

TITLE PAGE

GOVERNING INTER-ORGANIZATIONAL SUPPLIER COLLABORATIONS AT JLR USING A CONTINGENCY FRAMEWORK

*Ben Clegg**

Senior Lecturer, Operations and Information Management Group, Aston Business School,
Aston University, Birmingham, B4-7ET, UK, Email: b.t.clegg@aston.ac.uk, Tel: +44 (0)121
204 3063

Mario Binder

Project Manager Automotive, ZLU Consulting and Management GmbH & Co. KG,
Rotherstrasse 8, 10245 Berlin, Germany, Email: mario.binder@zlu.de, Tel: +49 (0)30 600
501 511

John Edwards

Professor of O.R. and Systems, Operations and Information Management Group, Aston
Business School, Aston University, Birmingham, B4-7ET, UK, Email:
j.s.edwards@aston.ac.uk, Tel: +44 (0)121 204 3087

Simon Chandler

Electrical Programme Leader, Jaguar & Land Rover Engineering Centre, Abbey Road,
Whitley, Coventry, CV3 4LF, UK, Email: schandl3@jaguarlandrover.com, Tel: +44 (0)2476
204175

***contact author**

Abstract

Inter-organizational relationships are becoming an increasingly important source of competitive advantage and innovation. This paper looks at supplier relationships in the context of inter-organizational R&D collaborations in enterprises based in the European automotive industry. The concept of Collaborative Enterprise Governance (CEG) is presented and the Dynamic Enterprise Reference Grid (DERG) is used as a contingency framework to help manage CEG.

Distinct types of enterprises are characterized based on empirical research conducted at Jaguar Land Rover, in the UK. The study explains and illustrates developmental paths and patterns in the evolution of inter-organizational relationships using three research and development examples. Each examples' configuration and dynamic evolution is shown to be contingent upon the 'engageability' of the partner companies' competences based on attractiveness, transferability and maturity. The study shows that the DERG is a contingency framework that is theoretically robust, transferable and useful.

Keywords: R&D collaboration, inter-organizational governance, enterprise management, innovation, contingency framework, supplier integration

GOVERNING INTER-ORGANIZATIONAL SUPPLIER COLLABORATIONS AT JLR USING A CONTINGENCY FRAMEWORK

Abstract

Inter-organizational relationships are becoming an increasingly important source of competitive advantage and innovation. This paper looks at supplier relationships in the context of inter-organizational R&D collaborations in enterprises based in the European automotive industry. The concept of Collaborative Enterprise Governance (CEG) is presented and the Dynamic Enterprise Reference Grid (DERG) is used as a contingency framework to help manage CEG.

Distinct types of enterprises are characterized based on empirical research conducted at Jaguar Land Rover, in the UK. The study explains and illustrates developmental paths and patterns in the evolution of inter-organizational relationships using three research and development examples. Each examples' configuration and dynamic evolution is shown to be contingent upon the 'engageability' of the partner companies' competences based on attractiveness, transferability and maturity. The study shows that the DERG is a contingency framework that is theoretically robust, transferable and useful.

Keywords: R&D collaboration, inter-organizational governance, enterprise management, innovation, contingency framework, portfolio model

INTRODUCTION

The literature on inter-organizational architectures shows little consistency in terminology.

An overview of the various scholarly terms is provided by Binder and Clegg (2007) and Jones *et al.* (1997). Nassimbeni (1998) identifies three basic characteristics that inter-organizational relationships have in common (1) they are formed by two or more organizations (separate legal entities) leading to voluntary exchanges (2) the mechanism used to govern these transactional exchanges is a form of relational contract that usually departs from economic motives and becomes socially embedded over time (3) dynamic forms of communication and coordination are used to synchronize partners' activities and influence the adaptability of the relationship based on exogenous and endogenous contingencies. This paper discusses inter-

organizational architectures as part of a concept referred to here as *Collaborative Enterprise Governance*.

THEORIES OF INTER-ORGANIZATIONAL COLLABORATION

Researchers such as Amit and Schoemaker (1993) and De Toni and Tonchia (2003) argue that the traditional ‘outside-in’ (exogenous) and ‘inside-out’ (endogenous) views of the firm need to be integrated, complemented and balanced as excessive focus on either approach is not beneficial. For example, on the one hand, governance choices may have a significant impact on how rents, created through valuable resources, are appropriated (Barney *et al.*, 2001); and on the other hand, capability differences can be considered as a necessary condition for vertical specialization (Jacobides and Winter, 2005). However, to date a simple conceptual framework addressing this in the inter-organizational context is absent from the literature (Fynes *et al.*, 2005; Narasimhan and Nair, 2005).

For this reason, this paper draws upon a polyvalent body of knowledge to provide relevant insights for the architecture and governance of inter-organizational relationships. This necessity is supported by many researchers (e.g. Croom *et al.*, 2000; Ho *et al.*, 2002; Ilinitich *et al.*, 1996; Ketchen and Giunipero, 2004; Min and Mentzer, 2000; Svensson, 2004; Trienekens and Beulens, 2001) who argue that a cross-fertilization of theories from related fields is necessary for a further theoretical development and conceptual grounding of inter-organizational governance. Further insight into this body of knowledge is given in Table 1.

Insert Table 1 here

Similar discussions drawing on different theoretical perspectives in the inter-organizational context can be found in Gulati *et al.* (2000), Sydow (1992) and Grandori and Soda (1995).

Harland *et al.* (1999) make the point that the plethora of subject titles related to the study of inter-organizational governance may well discourage any further research. However, gaps remain in the literature and questions remain unanswered. For instance, what determines whom to engage with and in what type of relationship? What are the critical success factors that determine the degree of engagement? What characteristics facilitate or hinder relationships? How should the relationship be structured? What longevity is expected in any relationship? Hence, the architecture needs to be considered as a dependent variable in the inter-organizational development and design process in order to understand what influences a particular structure (Madhavan *et al.*, 1998).

In particular, very few studies consider inter-organizational architectures as dynamic entities that adapt to varying contingencies (e.g. Choi *et al.*, 2001; Olsen and Ellram, 1997). Inter-organizational architectures are complex systems that need to be adaptive to the industrial environment because strategies and organizational forms that were effective at a past competitive juncture might be entirely inadequate for present or future circumstances (Ilinitch *et al.*, 1996). This research examines the details of how these inter-organizational architectures evolve over time, the role of each member (Bessant *et al.*, 2003), how value is created, and how a position or role between incumbents may be improved or forged with newcomers. Studies that lead in this direction include Harland and Knight (2001), Möller and Svahn (2003) and Ritter *et al.* (2004). The authors refer to such inter-organizational architectures in this paper as an *enterprise using* the European Commission (2003) definition of an *enterprise* as “... an entity, regardless of its legal form ... including partnerships or

associations regularly engaged in economic activities”. See Table 2 for a characterization of the three main typologies enterprises; vertically integrated, virtual and extended.

Insert Table 2 here

Whilst most studies of inter-organizational architectures focus on the individual organization rather than the whole enterprise (Boer, 2003), this research takes the viewpoint that the focus of strategic analysis should be on the enterprise. Similarly, Gulati (1998) argues that more attention must be directed to the context in which inter-organizational relationships exist whilst Normann and Ramirez (1993) state that the focus should be on the value creation system. This paper is believed to be the first to explain the new concept of Collaborative Enterprise Governance (CEG) using cases where the *enterprise* is the primary independent unit of analysis and *enterprise modules* are a secondary dependent sub-unit (see Table 2 for characteristics of an enterprise module). This research uses three examples of new product development taken from Jaguar Land Rover to illustrate the CEG concept.

Insert Table 3 here

APPROACH TO EMPIRICAL STUDY

The research was conducted at Jaguar Land Rover (JLR), an Original Equipment Manufacturer (OEM) in the automotive industry based in the United Kingdom. Three collaborative R&D technology projects were chosen: the Rotary Shifter (RS), the Dual View Screen (DVS), and My Connected World (MCW). These cases were similar enough to make comparisons between data but different enough to look for contrasts (Eisenhardt 1989). All three cases were technology-based R&D projects involving JLR Research in association with

other organizations and subsequently transferred to JLR Electrical Engineering for industrialization. Interviewees included a variety of disciplines (e.g. project champion, engineering leader and purchasing manager from JLR and managers from the tier 1 suppliers); fourteen semi-structured interviews were conducted in all (see Table 4).

