecture.

What is an experimentalist governance architecture? How do the successful MNCs diffuse these practices throughout their organizations? We describe the governance architectures in manufacturing MNCs as experimentalist because they resemble what Charles Sabel, Jonathan Zeitlin, William Simon and others call “experimentalist governance architectures” in public policy and public law contexts (Sabel 2005, Sabel & Simon 2011, Sabel & Zeitlin 2008). By calling the recursive, public processes of joint goal setting, revisable regulation and learning they study “experimentalist”, those scholars draw theoretically on the American Pragmatic tradition’s use of the word experimentation. Experimentation pragmatically understood describes the relational, interactive and social character of identity, goal setting and action, in which goals and the means adopted to achieve them are continuously modified and optimized through the social action process (Dewey 1922, Joas 1996).

In its most abstract analytical form, the experimentalist governance architecture is a formalized four step recursive process. All actors are aware of the formal rules and obligations that constitute the system. First, there is joint or collective goal setting. Relevant stakeholders (what Dewey called “publics”) commonly affected by a given problem openly deliberate about solutions and future goals for their common interactions. Second, these solutions and goals are then implemented/pursued by the stakeholders in their local milieu. Application or realization of the common standard in the local environment invariably requires discretion by local players: unanticipated problems emerge, intermediate benchmark goals are not fulfilled, local conditions differ from the stylizations used during the general deliberations, etc. Local discretion—deviation from agreed upon practice or norms—is permitted in order to solve the problem or make changes to allow the local organization to achieve the goal target. But these deviations must be transparent (other players must be able to observe or review them) and, in a third step, the norm deviation must be explained and defended among the peer parties to the central goal agreement. Finally, fourth, successful local experiments are then used to review the effectiveness and desirability of central/common goals and standards. If the local innovation is compelling enough, this can result in modification of the central standard.

The experimentalist governance school applies this framework to workings of public policy, but we think it is a very fruitful way to understand how contemporary MNCs govern their global relations through broad diffusion of CPSs and other formal mechanisms throughout their operations. Corporate production systems are formal systems that organize group or stakeholder based goal setting within firms to achieve product and process innovation, optimization (cost reduction) and learning on a
continuous basis. The systems are rooted in team goal setting procedures (regular goal setting meetings) and constitute a hierarchical architecture of team based goal conversations, ultimately linking (through many mediations) the shop floor to the top management. The conversations are also systematically cross-functional—in the best systems, this cross-functionality runs throughout the firm, right down to the shop floor. And, crucially for our story, the team conversations are global. Product teams, customer teams, design and manufacturing teams, continuous improvement teams all are constituted in multiple locations and form super-ordinate or umbrella teams that engage with one another across markets and geographical space to identify common goals and standards and compare (and defend) their local experiments.

CPSs have diffused widely among manufacturing MNCs. Many company’s brand their CPS (eg The Siemens Production System or “The Volkswagen Way” or the Caterpillar Production System or “Formel ZF” or the “Achieving Competitive Excellence” (ACE) system at United Technologies). The companies also characteristically provide their own corporate names to the mechanisms of goal setting, self-evaluation (performance review), benchmarking, joint-problem solving and goal revision. Despite this nominal variety, however, all follow the general experimentalist logic outlined above. Smaller companies also embrace the formal experimentalist principles of team governed lean production even though many did not attempt to “brand” their system.

The following example, taken from a German Truck and Omnibus transmission producer, illustrates the globally recursive and learning elements of these systems. Joint German design and manufacturing teams develop a new variant of a medium sized transmission for the global market. Technical specifications, cost targets, and manufacturing time are worked out in an iterative process of experimentation and exchange between design and manufacturing engineers, the prototyping workshop and the home location shop floor. Conversations between this product team and a higher level global strategy team, very early on, suggest that the transmission will also be produced in China, Russia, India and other emerging markets. Design and manufacturing teams from these markets are incorporated into the development process and technical specifications, cost targets and manufacturing cycle parameters (metrics and standards) for those markets are provisionally established.

We followed the transfer of the technology to the Chinese markets (Herrigel et Al 2016). German team members, design and manufacturing engineers, as well as skilled workers from the proto-type workshop and home location shop floor, travel to China to assist local engineers and workers with the initial set up of production. Local Chinese engineers educate their skeptical German counterparts about the possibilities and limits of the Chinese location. Adjustments along several dimensions have to be made locally, involving a variety of metrics and standards on input materials, contour design, machine usage and cycle time. Engineers from the transmission producer’s Chinese design center are called in to assist the collaborating teams with these adjustments. Since design and

production metrics and standards have been altered, the German design office is consulted to approve suggested changes to the original targets. The local production and design teams defend the changes to the central teams. In the process, the central team notices that the adjustments in the flow of manufacturing can be used for the same product in eastern European and in Indian production locations. Changes are made to the central design. Production performance both in Germany and in offshore locations is, in this systematic fashion, regularly reviewed, metrics and standards are optimized, and roles and relations recomposed.

All of this iterated transfer and exchange occurs within the language and team based procedures of the CPS, which requires regular goal setting and performance review meetings. CPSs insist on the specification of explicit, written down, metrics and standards. Significantly, stakeholder teams working with agreed upon metrics and standards drive each step in this development and transfer process. The jointly defined standards and metrics serve as benchmarks for local experimentation. Iterated revision (experimentation), guided by the formal metrics, characterizes the entire process. Transnational know-how transfer and experience driven learning, facilitated by team interactions, are systematic features of this system. There is, moreover, recursivity in the system as the central teams learn from the experiments of the local teams, even as the latter are learning from the former. Finally, revision of the metrics and standards involve role and rule changes within the organization. The division of labor in design and production is continuously optimized and varied. Stakeholder interests are not aligned by the system, they are continuously changed by the process of metric and standard creation, performance review and optimization.

