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Sensemaking, Safety and Situated Communities in (Con)temporary Networks

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Abstract

This paper addresses the difficulties involved in managing knowledge-intensive, multi-national, multi-organisational, and multi-functional project networks. The study is based on a two-year quasi-ethnography of one such network engaged in the design and development of a complex new process control system for an existing pharmaceutical plant in Ireland. The case describes how, drawing upon the organisational heritage of the corporations involved and the logic implicit within their global partnership arrangements, the project was initially structured in an aspatial manner that underestimated the complexity of the development process and the social relations required to support it. Following dissatisfaction with initial progress, however, a number of critical management interventions were made, which appeared to contribute to a recasting of the network ontology that facilitated the cultivation and protection of more appropriate communicative spaces. The case emphasises the need to move away from rationalistic assumptions about communication processes within projects of this nature, towards a richer conceptualisation of such enterprises as involving collective sensemaking activities within and between situated 'communities' of actors. Contrary to much contemporary writing, the paper argues that space and location are of crucial importance to our understanding of network forms of organising.

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1. Introduction

There is a contemporary fascination with networks of all sorts, but especially with knowledge–intensive, multi-national, multi-organisational, and multi-functional networks (see Araujo and Easton (1996) for an excellent review). Even though the quantity of research into networks is ever-growing, our knowledge about these kinds of organisational forms is still limited. How do they operate in practice? What kind of problems do they bring with them? What is it like to work within such a structure? How should they be organised? In this paper we consider one particular lacuna in the networks literature, namely the nature of the political and sensemaking activities in this institutional context.

While other methods may have merit, a longitudinal, ethnographic approach seems most appropriate and even necessary if we are to study how actors act politically within networks. This paper presents one such ethnography that amounts to a political study of a project's dynamics where many different actors brought with them different interests, agendas and organisational heritages. The work is based on a two-year, intensive study of the design and development of a complex process control system in Merck, Sharp and Dohme's pharmaceutical plant in Ireland. The study is significant because it is one of the few long-term, longitudinal studies of a temporary network where the various corporations provided virtually unlimited access to project participants, meetings and documentation. Some 25 daylong project meetings were attended and 40 formal, taped interviews were held and there were countless informal interviews and observations. The research produced over 1.8 megabytes of data files based on these interviews and field notes.

The ethnographic approach provides a detailed understanding of how this form of organising works in practice as it allows us to drill down beneath the hype that pervades much of the discourse about inter-organisational relationships. As is normal in ethnographic research, the ethnographer tries to suspend his/her prejudices and to learn from the interpretations that the participants provide us. Hence, we will begin by telling the story as much as possible from the actors' points of view, and we will then present our own interpretation that is both sympathetic to the tenor of their understanding and also a contribution to theory. In particular, we have sought to move beyond a functional, deterministic or reductionist understanding of projects wherein the key issue is simply about interfacing groups, moving documents, structures and methodologies, and where political activity is marginalised or even seen as dysfunctional. Instead, our theoretical approach is informed by the writers who have emphasised the importance of power relations, sectional interests, and vulnerability. Moreover, we do not reduce communication – which is invariably seen as a key issue in networks of this type - to simply information exchange, but instead we recognise that it is complicated by the indexicality of language (i.e. words and sentences only have meaning in particular contexts) (Wittgenstein, 1953), and is also dependent on the time-space organisation of work activities and interactions (Giddens, 1991).

The case highlights the importance of collective sensemaking in successfully addressing the design problems in question, and we argue that the structure of social relations that pertained at the beginning of the project was not conducive to this kind of activity. We go on to describe how the actors' strategic actions contributed to a local re-casting of the network, thus facilitating more productive work practices. This

4

transformation involved the construction and maintenance of new forms of collective identity and shared languages of representation that were grounded in situated personal relationships. We focus, in particular, on these construction and maintenance processes and note the importance of physical co-location in creating 'safe' communicative spaces to facilitate design activities.

2. The PCS Replacement Project

2.1 Background and Project Organisation

Merck Sharp and Dohme (MSD) is the production arm and a wholly-owned subsidiary of the pharmaceutical giant Merck & Co. Inc. (which had sales of $27 billion in 1998). In 1973 MSD built a pharmaceutical plant in Ballydine, a townland in Tipperary, Ireland, and today over 300 people are employed there, manufacturing about 10 products for the pharmaceutical sector. Like all pharmaceutical plants, the Ballydine plant has a quite sophisticated, computer-based control system – termed the Process Control System (PCS) - which ensures the safe and consistent manufacture of product. By the late 1980s, MSD's manufacturing team in Ballydine had initiated a project to replace the system with more modern technology. This, they all knew, was going to be a complicated and expensive task, akin to giving the plant a 'brain transplant'.

After a couple of years of in-house planning, the project formally kicked-off in September 1991 with a meeting in Ballydine that was attended by various departmental representatives from the plant and from Merck's head office in New Jersey. Merck had designed and developed the original PCS in the 1970s, but by the 1990s other companies were specialising in process control and Merck had already selected ABB and Fischer

Controls as its preferred suppliers of process control systems. In November 1991, MSD issued a Functional Requirement Specification (FRS) and a request to tender to both ABB and Fischer Controls. The FRS, in essence, was MSD's statement of how they were running the Ballydine plant, what they did and what was required of the control system. In April 1992, after a protracted selection process, MSD contracted with ABB Process Automation, a subsidiary of ABB[1], based in Stevenage, England, to build, supply and install their new PCS. The budget for this project, including hardware, software and building reconstruction amounted to about $15m.