Insert Table 4 here

An interview guide was pilot tested with volunteer managers from JLR and was subsequently refined to ensure the elicitation of the appropriate data (see Appendix 1). The interviews were conducted during August and September 2009, each lasted 1-1^{1/2} hours. They were recorded and transcribed (200 pages resulted) (as per McCutcheon & Meredith 1993).

The study considered how *technology based projects* can affect Collaborative Enterprise Governance. The data were analyzed using the principles of grounded theory (Glaser 1992; Strauss and Corbin 1998, Binder and Edwards, 2010). The authors conducted coding and analysis according to the following steps. (1) The interviews were coded using Open Coding. During the coding process memos were created that explained how the data were opened up to get a greater understanding of the responses; 80 individual codes were extracted (2) Axial Coding was also used in order to validate the Open Coding process. The text was analyzed and coded again but in the Axial Coding the memos were used to seek understanding about each code in terms of Conditions (things that were happening that affected what was going on), Actions and Interactions (relating to the phenomena); and Consequences (things that actually happened as a result of the actions and interactions). From this, 40 further individual codes were extracted. (3) The 120 codes were entered into a master document. (4) Through iteration the codes were abstracted into 15 propositions as defined in Table 5.

Insert Table 5 here

These new findings add to the *a priori* CEG concept and validate its grounding specifically within technology based projects.

THREE TECHNOLOGY CASES

To illustrate the CEG concept the product development three case histories are now briefly described using terms from the Dynamic Enterprise Reference Grid (DERG). These examples are "polar types" making it easier to observe their characteristics (Eisenhardt, 1989); see Table 6.

Insert Table 6 here

The most significant difference between the three examples was the final outcome. Case RS was successfully implemented in production vehicles whereas the MCW did not make it successfully onto its targeted vehicle program. Case DVS was successfully industrialized, but the project team had to cope with the difficulties surrounding a change of suppliers mid way through the development.

The Rotary Shifter (RS)

Jaguar launched the new XF sports saloon in 2007. During its development, Jaguar Design wanted to achieve a modern and 'clean' interior. Jaguar Design very much wanted to remove the stick shift (or gear lever) because it caused the continuity of the interior lines to be broken. This triggered a project to come up with a new generation of interface that became the Rotary

Shifter (RS). The RS is a rotary knob that is positioned similar to where the stick shift would be. The RS was seen as a very ambitious and ground breaking project because gear shifting is such a fundamental part of the driving experience. The RS project was initiated by JLR Research in March 2004. During this phase Jaguar Design were responsible for creating the visual aspects of the RS and working out how it would aesthetically integrate into the interior, JLR Research were involved in some initial engineering development work and specification tasks as well as undertaking some initial ergonomic trials, external partners are also summarized in Table 6.

After progressing to Implementation Readiness (IR) in June 2005 the RS lead transferred to JLR Electrical Engineering. Simultaneously, the RS design specification was sent to a number of tier 1 suppliers to quote for designing and developing it. Production supplier 'K' (note: companies other than JLR and Ford remain anonymous in this paper to preserve their confidentiality) were awarded the contract to deliver the production RS and started working with JLR on the project at this point. The tier 1 supplier 'Z' of the transmission unit and its Electronic Control Unit (ECU) were also engaged to help develop the shift-by-wire interface between the transmission ECU and the RS.

The Dual View Screen (DVS)

The Dual View Screen (DVS) was installed in the 2010 Model Year (MY) Range Rover and will also be in the Jaguar XJ from 2010. The DVS is a display that allows two different images to be presented simultaneously depending on the viewing angle. In the Range Rover and XJ the DVS means that the front seat passenger can watch TV or a DVD while the driver can continue to see system information (e.g. a satellite navigation map). The DVS project started in 2004 when one of JLR's automotive tier 1 suppliers 'A' demonstrated a very early prototype of the DVS to JLR Research that resulted in a development project with supplier

‘A’, JLR Research and the tier 2 supplier ‘S’, supplier of the liquid crystal display panel.

Other companies involved in the DVS project are also defined in Table 6.

Several months prior to IR and hand-over to Electrical Engineering, the 2010MY navigation display business was split between two different tier 1 suppliers, neither of whom were involved in the R&D project. This meant that the project team had to rapidly adjust to working with two new suppliers and had to transfer knowledge about the system quickly and efficiently to avoid compromising the lead-times. Despite these issues, the technology was delivered on time for its first application on Range Rover 2010MY.

My Connected World (MCW)

The aim of the My Connected World (MCW) project was to allow drivers to connect to their cars via the Bluetooth link on a mobile digital device. This would facilitate features like personal contacts to be downloaded to the car so that a navigation postcode could be automatically entered. The MCW project was a concept that was born out of ongoing collaboration between the Infotainment groups in Ford Scientific Research Labs (SRL) in the US, Ford Research in Aachen, Germany and JLR Research. The project began with SRL as the lead, JLR Research as a contributor and Jaguar XK as the targeted vehicle line. Further partners are also given in Table 6.

In August 2003 the project, now led by JLR Electrical Engineering, needed a production route so a specification was sent to a number of suppliers for quotation, including supplier ‘M’ who were the incumbent supplier at the time for the Bluetooth Phone Module (BPM), even though they were potentially due to be replaced by another supplier. Since the existing BPM was already a Bluetooth interface to the car it was much more cost effective to host the new

technology in a modified version of the existing BPM so a development project with the incumbent tier one supplier 'M' of the BPM kicked off. Throughout the 12 month period of the development project working with supplier 'M' the team were unable to define use cases that added customer value. In parallel, the targeted Jaguar vehicle line was reaching Program Approval (PA) where financial objectives needed to be firmed up. During the PA gateway review the project was rejected as it was seen as unaffordable and without widespread vehicle program compatibility throughout Ford groups, and the technology was 'book shelved'.

Table 7 shows how each case can be typified as a different enterprise type at different stages of the new product development lifecycle.

Insert Table 7 here

COLLABORATIVE ENTERPRISE GOVERNANCE AND THE DYNAMIC ENTERPRISE GRID

The rationale for why enterprise types change throughout the product development lifecycle is now explained using the case histories and propositions from above. In general, there was a distinct difference between the enterprise structures of technology projects whilst led by JLR Research compared to those led by the mainstream engineering areas, as during research activities there is a tendency to be more open (prop. iv). In all three cases, internal JLR and external groups worked together in a flexible way to deliver the technologies to IR (prop. ii). This was attributed to the high risk involved in new technologies and the need to be able to quickly dissolve an enterprise if the technology project failed during its infancy (prop. i & ii).

In the RS case, initially specific suppliers were brought into the enterprise to undertake specific work-packages and then were no longer involved (prop. iii). Various internal teams were also involved on a temporary basis. For the DVS case, production tier 1 'A' and tier 2 suppliers 'S' were involved early-on in the enterprise because they had knowledge about how to design and integrate the DVS but at that stage had no guarantee of future business (prop. iv). In the MCW case, the enterprise initially consisted of Ford Research and JLR Research, and the engineering services company 'P' was recruited later, remaining until the IR phase of the project. In the early stages, the enterprise was a virtual enterprise because it was comprised of particular short-term partners, for a single particular project where each member was brought in based on a certain capability (prop. xii), and they worked in a flexible/informal way.

In all cases, when the technology reached IR a production supplier was chosen and the technology lead transferred to JLR Electrical Engineering (prop. i). The enterprise structure changed as JLR work exclusively with tier 1 suppliers to industrialize the technology (prop. ii, iii & v). There are no longer many companies involved delivering specific work-packages but instead JLR works exclusively with a tier 1 supplier (prop. v). At this point both JLR and the production supplier's destinies become interdependent because if the technology fails to get into production successfully then both parties have lost out which is one of the basic principles of CEG (prop. vi & vii). Although the production supplier's development costs would be funded to some extent by JLR, the business models of tier 1 suppliers still rely heavily on sales of production components as the main means to generate revenue (prop. v). Furthermore, neither JLR nor the production supplier can afford to expend their finite resources developing a technology that fails when there could be other opportunities to exploit (prop. viii - xi). However, if a technology module becomes implemented across the

whole range of models and high volumes result then a tendency towards a vertically integrated enterprise structure would occur (prop. viii & xv).

