“The Ground Beneath My Feet”: Projects, Project Management and the Intensified Control of R&D Engineers

Abstract

This paper examines the erosion of autonomy among R&D engineers in a global IT company and the ways in which they responded. Over a 14-year period, we examine the changing regime of control as knowledge workers in this firm are increasingly subjected to increased project and portfolio management interventions. Drawing on extended interviews, we consider the propensity of such knowledge workers to challenge, subvert or else acquiesce to these enhanced control mechanisms. The idea of the project, we argue, plays a critical role in affording meaning and security and informing their responses.

Introduction

Research into the control of knowledge workers has historically focused on the limitations of traditional forms of control such as hierarchical surveillance and direct control (Burns and Stalker, 1961; Friedman, 1977; Causer and Jones, 1996). In the wake of burgeoning interest in the ‘knowledge economy’, increasing attention has been paid to the economic and social significance of ‘knowledge intensive firms’ (Alvesson, 1995; Kärreman *et al.*, 2002) which, it is argued, rely upon post-bureaucratic organisational arrangements based on cultural-ideological control (Ouchi, 1980; Kanter, 1983; Alvesson, 1995). As Child notes, ‘If management seeks to benefit from the judgement of the accountant, the development skill of the engineer or the creativity of the scientist, then it cannot decompose the tasks of such professionals without dispensing with the very professional qualities it requires’ (1982: 236). The nature of expertise and the labour market position of knowledge workers were seen to demand a particular, post-bureaucratic organisational form and a management approach based on decentralised flexibility and significant levels of autonomy (Reed, 1996; Storey 2005).

The field of R&D exemplifies the characteristics of knowledge-intensive work, focused on knowledge creation and diffusion through the creative endeavours of highly skilled and motivated expert workers (Leonard-Barton. 1995; Daniel and Dawson. 2011). Given the over-extension of the term ‘knowledge work’ to describe almost any form of middle-class, office-based occupation requiring a degree or equivalent, it is necessary to differentiate R&D engineers and scientists as a distinctive, even archetypal group of knowledge workers. Such

employees are highly-educated and are not only the users but often the creators of specialised new knowledge and technology. In terms of the typology of Frenkel *et al.* (1995), these are knowledge workers whose intellectual skills and creativity are high, and who rely upon theoretical as opposed to contextual knowledge. Following traditional research on knowledge work, such workers might be expected to be the most committed to autonomy and the least amenable to more intrusive modes of control.

Responses of expert labour to new organisational forms have been examined by several writers (Leonard-Barton, 1995; Scarbrough, 1999 and Arthur and Rousseau, 2001, among others). However, in recent years, with increasing competition there has been an evident reluctance in many such firms to rely exclusively on normative, decentralised forms of control. In organisations dependent on expert knowledge workers, the management technologies of project and portfolio management have been identified as a technology by which managerial control may be imposed over the unpredictable processes of creation and innovation (Zeller, 2002; Hodgson and Cicmil, 2006). But the ways in which experts accustomed to more autonomous and collegial working conditions respond to these increasingly assertive modes of project and portfolio management technologies remain underexplored. The contribution of this paper is to clarify how expert R&D engineers in one leading hi-tech company were subject to increasing control using project and portfolio management techniques and how they responded to this shift in the organisation and management of work.

The paper focuses upon developments in Compuco, a global, multinational IT company widely recognised for its highly distinctive culture based on innovation, creativity and favourable employment conditions. As will be illustrated, some R&D staff could not tolerate the new regime and left the corporation, others focused on their projects in the hope that the old culture and procedures would reassert itself, others joined in the new managerial game, often in an attempt to defend their autonomy. A few sought to actively resist in a more material manner. Attachment to a 'project', we argue, plays a critical role in affording some meaning and security in this context, and thus informs the responses of these knowledge workers.

R&D as Knowledge Work

The specific challenge of managing R&D work according to Causer and Jones (1996) derives from three factors. Firstly, such expert knowledge workers rely upon a specialist expertise

which is not readily accessible to non-expert managers, or indeed other experts in cases of extreme specialisation. The specialist knowledge implicit in R&D often necessitates decentralised structures, as ‘managers of complex projects find it difficult to understand and to keep up with the unique scientific knowledge of their specialized, subordinate scientists’ (Shenhav, 1988: 12). Secondly, there is significant indeterminacy in the link between activity and outcomes in such fields, making direct performance evaluation difficult or impossible. This inherent ambiguity is seen by some as the essential characteristic of knowledge-intensive work (Alvesson, 1995; Reed, 1996; Kärreman *et al.*, 2002). Thirdly, research in this area repeatedly highlights the perceived conflict between professional values of autonomy on the one hand and managerial goals of control on the other. The managerial challenge is to prioritise the economic goals of the organisation over what has been described as ‘the scientific aims of publication, knowledge for itself and independence from the practical affairs of the company’ (Ritti, 1968: 118). In a key paper on the politics of control in such environments, Scarbrough emphasises the core tension “between ‘organic’ settings of trust and autonomy which favour the production of knowledge as against the rationalised and highly structured conditions which secure its appropriation” (Scarbrough, 1999: 9).