Obviously, the key to the success of this system is that it is global and extends seamlessly throughout all the operations of a firm. For innovation, optimization and learning to flow recursively within the MNC, everyone must speak the language of the company’s CPS. Practices of joint goal setting and systematic performance review need to become second nature—a new form of self-disrupting routine. This poses the interesting problem of how such systems are globalized. Firms deploy a number of different diffusion mechanisms. At the German truck and omnibus transmission producer, for example, functional operations in specific locations within the company that had most successfully implemented the new system, and which had performance results to prove it, were given the responsibility to help other company operations doing the same thing elsewhere adopt the CPS routines and develop the capacity to hit performance targets and engage in regular self review and optimization. The company called these teaching locations “Centers of Competence” (CoC).

We observed CoC at work in the truck driveline technology, medium and heavy ranges, assembly and logistics group, and in the truck transmission housing casting and assembly group. In both cases, the most advanced workshops were located in company’s home German location. Teams from, for example, the assembly workshop (including managers, 6 These dynamics can also generate counter-productive forms of exclusion and hierarchical insulation. We discuss these possibilities and the mechanisms firms are developing to deal with them, in section Three below.
engineers and line workers) travelled to assembly operations in France, India and China to assist teams there set up operations. These interactions were, in turn, observed by superordinate “international” teams composed of management, engineering and shop floor representatives from all the truck driveline assembly and logistics operations worldwide. The goals were, on the one hand, to get agreement on product and quality metric and standards among all truck driveline assembly operations (and among global suppliers), and, on the other hand, to get agreement on the core performance review and problem solving procedures consistent with the company’s CPS. The CoC convened face to face international team meetings once a year. In addition, two hour phone meetings occurred once every quarter (always @ 15:00 Germany time) on which “red status” (i.e. problem/local deviation) issues were discussed and group decisions were made.

Crucially, the home country CoC’s ambition was not to impose common assembly procedures, materials or logistical flows across the entire company. Rather it was to construct procedures to achieve agreement on metrics and standards, and establish transparent self-optimizing processes of regular performance review. The German location provided the off-shore operations with technical advice, demonstrated German procedures, and actively assisted with the industrialization of the offshore locations. But local managers were given wide berth to achieve agreed metrics and standards in location appropriate ways. Deviations from central practices had to be defended, in particular in discussions within the international team. But if the metrics and standards could be maintained or improved upon, deviations were accepted. Indeed, especially innovative alternative practices were embraced by other operations, through the information channel of the international team. See the example of a local Chinese innovation being diffused through team deliberations to Indian and Russian production facilities discussed in the previous chapter.

Continuous improvement teams (CITs) are an alternative mechanism for global experimentalist governance diffusion. These teams are especially common in Machinery firms. Here the idea is to create a team of CPS experts (lean production specialists, Six Sigma blackbelts, quality engineers, skilled production workers) travelling throughout the functional areas of the firm and all global production locations interacting with functional teams as CPS consultants and service providers. CIT members continually provide advice about CPS procedure, how to implement practices of joint goal setting and systematic performance review (as the next section will show, this can be a purposefully disruptive activity). But they also, crucially, enact the CPS with their interlocutors, making suggestions for workflow improvement and socializing teams in joint problem solving. CIT teams routinely help multifunctional production or product teams construct better ergonomic workplace arrangements for machining and assembly (using CIT budgeted resources). CITs are also globally constituted (indeed, in the two largest machinery producers we observed, CITs are the largest global teams) and engage with offshore locations in the same CPS proselytizing and service providing manner in which it engaged home country teams.

Again, as with the CoCs, the aim of CIT activity is not to impose uniform technical and work practices across all parts of the company. Rather it is to cultivate a common team
based practice of joint goal setting and systematic performance review focused on optimization and learning. Significantly, even as they help establish intra- and inter-team communication procedures, the circulation of experienced CIT members diffuses innovation and useful practical innovations throughout the MNCs global operations. As the CIT head at the German Power Drive producer told us: “We are very careful to ensure that information .. gets transferred. That is, we train employees, world wide, in these themes. And ideas get discussed and solutions outlined at local units all over the world – we are permanently present, locally. At the same time, our members are constantly traveling between units. We achieve information transfer in this way” CITs generate organizational learning, establish procedures to sustain it, and help to diffuse it within the global organization.