In terms of the DERG, these cases validate the earlier work in that extended enterprise structures occur where enterprise modules have high current and future engageability (prop. ii). However, truly extended enterprises at JLR may not be realized if there are issues with relationships and/or trust between members (prop. iv, ix & xiv), resulting in at best only an approximation to extended enterprises; in terms of the working processes and limited number of partners involved during the phase from IR to production. Furthermore, previous research did not take into account the need for new technologies to be migrated into existing component level planning strategies (not fully appreciating the implications of proposition. This is because in current JLR enterprise management, assessment of tier 1 suppliers' core competences occurs mostly at component level and not at technology level (prop. xi). This introduces discontinuity when new technology needs to be migrated into a component where the supplier of that component may be superseded in the near future by another supplier whose core competences are becoming more important.

In the case of the DVS and the MCW projects, the technologies were to be hosted in fairly mature existing components that were due to be replaced within a 2 year timeframe and therefore there was a risk of low future *engageability* (see Table 8) because alternative suppliers had already been chosen to supply the replacement commodities when the current ones reached their end of life (prop. i & ii).

Insert Table 8 here

In the case of the RS it was industrialized into a completely new RS module thus allowing the correct core competences of the production supplier to be assessed for the component and long term technological aspects *per se*, and hence was perceived by the tier 1 suppliers to have a much longer life expectancy, and possible use in other vehicles.

It is therefore proposed that for new technologies the enterprise architecture will change interdependently, not only based on the current and future needs for core competence in delivering the new technology, but also based on the life-cycle phase of the commodity hosting the new technology. If the technology is being industrialized into a module that has a considerable remaining lifespan, the supplier is more likely to be engaged and pro-active in the enterprise than if the hosting component is likely to be replaced by another supplier's component. Figure 1 shows generic *a priori* DERG contingency framework and Figure 2 shows the actual enterprise paths for each of the JLR cases.

Insert Figure 1 here

Insert Figure 2 here

In the RS case the architecture began as a flexible, virtual enterprise and is now tending towards an extended enterprise structure as the engageability of the core competences of the production supplier is high currently and becoming potentially higher in the future, and the commodity hosting the technology is new. In the DVS case, again beginning as a virtual enterprise, the structure of the enterprise was bordering on extended enterprise for the 2010MY Range Rover because the core competences of the supplier were potentially high, but potentially becoming low as the navigation screen component will be provided by another

supplier for the new XJ, and the component is currently in the mature phase of its life. New partners had to come on board to do initial conceptual design due to incumbent supplier difficulties and necessary modifications. Hence this saw a new virtual enterprise develop from an existing extended enterprise. In the MCW case, the BPM technology was very mature and so the project began with existing structures. In addition, within one model year program the technology was due to be replaced by another supplier's component; therefore the enterprise structure became 'defunct'.

In general, there were a number of management factors that affected the success of JLR technology projects. One of the main issues was found to be lack of traction when another member took over the lead post (prop. iv, vi & viii). This is believed to be down to misalignment of the enterprises' vision. Strong technology champions, heading up the enterprise, are required to make sure all participating groups are engaged and are aware of what the vision is, and to break down organizational barriers where required (prop. xiii). This came across very strongly in the case of the RS where there was executive champion support both within JLR and at the tier 1 production supplier throughout, which contributed towards its relative success.

Another issue was that effective communication is an important requirement for a successful enterprise (prop. xii). Communication was found to be much richer in the two successful technology case studies. For instance, inviting supplier partners to attend key internal JLR reviews or feeding back the outcomes was found to be a particularly useful communication method which served to create an atmosphere of inclusion with all project partners; this was practiced particularly well in the RS case. Additionally, it is worth noting that specialized data-sharing tools (i.e. relationship specific assets) were not used in any of these cases, and given the increasing pressures to leverage off-shore to low cost country sourcing, coupled

with the need for better requirements capture, it is something that should be considered in the future (prop. xii) to help with technology industrialization.

IMPLICATIONS FOR COLLABORATIVE ENTERPRISE GOVERNANCE

The DERG can be used in two ways. The first is to help managers plan R&D projects. The JLR cases highlight the dynamic properties of the DERG, and the iterative structure of the CEG concept. The DERG especially bring out the need to plan for different enterprise architectures at different stages of the project. For example, in each of the three cases there is a clear need for a change in enterprise architecture at the point JLR call Implementation Readiness, where the lead transfers from a technical research department to a mainstream engineering department (different enterprise modules, although both part of JLR). The DERG is thus proposed as a decision support tool for managers to enable them to consider strategic commodity and technology decisions simultaneously in order to avoid sub-optimal or defunct enterprise architectures downstream in R&D projects.

Since an organization may be involved in many enterprises at any one time, the status of the DERG is that of a portfolio approach to management. Such approaches (e.g. the BCG Growth-Share Matrix, or the GE matrix) have a long standing tradition of value to specific fields, such as marketing or purchasing, despite their criticism for over-generalizing (Olsen and Ellram, 1997). More recently, the underlying contingency idea of portfolio models has also been applied to the field of purchasing and supply management by various scholars (e.g. Bensaou, 1999; Kraljic, 1983; Olsen and Ellram, 1997; Dubois and Pedersen, 2002).

However, in the context of inter-organizational architecture the existing portfolio models suffer from various shortcomings which are addressed by the DERG, as discussed below.

Focus on Competence Rather than Product

Most outlined portfolio models are based on the purchasing of products, and a product by definition is a formal tangible entity. In contrast, inter-organizational architectures out of necessity must combine the formal with the informal. This research has established the validity of the proposition that it is necessary to focus on the sourcing of competences that create value in inter-organizational R&D collaborations. Nellore and Söderquist (2000) argue that portfolio models based on product types fail to make the link between engineering, purchasing and suppliers within the process of product development. Similarly, other authors (e.g. Dyer and Hatch, 2004; Petersen *et al.*, 2003) find that successful supplier integration into R&D and product development is the transfer and application of technological knowledge and cost information because this provides the natural source of value creation in inter-organizational R&D collaboration. Hence, the primary task is to establish the architecture through which dispersed knowledge can be integrated. However, the capability to receive, interpret and apply knowledge through ‘absorptive capacity’ is equally important (Cohen and Levinthal, 1990).

Consideration of the Stages of the R&D Process

Most portfolio models provide typologies based on distinct strategies and roles which are assumed constant for the entire R&D project. This limitation was recognized by Wynstra and Pierick (2000) who offer a supplier involvement portfolio that distinguishes specific development situations rather than generalized supplier roles on the basis of two dimensions: (i) the degree of responsibility for product development that is awarded to the supplier (e.g.

detailed design, manufacturing, etc.); and (ii) the development risk (e.g. importance, newness and complexity of the development). They further argue that if the development *responsibility* is related to the competences of the supplier it affects their stage of involvement, whereas the development *risk* relates to the stage of a product's development. Hence, a portfolio grid needs to be seen as applying differently at specific stages in a project.

Multiplicity of Relationships

Most traditional portfolio models do not account for the fact that in practice a company with a certain product or competence can be involved in more than one inter-organizational project at the same time thereby eventually deploying the same resources and expertise in different types of relationships and architectures. *“An organization may be part of more than one value system, that is, as it operates a number of business units, one of its business units may be part of one value system and another business may be part of another value system with each business unit [deployment] having a different value proposition”* (Bititci *et al.*, 2003; p. 422); see also Bititci *et al.* (2004) and Karlsson (2003). Parise and Casher (2003) also recommend that the supplier base should be managed as a ‘portfolio’ of relationships because a company will be involved with several alliance partners at the same time. For most portfolio models the unit of analysis is the (whole) organization, whereas in the DERG it is the enterprise and the enterprises’ modules.

Dynamic Evolution and Reconfiguration of Relationships

Enterprise architecture both shapes and is shaped by the evolving nature of inter-organizational relationships and the nature of the products and services they deliver. Most portfolio approaches neglect the dynamic component of inter-organizational architecture, i.e. moving between quadrants in adaptation to changes in the inter-organizational relationship

that may be internal or external. An exception is the work of Lamming *et al.* (2000) who acknowledge that positions in their classification matrix are not static as companies might move between the boxes (e.g. from unique to functional as products mature over time) which, however, need to be linked to the change of architecture (known as ‘relationship strategy’ in their terminology). Galunic and Eisenhardt (2001) termed this kind of adaptive organizational form ‘dynamic community’ that “*involves diverse and quasi-independent divisions whose capabilities are frequently recombined to create new productive assets within the context of changing markets and coevolving divisions*” (p. 1246). Similarly, Kodama (2005) refers to it as ‘strategic community’, whereby members with different values contribute to a dynamic process of knowledge creation.