Hence, a major feature of the employment relationship of research scientists and engineers is the autonomy attributed to such employees, arising from the indeterminacy of their jobs. In corporate R&D settings, autonomy has traditionally been subject to greater direct managerial control than in academic research settings (Bredin and Söderlund, 2006). While academic researchers may possess *strategic* autonomy (Bailyn, 1985: 132) with the freedom to choose research projects, scientists and engineers in industrial research settings can only aspire, at best, to *operational* autonomy affecting how a given agenda will be pursued within given resource constraints. Raelin (1985) describes the battle for strategic autonomy as a ubiquitous conflict in industrial R&D firms, typically staged between senior managers and researchers. Importantly, he points to the specific challenge facing managers of knowledge workers, whose primary role is to ‘contain’ such contradictions in situations where employees are engaged in difficult, complex and novel tasks mobilising highly specialised knowledge and high degrees of creativity (Kunda, 1992; Blackler, 1995). As this kind of work cannot easily be standardised, and some degree of autonomy thus becomes necessary, “management in knowledge-intensive firms tends to pay more attention to the regulation of ideas, beliefs, values and identities of employees than most other organizations” (Kärreman and Alvesson, 2009: 1117). Cultural control, then, represents a key means by which the identity of

knowledge workers is engineered, such that they forgo autonomy and comply with corporate strategic goals, often supplemented by the additional placement of generous material rewards (Scarbrough, 1999). In such settings, Kärreman and Alvesson (2009) suggest that compliance, subordination and conformity may be the norm.

However, Hill *et al.* (2000), point to an alternative and arguably conflicting strategy whereby the R&D function of many major corporations may be *operationally autonomous*, but subject to intensive financial control as a cost centre, or subjected to market discipline through subcontracted market relationships (Whittington, 1990). In contrast to Whalley's (1986) claims that knowledge workers have traditionally been deliberately 'insulated' from bureaucratic hierarchies through the creation of 'enclaves' (May et al., 2002) so as to create conditions of relative autonomy within a larger corporation, it seems many firms in recent years have turned to market discipline to supplement or indeed replace a reliance on cultural or ideational control. In practice, the complementary technologies of project and portfolio management have been widely applied in R&D and similar settings to facilitate the strategic control of such activities; the former, to ensure tight monitoring of R&D projects, the latter to enable coercive comparisons between performance of multiple projects in one firm (Maylor et al, 2006). Thus in many industries, project and portfolio management represent the principle way to retain centralised control over the uncertain process of knowledge production. As will be argued below, this engineered market discipline challenges both engrained expectations of professional autonomy and also commitment to organisational cultures and brand. In its place, workers appear to rely on strong affiliations to their project, resulting in compliance, subversion but also on occasion, overt resistance to organisational control.

Controlling Knowledge Work Through Project and Portfolio Management

Project and portfolio management have increasingly defined the practice and coordination of R&D across a range of industries (Wheelwright and Clark, 1992; Zeller, 2002). The 'projectification' of knowledge work relies on a vision of projects as 'universally applicable templates for the deliberate integration of diverse specialisms, enabling the organisation of flexible, autonomous, and knowledgeable individuals into temporary teams for the timely, efficient and effective accomplishment of defined goals' (Hodgson and Cicmil, 2007: 222). The widespread adoption of project management as an organisational form and management technique in recent years has been attributed to its perfect suitability for a knowledge-based

economy. Project-based organisations are argued to be the most appropriate arrangement for situations of rapid technological change, rapidly changing demand for tailored goods and services and intensified competition (Drucker, 1988), representing a specific way of ‘organizing highly skilled workers dealing with complex problems in their concern to create novel outputs by integrating varied forms of expertise in fixed time periods’ (Whitley, 2006: 78).