CoC’s and CITs are two of many variants currently diffusing CPSs across MNC firms global operations. Like the CPSs they are constructing, these organized practices are disruptive mechanisms. Their aim is to instigate local experimentation for practical improvement of jointly agreed upon central norms and metrics. They are not establishing incentive alignments; they are convening discussions to define (and redefine) common incentives. The Power Drive CIT head describes the character of the process in this way:

We present our plans for investment and change to the local colleagues in a workshop in their plant. We then get together with the employees and do an “Is” analysis: We look at the existing process and determine what is good and what is bad. In most cases we also look at material flow. Once we have done all of these things, we work together with the local actors to develop a new production island. Modularity in the component narrows the options a bit, so either the island will have curves, or it will be straight, it will have 1, 2 legs or 3 legs. Within those parameters, anything is possible. Our job is to see that whatever result is worked out is developed and worked through jointly with the colleagues locally. Here is a picture of an optimized process in Korea. In this case, the Korean management reacted to our proposals by saying: “We installed a manual conveyor here only three or four years ago and we don’t want to just throw it away. We will integrate it into the new module ourselves.” They then further looked at the way that we did things (in Germany), we sent them our blueprints and they made the island themselves exactly to those designs, but with the desired modifications. This was fine with us because the production costs were significantly lower in Korea than in Germany. That was obvious. But it was important for us to realize that because the value creation principles and the investment costs were much lower for them in Korea than they would be if they took everything from us in Germany, it was possible and even advantageous to accept modifications. In the end, they paid us consulting and traveling expenses and that was it!

In the next section, we will see how this interactive joint problem solving process plays a crucial role in destabilizing the obstacles to learning that emerge through efforts on the part of managers and worker groups and representatives to insulate or exclude interests
from the experimentalist process. In the present context however, we emphasize again that it is inaccurate to understand the workings of these mechanisms as encounters between distinct home and host country institutional logics. CoC and CIT team actors do not regard the practices of local interlocutors as a foreign logic; they view local player perspectives as potential resources to be leveraged in a continuous optimization and learning process. Similarly, local players regard CoC and CIT players not as hierarchical principals giving them orders out of a foreign institutionally embedded universe, but as potential resources and partners to help them achieve goals that both have agreed on. When insights gained from local deviation from central norms prove effective, they are moreover diffused elsewhere in the MNC. In this way, institutional logics do not clash and give rise to deliberation. Instead, systematic disruption and joint problem solving give rise to continuous mutual institutional recomposition.

Another way to make the same point is to note that CoC’s and CITs do not carry knowhow and learning only in one direction. They are recursive mechanisms designed to root out, identify and globally diffuse possibilities for improvement and change in their specialized areas. Regular manager and team meetings across MNC global operations, driven by the formal imperatives of CPS procedure, systematically leverage useful knowledge and practices. Learning recursivity is systematic, multivalent and global. 7

MNCs committed to a CPS logic are very emphatic about the distinctively collaborative and experimentalist aspects of the system. Often this is true because many had tried (and failed) to arrange the process of technology transfer in a more conventional hierarchical interest alignment way prior to working toward the experimentalist (formally collaborative) architecture. Prior to the creation of CoC’s for example, the German car and truck transmission manufacturer tried to manage technology transfer very hierarchically. Products were developed centrally at the home production location. Designs, discrete manufacturing process instructions and specific machinery to be deployed were then handed off to the subsidiary location. The subsidiary locals were then expected to implement exactly what had been handed to them, and their incentives were set according to the output and cost measures that had been centrally determined.

Invariably, locals ran into trouble getting the German designs and machinery to work in the ways the Germans did: locals could not get machines to produce error free, costs were out of line, processes ran into unanticipated bottlenecks due to operator unfamiliarity with procedure (or differences in training and competence). Ramp up of new products, as a result, very frequently took longer than desired. Under that old system, the solution to such problems was for a team of production and design experts from the home location to be sent to the subsidiary, where they would typically spend weeks telling locals exactly how to set up the German system, how to make the prescribed machinery work properly, how to avoid bottlenecks. According to the senior

7 Crucially, when asked in response to the story of module adaptation in Korea above: Is it always simply a matter of deviations from a standard module or can the process also result in a reconstruction (Umbau) of the module (central standard) itself? The Power Drive CIT Chief replied: “That happens quite often. It is very explicitly never excluded as a possibility. It is an essential part of the transfer process”.
production manager we interviewed, the old system was an endless, and very expensive, cycle. The expert teams were no sooner home than they were called back to address new problems that had emerged. The transfer process was too rigid and the resources of the subsidiaries to address ramp up problems too under-utilized in the old system.

CoC’s were developed to introduce communication, flexibility and local discretion into the technology transfer process. First, rather than locating responsibility for transfer with elite integrated whole product teams, the mother company elevated discrete processes to the transfer carriers: assembly and logistics, gear making, housing machining and assembly, heat treatment, transmission parts—etc. Each of these specialized process areas had to have competence in four areas: they needed to have demonstrable connections to the product development design teams, demonstrated excellence in their area (according to internal and external benchmarks), connections to other subsidiary works and effective and collaborative ties to suppliers. Note that the key evaluative criteria here is not the CoC’s technological knowledge per se; rather it is its organizational abilities to excel collaboratively within the MNC organization.

Once these capabilities were determined and CoC status allocated, then the CoC area assumed responsibility for helping the subsidiary location ramp up the specific CoC process in a new product introduction. The CoC and the subsidiary location jointly worked out process and output metrics with a superordinate team that had responsibility for overall product design, known as the “operations council” (and which included designers and manufacturing reps from both the home and global subsidiary locations). They then engaged in local experimentation processes to achieve the agreed upon standards. Home location procedures and machinery were introduced as an initial template, but local players were encouraged to deconstruct (zerlegen) home country solutions to introduce more location-appropriate solutions right from the beginning. Thus, in one case, the operations council along with the home country transmission parts CoC designated a complex five axis machining center, made by a German machine tool producer and valued at over €700,000, as the most appropriate technology for specific gear production. The CoC and its local subsidiary partners soon discovered, however, that they did not have the local competence to run such machines cost effectively—maintenance costs alone failed to justify use of the machine. As an alternative, the subsidiary suggested that the machining center could be substituted with four simpler machine tools that cost a fraction of the expensive German machine. Quality and output targets could be maintained—and cost targets could be reduced. Not only that, the new arrangement increased operating flexibility and enhanced the subsidiary locations ability to ramp up products in the next round. The operations council approved the suggested change, and the CoC suggested that the new arrangement be tried in other subsidiaries with similar cost and workforce profiles.