According to Merck corporate policy, its Central Engineering Department could take responsibility for project management on any project over $1m and it promptly did so in May 1992. In September 1992, the bulk of the project was put on hold when funds for the project were not allocated, although some MSD and ABB technical staff continued to work on the project until funds were organised in March 1993. At this stage, Merck Central Engineering had decided to sub-contract much of the project management task to Jacobs Engineering, its preferred supplier of Construction Management and Architect/Engineering services. (Jacobs had already been given responsibility for the design of the building's new structure and fit-out). Jacobs is a multinational design and construction management company with an annual turnover of over $1 billion and some 7000 employees. Its headquarters is in Pasadena, California, and as well as having offices across the US it has offices in Dublin and Cork. Thus it was Jacobs - through their Cork office - rather than Merck or MSD, who actually placed the primary purchase order with ABB (Stevenage).

The final significant player in this story is Merck's Automation & Instrumentation Technologies Department (A&IT) - based in Merck's head office in New Jersey - which had a "watching brief" on the technology, cost and schedule of all computer projects, and which also had the corporate partnering responsibility with ABB (principally with ABB's office in Columbus, Ohio). Merck A&IT were championing the idea of a corporate partnership with ABB, since they believed this would benefit technology transfer and learning from project to project and from plant to plant. In pursuit of this policy, A&IT sought to link the project in Ballydine with a similar project in another MSD plant in Auckland, Georgia. This plant, known as Flint River Factory 3, was an identical sister plant of Ballydine: "so when you walk through the plants they're the very same. When you are in the control rooms you don't know where you are" [Bill Franklin].

Schematically, we can represent the overall project network as follows, showing only the primary relationships:

Insert Figure 1 here

By March 1993 the major actors were in place. In telling the remainder of the story, we will structure our narrative in terms of the significant events and interventions around which the story revolved (and evolved) over the next 15 months. As much as possible, we tell the story from the actors' point of view, although we recognise that we are necessarily interpreting and analysing the story in its re-telling. It is also clear that the consequences of some actions were more unintended than intended, but then again post-hoc rationalisation is an unavoidable aspect of all story-telling.

2.2 Breaking the links with Flint River

As already stated, ABB had been appointed as Merck's worldwide 'preferred supplier' of process control systems.   This decision had been made in Merck's Head Office in New Jersey, and Merck's A&IT Department, in particular Mark Shine, was assigned responsibility for maintaining and building the relationship with ABB.   In turn, Mark Shine's relationship was with a few senior ABB executives based in Columbus. This is how Robert Jagoe, MSD's lead software engineer, saw this relationship:

> . . .they were quite tight - they knew one another personally and Merck in the US could pick up the phone at vice-president level and say to ABB in the US that this isn't going right, I want somebody to fix it.   ABB would jump to. . .

The Flint River and Ballydine projects provided what appeared to be an ideal setting for leveraging the benefits of such a global partnership. Here were two identical plants engaged in basically the same task – replacing their process control system – and a 'global' partnership opened up real opportunities for savings and reward, in terms of economies of scale, knowledge transfer, knowledge accumulation and learning. In pursuit of this 'global' policy, A&IT sought to merge much of the Ballydine and Flint River projects together - even though they were happening on different continents - so as to achieve economies on the "commonalties" between them. Initially, the MSD team in Ballydine went along with these plans because they needed A&IT's support to ensure corporate funding for the project, and they therefore developed their relationship with Merck A&IT (in New Jersey), MSD-Flint River, and with ABB-Columbus.

Once this corporate support for the Ballydine project was received, the Ballydine engineers worked to decouple the Ballydine and Flint River projects, and also sought to extract themselves from A&IT's plans for a hegemonic, global Merck-ABB relationship in

favour of their own, local relationship with ABB-Stevenage. Their reasons for doing this were as follows.   First, they believed that the two 'identical' plants had evolved into different entities over the twenty years since their construction: as Robert Jagoe (MSD-Ballydine's lead software engineer) put it ". . . [the two plants] may have been identical at corporate management, ideas level but when they were actually built they are different and the way they actually operate is radically different."   Second, the commonality requirement with Flint River forced the team to commence the detailed design of the system before the general design had been agreed: "we were putting wing mirrors on ... without really understanding how all the nuts and bolts worked" [Robert Jagoe]. Third, ABB-Stevenage wanted to have one clearly defined client (i.e. MSD Ballydine), as was the case prior to March 1993. This is how Chris Tory, ABB's Director of Operations, put it:

> Why the hell do we have three vested interests?   I understand Central Engineering, I understand the Plant [MSD Ballydine] - but Central Engineering is really only a rowing machine and the Plant are doing all the work - Robert and them.   And then you've got this other wing [Merck A&IT] - why the hell three wings?

Robert Jagoe, of MSD Ballydine, concurred:

> A&IT, who would have this corporate partnering responsibility with ABB, expected ABB UK to respond in the same fashion [as ABB US], while ABB UK saw MSD Ballydine as their client, and didn't really want to be involved - no I don't want to say didn't want to be involved - but certainly didn't jump to as fast as A&IT expected them to.   So there was probably a culture clash between A&IT and ABB UK at the start of the job.

> Thus, as a result of the first significant strategic action the Ballydine-Stevenage relationship was cemented at the expense of others.

> By December 1992, the attempt to link the Flint River and Ballydine projects was effectively jettisoned. As Robert Jagoe, MSD's lead engineer, put it:

… commonality effectively died a death . . . I think the penny dropped when the Flint River [Merck-US] and Columbus [ABB-US] people actually came and looked and saw what we [in Ballydine] do - that these are not identical plants and that that's why we appeared to be so obstinate.

For the remainder of the Ballydine project, there was very little interaction between the Flint River and Ballydine projects, and both MSD-Ballydine and ABB-Stevenage more or less ignored any plans for a global Merck-ABB partnership that would link 'their' project with others in the Merck-ABB stream of projects.