In practice, the attraction of project management as a means to organise activity is that it offers techniques to render a discontinuous, relatively unpredictable activity more controllable, and at the same time to discipline employees working in such environments by rendering them more accountable. The breakdown of an overall activity into an articulated life cycle, and the detailed specification of tasks and outcomes for each stage and sub-stage in the lifecycle, serves to ‘enhance the calculability and visibility of those engaged in project work’ (Hodgson, 2002: 818). Thus, project management can be seen as a process which can contain attributes of both top-down bureaucratic control (including requirements for initial application and approval of a project, monitoring, appraisal, stage gates, reviews, sanctions etc.) and also autonomy (project team self-determination of methods, time allocation, etc.). The level of detail attainable using this method varies significantly, depending on uncertainty and complexity of work process or environment and the degree of novelty in project work. Several writers differentiate between exploitation and exploration projects (Brady and Davies, 2004), highlighting the destructive effect of rigid structure and rules on exploration projects where there is a need for ‘visionary, flexible, and creative actions’ (Lundin and Söderholm, 1995: 441). The tension between uncertainty and predictability remains fundamental in project managing R&D.

This tension is not only mitigated in the management of the individual project, but also by the management of the overall portfolio of projects (Maylor et al, 2006). Müller (2011: 308) describes portfolio management as governing ‘the relative priority and the associated resourcing and visibility of projects’, and suggests that decisions on the composition and structure of the portfolio should reflect corporate strategy. Project portfolio management is thus depicted as a rational and equitable method by which multi-project companies and departments may strategically prioritise activities in the light of limited financial and human resources, by judging each project in terms of cost, risk and progress to date. Hence, Morris and Jamieson explain that ‘the project portfolio management process provides a means of consistently and objectively evaluating each proposed project that is vying for a limited pool

of resources, thereby aiding the process of making the most effective strategic use of the resources' (2005: 7). Portfolio management encompasses four broad activities (Archer and Ghasemzadeh, 1999): strategic activities to establish common portfolio management procedures and criteria; selection activities to identify projects for investment/support; balancing activities to coordinate support for projects in light of available resources; and monitoring activities, the constant or periodic tracking of project performance, which determines which projects will be further supported, redirected, or terminated. More advanced portfolio management often relies on sophisticated models to quantify project success, such as real options pricing. Project and portfolio management can thus be a powerful tool for intensifying knowledge work in R&D settings. As Zeller argues,

'Projects within an enterprise as well as between enterprises reflect the power relations of the structures in which the projects are embedded. The implementation of project teams as an instrument to rationalize and speed-up processes means that collaborative learning turns into a compulsory arrangement, with pressured working conditions for employees on a project team.' (Zeller, 2002: 287)

As noted, the intention of this paper is to explore developments which exemplify the application and consequences of project and portfolio management in a leading corporate R&D function. We draw upon episodic longitudinal research to examine the responses of expert knowledge workers to changing conditions of work, which indicate that projects offer a kind of anchor for such workers, resulting in acquiescence for some, but on occasion, opposition and resistance to the new regime for others.

Researching Compuco

Compuco is a leading and long-established US-based multinational providing computing and imaging solutions and services. The paper explores the responses of R&D-related staff to a series of cultural and managerial changes at a crucial juncture in the firm's history, and to explore the lasting impact of these changes. An exploratory case study methodology was deemed as most appropriate for these aims (Yin, 1994). The general methodology adopted in this paper draws on that used in Gleadow & Cornelius (2008) in that we focus on a process of change using data from a series of episodes which allow later reflections by key participants. Our aim was that of inductive theory-building through thematic analysis. Our methodology seeks to explore the nature of R&D workers' experience and their interpretation of events; our interest can be described as interpretivist and broadly phenomenological.

The analyses in the case cover a period between 1998 to 2012 as the organisation was researched in a series of engagements in 1998, 2001/2, 2005, 2007, 2009 and finally in 2012. The most concentrated period of the research was in 2001-2 and the subsequent contacts with the firm were to track the continuity or otherwise of the changes and of the R&D engineers' on-going responses to the changes introduced at that time. In total 32 interviews were conducted with 33 key stakeholders drawn from different levels within the Compuco R&D function and related areas. Table 1 sets out details of the interviews conducted.

Insert Table 1 about here

The first phase of interviews at Compuco took place in 1998. These were followed by a second phase of interviews in 2001-2 which coincided with the implementation of significant changes at Compuco, most notably the shift towards a tighter project and portfolio management approach. Accordingly, it is upon the interviews conducted during and after this phase that much of this paper concentrates to trace the impact of these changes. The data set elicited from key stakeholders access their experienced realities as to the significance of the changes. These were supplemented by the examination of documents to understand the history and context of the organisation, including company annual reports and internal documentation.