This shift from a hierarchical and one way transfer process to a collaborative and recursive one has proven to be a great success. The key is to emphasize the importance of formal targets, communication and the tolerance of local experimentation, rather than the transfer of specific knowledge, technology and production procedure. Managers at the German car and truck transmission manufacturer were driven to this experimentalist
governance architecture largely because the old hierarchical incentive alignment arrangement was ineffective. Through a benchmarking process, the firm discovered that the Robert Bosch Corporation had implemented these CPS driven experimentalist architectures for global product management, and the company made a decision to do so as well.

Interestingly, our interviews revealed that the most successful companies (and all of the largest companies) had moved in this direction, while some of the smaller companies still clung to the hierarchical transfer model. One producer of small electrical motors for use primarily in the automobile industry spent a great deal of time perfecting the transfer process from design through prototype construction to implementation in foreign location, emphasizing the duplication of both procedure and technology, exactly, worldwide (it had production locations in the Czech Republic, Mexico and China). Interviews with plant managers and workers in both the Czech and Chinese plants, however, revealed significant disillusion with the procedure: costs were unnecessarily high, processes over-automated, error rates and down time too high, and, as a result, the competitive position of the subsidiaries was suffering. Home country product implementation teams were both rigid and expensive to repeatedly call in to solve problems. As a result, informal local adjustments to the home country machinery and procedures had to be improvised—often at disappointingly high cost.

In both the Czech and Chinese cases, the inability of the foreign location to handle the effective ramp up of new products led to them being given fewer new products to ramp up. Older products, running out of active circulation with customers, producing mainly for the aftermarket, increasingly became the subsidiaries’ bread and butter. Both managers feared for the future of the production location and both were actively looking to leave the company for firms that offered greater career possibility and localization challenges. In this way, as in the case of the initial efforts of the car and truck transmission manufacturer, the hierarchical transfer method led to inefficiency and local disarray. While the larger company, through a self-reflective benchmarking process, shifted in a more experimentalist direction, the small producer sought to solve its problems by perfecting the home country product development and industrialization process and strengthening hierarchical control over subsidiary practices. The former strategy has produced promising success, while the later strategy seems only to be exacerbating the problems that gave rise to it.
3.) Internal Barriers to Experimentalism’s Diffusion Within Manufacturing MNCs and How Knowledge Diffusion Mechanisms Also Become Destabilization Mechanisms

Market uncertainty, linked and unremitting pressures to innovate and reduce costs, and constantly evolving best practice models drive the adoption and diffusion of experimentalist corporate production systems. The systems are attractive under those conditions both because they make organizational practices transparent to the actors engaging in them, and help actors see that the endurance of specific practical arrangements is contingent upon good performance. The formal experimentalist CPS procedures do this by inducing disruption of organizational habit through the formal imposition of joint self-reflection on stakeholders in the MNC’s value chain: writing down team goals and procedures, regularly reviewing their performance, fixing problems as they emerge, avoiding buffers and inventories that allow practices to go un-examined or unchallenged, regular central review and benchmarking of subordinate team performance in order to identify best practices all are standard elements of such self-disrupting/self optimizing systems.

Naturally, there are many barriers to the diffusion of these experimentalist CPS practices. Indeed, even in cases where actors extend the experimentalist logic quite far in their organizations, they often encounter limits to further extension. As a result, organizational optimization and recursive learning dynamics are compromised and blocked. This section will outline some of the most predominant organizational challenges to the diffusion of experimentalism within manufacturing MNCs. It will also point to an array of strategies that MNCs pursue to overcome these blockages. The main diffusion barriers that we have observed in our cases are: hierarchical insulation, stakeholder exclusion and inadequate empowerment resources for participants.

Hierarchical insulation refers to efforts on the part of higher-level management to remove themselves from the continuing stakeholder joint goal setting and self-review procedures. In such cases, managers foster experimentalist problem solving within the domain that they command, but neither confer across domains with other managers or superiors regarding the relative performance of their domain, nor do they negotiate with peer stakeholders regarding goal setting. In these cases, principle-agent incentive structures govern top management, while experimentalist practices govern the practical domains of design and production. Upward diffusion of experimentalism is blocked by the egoism of managerial ambition within the upper managerial hierarchies. Such governance segmentation within companies can lead to sub-optimal organizational outcomes. Higher managers pursuing incentives based on results grow impatient with the CPS’s process focused bottom up problem solving procedures. They suspend or circumvent the process to generate results for which they will be immediately rewarded. This can create chaos and incoherence in the design and manufacturing value chain: rigorous problem solving

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8 Most of the empirical examples presented are drawn from fieldwork in German and US MNCs. For an alternative (complementary) perspective on diffusion obstacles, see Netland & Federow 2014
is disrupted, learning blocked and, ultimately, innovation inhibited. And, in worst cases, it frustrates and delegitimizes expansive experimentalism at lower levels. Good willed innovation is blocked by arbitrary power driven by rarified and incompatible managerial incentive structures (cf. Hafner 2009).