2.3 Establishing effective working relationships

Initially, the project was managed by MSD-Ballydine, and ABB-Stevenage was used to and happy with this arrangement of a single client. Soon, however, ABB were dealing with not only MSD Ballydine, but also Merck Central Engineering, Merck A&IT, and Jacobs Engineering, and it had to treat each of these as its 'Client'. The Ballydine engineers and managers who had initiated the project were well aware that the advent of these new actors marked a major change in the project: for Tim Masterson, MSD's Manufacturing Manager, the project "went from being a two cornered shop [Ballydine and Stevenage] to a four-cornered or five-corned shop". This is how Jack Courtney (Jacobs' Contracts Manager) read the situation:

> In the beginning the project was definitely owned by MSD - Tim Masterson, Robert Jagoe and those people - and they definitely weren't at all pleased with the influx of new players. I think Tim accepted the fact that the thing was so big that he had to come on board with his corporate policy [i.e. Merck Central Engineering], but I think the likes of Robert and Martin [MSD engineers], who had been the soldiers in the whole thing, were not that enthused by their new army. And certainly up to [May 1993] there was a resentment against both Jacobs and Merck Central Engineering . . .

ABB's relationship with both Jacobs and Merck Central Engineering was also strained because neither of the latter two groups routinely managed software projects. Instead, their normal work revolved around designing and constructing 'total' systems, and even though this type of work was inevitably complex, it usually followed well-known design processes and standards.

From the earliest stages, all of the actors recognised that the uniqueness of the endeavour demanded imaginative organisational and technical solutions, and, in particular, the more senior individuals actively endorsed a partnership rather than an adversarial approach, throughout the project. Yet, in early 1993, Tim Masterson, MSD-Ballydine's manufacturing manager noticed some difficulties emerging:

> … we could see big problems particularly between Jacobs and ABB. Again its very easy to see the problems in everyone else's relationships but we felt that it would be good to get people into a room to trash out the mechanics of this, rather than the details, to trash out the mechanisms, the logistics, which is what we did.

In May of that year, Tim organised a team-building meeting and this was subsequently seen by everyone to be a major turning point. Jack Courtney, the Jacobs Contracts Manager, had this to say:

> One of the problems at that stage was that nobody understood what everybody was supposed to be doing. Nobody really understood the relationships between Jacobs, Merck Sharp and Dohme and ABB. There are so many people involved in the project they didn't understand who was doing what. . .

> But I think that team-building meeting showed that we weren't just in for the ride, that we were actually going to contribute something and that if we did see a weakness we'd support that end of things - to make it strong again. I think Robert [Jagoe], at the end of that meeting, realised that, and he saw us then as a tool that he could use to get the job done.

11

Even though everybody felt the team-building meeting was a success and agreed to have similar sessions during the project, only one further team-building meeting took place in September 1993.

Another issue centred on MSD's perception that ABB's standard procedure for dealing with their Client's (MSD) requirements was inappropriate for this project. MSD's lead software engineer, Robert Jagoe, brought this problem into sharp focus, when he speculated, *en passant*, on how the PCS project differed, for ABB, from other projects:

> ABB operate within tramlines – 'you give us the specification of exactly what you want and we'll go off and build that, document it and give it back to you working, but don't get us to help you decide what you want'. This really comes across when you start working with them. They're very used to getting a big design package from a Jacobs or a Foster Wheeler of this world - someone who's designing a whole oil rig or petroleum facility - someone who has designed the whole process and the control system in the whole process design and gives them the spec of the whole process, the P&IDs, the logic diagrams etc. Whereas we ourselves know how the plant works - but we haven't documented it very well - and we're really trying to get them on board to help us define how it should work and to make sure that the modules on the system were being properly exploited by us - that we weren't missing the gold nuggets as it were.

The key task, as identified by Robert, was to "define how it [the plant] should work" and he saw ABB's role as essentially helping MSD "decide what [MSD] wants." In line with this analysis, MSD asked ABB, in March 1993, to locate one of their project engineers in the Ballydine plant:

> . . . to use him as a sounding board, to bounce ideas off, and also to integrate him into the plant, to get him to go to a few plant meetings and to try to understand what we were actually doing, because we always felt that there was a lack of appreciation on their [ABB's] part, or a lack of communication on our part, as to

how well they really grasped what the plant did, and how it worked and how involved their software would have to be. [Robert Jagoe]

But...

That didn't work very effectively - his [Phil Deutsche's] mode, and maybe that was his instructions from base, was to say 'you give me instructions on what you want, but don't expect me to get involved in helping you decide what you want', which we found quite frustrating.

Notwithstanding this difficulty, the decision to move Phil Deutsche to Ballydine proved to have important consequences that we will discuss in the next section.

2.4 Co-locating the development team

An important feature of the Ballydine-Stevenage relationship was that, notwithstanding the large amount of personal communication and telephone conversations, it was essentially *epistolary*, in so far as it hinged on the transfer and approval of key documents between the parties. The first document, the Functional Requirement Specification (FRS), was produced by Ballydine, and ABB responded to this by producing a General Design Specification (GDS), which said, in general terms, what the project was, software, hardware, how many, where, etc. Once MSD/Merck approved this, ABB then produced Detailed Design Specifications for the various modules, and after these were approved they 'built' the software/databases. ABB also produced Test Specifications for each module and these also had to be approved before testing could commence.