Initial interview questions addressed broad issues of change in the organisation of work; the importance of project and portfolio management was an emergent property. Between 2005 and 2012, we followed up a selection of the original interviewees, as well as the former HR manager, and the former strategic planning manager for the R&D function. Each of these interviewees was asked to reflect back on the earlier period in order to gauge its significance when viewed from a distance. Additionally, these three later rounds of data collection were used as opportunities to assess subsequent developments in project and portfolio management techniques. Where the interviews were conducted face-to-face, they were recorded and transcribed verbatim; the later interviews were conducted by telephone and for these detailed notes were taken. For ethical and methodological reasons, confidentiality and anonymity were assured for both interviewees and the organisation as a whole. The interview data was subsequently reviewed by all three authors and preliminary coding undertaken for a second time. The transcriptions and interview notes were broken down into themes and coded to compare, analyse and assess the significance of the data collected (Strauss and Corbin, 1998).

Projects at Compuco

Historically, Compuco's culture and values were perceived by many employees as distinctive, with interviewees repeatedly indicating their deep attachment and pride in the cultural values with which Compuco as a corporation was associated. This was especially evident in the data from the late 1990s with one interviewee commenting;

'The Compuco environment...is something that a lot of people who have come in from other companies very much value. And that people are really treated as people...I think some of it comes to do with, I guess, a very kind of open and informal, friendly kind of approach that we feel we have and a very, well a very informal kind of atmosphere....But they do feel they can kind of speak on things that they want to...And so there is a lot of freedom in their position so long as they don't abuse it.'

(Engineering Productivity Group employee, 1998)

To some extent this culture survived into the early 2000s. In 2002, some respondents could still maintain:

'The fundamentals of the Compuco Principles are about respecting people with intelligence and desire to do a good job, give them the tools and the responsibility and freedom to do so. Compuco is very respectful of people; it is a warm and comfortable environment in which to work.' (Project Manager 1, 2001/02)

The open and supportive culture at that time and the technical and commercial success of the company were seen by many to be intimately linked, Research Engineer 1 noting that even staff at his (relatively junior) level could make direct personal contact with the VP of Research. Management of technical staff was viewed as involving 'soft' influencing skills rather than outright direction, something appreciated by many engineers perceiving that they enjoyed substantial autonomy, and that the 'nudges of approval' reflected an appropriate balance of power within Compuco.

During the period 2000-2002, a series of key changes were initiated. A relatively young outsider had been appointed as the new CEO who was to prove to be a harbinger of significant change. His new strategy included a move to fewer R&D projects which were to be rationalised and integrated with the aim of achieving radical rather than incremental advances. This change in strategy was accompanied a reprioritisation of shareholder value and attempts to overhaul the firm's traditionally slow, consensus-based decision-making style with a faster, more centralised and directive managerialism. The impact of this strategic and

operational reorientation in the 2000s would challenge many deeply-held understandings of what it meant to work at Compuco. These changes and the subsequent sequence of events are shown in Figure 1.

Insert Figure 1 about here.

As shown, the top-down reforms involved increased centralisation in line with similar trends in R&D more generally (Hill *et al.*, 2000). At this time UK departmental managers were asked to report directly to the US whereas in the immediate past, they had reported to a UK head of corporate R&D. Beneath the departmental heads were project managers, usually themselves engineers by background, who managed research engineers occupying highly prized roles conferring both recognition of technical merit and material benefits such as a company car. There was a deep sense of shock at the first major sign of radical change when, within months of his arrival, the new CEO sacked two very senior managers for failing to meet their targets (see Fig. 1). Despite the apparent renewed emphasis on R&D which requires a long-term focus, this sacking was widely seen as heralding a new management style where mistakes were no longer to be forgiven in a climate of financial short-termism. It is against this background within Compuco that new project and portfolio management techniques were initiated.

Although historically, many projects at Compuco were initiated by senior management, the company relied on a bottom-up process of idea generation; the engineers interviewed suggesting that the ‘best managers’ were always on the lookout for new ideas, and the ‘best projects’ often came about because of a new insight by an engineer. On average there were five individuals on a project team although some larger ones employed around eight to ten staff. While most projects lasted between two to three years, the longest might continue for up to nine years. Engineers commented that projects often enjoyed a year-long honeymoon period during which time any formal reviews were fairly ‘light-touch’. Instead, control would tend to be limited to day-to-day communications between engineers and their departmental managers and project managers. After this initial period, there would be reviews every 6-12 months by senior managers across sub-divisions of a lab according to the project life cycle. These reviews would assess whether a project was delivering against strategic priorities. As a result, projects might be accelerated or reorganised, or halted and the team disbanded. In 2002, it was estimated that Compuco supported around 12-15 separate projects across a

population of 75 researchers, and that around 10% of these projects were cancelled every year (Project Manager 1, 2002).