Linking Formal Governance and Informal Relationships

Various terms are used in the literature to describe the components of inter-organizational architecture structures and relationships: such as supply network management (Harland and Knight, 2001), networked R&D management (Blomqvist *et al.*, 2004), and network management (Ritter and Gemünden, 2003). Elements considered common to all of these approaches can be identified as supplier evaluation, supplier coordination and supplier development (Hines, 1994; Krause and Ellram, 1997; Mills *et al.*, 2004). However, none of these are able to determine relationship and sourcing strategies between partners in a *portfolio* model. In contrast, CEG and the DERG demonstrate links between strategies, architectures and products that enable effective and efficient inter-organizational relationship governance using a portfolio approach.

Leadership

Whatever the formal and informal elements of the architecture, or the current place of the project in the DERG, leadership still has an important influence on success, especially in technology projects. Champions are needed to ensure a strong shared vision exists and is communicated to all partners in an enterprise, and to break down any barriers that are present. Rizova (2006) has described such people as “Technical and Managerial Stars”. And the ability to align the informal aspects of the architecture to the formal ones is one of the most important parts of this leadership task. The study identified that crucial points in the evolution of a project are those where its overall leadership changes from one enterprise module to another.

Competences and Knowledge Exchange

Information and knowledge are both central components of inter-organizational architecture, and free circulation of information can generally only be of benefit. This study found that JLR should consider the use of formal and shared IT tools and systems to allow information to be quickly and efficiently circulated between enterprise members, especially when members are geographically remote. Knowledge, by contrast, requires more careful consideration because of its greater strategic importance. OEMs must rethink the value of external connections, i.e. they must assess the trade-offs between improving internal skills and accessing superior external capabilities through collaboration with partners that may offer the same competences to competitors. In other words, the challenge (particularly in technical relationships such as R&D) is to maintain open knowledge exchange by securing, preserving and leveraging the unique competences of partners whilst also controlling a sufficient level of technological knowledge to avoid complete dependency on the partners (Van de Vrande, 2006; Noori and Lee, 2004; Takeishi, 2001). In this context Takeishi (2001) suggests to keep

integrative capabilities (e.g. key architectural knowledge) in-house since they are a critical source of competitive advantage through their influence on network positioning.

This relates to the fact of the OEM being the ‘architect’ of the car. Thereby, the OEMs (e.g. JLR) do not need to fear a hollowing out (Becker and Zirpoli, 2003) of know-how to suppliers if they possess a strong competence as car integrator and apply the principles of modern supply chain management (Caputo and Zirpoli, 2002). Oxley and Sampson (2004) add that this can be facilitated by the choice of an appropriate governance structure and adequate management.

CONCLUSION

This paper has reported on research into the concept of CEG, as a practical strategic concept for strategizing alliances and joint ventures, which considers inter-organizational architectures by taking an enterprise perspective where the enterprise is made up of enterprise modules (i.e. parts) from different companies. The concept was first proposed by Boardman and Clegg (2001) during action research in the aerospace industry and further developed in a study of supply chains for the automotive industry based on the OEMs in one country (Germany) (Binder and Clegg, 2007). This paper concentrates on a confirmatory transfer study based in Jaguar Land Rover (UK) and focuses on R&D projects involving new electrical technologies. This study was carried out using the grounded theory method, to induce new propositions.

The results support the earlier studies of the CEG concept, as well as validating new propositions specific to the particular context, such as “Compatible electrical architecture is important to technology implementation because technologies can be reused with less application costs”.

Most significantly, the study was able to confirm the usefulness of the central element of the CEG concept, the DERG. Comparison of the actual paths followed by the three case studies (Figure 2) with the theoretical ideal shown in Figure 1 shows a very close association with their eventual success. The Rotary Shifter (RS) project was a complete success, and followed the expected trajectory. The Dual Video Screen (DVS) project followed the ideal trajectory only with some iteration, and was eventually a success once some operational challenges had been resolved. The My Connected World (MCW) project did not follow the expected trajectory, and was eventually not implemented.

Thus the DERG was successfully demonstrated as a tool to understand the evolution of inter-organizational architecture, and it is further suggested that managers could use it pro-actively as a tool to support the management of a portfolio of enterprise architectures in joint ventures or alliances, since it possesses a combination of features that no other portfolio model has. These include a focus on competence rather than product, explicit consideration of the stages of the R&D process, allowance for a multiplicity of relationships, which dynamically evolve and reconfigure, and linking formal governance with informal relationships.

However, it should be noted that the authors do not claim that all inter-organizational relationships follow this behavior. Neither is it claimed that a deterministic relationship exists between enterprise architectures and the prevailing type of core competence, as it is only probabilistic. The authors only claim that a dependency is observable and that behavior is driven by a combination of exogenous and endogenous factors as defined by current literature. Despite this it is deemed that this dependency is sufficient enough to use the DERG

as a decision support tool for the pro-active management of inter-organizational enterprise architectures.

ACKNOWLEDGEMENTS

Extensive thanks the interviewees from Ford, JLR and its supply base.

REFERENCES

- Aldrich, H.E. (1979), *Organizations and Environments*, Prentice-Hall, Englewood Cliffs.
- Amit, R. and Schoemaker, P.J.H. (1993), "Strategic assets and organizational rent", *Strategic Management Journal*, Vol. 14, No. 2, pp. 33-46.
- Bain, J.S. (1956), *Barriers to New Competition*, Harvard University Press, Cambridge.
- Barney, J.B. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17, No. 1, pp. 99-120.
- Barney, J.B., Wright, M. and Ketchen Jr., D.J. (2001), "The resource-based view of the firm: ten years after 1991", *Journal of Management*, Vol. 27, No. 6, pp. 625-641.
- Becker, M.C. and Zirpoli, F. (2003), Organizing new product development: knowledge hollowing-out and knowledge integration – the Fiat auto case", *International Journal of Operations & Production Management*, Vol. 23, No. 9, pp. 1033-1061.
- Bensaou, M. (1999), "Portfolios of buyer-supplier relationships", *Sloan Management Review*, Summer, pp. 35-44.
- Bessant, J., Kaplinsky, R. and Lamming, R.C. (2003), "Putting supply chain learning into practice", *International Journal of Operations & Production Management*, Vol. 23, No. 2, pp. 167-184.
- Binder, M. and Clegg, B.T. (2007), "Enterprise management: a new frontier for organisations", *International Journal of Production Economics*, Vol. 106, No. 2, pp. 409-430.
- Binder, M. and Edwards, J.S. (2010), "Using grounded theory method for theory building in operations management research: A study on inter-firm relationship governance", *International Journal of Operations & Production Management*, Vol. 30, No. 3 (to appear)
- Bititci, U.S., Martinez, V., Albores, P. and Mendibil, K. (2003), "Creating and sustaining competitive advantage in collaborative systems: the what and the how", *Production Planning & Control*, Vol. 14, No. 5, pp. 410-424.
- Bititci, U.S., Martinez, V., Albores, P. and Parung, J. (2004), "Creating and managing value in collaborative networks", *International Journal of Physical Distribution & Logistics Management*, Vol. 34, Nos. 3/4, pp. 251-268.