Due to the Ballydine plant's organic growth over twenty years, it proved impossible to produce an FRS that unambiguously and accurately represented the plant's physical operating characteristics.   Thus, when ABB submitted their GDS to MSD for approval in March 1993, MSD were unhappy with the document and demanded a large

number of corrections. Coincidentally, the ABB Engineer, Phil Deutsche, was halfway through his seven-week stint in Ballydine when MSD asked him to sit in on their review of the GDS and to amend, with them, ABB's version of the GDS:

> We had Phil Deutsche there - we said he can sit in on the meetings, mark up the GDS and give it to one of our secretaries here who can amend it on a copy that ABB would courier over to us. And we did that. The GDS was actually finished in Ballydine by this guy actually sitting in on the meeting with us. [Robert Jagoe]

Some months earlier, Robert had already found it necessary to visit Stevenage himself to work with ABB on the pre-shipment qualification (PSQ) document for an early prototype module, and this latest incident reinforced his opinion that moving ABB personnel to Ballydine and MSD people to Stevenage was crucial to the project's success.

From then on the project had to deal with a series of 'technical' problems and a pattern began to emerge whereby the solution to these problems usually required that an MSD engineer visit Stevenage and spend time with ABB's software engineers there. By September, MSD had moved several of its engineers to ABB's office in Stevenage where they worked full-time with the software team and this speeded up the production and approval of specifications immensely. One reason for this was because, unlike 'greenfield' projects, MSD did not have a fixed, unequivocal view of how the current control system was operating (since this had evolved over twenty years), nor had they a clear view of how the new PCS *should* operate. Thus, a satisfactory requirements specification for the system did not exist *a priori* but rather, needed to be created (imagined) through a complex sensemaking (learning) process (see Ehn 1988, Salzman and Rosenthal 1994).

By the autumn of 1993, the project management team from MSD, Merck Central Engineering and Jacobs had become increasingly frustrated with ABB's apparent inability

to accurately report on progress, and therefore, in November 1993, they moved the Jacobs scheduler, Don Hyland, to Stevenage to monitor progress directly. Again, this followed the pattern of moving the key project personnel into a single location. Thus, by November 1993 there were about five MSD people and one Merck A&IT engineer based full-time in Stevenage, as well as a scheduler from Jacobs. According to Robert Jagoe, MSD's lead software engineer, the ABB people were initially:

> very defensive about having us down in their project offices areas. We were encouraged to stay [in our own offices] and if we wanted something we had to ring down . . . That was eliminated in December when we insisted that we go down there with them and that eliminated another logistics problem and that was also a very good move.

At this point also, the bi-weekly project review meetings - which up until then had rotated between Stevenage, Cork and Ballydine - were all re-located to Stevenage in addition to various ad-hoc management meetings. Hence, the project management team from Merck Central Engineering, MSD, and Jacobs as well as their technical personnel, spent much of their time in ABB's office in Stevenage from November 1993 to March 1994 when the tested software was shipped to Ballydine. Around the same time, MSD moved some of their Control Room Attendants (the end-users of the system) to Stevenage to participate in the testing. Here Robert Jagoe reflects on this particular move in May 1994:

> There has been a big effort recently to get the CRAs involved by sending them to Stevenage; this has dawned on [Tim Masterson] last November-December. The time to do this was two years ago – so that ABB would have had access to the real users, to fish out their requirements.

The end result of this inexorable move to Stevenage was that the project began to resemble Chris Tory's – ABB's Manager of Project Operations - description of one of the better jobs he was involved in:

> . . . we put men into the Client's office and worked with them - we went in and designed things together so we got things from the process engineers and we got a Client man or two or three and some of our lads and they spread the work out, and *when you saw them work together you couldn't say who was who. Couldn't tell the difference.*[2]

In summary, then, we can see that what originally began as a "two-cornered shop" (or, more accurately as a one-cornered shop), and which then became a "five-cornered shop" with anchors across the globe and which was seen as an initial phase in a hegemonic, global partnership, finally converged into a few offices in ABB's facility in the town of Stevenage, England. After testing, the software was shipped from Stevenage to Ballydine and in this case a small team of ABB engineers went with it to join the engineers in Ballydine. Again the team stayed together, although this time located in a different place. This is not to say that the project concluded with a "one-cornered shop", but that some corners were certainly knocked off the network and those that remained coalesced towards a single location in space, even if this location moved over time and even if connections to remote actors remained in place.

2.5 Protecting the development team

From the early days of the project, MSD's process engineers and ABB's software engineers sought protection from what they saw as unnecessary interventions by the non-technical (i.e. managerial) US-based actors from both Merck and ABB (see figure 1). Brett Hurton, ABB's project manager, put it this way:

> . . . the minute there is any sort of problem it's at the top level, and there's table banging and international phone calls and nobody has any time to think, nobody is in the position to sensibly sit down and discuss it because you're under pressure all the time. . .

MSD-Ballydine, for their part, recognised that Merck's complex organisational structure, and what was often referred to as the "cast of thousands", made things difficult for ABB:

> Hurton is always amazed at this - at how many Merck entities are involved - I think he was kind of overwhelmed "I'm getting phone calls from all over the US from groups that I don't know what they're doing and they're all asking me to do different things". [Robert Jagoe]

The design team commonly referred to this phenomenon as problems going into "hyperspace," - i.e. US-based personnel from Merck and ABB, who did not share the software designers' context of understanding, became involved in what might ultimately be no more than minor technical problems. ABB, in particular, perceived this to be a significant issue and therefore, in September 1993, the team put a procedure in place whereby, once a 'problem' was identified, ABB were granted a period of time to come up with a solution, with the undertaking that they would not be 'bothered' during this 'safe-time'. In effect, the team sought to limit the networking (in this case communications about the status of problems) so as to isolate the 'sensemaking' designers. As part of this procedure the management team agreed to be more sensitive about reporting 'problems' to their superiors and thereby prevent 'problems' entering "hyperspace." The notion of the 'butterfly effect' from chaos theory was used to vividly describe the phenomenon: a butterfly or small problem in Stevenage could set off a chain reaction that might cause a thunderstorm in New Jersey and Columbus that would quickly cross the Atlantic and engulf the whole team in Stevenage. Building on this analogy, the project managers were

encouraged by the designers to see their role as ensuring that the butterflies did not 'escape' unnecessarily (and, conversely, to keep the 'pigeons' – i.e., actors who visit from afar – out).