From 2001-2002 on, however, tighter governance of R&D projects began to challenge taken-for-granted culture of consensus-based decision making and employment security at Compuco. As part of this tighter governance, portfolio management and tighter project management were introduced in the corporate R&D function. Under new project and portfolio management procedures, a project team would be obliged to officially present their progress at formal reviews and convince a non-specialist panel why their project should continue. Should a project be allowed to continue, stringent objectives would be set for the next six-monthly review. These moves represented a substantial change from the informality of previous reviews with panels dominated by fellow engineers willing to respect and defend professional autonomy of their peers.

This was complemented by the company-wide introduction across Compuco of forced ranking in staff appraisal shortly after the new CEO's arrival. Under this system, staff were rated against specific behaviours, including speed of execution, teamwork and promotion of the Compuco brand according to a predetermined ratio of high, average, and low performers. Furthermore, desired behaviours were now specified in detail, whereas in the past, these had remained unarticulated and so were open to wider interpretation. This standardised performance evaluation, alongside organisational layering, meant that the performance of R&D engineers and projects were increasingly made visible to senior management with the responsibility for portfolio management – who, it was assumed, would utilise this decontextualized data to support decisions to axe projects. The combined consequences of the changes were felt at all levels, resulting in increased competition and vulnerability among R&D staff, and more politicised work environment. Hence 'Portfolio management chopped things up in a different way and it led to huge amounts of political in-fighting and senior managers getting very territorial.' (Project Manager 4, 2001/02)

The changes originating from this period became deeply embedded through the 2000s. Following the appointment of a new head of corporate R&D in 2007, one interviewee observed 'there is a lot more process and structure associated with new activities (...) there is now a bit too much process.' (Research Engineer 5, 2009). This perception of a more depersonalised, process-driven approach was a common theme in the interviews conducted at this time, described by one engineer as 'management's mania with metrics' (Research Engineer 8, 2005). This was to persist with a move towards increased measurement of R&D

effort from 2007, in terms of the number of papers published and patents produced by the individual researcher, a development instigated by a new Head of Compucor R&D in the US. A significant factor in this development was judged to be the appointment of a new CEO in 2007 (see Figure 1), whose ‘focus was very much on the detail and who was known to give even very senior managers a tough time.’ (Research Engineer 8, 2009). From 2007 on, engineers were allocated points reflecting their performance which, it was suspected, affected their level of bonus reward and vulnerability to redundancy. By 2009, much more attention was paid by senior management to detailed monitoring with a ‘focus on execution and cost reduction.’ (Research Engineer 5, 2009). At the level of the individual R&D engineer, formal procedures were introduced which required compilation of work plans including 3-year roadmaps. Over time, the reliance on quantitative metrics meant that fewer and fewer supervisory processes were mediated by a human being, such that by 2009, as one engineer argued, at Compucor, ‘the human contact aspect has completely disappeared.’ (Research Engineer 5, 2009). The consequence by the end of the decade was that the traditional Compucor culture was, if not dead, then certainly placed ‘on life support.’ (Research Engineer 5, 2009)

Impact of Project Cancellation

It was widely agreed that successful R&D engineers required substantial self-belief to cope with the uncertainty deriving not just from Compucor management decisions but also from the rapid technological change in the sector – change which, ironically, research engineers were themselves instrumental in shaping.

‘Mostly, you have to believe in yourself that you can eventually succeed, according to your own definition. For some people that would be money, for others it would be changing the world even in a small way. For most people here I would say they are trying to change the world.’ (Research Engineer 8, 2001/02)

The traditional Compucor culture, while consensus-based, also expected resilience and self-belief from their engineers, and intensified pressure to live up to this ideal through various symbolic activities intended to celebrate heroic individualism. As one departmental manager explained:

‘The Compucor perceived official culture (...) is probably still one of being heroic, it’s the super-techie who does everything and can walk on water. So it’s the St George and the dragon image. This is institutionalised in the culture. There is a prize given annually

in corporate R&D called the Smith Prize after a previous director of Compucor R&D which is for triumphing against undue odds. For example, your division management did not believe in you but you overcame - it is very heroic. That is probably the cultural model and it is kind of imposed from above...' (Departmental Director 1: 2001/02)

Such expectations contrast starkly with the isolated position of the R&D engineer. Despite the purportedly 'collegial culture', interviewees reported a distinct lack of support in practice, from peers or from management, and the deterioration of a sense of community through the 2000s.