Hierarchical insulation is a central criticism of CPSs in the critical industrial sociology literature. Sauer (2013), Gerst (2012, 2013a-b), Pfeiffer (2008a-c) und Dörre (2014), to take only the most prominent interventions, all point to hierarchical elements that are imposed on production line workers without negotiation: Financial data targets that are set without production level participation, human resource hiring practices are two aspects of hierarchical management insulation that all of those authors point to in particular. In our interviews in the US Germany, Eastern Europe and China, these pathologies were present, but they were by no means uncontested, even by players beyond the shop floor. We found two different strategies in play seeking to undermine persistent hierarchical insulation. First, uncertainty and pressure to innovate and reduce costs induces upper management to foster regular cross-domain conferences. In many, especially initial, cases, meetings do not utilize the formal procedural vocabulary of an experimentalist CPS, but they embrace the experimentalist logic of joint center-local goal setting, local discretion with a requirement of justification and then recursive evaluation of joint plans in light of local experiences. Many smaller and family owned companies, such as a woodworking machinery maker and an automobile front end supplier, engage in informal experimentalism in this manner. Such procedures, however, because they are informal and not constitutional as they are in formal CPSs, are subject to disruption by arbitrary power—say the caprice or idiosyncratic interest of the firm’s family owner or by older managers with significant experience who resist the collective procedures of younger management. But, in our view, the gradual diffusion of such informal experimentalism within the small and medium sized firms in our sample is a sign of its power in the current environment.

Another driver undermining hierarchical insulation induced governance segmentation is the recognition on the part of upper management that they need to continuously optimize their own practices—that is, eliminate waste and redundancy in office procedures, identify economies and hidden possibilities in the professional practices of bid construction, budget projection, performance evaluation, auditing etc. The broad diffusion of Six Sigma formalization practices within managerial domains and the rising significance of Six Sigma accreditations --black belts, green belts – for managerial promotion in manufacturing circles is one indicator of this transformation. Another is the increasing awareness that lean principles need to be applied throughout the entire organization and the emergence of consultancies and associations making such training available to top management actors (for an artifact, see Petersson et al 2013; Lay & Neuhaus 2005, Lay 2008, Friedli & Schuh 2012).

Stakeholder exclusion is in some ways a variant of hierarchical insulation, and in any case, it also engenders governance segmentation within organizations. Basically this phenomenon involves the implementation of formal self-optimization procedures without involving all relevant stakeholders. Thus, manufacturing and design engineers are
included in product development discussions, but purchasing executives are excluded or only brought in after crucial decisions have been made. Or manufacturing and design engineers, and purchasing people are included, but key suppliers are left out or brought in with a delay. These used to be classic errors of exclusion in the early days (1990s) of the diffusion of lean practices within industry (Helper 1991a, 1991b, MacDuffie & Helper 1999, Springer 1999, Schumann et al 1994). A great deal of progress has been made in this area since then, especially in the supply chain and in the product development process. (Herrigel 2010, Whitford 2005, Helper et al, 2000, Sako 2006). But the large body of critical industrial sociological literature is evidence of its continued persistence in German plants. In our field work, we found that stakeholder exclusion recurrently appears as the experimentalist CPS process progresses. That is, as the experimentalist process itself recasts roles, work and process organization, it creates new opportunities for exclusion. Unlike the earlier (1990s) period, however, where persistent exclusion made the early “lean production” features of what has evolved into CPS systems seem like new variants of hierarchical Taylorist rationalization, we will note below that firms are increasingly putting mechanisms in place to destabilize this kind of power insulation.

Perhaps the most prevalent exclusionary barriers are those preventing production line worker participation. Important case studies of CPS introduction in the German automobile industry, such as Pfeiffer’s (2008a-c) analysis of a complex automobile assembly line, point to the continued exclusion of production level teams from upgrading and process re-design discussions, at least in some plants. This can occur when management designates its own agent as speaker of an allegedly self-governing production team, or when higher-level teams simply rely on plant managers, section supervisors or set-up engineers for information on work team performance. Or when work-flow improvements are imposed unilaterally by continuous improvement teams without interaction with the line workers whose process is being improved. In all of those cases, it is usual for workers and supervisors to communicate informally. But without the formal obligation to make their habitual actions transparent, workers can hide information (e.g. about finicky machines), protect favorite routines from alteration and, worst, become complacent about opportunities to make their own collective efforts better and more competitive. They withhold or bury basic information about the character of production. The firm (and management) in this way foregoes valuable knowledge of its operations and squanders resources for recomposition, innovation and competitiveness (Pfeiffer 2008a-c).

The above forms of exclusion are hierarchically imposed, hence their affinity with hierarchical insulation. But it is also possible for certain stakeholder groups to self-exclude themselves from experimentalist self-optimization processes. This can presumably occur in a variety of ways. In our German cases, we encountered a number examples of works council self-exclusion from newly introduced CPSs in their firm (a north German manufacturer of stationary power drives was one example). The works-councils in these cases viewed the new system as a threat and refused participation. Abstinence from participation in the CPS, however, proved confusing for the employees in work teams at all levels, because they experienced a management discourse of empowerment and self-organization and a works council/union discourse of property
divide, asymmetric interest and mistrust. Sometimes self-exclusion redounds negatively for the works council, as the CPS self-optimization process’s success undermines the sense of organizational indispensability associated with the works council role. Other times the effect is the reverse: traditional role and identity cultivation prevents the CPS from gaining genuine traction in the firm (this seemed to be the case at the power drives producer).