2.6 Developing project metrics

In November 1993, MSD moved the Jacobs scheduler to Stevenage and virtually everyone believed that this move was a turning point in the project. Tim Masterson, MSD's Manufacturing Manager, gave the following assessment in March 1994:

> We put Don Hyland from Jacobs into ABB to act as a scheduler which turned out to be a brilliant move, in that he was able to demonstrate to them [ABB] that they had a problem.

One of the first things that Don did was to introduce a new way of representing progress. In particular, he developed a series of "S-curves" to depict the progress of various items of work, like test specifications, modular tests, recipe tests, software remedial notes, etc, and this format proved to be very popular because it provided a much less equivocal representation of progress than the bar-charts that were previously used for progress-tracking. These curves were instrumental in reconstructing the 'visibility' that was lacking in September-November and re-building MSD's trust in ABB's capabilities. One could even speculate that the most significant change between September '93 and January '94 was in how progress was represented rather than the actual rate of progress.

ABB's Chris Tory quickly came to the conclusion that Don Hyland could make a valuable contribution to the project - "I think Don has been positive on the project" [Chris Tory] - and he repeatedly told his staff to provide him with any information he requested. ABB's Brett Hurton was equally positive:

. . . the way in which the information is being presented is very different, the schedule is being red-line updated twice a week and the updates reviewed by Jacobs and/or Merck, and graphs are being produced on certain items twice a week; so the visibility of what's going on is a lot higher, and quite frankly I think that's very good.

The S-curves introduced by Don can be usefully contrasted with the standard project planning software (based on the critical path method) that was the main way in which progress was measured and represented up to November 1993. A central feature of the project planning approach was that the project was divided up into some 750 discrete *tasks*, each of which was assigned to a particular actor on the project, namely ABB, Jacobs or MSD. One, unintended, effect of the project planning approach was that it constructed divisions in the project where, in some instances, integration was called for. The S-curves approach, in contrast, focused solely on the *entities* that were created by the project team – test specifications, software remedial notes, built modules, tested modules, etc. - and made no attempt to draw categorical distinctions between the different actors in the project team. As such, it served to integrate rather than divide the project team.

2.7 Contract Renegotiations

Throughout 1993 the projected final cost of the software was gradually increasing, which worried MSD and Merck especially since the software contract allowed ABB to claim reimbursement for every hour a programmer spent on the job. Nevertheless, none of the parties engaged in substantive discussions about cost during this period for fear it would detract from the overriding objective of maintaining the schedule. By January 1994 the project was back on schedule but the projected cost was still rising. In February, the cost issue was dealt with in a marathon meeting at which ABB agreed to carry some of the extra costs and to reduce their hourly rate if the number of hours expended on the project exceeded an agreed figure. MSD were quite satisfied with these changes to the contract since they shifted more of the risk onto ABB and also ensured that the overall project

could remain within the budget. The project was finally completed, on time and within budget, in late 1994.

3. Facilitating effective collaboration in the PCS replacement project

The PCS case, as described above, highlights the difficulties involved in managing complex

development projects of this nature. Initially progress was very slow and it was only after

a number of fundamental changes[3] were made to the manner in which the project was

organised that those involved began to express satisfaction with the way the work was

being carried out. In this section we attempt to explain why these changes appeared to

make such a positive contribution to the dynamics of the process.

As we have seen, those involved in the design and development of the PCS system

quickly became frustrated with the initial organisation of the project, involving as it did a

number of different, geographically distributed, groups, communicating primarily through

the exchange of formal project documentation. One of the implicit assumptions underlying

such an approach was that a set of requirements could be comprehensively and

unambiguously specified in a documentary form, which could be subsequently directly

translated into an appropriate software solution. In other words, it was assumed that those

involved in the operation of the plant could explicitly and unambiguously articulate a

specification of their requirements for the new PCS.   This perspective on software

development was actively promoted by ABB-Stevenage, whose standard *modus operandus*

was to agree an explicit requirements specification with clients before proceeding to develop

a system to comply with this (indeed this approach is quite common within the wider

software development community and has been the bedrock upon which formalised

systems development methodologies have been built (Fitzgerald, 1996; Kelly, 1996;

Mullery, 1996). One of the great benefits of such an approach for the developer is, of course, the manner in which it reduces the complexity and risk involved, by having the client agree to a fixed and explicit set of requirements at the outset. We argue, however, that this approach proved detrimental to the PCS project as it ignored the complexity of the domain knowledge involved and the manner in which this could be communicated and shared. Specifically, it assumed that this domain knowledge existed 'somewhere' and that it could be made explicit and objective, thus facilitating its easy transfer (i.e. communication) across geographical and organisational boundaries in objectified form[4] (thereby rendering the number of actors involved and their relative location inconsequential).