In this environment, project cancellation in R&D at Compucor was a common and often traumatic experience. One research engineer talks of the axing of a project as 'Having the ground taken from under your feet.' (Research Engineer 5, 2001/02). This perception persists, with another research engineer commenting: 'Project cancellation is most emotionally damaging where whole bodies of work are axed, something that happened recently to a long-term project.' (Research Engineer 8, 2012). For others, the impact was more dramatic and painful. One project manager compared the cancellation of a project to the discovery of personal infidelity: 'It was like being betrayed by your wife'. (Project Manager 2, 2001/02).

Despite such sentiments, Compucor R&D staff were well aware that only around 5% of projects were successful, given many were cancelled at different stages in development following reviews or changes in strategic direction at Compucor HQ. When a project is axed, discontinuities mean that engineers are often required to master a different knowledge domain in order to contribute to a new project. One explained that it may take months or years establish their expertise and reputation; 'You have to start from scratch - it's a case of throwing away all your experience.' (Research engineer 8, 2001/02). The consequences of this were substantial: 'On ending the project, I spent almost one year in the wilderness, reading papers etc. before I could contribute to a new project.' (Research Engineer 5, 2001/02). When interviewed again a decade later, Research Engineer 8 noted the persistence of this shift. He described how when a long-term project was recently disbanded, the team members were told they had a year to find other work within Compucor corporate R&D.

In summary, with increased management of projects came more frequent forced closure of projects, with substantial impact both personally and professionally for the R&D staff at Compucor. As organisational culture is transformed and professional autonomy increasingly challenged, interviewees described a range of responses to the changing organisational climate.

Responding to Change

R&D engineers responded to the new situation in a variety of ways, including deliberately ignoring the changes, engaging in political manoeuvring in the organisation, actively resisting control, or else effecting an 'escape', either from the firm or the role - often by ascending the corporate ladder into management.

In the context of change and increasingly intrusive forms of control, a widely adopted tactic among these experts was simply to try to ignore change, particularly in the early years: 'Some, like me, take the attitude it will wash over us, it will change.' (Project Manager 4, 2001/02). Similarly, the ex-HR manager, speaking in 2005, reported how technical staff would 'squirrel themselves away and ignore change'. This was echoed by the engineers: 'Some go into 'huddle' mode and get on with what (they're) doing and do a good job of it and take it on trust that the company will value it.' (Project Manager 4, 2001/02). Such tactics reflect a deliberate attempt to maintain scientific integrity by refusing to engage with what they regarded as the tawdry politics of 'management' and the transient waves of initiatives.

Others took a more proactive and politically engaged position, creating alliances between project managers and engineering staff. Situations arose where project managers would devote more and more time to persuading senior management of a project's value, 'spend(ing) all their time doing Powerpoint trying to protect (their) staff.' To quote one research engineer: 'Sometimes there are things presented that determine whether a project lives or dies (...) The emphasis in our presentation has had to change to satisfy our current masters.' (Research Engineer 5, 2001/02). Another engineer (Research Engineer 3) reported how on one occasion his group was able to reinvent itself by 'tweaking our work to match the (new strategic) story.' Another manager noted that project teams would often change their name and the description of their project in order to appear to respond to the current situation.

Another research engineer spoke of how a project was discontinued, only to be resurrected as a 'hot topic', sparking resentment among some engineers that projects at Compuco were discarded recklessly and irresponsibly with little consideration of personal cost or long-term value. This sentiment sheds some light on the most radical instance of resistance encountered at Compuco, undertaken by engineers after a project had been axed:

'It was a very strong programme, it had a fantastic value proposition, it had grand ambitions and goals and was an absolute pleasure ... we had divisional backing and that was fantastic. Sadly, in the end it was killed by the company. That really felt like a

death, in fact we had a wake and symbolically burned our files at someone's house and had a BBQ. We did recognize in ourselves that it was such a big thing that you had to go through the mourning process to get over it.' (Project Manager 2, 2001/02)

The passion is evident in this account, but the reaction - to commemorate this 'death' with a funeral wake - is not purely symbolic. The tangible outputs of the project, the project files, are destroyed rather than stored away, so that the project cannot be resurrected at a later date, bringing home to Compuco (it is hoped) the cost of such decisions. Given the engineers' commitment to projects expressed elsewhere, such acts of resistance are particularly striking.