One sign that the CPS stakeholder empowerment dimension in particular and the system’s general competitive attractiveness in general are gaining traction over traditional skepticism is that increasing numbers of German company works councils are incorporating themselves into the CPS as stakeholder groups (Jürgens 2014). In several other of our cases, such as the drive train and transmission producer or a southwest German producer of stationary power drives or in many Automobile assembly locations (such as in Neckarsulm) where we have conducted interviews, the works council (with union support) has involved itself in the co-implementation of the CPS and, in this way, tried to solidify itself in the formal deliberative system as a stakeholder. In these cases, the CPS rollout was very successful and found significant acceptance among workers. When they cooperate, works councils participate in cross-functional goal setting and periodic self-review procedures in order both to optimize the services they provide to the dynamic work context their employees confront and to legitimize their role as a representative stakeholder within the self-transforming firm.

At this level, the role of extra-firm actors, such as trade unions, can be decisive. If the union supports works council participation in the CPS, and negotiates participation into a formal agreement with the company that defines the architecture of the system, the effect can be extremely beneficial for all parties (works council, union and firm). This appears to be the case at the transmission and drive train manufacturer as well as in many Automobile final assembler locations in Germany. But if the Union views participation with skepticism or mistrust and discourages it, the effect can be negative for the works council and make firm efforts to be flexible and innovative more difficult. Ironically, opposition to participation can encourage the firm to pursue more stakeholder exclusion based adjustment strategies.

A final internal barrier experimentalist diffusion is inadequate empowerment resources for participants. By this is meant, most prominently, the lack of adequate skills at the production and lower level management levels such as one finds in emerging market contexts. Many firms that run CPS procedures in broadly inclusive ways in their home market locations, find it difficult to implement thoroughly inclusive self-optimization practices in emerging market operations because language and cultural difference combined with skill and educational competences within the available labor pool makes it difficult to configure production in a way that engages employees in useful self-optimization. In part, low wages and structural weakness on the employee side allows management to not try so hard to implement an experimentalist system. Instead they crassly exploit cost advantages without continuous optimization or they impose improvements developed elsewhere on a compliant workforce. Self-optimization processes elsewhere in the company—even those higher up in the emerging market
operation—in this way carry the inefficiency of very low cost and very manipulable labor.

Inadequate empowerment resources are not, however, only an artifact of power imbalances. Often firms believe that the constraints that available skill and competence pools place on efforts to localize production and work practices developed in the home market result in the loss or destruction of useful knowledge rather than the generation of new or alternative knowledge about familiar technologies and production processes. For example, in their German operations, the woodworking machinery and automobile front end makers both use highly skilled workers capable of performing a variety of operations. Their experience generates unique product technology knowledge that can be leveraged for innovation in cooperation with engineers and product designers. Such workers in Westfalen and on the Schwäbisches Alb are wholesomely incorporated in to self-governing multifunctional teams and in the serial self-review processes in their respective firms’s CPS variants. In China, however, those workers do not exist in the broader Shanghai labor pool where the firms have their production operations. Hence, when the firms produce the same products in Shanghai that they produce in Germany, even when there are significant localization changes made in the product design, the local management teams have to devise ways to make the product with many fewer skilled workers. Typically this means that several more narrowly skilled workers will perform in a sequential and disintegrated way what one highly skilled worker would perform in a synthetic way in Germany. The firms incorporate the disintegrated workers less into the self-optimization procedures of their respective CPSs because they believe that the knowledge such workers could contribute through inclusion is less valuable.

This may be a mistake in the long run. Firms like the transmission and drive train maker that are highly committed to applying their CPS’s logic across all global operations, are very mindful of the benefits that the experience of participation and empowerment can have on whole firm knowledge optimization. As a result, they make efforts to incorporate these less skilled production workers as stakeholders into shopfloor level self-optimization teams. They also invest significantly in worker training and spend a great deal of time socializing their Chinese workers into the logic of the company’s CPS system. But, for many other firms who are otherwise and elsewhere cultivating extensive experimentalist governance and recursive learning processes, the absence of worker resources in China is a barrier. In the short term, prudence, time and cost often argue against an inclusion strategy.

Interesting about all of these obstacles is that they exist not only \textit{ex ante}, as firms attempt to construct corporate production systems and implement them throughout their global operations. They also continually regenerate through the CPS’s experimentalist dynamics themselves. This is particularly true of stakeholder exclusion and empowerment resource issues. The revision of commonly agreed upon frameworks in light of changes to processes and products introduced at a local level frequently redefines

\footnote{Jürgens and Krzywirski’s (2013a-b) studies of VW in China and elsewhere foreground VW efforts to create skilled employees in these locations and to the company’s efforts to incorporate those workers into the CPS practices}
power relations and stakeholders, creating new possibilities for insulation and exclusion at various levels and in different locations within the firm. For example, many firms find that operations that are highly automated in German operations, do not require the same degree of automation in lower wage locations, such as Poland or China (or Korea, as in the quoted example provided earlier). As a result, local players there deconstruct the home procedures and render production flow into a series of manual operations. In some cases, these innovations actually prove more flexible and productive than the automated operations that they replace and, as a result, cooperating teams in the home operations try to replace automation with the newer manual procedures. In so doing, new worker groups emerge and teams are re-constituted. If the firm is not careful to ensure that the newly emergent groups become integrated into existing team deliberative relations in the plant, the new groups can be excluded (not recognized) as (knowledge bearing) stakeholders in the production process.