Such assumptions clearly did not hold in the PCS case as evidenced by the difficulties encountered in attempts to explicitly articulate how the plant worked. Here, 'how it works' had evolved over twenty years of operation and, consequently, much of the knowledge about the plant was not codified (it wasn't "documented very well") but was embedded in working practices and tacit knowledge (Polanyi, 1957). This posed a significant problem for the software developers at ABB who had to learn a lot about the operation of the plant (domain knowledge) that was not held by any single person (i.e. it was distributed throughout a group) and that was difficult to explicitly articulate. On the other hand, the engineers at Ballydine believed that there was an opportunity to transform aspects of the way in which the plant operated rather than simply automating existing processes, but they did not have a good enough understanding of the new PCS technology to envision precisely how this might be achieved. Hence, we had a situation where ABB-Stevenage people had an understanding of the technology and the manifold ways in which it could be configured, but knew very little about the application domain, while MSD-

Ballydine staff had some collective understanding of the latter but were largely ignorant of the former. Thus, we argue that nobody was in a position to specify the detailed requirements for the new PCS system at the beginning of the project as these needed to be actively constructed in an emergent fashion.

The project, then, could be viewed as involving a collective learning and sensemaking[5] (Weick, 1995) task to design (imagine) the new system. The development team was primarily concerned with creating new entities - be they test specifications, screen layouts, computer programmes, layout drawings or whatever – through problem-solving and sensemaking, which, according to Weick (1995: 13-14),

> … is less about discovery than it is about invention. To engage in sensemaking is to construct, filter, frame, create facticity, and render the subjective into something more tangible.

We argue, however, that the conditions that prevailed at the outset of the project were not very conducive to such collective sensemaking activities and, furthermore, that many of the key management interventions that were subsequently made can be understood as contributing to the cultivation of a more appropriate communicative space for the open and playful interaction such collective sensemaking activities require. In particular we want to address two issues that appeared to have serious implications for the development effort - the lack of a shared language to facilitate meaningful communication, and the absence of a sense of mutual solidarity and established bonds of trust between the participants.

Drawing on Wittgenstein (1953), we argue that the difficulties involved in trying to explicitly capture knowledge that was highly tacit and distributed, was accentuated by the fact that the MSD-Ballydine and ABB-Stevenage teams did not share a common context of

understanding or 'form of life'. The development of any shared understanding is predicated upon the sharing of a language (Maturana and Varela, 1987) and, as Wittgenstein (1953) argues, language is always situated and can only be understood in relation to specific 'forms of life'. Each form of life has an associated 'language-game', consisting of a vocabulary and a set of rules (not necessarily explicit) for how the words in that vocabulary may be used, which is developed and subtly altered in the course of ongoing social interaction. Therefore, a key problem in the case of the PCS project was that the chemical engineers from MSD and the software engineers from ABB did not have a common language-game to support rich forms of interaction. As Introna and Tiow (1997: 1005-1006) illustrate, the development of such a language-game is not a trivial undertaking:

> … each language-game is incommensurate with the others. This means that the terms and ideas cannot move from one game (form of life) to another without losing the meaning (sense) that is local to that game. Now, since each partner has a locally situated language-game that captures what and how they do things, and since these games are incommensurable, the only option is to develop a new language game that situates the discourse of the different partners into a new combined context. This implies that they have to share a form of life – they have to do things together for a reasonably extended period of time in a shared space, a lifeworld.

Notwithstanding talk of a 'corporate partnering' and 'special relationships' between the different companies involved, it is clear that the different groups working on the development did not share such a lifeworld at the outset of the project. Indeed, one of the striking features of the project was the multiplicity of different constituencies involved – initially, there were no less than eight distinct groups (MSD-Ballydine, MSD-Flint River, Merck CE, Merck A&IT, ABB-Stevenage, ABB-Columbus, Jacobs-Cork, Jacobs-Pasadena) – and the manner in which they were distributed across seven locations in three

23

different countries. This heterogeneity, combined with the fact that most of the different groups did not have well-established working relationships, meant that a shared language-game needed to be created to facilitate the development work.

It is against this backdrop, then, that we should attempt to understand the significance of, what appeared to many to be, one of the most important interventions that management made to the initial project structure - the decision to co-locate important actors for extended periods of time, beginning with the initial transfer of Phil Deutsche (ABB-Stevenage) to Ballydine to help with the requirements definition and followed by the more longer-term transplantation of Ballydine staff to Stevenage. In so doing, management effectively subverted the essentially *aspatial* Merck-ABB relationship – using the word 'aspatial' to stress that it was conceptualised as being independent of location – and replaced it with a relationship that was *spatially anchored* in Ballydine and Stevenage. In other words, the strategy asserted the pre-eminence of two places in the net - Ballydine and Stevenage. The co-located group was able, through face-to-face interaction on an ongoing basis, to jointly develop a shared language-game that facilitated more effective communication and so supported the process of collective sensemaking about the PCS design.

This is not to suggest that processes of this nature *require* co-location and face-to-face interaction but, rather, that they are greatly facilitated by it. There are a number of reasons for this. For one thing, in face-to-face interaction it is easier to monitor the reactions of others, as immediate feedback is available regarding the level of mutual understanding of highly equivocal concepts (Giddens, 1984). This facilitates an interactive process of exploring/ playing with ideas and of developing the language-game. A further

advantage of face-to-face interaction over written communication is the fact that no formal consultable record is inscribed. Thus, people may be more willing to contribute experimental ideas without fear of them being subjected to the close and critical scrutiny of others outside the group at any time in the future (see Ciborra and Patriotta, 1996).