However, an altogether different choice, that of exit, may be made and this took two different forms. Some engineers responded by leaving the company. An alternative course of action was to join the ranks of management. Choosing a managerial career aroused strong emotions with many engineers making it quite clear that the managerial route is 'second best'. Reactions to undertaking managerial work varied from ambivalence to downright hostility, exemplified by one research engineer who described Compuco managers as 'the enemy', stating; 'Work is war: I am here to fight.' (Research Engineer 8, 2001/02). While downright opposition to undertaking managerial work was more common, some viewed such a position as enabling the reassertion of some control: 'I became a manager (after joining as a researcher) because it was easier to change things.' (Departmental Manager 1, 2001/02). For some, the roles of manager and engineer/researcher are not necessarily conflicting identities, and, as noted above, several project managers actively collude with research engineers to safeguard projects. Whether ignoring change and concentrating on the project, politicking to defend the project, destroying the project in protest or moving to a management role, the project typically serves as the focal point of activity, a point explored at more length below.

Discussion

The case of Compuco traces the degradation of autonomy among R&D engineers as conditions of trust and professional autonomy are replaced by a new regime of control. During the key period of change in Compuco during 2001-2002, tighter and more centralised control systems were set up to enable more direct senior managerial intervention and control of expert work. Key decision points including project start-up authorisation, periodic review, stage-gate methods of governing increasing investment or dis-investment, and, ultimately, project termination, increasingly required corporate management involvement and decision-making and drew on external managerial assessments of the commercial viability of the

project. This was accomplished with the aid of rationalistic models of project and portfolio management, resulting in a reduction in both strategic and operational autonomy for knowledge workers in R&D. The argument that the nature of knowledge work renders it 'inherently resistant to incursions by the carriers of bureaucratic rationalization and control' (Reed, 1996: 585) is challenged by the transformations wrought in this corporation. The overall effect of a decade of change was a significant loosening of the identification with the employer brand and culture, but a continued attachment to the concept of the project which provides some, perhaps illusory, sense of 'terra firma' for the identity of the research engineers.

The episodic longitudinal methodology adopted by our research which allowed periodic insights into the inner workings of this R&D function lends confidence to the observation that the key changes undertaken in 2001/2 were indeed significant and sustained. They were proved not to be merely transitory and associated with only one set of managerial players as some R&D engineers had hoped. Rather, these changes marked a point of significant disruption in the mode of managing expert knowledge work at Compuco. As such, the findings raise important questions about many of the assumptions and statements in the management literature concerning the unique and special nature of managing this kind of work. What is more striking is that this transformation took place in a corporation renowned for innovation, where, as noted, the knowledge workers in question have exceptionally rare specialist knowledge and skills and the corporate culture has historically emphasised a (heroic) individual autonomy.

The overall consequence of the changes has been to create a more precarious environment for even leading R&D engineers (Araújo, 2009). The manner in which R&D engineers, often in collusion with project managers, responded to changes at Compuco cannot readily be categorised as either clear compliance or resistance; most lamented the tightening of control over project work but many were willing to collude tactically for the sake of their research project. For many, it seems, the project itself represents a zone of relative stability, offering a level of ontological security and clarity of purpose. As has been noted elsewhere, commitment to a particular project offers a seductive 'anchor' for the self-identity of the project worker (Andersson and Wickelgren, 2009) - albeit for a fixed duration. Projects afforded these research engineers a purpose, a focus, and a degree of autonomy and control. But more importantly the project provided an anchor for the creation of a valued and secure professional identity.

However, this limited security comes under threat as a result of the intensification of managerial intervention into project and portfolio management implemented as a reaction to global competition and the fight for markets and margins (Whittington, 1990). When senior managers tightened the rules and procedures governing project work, taking strategic and operational decisions out of the purview of R&D engineers themselves, this presented challenges not only to work routines but also to the valued professional identity of these knowledge workers. In extreme cases, such decisions elicit strong opposition; the ‘file-burning’ incident, representing a ‘scorched earth’ tactic, is perhaps the most striking and active of the forms of resistance discussed, and reveals the personal damage experienced as projects were axed. More generally, however, resistance to the managerial disciplining technologies of project and portfolio management was contained within an overarching imperative and desire to keep projects going. To this extent therefore, due to their commitment to ‘their’ project, the R&D engineers emerge as *svejks* (Fleming & Sewell, 2002), misbehaving in relatively minor ways to defend it, but not seeking to challenge what they recognise as a situation of asymmetrical power relations.