- Blomqvist, K., Hara, V., Koivuniemi, J. and Äijö, T. (2004), "Towards networked R&D management: the R&D approach of Sonera Corporation as an example", *R&D Management*, Vol. 34, No. 5, pp. 591-603.
- Boardman J.T. and Clegg B.T. (2001), "Structured Engagement in the Extended Enterprise". *International Journal of Operations and Production Management*. Vol.21, No.5&6. pp. 795-811
- Boer, H. (2003), "Guest editorial: new challenges in operations management", *International Journal of Operations & Production Management*, Vol. 23, No. 10, pp. 1108-1113.
- Burns, T. and Stalker, G. (1961), *The Management of Innovation*, Tavistock, London.
- Caputo, M. and Zirpoli, F. (2002), "Supplier involvement in automotive component design: outsourcing strategies and supply chain management", *International Journal of Technology Management*, Vol. 23, Nos. 1/2/3, pp. 129-154.
- Child, J. (1972), "Organizational structure, environment, and performance: the role of strategic choice", *Sociology*, Vol. 6, No. 1, pp. 1-22.
- Choi, T.Y., Dooley, K.J. and Rungtusunatham, M. (2001), "Supply networks and complex adaptive systems: control versus emergence", *Journal of Operations Management*, Vol. 19, No. 3, pp. 351-366.
- Coase, R. (1937), "The nature of the firm", *Economica*, Vol. 4, pp. 386-405.
- Cohen, W. and Levinthal, D. (1990), "Absorptive capacity: a new perspective on learning and innovation", *Administrative Science Quarterly*, Vol. 35, No. 1, pp. 129-152.
- Cooper, M.C., Lambert, D.M. and Pagh, J.D. (1997), "Supply chain management: more than a new name for logistics", *The International Journal of Logistics Management*, Vol. 8, No. 1, pp. 1-13.
- Cousins, P.D., Lawson, B. and Squire, B. (2006), "An empirical taxonomy of purchasing functions", *International Journal of Operations & Production Management*, Vol. 26, No. 7, pp. 775-794.
- De Toni, A. and Tonchia, S. (2003), "Strategic planning and firms' competencies: traditional approaches and new perspectives", *International Journal of Operations & Production Management*, Vol. 23, No. 9, pp. 947-976.
- Dubois, A. and Pedersen, (2002), "Why relationships do not fit into purchasing portfolio models – a comparison between the portfolio and industrial network approaches", *European Journal of Purchasing & Supply Management*, Vol. 8, No. 1, pp. 35-42.
- Dyer, J.H. and Hatch, N.W. (2004), "Using supplier networks to learn faster", *MIT Sloan Management Review*, Spring, pp. 57-63.
- Dyer, J.H. and Singh, H. (1998), "The relational view: cooperative strategy and sources of interorganizational competitive advantage", *Academy of Management Review*, Vol. 23, No. 4, pp. 660-679.
- Eisenhardt, K. (1989), "Building theories from case study research", *Academy of Management Review*, Vol. 14, No. 4, pp. 532-550.

- Ellram, L.M. (1993), "Total cost of ownership: elements and implementation", *International Journal of Purchasing and Materials Management*, Vol. 29, No. 4, pp. 3-12.
- Ellram, L.M. and Cooper, M.C. (1990), "Supply chain management, partnerships, and the shipper-third party relationship", *The International Journal of Logistics Management*, Vol. 1, No. 2, pp. 1-10.
- European Commission (2003), "Commission recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises", *Official Journal of the European Union*, C(2003) 1422, L124/36-41.
- Fynes, B., Voss, C. and de Búrca, S. (2005), "The impact of supply chain relationship quality on quality performance", *International Journal of Production Economics*, Vol. 96, No. 3, pp. 339-354.
- Galunic, D.C. and Eisenhardt, K.M. (2001), "Architectural innovation and modular corporate forms", *Academy of Management Journal*, Vol. 44, No. 6, pp. 1229-1249.
- Glaser, B.G. (1992), *Basics of Grounded Theory Analysis*, 2nd ed., Sociology Press, Mill Valley.
- Grandori, A. and Soda, G. (1995), "Inter-firm networks: antecedents, mechanisms and forms", *Organization Studies*, Vol. 16, No. 2, pp. 183-214.
- Grant, R.M. (1991), "The resource-based theory of competitive advantage: implications for strategy formulation", *California Management Review*, Spring, pp. 114-135.
- Gulati, R. (1998), "Alliances and networks", *Strategic Management Journal*, Vol. 19, No. 4, pp. 293-317.
- Gulati, R., Nohria, N. and Zaheer, A. (2000), "Strategic networks", *Strategic Management Journal*, Vol. 21, No. 3, pp. 203-215.
- Hakansson, H. and Snehota, I. (1989), "No business is an island: the network concept of business strategy", *Scandinavian Journal of Management*, Vol. 5, No. 3, pp. 187-200.
- Hannan, M.T. and Freeman, J. (1977), "The population ecology of organizations", *American Journal of Sociology*, Vol. 82, pp. 929-964.
- Harland, C.M. and Knight, L.A. (2001), "Supply network strategy: Role and competence requirements", *International Journal of Operations & Production Management*, Vol. 21, No. 4, pp. 476-489.
- Harland, C.M., Lamming, R.C. and Cousins, P.D. (1999), "Developing the concept of supply strategy", *International Journal of Operations & Production Management*, Vol. 19, No. 7, pp. 650-673.
- Hickson, D.J., Pugh, D.S. and Pheysey, D.C. (1969), "Operations technology and organization structure: an empirical reappraisal", *Administrative Science Quarterly*, Vol. 14, No. 3, pp. 378-397.
- Hines, P. (1994), *Creating World Class Suppliers: Unlocking Mutual Competitive Advantage*, Pitman Publishing, London.

- Ilinitch, A.Y., D'Aveni, R.A. and Lewin, A.Y. (1996), "New organizational forms and strategies for managing in hypercompetitive environments", *Organization Science*, Vol. 7, No. 3, pp. 211-220.
- Jacobides, M.G. and Winter, S.G. (2005), "The co-evolution of capabilities and transaction costs: explaining the institutional structure of production", *Strategic Management Journal*, Vol. 26, No. 5, pp. 395-413.
- Jones, C., Hesterly, W.S. and Borgatti, S.P. (1997), "A general theory of network governance: exchange conditions and social mechanisms", *Academy of Management Review*, Vol. 22, No. 4, pp. 911-945.
- Karlsson, C. (2003), "The development of industrial networks: challenges to operations management in an extraprise", *International Journal of Operations & Production Management*, Vol. 23, No. 1, pp. 44-61.
- Kauffman, S. (1993), *The Origins of Order: Self-Organisation and Selection in Evolution*, Oxford University Press, Oxford.
- Kodama, M. (2005), "Knowledge creation through networked strategic communities: case studies on new product development in Japanese companies", *Long Range Planning*, Vol. 38, No. 1, pp. 27-49.
- Kraljic, P. (1983), "Purchasing must become supply management", *Harvard Business Review*, September-October, pp. 109-117.
- Krause, D.R. and Ellram, L.M. (1997), "Critical elements of supplier development: the buying-firm perspective", *European Journal of Purchasing & Supply Management*, Vol. 3, No. 1, pp. 21-31.
- Lamming, R. (2000), "Japanese supply chain relationships in recession", *Long Range Planning*, Vol. 33, No. 6, pp. 757-778.
- Madhavan, R., Koka, B.R. and Prescott, J.E. (1998), "Networks in transition: how industry events (re)shape interfirm relationships", *Strategic Management Journal*, Vol. 19, No. 5, pp. 439-459.
- McCutcheon, D.M. and Meredith, J.R. (1993), Conducting case study research in operations management, *Journal of Operations Management*, Vol. 11, No. 3, pp. 239-256.
- Mentzer, J.T., DeWitt, W., Keebler, J.S., Min, S., Nix, N.W., Smith, C.D. and Zacharia, Z.G. (2001), "Defining supply chain management", *Journal of Business Logistics*, Vol. 22, No. 2, pp. 1-25.
- Miller, D. and Friesen, P. (1980), "Archetypes of organizational transition", *Administrative Science Quarterly*, Vol. 25, No. 2, pp. 268-299.
- Mills, J., Schmitz, J. and Frizelle, G. (2004), "A strategic review of 'supply networks'", *International Journal of Operations & Production Management*, Vol. 24, No. 10, pp. 1012-1036.
- Mintzberg, H. (1979), *The Structuring of Organizations*, Prentice-Hall, Englewood Cliffs.
- Möller, K.E. and Svahn, S. (2003), "Managing strategic nets: a capability perspective", *Marketing Theory*, Vol. 3, No. 2, pp. 209-234.