This latter point is of no little significance given the highly political nature of the project. For instance, another consequence of the diverse composition of the development team was that there was little sense of mutual solidarity or trust amongst its members, a point illustrated by Ballydine's initial hostility to the imposition of the Jacobs project management staff. Moreover, despite the rhetoric of partnership that pervaded the enterprise, the project was based on a formal-legal contractual relationship between Merck, Jacobs and ABB[6]. This, inevitably led to the different groups involved pursuing subtly different, not altogether congruent, agendas (note, for example, the manner in which ABB attempted to have a single point of contact appointed for Merck as a means of trying to ensure that conflicting requirements were not specified by different parts of the organisation). Even within these organisations different agendas existed and a high degree of political gamesmanship was evident, no more so than in Ballydine's development of the links with Flint River in order to secure funding for the PCS, and their subsequent jettisoning of the latter once the project got underway[7].

We argue, then, that not only did co-location facilitate the development of a shared language game amongst those involved with the development effort, but it could also be seen to have contributed to the emergence of a greater sense of collective responsibility and mutual understanding. Indeed, the team building exercises early on in the project began this process, providing as they did the first real opportunity for the central actors to meet on a

face-to-face basis, to personalise what had heretofore been mainly abstract relationships, and to gain an appreciation for each other's concerns and constraints. The subsequent co-location of staff, combined with the introduction of new project metrics and ABB's voluntary renegotiation of the terms of their contract, appeared to contribute to the strengthening of inter-personal bonds and the development of a distinctive collective identity for the group within the overall project. As Chris Tory put it:

> When you saw them [those involved in the design work] work together, you couldn't say who was who!

Thus, people whose identities within the project were previously defined largely according to who employed them (i.e. MSD or ABB) and the job that they did (e.g. chemical engineer, computer analyst, manager) now came to be seen (and saw themselves) as part of a common development team. In this way the ontology of the network was partly reconstituted and the adversarial relations implicit in the contract (MSD as clients, ABB as contracted suppliers) were subjugated to this new, more task-centred, alignment. The design team became more of a *community* (c.f. Lave and Wenger, 1991; Robinson and Bannon, 1991) through the development of a sense of mutual solidarity and trust that enabled the interaction of the constituent members to take on a new, more open and creative, dynamic. In other words, a communicative space was created where people were able to develop a shared language game and a common set of norms and expectations to govern interaction. This latter component provided people with a sense of security and the confidence to participate openly in design discussions.

It is also interesting to note, however, the apparent importance of buffering the development team from those outside the immediate community as evidenced by the

difficulties caused by 'problems going hyperspace' when misinterpreted by management only peripherally involved with their activities. Here, it seemed that the 'gatekeeper' role played by project managers seemed to work quite effectively. Not only did this protect the team from unnecessary interruptions (something that other authors have identified as being important in this type of creative context (Kidder, 1981, Kawasaki, 1989, Rhodes, 1986), but it also allowed the project managers to play an interpretive role for senior management by effectively straddling two communities (i.e. that of the development team and that of senior management). In other words, they were able to represent the activities of the development team to this other community in which they also participated[8] while, at the same time, protecting the former. What we saw, then, was the creation of safe spaces in the network where actors felt less vulnerable, were more willing to engage in 'back-stage' activities (Goffman, 1956), and were more trusting of the Other (often because, of course, the 'Other' was no longer seen as an 'Other'). This illustrates, perhaps, the somewhat paradoxical importance of 'closedness' within such open network structures.

4. From Managing Organisations to Cultivating Communities

What does our particular story tell us about the nature of multi-organisational, multi-functional, multi-locational networks more generally? Centrally, we believe that the concept of *community* draws together the ideas discussed in the previous section and we will therefore use it as an organising theme in the remainder of our discussion.

We speak of a community rather than an organisation because the latter term is too bound up with the legal concept of the firm. In other words, we need to make an

ontological distinction between MSD, ABB, and Jacobs – which are all legal entities – and the PCS project team/network, which has no legal status (see Fuehrer and Ashkanasy (1998) for development). Brown and Duguid (1991: 49) put it thus:

> The communities that we discern are . . . often noncanonical [non-legal] and not recognized by the organization. They are more fluid and interpenetrative than bounded, often crossing the restrictive boundaries of the organization to incorporate people from outside. . . Indeed the canonical organization becomes a questionable unit of analysis from this perspective.

Building on this point, we also speak of a community rather than a team or network because, for us, a team does not capture the diversity of the group in terms of composition and objectives, while the concept of network is too structural and unable to adequately capture the fundamentally political nature of the setting. Indeed it is precisely because the term community centres the concepts of difference and the political that we speak of the European community, the global community, and the local community. As Finlayson (1999) has recently observed, ". . .community can be conceived of as the shell or location of political activity, perhaps even its origin. It is imagined to be 'pre-political', a condition that must be satisfied before politics can take place."

We also speak of community because it moves us away from rationalistic assumptions about communication and metaphorical images of opening channels and conduits through which information flows between independent actors. Instead, we understand communication as a collective sensemaking activity occurring within and between temporally and spatially situated communities of practice. The construction of these communities is an ongoing process that also involves their protection or buffering to

ensure that mutual understanding, security, trust, and norms of appropriate behaviour can develop.

Physical proximity has long been used to define and identify communities ever since Aristotle conceptualised the city-state as primarily a physical space. But in today's world, brimming as it is with information and communication technologies that have effectively collapsed space, most contemporary writers consider location an inadequate ontological basis for understanding community (Harvey, 1989; Jameson, 1991). Indeed Virilo has even gone so far as to attest that "distinctions of *here* and *there* no longer mean anything" (Virilio, 1991: 13). Yet, in the PCS case, we saw the importance of converging and isolating the design team into one *place*, Stevenage, and, more broadly, co-location has been presented as one of the main tools enabling concurrent engineering in new product development (Sharifi and Pawar, 1999). This suggests that far from jettisoning space from our discourse, *place* and displacement across space need to be centralised if we are to develop a fuller understanding of contemporary networks. One of the few organisational theorists to have done so is James Thompson, who posited that "[o]rganizations seek to place reciprocally interdependent positions tangent to one another, in a common group which is (a) local and (b) conditionally autonomous" (1967: 57). While this is precisely what happened in the PCS case - where the "common group" consisted of the MSD and ABB engineers, and where the "local area" was ABB's office in Stevenage – his concept of reciprocal interdependence (where the output of each actor becomes the input for the other) seems, on its own, inadequate since one can easily think of instances where reciprocal interdependence does not require local, conditionally autonomous groups.[9] Our own research indicates that co-location is more dependent on situations where the primary

29

activities involve sensemaking and where a common context of understanding does not exist *a priori.* We can also posit that once a community has been constructed, the need for co-location may be attenuated.