In order to prevent such obstacles from paralyzing the global recursive learning process, we find that MNCs deploy an array of destabilization mechanisms that systematically undermine insulation and exclusion strategies within the global firm and reconstitute the deliberative experimentalist learning process. Interestingly, CPSs also often contain penalty default mechanisms as part of the standard operating procedure (Ayres & Gertner 1989, Ayres 2001). The threat of default is itself a mechanism encouraging players to avoid paralysis. Penalty defaults typically do not impose specific solutions on deliberating actors. Instead, it redefines the deliberative terrain in order to re-start problem solving (and learning) on a new basis with an alternative array of (stakeholder) interlocutors.

Most of the organizational forms described above as knowledge carriers throughout the MNC’s global operations—CoCs, CITs, Cookbooks -- also act as destabilization mechanisms undermining efforts to insulate knowledge and exclude stakeholders. This makes sense, since their aim is to manage center and local deliberation in ways that circulate technical and organizational knowledge through the company’s transparent formal CPS procedures. They both implement the CPS itself and carry knowledge around the global firm that CPS procedures generate. Local players seeking to exclude stakeholders (e.g. production workers or suppliers) or central actors looking to insulate their own practices from the changes generated by subsidiary actors are targeted by these third party organizations and challenged to defend their efforts. Often this challenge is enough to initiate inclusion processes: “Why are production line workers not involved in team discussions with line leadership staff and application engineers? How will production implementation and run-up problems be dealt with without their input?”

It is not only talk, either. Because the CoC’s and CIT’s, in particular, are not supposed to impose solutions on players, but simply to instigate local discussions regarding the implementation of central technologies and metrics (for CoCs) or of possibilities for process improvement in the context of CPS procedures and global best practice (CITs), they have the organizational authority to provoke local actors into defending exclusion or insulation practices. And, since they are globally active, they come to individual central or local conversations with independent knowledge of practices throughout the MNC’s
operations. They can use this knowledge to insist that specific players contend with best practice within the firm. This use of organizational mission and accumulated practical knowledge to destabilize relations is a crucial dimension of CoC and CIT activity. They do not impose solutions, but rather use their organizational mission to destabilize practices and provoke deliberation about solutions.

But what if, for all that, stalemate or paralysis emerges? Or, what if deliberation proves so contentious and arduous that despite exchange, progress is too long delayed? In such cases, most CPSs provide for a penalty default. That is, if local players are locked in dispute or cannot resolve a local problem, a higher order stakeholder team will intervene to redefine the problem that is stymying the local actors in an effort to create better conditions for agreement. Such interventions, moreover, frequently do not at all depend on higher level team judgment. Rather, the CPS itself establishes penalty default triggers—most often in the form of time frames for decision making, or outer boundary cost or return on investment targets (“Gates”) for processes. If local deliberation exceeds the allotted time or under or overshoots cost targets, then relevant higher level teams are automatically called in (usually following a logic imposed by Six Sigma instruments) to evaluate the situation.

The CIT head at a producer of stationary power drives (quoted earlier) outlined the procedures they follow for improvement project implementation. His description highlights both the CIT role as a destabilization mechanism—in particular in identifying stakeholder exclusion and developing strategies for inclusion—and the key role played by penalty default—primarily in the form of strict time frameworks for project implementation.

We are continuously and permanently improving our processes through the involvement of all those who are affected and participating in them. That is our core approach to secure process sustainability. If you like, you can see it as a mixture of business reengineering and classic Toyota continuous improvement processes or Kaizen or whatever you want to call those broadly lean principles. It is a path of many small and tiny steps. We start with small or medium sized focused projects which then embrace the goal of producing process excellence. The limiting factor is always the time frame. That is, we always have a 12 week model. Within 12 weeks we try to organize the process in a new way. The 12 weeks are a basic grid for us. If we see that the spectrum of themes, the degree of effort or the scope are too large and can’t be resolved within 12 weeks, we then start to segment the themes, and create sequences for effort in very transparent ways. So 12 weeks is our basic standard. There is usually no problem to extend to 13 or 14 weeks, but the norm is 12 and it cannot be extended without explanation.

Twelve weeks, in other words, is a penalty default trigger. Projects that cannot be accomplished in that timeframe are redefined to facilitate more possible forms of collective problem solving. The power drive CIT chief also emphasized that the role of CIT actors is to make all projects inclusive:
We (the CIT team) in fact rove through the shop floor, observing production and frequently make suggestions for improvement. That is a permanent activity. It frequently happens, however, that the middle management comes to us and says: “I have a concrete problem in this area. Can you try to get people working toward a solution?” A project will be created which is—and this is a foundational principle for our firm—interdisciplinary in makeup: that is, all stakeholders (Beteiligten) sit at the table and we try to construct a comprehensive/inclusive (ganzeitliches) image of optimization. All those affected by the problem participate in the work toward a creating a solution. That is a core principle. An interdisciplinary project in our firm creates the foundation for a sustainable solution. And interdisciplinarity and communication should continue after the solution is implemented in order to allow a high level consciousness for on-going continuous improvement (KVP) to develop.