- Narasimhan, R. and Nair, A. (2005), "The antecedent role of quality, information sharing and supply chain proximity on strategic alliance formation and performance", *International Journal of Production Economics*, Vol. 96, No. 3, pp. 301-313.
- Nellore, R. and Söderquist, K. (2000), "Portfolio approaches to procurement: analysing the missing link to specifications", *Long Range Planning*, Vol. 33, No. 2, pp. 245-267.
- Noori, H. and Lee, W.B. (2004), "Collaborative design in a networked enterprise: the case of the telecommunication industry", *International Journal of Production Research*, Vol. 42, No. 15, pp. 3041-3054.
- Normann, R. and Ramirez, R. (1993), "From value chain to value constellation: designing interactive strategy", *Harvard Business Review*, July-August, pp. 65-77.
- Olsen, R.F. and Ellram, L.M. (1997), "A portfolio approach to supplier relationships", *Industrial Marketing Management*, Vol. 26, No. 2, pp. 101-113.
- Oxley, J.E. and Sampson, R.C. (2004), "The scope and governance of international R&D alliances", *Strategic Management Journal*, Vol. 25, Nos. 8/9, pp. 723-749.
- Parise, S. and Casher, A. (2003), "Alliance portfolios: designing and managing your network of business-partner relationships", *Academy of Management Executive*, Vol. 17, No. 4, pp. 25-39.
- Peteraf, M. (1993), "The cornerstones of competitive advantage: a resource-based view", *Strategic Management Journal*, Vol. 14, No. 3, pp. 179-192.
- Petersen, K.J., Handfield, R.B. and Ragatz, G.L. (2003), "A model of supplier integration into new product development", *Journal of Product Innovation Management*, Vol. 20, No. 4, pp. 284-299.
- Pfeffer, J. and Salancik, G.R. (1978), *The External Control of Organizations: A Resource Dependency Perspective*, Harper & Row, New York.
- Porter, M.E. (1980), *Competitive Strategy*, Free Press, New York.
- Porter, M.E. (1985), *Competitive Advantage: Creating and Sustaining Superior Performance*, Free Press, New York.
- Prahalad, C.K. and Hamel, G. (1990), "The core competence of the corporation", *Harvard Business Review*, May, pp. 79-91.
- Rayport, J.F. and Sviokla, J.J. (1995), "Exploiting the Virtual Value Chain", *Harvard Business Review*, November-December, pp. 75-85.
- Ritter, T. and Gemünden, H.G. (2003), "Network competence: its impact on innovation success and its antecedents", *Journal of Business Research*, Vol. 56, No. 9, pp. 745-755.
- Ritter, T., Wilkinson, I.F. and Johnston, W.J. (2004), "Managing complex business networks", *Industrial Marketing Management*, Vol. 33, No. 3, pp. 175-183.
- Rizova, P. (2006), "Are you networked for successful innovation?", *MIT Sloan Management Review*, Vol. 47, No. 3, pp. 49-55.
- Spekman, R.E., Kamauff Jr., J.W. and Salmond, D.J. (1994), "At last purchasing is becoming strategic", *Long Range Planning*, Vol. 27, No. 2, pp. 76-84.

- Strauss, A.L. and Corbin, J. (1998), *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*, 2nd ed., Sage, Thousand Oaks.
- Svensson, G. (2004), "Supplier segmentation in the automotive industry: a dyadic approach of a managerial model", *International Journal of Physical Distribution & Logistics Management*, Vol. 34, No. 1, pp. 12-38.
- Sydow, J. (1992), *Strategische Netzwerke: Evolution und Organisation* [Strategic networks: evolution and organisation], Gabler, Wiesbaden.
- Takeishi, A. (2001), "Bridging inter- and intra-firm boundaries: management of supplier involvement in automobile product development", *Strategic Management Journal*, Vol. 22, No. 5, pp. 403-433.
- Van de Vrande, V., Lemmens, C. and Vanhaverbeke, W. (2006), "Choosing governance modes for external technology sourcing", *R&D Management*, Vol. 36, No. 3, pp. 347-363.
- Wernerfelt, B. (1984), "A resource-based view of the firm", *Strategic Management Journal*, Vol. 5, No. 2, pp. 171-180.
- Williamson, O.E. (1981), "The economics of organization: the transaction cost approach", *American Journal of Sociology*, Vol. 87, No. 3, pp. 548-577.
- Woodward, J. (1965), *Industrial Organization: Theory and Practice*, Oxford University Press, London.
- Wynstra, F. and Pierick, E. ten (2000), "Managing supplier involvement in new product development: a portfolio approach", *European Journal of Purchasing & Supply Management*, Vol. 6, No. 1, pp. 49-57.

Table 1. Polyvalent body of knowledge related to inter-organizational governance

Discipline	Theoretical perspective	Reference	Key issues	Relevance for inter-organizational governance
Organizational Economics	Transaction Cost Economics	Coase (1937), Williamson (1981)	<ul style="list-style-type: none"> • Search for most economic mechanism to govern transaction • Efficacy of mechanism determined by transactions specificity, uncertainty and frequency • Contracts safeguard bounded rationality and opportunism • Ignores necessity to collaborate even if not transaction cost economic 	Identification of appropriate inter-organizational forms to govern collaborative transactions in inter-organizational relationships
Strategic Management	Industrial Organization Theory	Bain (1956), Porter (1980)	<ul style="list-style-type: none"> • Competitive advantage determined by external industry factors • Sees inter-organizational relationship as means for firms to gain competitive advantage • Ignores relationship as unit of competitive analysis 	Positioning and role of individual partners within inter-organizational relationship based on competencies in order to gain competitive advantage for whole relationships and partners within competitive empirical context
	Competence Theory	Wernerfelt (1984), Barney (1991), Peteraf (1993), Prahalad and Hamel (1990), Grant (1991)	<ul style="list-style-type: none"> • Competitive advantage determined by internal resource base • Resources are heterogeneous and imperfectly mobile • Firms should be considered as portfolios of competencies • Ignore external context and rigidities that can be caused by competencies 	
	Resource Dependency Theory	Pfeffer and Salancik (1978), Aldrich (1979)	<ul style="list-style-type: none"> • Firms are interdependent due to restricted availability of resources • Control over critical resources determines power position relative to other firm • Collaboration reduces autonomy but enables access to resources 	
	Value Chain Concept	Porter (1985), Rayport and Sviokla (1995)	<ul style="list-style-type: none"> • Firm conceptualized as set of strategically relevant activities • Conceptualization of joint product development process as virtual value chain 	
Organization Science	Contingency Theory	Woodward (1965), Burns and Stalker (1961), Hickson et al. (1969), Child (1972)	<ul style="list-style-type: none"> • Organizational structure dependent on fit with internal and external contingencies as well as strategic choice of decision maker • Inter-organizational relationship require twofold fit • Lacks of explanations for re-configuration of structures as contingencies change 	(Re)structuring of inter-organizational relationships to be adaptive to environmental (exogenous) and relationship (endogenous) contingencies
	Complex Adaptive Systems	Kauffman (1993), Mintzberg (1979), Hannan and Freeman (1977), Miller and Friesen (1980)	<ul style="list-style-type: none"> • Organizations are complex adaptive systems that co-evolve within social ecosystem • Trade-off between internal structural consistency and fit to external contingencies needs to be managed • Change occurs radically rather than moderately 	
Industrial Marketing Management	Relational View	Dyer and Singh (1998), Cooper et al. (1997)	<ul style="list-style-type: none"> • Boundary-less organization through elimination of boundaries within and across firm boundaries • Close relations create joint customer value in form of relational rents 	Establishing close relationships within and across company

	Interaction model of Industrial Marketing and Purchasing Group	Hakansson (1987), Hakansson and Snehota (1989), Ford (1990)	<ul style="list-style-type: none"> • Relationship as most important resource for a firm • Interaction options of actors depend on their position in network 	boundaries to create customer value
Purchasing & Supply Chain Management	Total System Optimization	Ellram and Cooper (1990), Mentzer et al. (2001) Boardman and Clegg (2001)	<ul style="list-style-type: none"> • Views supply chain as single entity tying individual success to success of overall supply system 	Building and managing effective inter-organizational relationships based on total system optimization and strategic sourcing
	Strategic Sourcing	Spekman et al. (1994), Ellram (1993), Cousins et al. (2006)	<ul style="list-style-type: none"> • Move from traditional commodity purchasing to business relationship management • Total cost of relationship becomes crucial 	

Table 2: Enterprise structures fundamental to Collaborative Enterprise Governance