It is interesting to note that despite the fundamentally spatial nature of the network described in the case, spatiality was largely *ignored* in the significant representations of the project that were produced and used by the management team. For example, while the bar charts and critical path network diagrams listed the duration of project activities, and the actors responsible for each activity, they made no mention of *where* activities would or should occur. This indifference to space is also reflected at a theoretical level, where the dominant model in the industrial networks tradition – the so-called 'Activities-Resources-Actors model' (Håkansson and Johanson, 1992) – is denuded of any spatial dimension, as indeed is most of organisation theory. In contrast, our line of thinking is consistent with the sociologist Anthony Giddens' (1984) view of time-space as central to the constitution of social relations and conceptions of identity (Giddens, 1991). In other words, actors' identities were shaped to some extent by *where* they were located. Thus, the reality of contemporary networks is that even though some actors may be high-flying, root-less nomads, geography is still a central and oft-overlooked dimension in defining the identity of actors and networks (see Soja (1989) for development).

In conclusion, the research provides an interesting insight into the workings of such contemporary networks and the *realpolitik* of 'global partnerships.' In particular, our intensive ethnographic study has altered our understanding of management, the manager, the organisation and business, to the point that we now prefer to speak of disparate semantic communities fumbling to construct a workable and working, if temporary, community of

practice. And rather than excising space from theory, we argue that place, displacement and co-location need to be re-centred in our discourse about the nature of organisational life and identity.

Acknowledgements

Endnotes

[1] Asea Brown Boveri (ABB) is a $30 billion conglomerate that specialises in power generation, high-tech automation and environmental systems. With 210,000 employees (of which only 150 are located in its Zurich head office) spread over 1300 companies in 140 countries, ABB has been referred to as "the prototype of the post-industrial organization" (de Vries, 1994).

[2] Emphasis added. Chris Tory's use of gender-biased language was not unusual in the project. Of the sixty or so people involved in the project there was, to our knowledge, only one woman employed in either a technical or a managerial role.

[3] Including a greater emphasis on face-to-face interaction as opposed to the production and exchange of formal documentation, the involvement of staff in team-building exercises, the co-location and organisational buffering of key participants in the development process, the development of new project metrics, and the renegotiation of the terms of the contract between Merck and ABB.

[4] Borgmann (1999) refers to this as the 'conduit' metaphor of communication.

[5] Such a perspective would also help explain the inability of the designers – the sensemakers – to accurately report on progress (this was a great source of frustration to senior management until Don Harley developed an alternative set of project metrics). To understand the difficulties involved here it is useful to recall one of Weick's key insights into the nature of sensemaking. He pointed out that since sensemaking is prior to representing, and given that it is essentially about the *creation* of understanding, it is prior to being:

> To talk about sensemaking is to talk about reality as an ongoing accomplishment that takes form when people make retrospective sense of the situations in which they find themselves and their creations. (1995: 15)

To further illuminate this point, Weick contrasts sensemaking with interpretation:

> It is common to hear that someone made "an interpretation". But we seldom hear that someone made "a sensemaking". We hear, instead, that people make sense of something, but even then, the activity rather than the outcome is in the foreground. A focus on sensemaking induces a mindset to focus on process, whereas this is less true with interpretation.

Even when interpretation is treated as a process, the implied nature of the process is different. The act of interpreting implies that something is there, a text in the world, waiting to be discovered or approximated (1995: 13). In other words, since sensemaking is about creating a previously non-existent reality, it is, axiomatically, difficult to unproblematically represent this reality or even the process through which it is constructed.

[6] The institutional heritage, within which each of the actors operated, caused certain difficulties in the network of relations, especially in terms of the project management function. In particular, this heritage was based on (a) industry-standard contract documentation that made clear categorical distinctions between the purchaser or Client (MSD/Jacobs/Merck CE) and the supplier or Contractor (ABB), and (b) a standard structured methodology that ABB followed in software design projects.

[7] We do not mean to be critical of Ballydine here. One could argue that the strength of the received wisdom (discourse) that global partnerships should be encouraged within the organisation merely forced people to play such games.

[8] The notion of 'spin-doctoring' and its associated (usually negative) political connotations comes to mind here.

[9] Thompson's own example of reciprocal interdependence – the operations and maintenance units of an airline – actually disproves his thesis since many, if not most airlines, now subcontract the maintenance function to independent firms specialising in this activity

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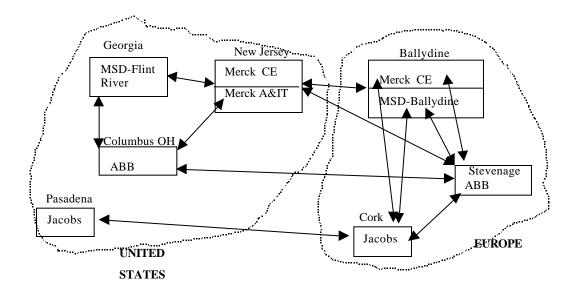
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Figure 1. The PCS project network