Conclusion

In this article, we have examined the process of erosion of the autonomy among R&D engineers through the use of tighter centralised management control using techniques of project and portfolio management. The contribution of the article has been to analyse and explain the complex and varied responses of R&D engineers to these processes. Using an episodic longitudinal methodology we have shown that a set of critical changes which began at the turn of the 21st century were embedded and sustained over the next decade and more. Corporate management’s attempts to exert control over the supposedly indeterminate and necessarily autonomous nature of expert knowledge work through project and portfolio management forcefully disrupted the established culture of professional/scientific autonomy.

While engineers and other professionals are often thought to have an ambiguous attitude to management (Ritti, 1968; Whalley, 1986), very few Compuco R&D engineers were inherently opposed to the principles or practice of management on an ideological basis; on the contrary, they were generally receptive to managerial rationalism. They broadly accepted management as ‘embedded within the activity – a means towards the end of the production of good science’ (McAuley *et al.*, 2000: 109). But they struggled to come to terms with the shift from a much more autonomous relationship with management which they had experienced

and celebrated up until a more controlling mode was introduced. This triggered a long period of adjustment whose nature and varieties have been here described. It is possible that new generations of R&D engineers, unfamiliar with the previous practices and understandings may be more accepting of the new orthodoxy. It is impossible to predict which regime would have been more effective over the past decade in delivering innovative and commercially successful products; what is clear, however, is the deleterious effects of intensified control on the expert knowledge workers who lived through this change (Scarbrough, 1999).

The case focuses explicitly upon privileged and prestigious expert knowledge workers who, by experience and inclination, are assumed to expect and demand autonomy in their working practices. This does not mean that R&D engineers are necessarily ‘reluctant, idiosyncratic members of the organizations in which they work’ (McAuley et al., 2000: 87); however, given the strong tradition of autonomy and professional discretion within R&D, especially within Compuco, the attachment of these expert knowledge workers to these values, one might perhaps have expected substantial resistance to increasingly intrusive managerialism. In reality, the response to the changes covered a diverse range: from tactical accommodation, some self-reinvention as a ‘manager-engineer’, attempts at simple avoidance, or some limited, but illuminating, examples of protest and resistance. We interpret these responses as attempts by R&D engineers to defend their projects and their identity (Hodgson and Cicmil, 2006). Some have argued that attachment to ‘the project’ renders expert staff open to being ‘colonised’ (Andersson and Wickelgren, 2009); experiences at Compuco suggests that while this attachment may equally result in resistance, at the same time many senior and expert R&D engineers cannot extricate themselves from such colonisation. In extremis, however, the valued project may also form the means of resistance against an implacable managerialism.

As with any detailed case-study, what is not addressed here is the extent to which the degradation of autonomy at Compuco is reflected more widely, across private and public R&D and stretching to expert knowledge workers in other fields. We would therefore call for wider, comparative research into the broader consequences of enhanced control and intensified work through project and portfolio management in such fields, and greater critical attention to the role of the project as informing the complicity or resistance of such knowledge workers.

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Figure 1: Timeline of key events for Compuco corporate R&D

Table 1: Details of interviewees~

Interviewee	1998	2001/2	2005	2009	2012	Time with Compuco
R&D Director		1				Long-standing*
Departmental director 1		1				12 years
Departmental director 2		1				8 years
Project manager 1		1	1		1	16 years
Project manager 2		1				8 years
Project manager 3		1				1 year
Project manager 4		1				17 years
Project manager 5		1				17 years
Project manager 6		1				5 years
Research engineer 1		1				11 years
Research engineer 2		1				13 years
Research engineer 3		1				20 years
Research engineer 4		1				4 years
Research engineer 5		1	1	1		10 years
Research engineer 6						4 years
Research engineer 7		1				5 years
Research engineer 8		1	1	1	1	15 years
R&D section manager 1 plus Engineering Productivity Group employee (joint interview)	1					Unknown
R&D section manager 2	1					Unknown
R&D section manager 3	1					Unknown
UK HR Director	1					Unknown
Intellectual property manager		1				5 years
R&D ex-HR manager			1			6 years
R&D strategic planning manager			1			Long-standing *
R&D IT manager		1			1	6 years
Total	4	18	5	2	3	n=32

*Exact time employed with Compuco unknown as have since left the organisation.

~All interviewees based at Compuco corporate R&D in the UK except for the following: 3 R&D section managers, employee from Engineering Productivity Group and the UK HR Director.