Characteristics	Virtual Enterprise	Extended Enterprise	Vertically Integrated Enterprise
Similar terms and supply chain philosophies	Virtual enterprise, virtual corporation / organization; agile philosophy	Extended enterprise, keiretsu, clan; hybrid philosophy	Vertically integrated enterprise; Lean enterprise; lean philosophy
Foundation of relationship	Mainly based on technical competence features; Emphasis on high innovation context; Decision of allocating resources depends on competitive and comparative advantage	Mainly based on social competence features; Past relationship experience important; Emphasis on strategic sourcing of critical products based on synergy for the whole enterprise	Mainly based on efficiency competence features; Emphasis on transaction costs (prices)
Evolution of relationship based on competencies	Newly emerging, speculative, untested, high risk, require many members to spread risk; high asset specific investments; high transaction costs	Tested to some extent, medium risk, has had some testing, understood by innovators; medium asset specific investments; medium transaction costs	Mature, well accepted, tested and widely usable; low asset specific investments; low transaction costs
Scope of relationship	Project based to quickly exploit specific opportunities across company boundaries; Present a unified face to externals; Partners involved in other collaborative activities simultaneously for more power and maturity	Long-term and holistic thinking in collaborative dimensions; Often spans whole product life cycle across company boundaries	Standardisation of high product volumes and corporization of structures; Focus on scales of economies rather than on extension and virtualisation
Longevity of relationship	Short-term temporary alignment of operations	Medium - long-term	Foreseeable as permanent (as long as competitive)
Proximity and depth of relationship	No stability as well as dynamic and unpredictable environment; Collaboration impacts operations directly and immediately (agility, flexibility and leanness); low degree of interdependence and integration	Strategic dimensions of collaboration; Relationship, technology and knowledge management become critical; medium degree of interdependence and integration	Tend toward industrial dominance; Emphasis on removal of legacy systems; high degree of interdependence and integration
Governance of relationship	Loose and flexible environment based on innovator scouting; Temporary, re-active and loose governance; Right balance of control and emergence (i.e. co-competition)	Stable and strategic environment based on integration through appropriate strategic sourcing and partner development; Design and implementation of business mutual processes; Strategic and pro-active governance	Unity of command and control; Focused on monitoring and control through standardisation and corporization
Strategic role and main tasks of enterprise governor	Incubator; Scouting for potential value members; Initiate collaborative activities	Integrator; Coordination of collaborative activities; Support value members in competence development	Incumbent; In-house development of proprietary systems; Relying on power and authority
Strategic role and main tasks of value members	Innovation supplier; Deploying specific competencies for innovating new technologies and solving complex R&D problems	Integrator; Integrating parts to more complex systems and managing and coordinating sub-supply base based on meta-competence	Volume player; Value creation through cost efficient making and delivery of parts in high quality
Collaboration points in PDP	Mainly product planning and concept design	Mainly concept design / pre-series design	Mainly series design

Table 3: Elements of an Enterprise Module

Task specific assets (unique competencies)	Technical	Innovativeness Product know how Product and process quality R&D evaluation Interface management Delivery quality Total process partner R&D software knowledge (e.g. CAD software)
	Efficiency	Speed Cost alignment Project management Flexibility and adaptability Knowledge accessibility
Relationship specific assets (interface capabilities)	Commercial	Negotiation based on trust and fairness (collaborative contracts) Information sharing (cost) Financial stake-holding
	IT	Online sourcing platforms IT interface management
	Project	Simultaneous engineering (intra-organizational) Inter-organizational concurrent engineering Leadership (management support) Communication Inter-personal relationships Knowledge sharing
	Organizational	Collaboration infrastructure (e.g. Key account management) Cluster creation Holistic and strategic thinking
	Social	Structure and culture Customer focus Ownership Local presence Plug & play ability Stability and reliability Pressure resistance

Table 4: Interviewees from second phase research - JLR and their partners

	Case Study A Rotary Shifter	Case Study B Dual View	Case Study C My Connected World
Programme Champion			
Company	JLR	JLR	JLR
Department	Jaguar Programmes	Land Rover Programmes	Jaguar Programmes
Job Role	Chief Programme Engineer	Chief Programme Engineer	Chief Programme Engineer
Engineering			
Company	JLR	JLR	JLR
Department	Technical Research	Electrical Engineering	Technical Research
Job Role	HMI Technologies Technical Specialist	Group Leader Navigation & Displays	Infotainment & Telematics Technical Specialist
Purchasing			
Company	JLR	JLR	JLR
Department	Electrical Purchasing	Electrical Purchasing	Electrical Purchasing
Job Role	Purchasing Manager	Purchasing Manager	Purchasing Manager
Supplier contacts			
Company	Kostal UK Ltd	DENSO Sales UK Ltd	Pi Shurlok
Department	Account Manager	Liaison & System Leader	PAG Account Manager
Job Role			
Company		Alpine Electronics UK Ltd	Motorola UK
Department		Project Manager	PAG Account Manager
Job Role			

Table 5: CEG Propositions relating to technology development and industrialisation

No.	Second Phase Propositions
i	Different types of relationships exist between OEMs and supplier and between one supplier and another supplier
ii	Engageability of core competence in an enterprise is a key factor
iii	Companies participating in an enterprise should each use their own core competences to collectively deliver the projects
iv	Relationships are important because suppliers and OEMs will need each other in the future
v	OEMs and the tier 1 suppliers need to review current approaches of doing business and consider more collaborative and strategic approaches
vi	Internal issues to the OEM can lead to enterprise failure modes
vii	Future threats to the auto industry come from factors in the external environment
viii	Compatible electrical architecture is important to technology implementation because technologies can be reused with less application costs
ix	The vision, objectives and roles and responsibilities need to be clear from the outset of the project
x	Successful technologies can be those that draw customers into showrooms and have a hi-tech perception but are not necessarily complex to design and develop
xi	Technology planning is seen as a major factor affecting successful technology delivery
xii	The degree and quality of communication varies from member to member and from project to project
xiii	Successful projects have executive sponsors and strong enterprise leaders
xiv	OEMs and their suppliers should consider new ways to create a culture and environment for innovation
xv	New technologies should be market driven, either through feedback or market testing