The Power Train CIT head emphasized that CIT teams were needed as destabilizers because the “normal process” of self optimizing continuous improvement by specialized multifunctional teams very often tended toward myopia and self-blockage. They inadvertently excluded important players in the value chain:

No matter where you look, at Toyota or other benchmark Companies, not a single company has been able to operate only self-optimizing teams. External destabilizers such as CITs are needed. We are no different. We thought initially that the theme of optimization—I name it very self consciously optimization and not continuous improvement or Kaizen—would establish itself and run by itself. That didn’t happen. Every employee who is normally active on the line has his daily routine. It doesn’t matter if she is a work planer, a set up person, or a machine operator. When a new production or product related project is introduced it generally comes “on top” or in addition to their daily routine. I am sure this is the same in companies all over the world. What happens to this worker when they suddenly have to participate in a new project? Well, first he will make sure that his daily targets are fulfilled because that is what he is getting evaluated and paid for. That is natural. But what does leave out? Her work on the project. That is the first problem that CITs must address. The second point for us—and in my view the most important one—is that people do not look at their jobs in the whole context of production. This is what interdisciplinary Projekt work tries to overcome. When a worker—say a Work planer— is active in a specific area of production, that person is generally very highly specialized, say for example in the gear assembly process. Earlier I used the example of bevel gears: specialists there will know everything there is to know about bevel gears. But in the project teams, suddenly, he has to be concerned with material delivery and preparation as well as where the bevel gears that are made in her station will go to next—it might even have to get painted! The natural initial response here is to throw up your hands and say—this isn’t my job I don’t know anything about this. And the person will avoid looking at the whole production process—not out
of ill will, but simply because she sticks to what she knows. Our job is to remind people to see how their activity fits into the whole. We make models of the whole process chain and constantly remind the project participants what the big picture is.

Finally, the CIT head emphasized that it would be counter-productive for his firm’s CIT team to impose a solution on the parties engaged in the project. Their job was to convene a conversation among all the relevant stakeholders. The point is to have the stakeholders understand their respective roles and to make all of their actions explicit to one another and to the firm’s CIT team. When asked if his firm’s CIT imposed solutions on the deliberating project teams, he said:

If we simply imposed solutions on the projects, they would never actually get implemented. Why? Because every person that worked on the process once it was up and running would try to prove to me that the solution doesn’t work. Instead, our idea is to make the people who will be implementing the solution at the center of the process of developing the solution. This is the same in highly automated machining areas or in areas that have so much variance that it is nearly impossible to introduce automation. People have to be at the center in the design of the solution because they are the ones who will be responsible for ensuring that the process yields the quality, safety and reliability that we need. The workers have to be able to understand the technology they are working with and the procedures they are undertaking.

And the system only works, he emphasized, if it goes all the way down to the production line workers:

The project teams have to include machine operators, set up people, maintenance, logistics, work preparation, work planning, the foreman (depending on how complex the solution looks like it will be), someone from the tool shop and tool maintenance who will be able to ensure that the proper tools will be delivered to the new process. That whole team works together to come up with a solution for the new production process. In principle, the CIT team indicates only what methods and strategies are required. For example, some methods that are simply required in any of our assembly processes are one piece flow, Kanban-delivery, best-point principles and role flexibility for employees. These things have a kind of law like status in our company. But within these methods, that is, the way in which these practices are structured and implemented in a particular project, is completely open. Its up to the team members to choose. Of course, the solution has to be better than what it is replacing. That is the standard. The parameters are generated by our company’s formal production system, but the solution is generated by the stakeholder problem solving process.
We in the CIT are, relative to production, basically generalists. But relative to our company’s production system (GPS), relative to lean production and lean administration principles, we are most definitely specialists. That is perhaps the best way to see the difference. Our job is to organize project problem solving processes. We structure the groups, we make sure the goals and design principles are clearly understood, and we also provide guidance on the “Doing”: How do I work in groups? How does one make this? How can we work together? Who should do what? How is it possible to reach consensus? How can the solution be made transparent? How will it be possible for the project to achieve its solution within the time targets? Those are the things that we completely and massively concentrate on. That is what we take to be our job in the company.

All of these activities aimed at stakeholder inclusion and transparency creation are permanent and ongoing within MNCs. Projects and Products set up in one year are reviewed the next in order to ensure that the original designs are having the desired effect. Or, to see if optimization projects elsewhere in the value chain have created possibilities in the area that were not possible to see when the initial project was undertaken. Such continuous self-surveillance is disruptive. “Daily routines” are made explicit to those enacting them and reflection leads to change or recomposition. As a result, manufacturing MNCs operating within the logic of a CPS are constantly in flux. Projects that successfully overcome problems of exclusion or insulation often create new ones. The teams themselves, and the destabilizing CoC and CIT teams, must be vigilant and continue to root out exclusionary dynamics. Doing this on a permanent basis fosters learning and innovation within the entire global organization.

The upshot of all of this, of course, is quite paradoxical. The commitment to learning and permanent self-optimization on the part of manufacturing multinationals in the current environment constantly creates the possibility for blockage through insulation or exclusion. Indeed, there are no pure examples of a thoroughly inclusive and systematically deliberative recursive learning oriented manufacturing multinational. Rather, recursive learning organizations have heterogeneous, hybrid and constantly self-recomposing governance arrangements with varying and highly contingent admixtures of joint problem solving, team based deliberation, hierarchical insulation and stakeholder in/exclusion. In this sense, the core emergent institutions in the new multinational are those that disrupt, rather than those that govern. Disruption is a permanent process, while specific governance arrangements, like the organizational roles they manage, are always ephemeral.
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