Table 6: Summary of JLR technology cases

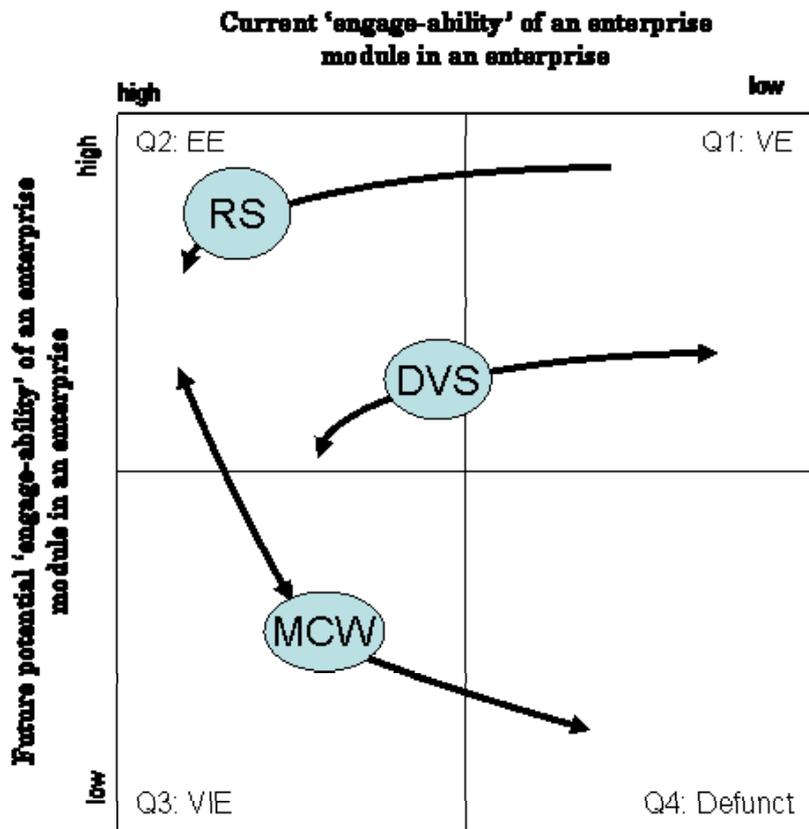
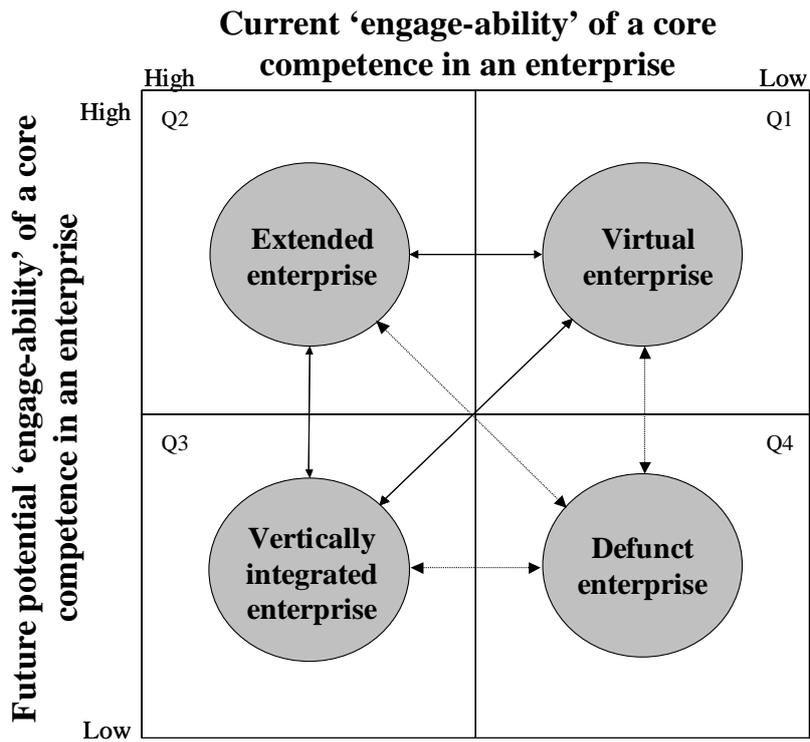
	Case A – Rotary Shifter (RS)	Case B – Dual View Screen (DVS)	Case C – My Connected World (MCW)
Impacted Engineering Disciplines	Switchgear, Power-train & Industrial Design	Displays, Infotainment	Telephony, Infotainment
Ford / JLR Research Departments	Jaguar Design, JLR Research Department, JLR Electrical Engineering (safety Software) and JLR Power-Train Transmissions Control Team	JLR Research Dept. (Ergonomic / user Interaction Team), Ford Finance, and tier 2 supplier ‘S’	Ford Scientific Research Labs (SRL), Ford Research in Aachen, and JLR Research
Research and Development Partners	Service engineering company ‘P’, research university ‘L’ and tier 1 automotive supplier ‘R’	Automotive tier 1 supplier ‘A’ and tier 2 supplier ‘S’	Purchased service engineering company ‘P’, and automotive tier 1 supplier ‘M’
Tier 1 Production Suppliers	‘K’ and ‘Z’	‘A’, ‘D’, and ‘B’	‘M’, and ‘P’
JLR Production Departments	Electrical Engineering	Electrical Engineering	Electrical Engineering
Vehicle Program	XF 2009MY	Range Rover 2010MY	XK 2006MY

Table 7: Provenance of the conceptual framework based on findings and examples

Conceptualization of Collaborative Enterprise Governance		Cases
Type	Characteristics	
Q 1 VE	<ul style="list-style-type: none"> • Flexible, loose, temporary, exploratory and project based collaborative venture (low degree of integration) • Spread risk over many partners (fragmented resource base) • Using highly specific but untested competences (high transaction cost due to high asset specificity) 	<p>Case A.1: The Rotary Shifter. Started off as a virtual collaboration between the research partners and JLR departments shown in Figure 1. This structure was used until a proof of concept stage was achieved.</p> <p>Case B.1; The Dual View Screen (DVS). Started off as one VE with one group of suppliers .</p> <p>Case B.3: The Dual View Screen (DVS). The DVS application in the Range Rover and new XJ required new development partners working in a new Virtual Enterprise to take it up to implementation readiness (IR)</p>
Q 2 EE	<ul style="list-style-type: none"> • More stable, strategic, close and quasi-permanent collaborative venture focused on mutual relationships (medium degree of integration) • Risk spread over critical and successful partners (agile resource base) • Using matured and tested competences that are synergistic to collaborative venture (medium transaction cost due to lower asset specificity and less involved partners) • Lean resource base 	<p>Case A.2: The Rotary Shifter. Once proof of concept had been achieved, main stream Electrical Engineering became involved in order to try and industrialize the idea. tier 1 suppliers were also included. This required production contracts to be established and a move towards an extended enterprise occurred.</p> <p>Case B.2: The Dual View Screen (DVS). The DVS becomes an extended enterprise structure as the product becomes industrialized in the 2010MY Range Rover.</p> <p>Case C.2: The My Connected World (MCW). A wholly owned but totally autonomous 3rd party subsidiary company ‘P’ was bought in to work in a new and more flexible manner to encourage innovative thinking.</p>
Q 3 VIE	<ul style="list-style-type: none"> • Potentially permanent collaborative venture focused on control and command (high degree of integration) • Corporization of risk through re-intermediation and ownership of assets (varied and extensive resource base) • Using fully matured, tested and widely accepted competences (low transaction cost due to low asset specificity) 	<p>Case C.1: The My Connected World (MCW). This started off as Vertically Integrated structure between Ford’s Research Departments and JLR Research.</p>
Q 4 Defunct Enterprise	<ul style="list-style-type: none"> • No active engagement in a current collaborative activity (no degree of integration) • Dormant relationship with negligible amount of trading (no transaction cost only data maintenance) 	<p>Case C.3: The My Connected World (MCW). This case ends up as a defunct enterprise as an economically viable technology provider could not be found in time for Program Approval (PA)</p>

Table 8: Attributes influencing the engageability of competences in the enterprise

Competence attribute	Exogenous and endogenous factors	Impact on engageability
Transferability	Competence specificity (endo) Transaction frequency (endo)	Negative if high Positive if high
Attractiveness	Marketability (market value) of competence (exo) Uncertainty of competence value (exo) Suitability of competence deployment (exo) Risk of competence deployment (exo)	Positive if attractive Negative if unknown Positive if suitable Negative if high risk
Maturity	Advancement and sophistication of competence (endo) Sustainability of competence (exo)	Positive if attractive Positive if sustainable



Appendix 1: Interview Guide used in JLR confirmatory transfer study

General/ Introduction

- Tell me about your company's competitive position?
- Where does your company sit with respect to its competitors?
- What are the key capabilities and skills of your company that differentiate you from competitors?
- Who are the main suppliers & customers? What is the balance of power?
- Describe current relationships with other companies and suppliers, in general.
- What is your company's current culture on new technology adoption? (e.g. innovators, fast followers, laggards, etc)
- What do you consider to be the future threats to the company?
- What do you think are the future threats to your core competences?

SPECIFIC PROJECT QUESTIONS:

Project Configuration

- Briefly describe the project and explain who the various internal and external teams who worked on the project were.
- How were the external project partners chosen?
- What was the part each company played in the project? What were their key capabilities and skills?
- Have you worked together before? Have you worked together since?
- At what point in the project did each partner become involved? Did any of these partners leave before the end of the project?
- Project partners over time – the same? Changing roles? New participants?
- Did the roles & responsibilities of any of the members of the project team evolve during the project?
- What were the timescales and what triggered the changes?
- Tell me about the relationships between the partners in the project –
 - Was there a dominant party?
 - Was it a trustworthy partnership?
- What is the likelihood of working with the same partners again in the future?
- How important are their key skills and competences to future collaborations?

Project Management Factors

- How were the project objectives & goals communicated?
- What were the methods for reviewing progress & risks throughout?
- How were the key decisions made during the project?
- What was the level of formality when working with project partners?
- Explain the extent to which each company's internal activities and processes were transparent to the other partners.
- How effective was information sharing in the project?
- What tools and processes were used for sharing information?
- How as the allocation of resources – adequate or not (\$, people, other assets)?
- Overall, was the project a success? Why?
- What would a good future collaboration be like?

Innovation Management & Technological Factors

- What do you consider the degree of complexity of technology to be – high or low tech?
- What is/was the degree of novelty within the industry?
- To what degree to does the market determined technological decisions?
- To what extent did other factors determine technological decisions (supplier technology plans, internally defined)?