GOVERNANCE ARCHITECTURES FOR INTER-ORGANIZATIONAL R&D COLLABORATION

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Abstract

Inter-organizational relationships are becoming an increasingly important source of competitive advantage and innovation. This study looks at these relationships in the context of inter-organizational R&D collaborations in the European automotive industry. Previous work led to the proposal of a competence based portfolio framework that explains the design of the inter-organizational architecture and an indicative relationship strategy. This framework comprises four distinct types of governance architecture and relationship strategy. This paper reports on the first confirmatory transfer study; conducted at Jaguar Land Rover, in the UK. The study illustrates developmental paths and patterns in the evolution of inter-organizational relationships using empirical insights. Their configuration and dynamic evolution is contingent upon the 'engageability' of the partner companies' competences based on their attractiveness, transferability and maturity. The study shows that the contingency framework is transferable and practically useful, as well as yielding further practical narrative about inter-organizational practice.

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

INTRODUCTION

Numerous scholarly contributions on the governance of newly emerging supplier relationships and structures over recent years have led to the creation of 'chain and network science' (Camps *et al.*, 2004) as an emerging philosophy. The governance of inter-organizational relationships can thereby be understood as, "… a matter of knowing whom to include in the network and managing the complex web of relationships required" (Harland *et al.*, 1999: 669).

However, despite the existence of a plethora of subject titles related to the study of inter-organizational relationships, there has been little theory building research that can help guide business practice. In light of that, this research seeks to shed light upon the appropriate architectures for inter-organizational relationships in collaborative R&D in order to achieve competitive success for the whole alliance or joint venture as well as its individual members. More specifically, it attempts: (1) to explore the current practice of inter-organizational collaborative R&D; (2) to determine contingencies that influence the inter-organizational architectures of collaborative R&D projects; and (3) to show the relationship between inter-organizational architecture and sustainable competitive success.

Thereby, this paper extends current literature by adopting a theory building and testing method drawing on an inter-disciplinary body of knowledge and focusing on holistic relationships as a unit of analysis rather than the individual organization or the dyadic relationship. It contributes to practice by explaining and illustrating the dynamic evolution of inter-organizational architectures as well as identifying contingency aspects that influence them and their competitive success.

This is embedded in the empirical context of inter-organizational R&D collaboration in the European automotive industry because (i) at the product development stages, strategic supply decisions are made that determine the inter-organizational architecture; and (ii) product development determines the overall competitiveness of a product (and hence the overall inter-organizational alliance) by satisfying generic category benefits such as quality, time and price (Barwise and Meehan, 2004).

INTER-ORGANIZATIONAL ARCHITECTURE

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 introduces these inter-organizational architecture issues as part of a concept referred to here as *Collaborative Enterprise Governance*; further details will be given in the presentation.

Theoretical Perspectives

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; Ilinitch *et al*., 1996; Ketchen and Giunipero, 2004; Min and Mentzer, 2000; 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. A summary of the body of knowledge is shown in Table 1.

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 (1975, 1979, 1981)	• 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), Porter and Fuller (1989)	• 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)	• 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)	• 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)	• 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)	• 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)

	Complex Adaptive Systems	Kauffman (1993), Mintzberg (1979), Hannan and Freeman (1977), Miller and Friesen (1980)	• 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	contingencies
Industrial Marketing Management	Relational View	Dyer and Singh (1998), Cooper et al. (1997)	• 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 boundaries to create customer value
	Interaction model of Industrial Marketing and Purchasing Group	Hakannson (1987), Hakansson and Snehota (1989), Ford (1990)	• Relationship as most important resource for a firm • Interaction options of actors depend on their position in network	
Purchasing & Supply Chain Management	Total System Optimization	Ellram and Cooper (1990), Mentzer et al. (2001) Boardman and Clegg (2001)	• 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)	• Move from traditional commodity purchasing to business relationship management • Total cost of relationship becomes crucial	

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).

In particular, very few studies consider inter-organizational architectures as dynamic entities that adapt to varying contingencies (e.g. Choi *et al*., 2001; Noori and Lee, 2004; 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.* The European Commission (2003) defines an enterprise as "… an entity, regardless of its legal form … including partnerships or associations regularly engaged in economic activities".

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 value creating system itself (Normann and Ramirez, 1993). Similarly, Gulati (1998) argues that more attention must be directed to the context in which inter-organizational relationships exist. This research is believed to be the first to explain collaborative enterprise governance and uses the *enterprise* as the primary unit of analysis (and the *enterprise module* as a secondary sub-unit).

This research has taken place in two phases; the first emphasized theory building, to produce a new contingency framework for managing enterprises. The second phase produced a confirmatory transfer study focusing specifically on R&D industrialization. Further details of this 2-stage grounded theory approach can be got by contacting the authors.

1st PHASE: GENERAL EMPIRICAL GROUNDING

The findings from this initial inductive study produced the concept of Collaborative Enterprise Governance, a set of 35 validated propositions associated with it, and its main component, the Dynamic Enterprise Reference Grid. The detailed methodology used in this phase is described further in Binder and Edwards (2010) and the findings are detailed in Binder and Clegg (2007). The second phase, a confirmatory transfer study, took the new framework as *a priori* knowledge, and applied it to three cases within a different scenario in the European automotive industry specifically focusing on new technology development and industrialization. This section summarizes the framework.

In accordance with assumptions made in Competence Theory, that an organization should be considered as a portfolio of competences, the Collaborative Enterprise Governance concept considers an individual company to be composed of a set of autonomous entities, known as *enterprise modules*, which deliver specific competences (e.g. special design and engineering know-how) to the enterprise. This contrasts to much current literature because it emphasizes that examples may be drawn from one part of a large company, whilst other parts of the same company are operating in a completely different manner with their partners and suppliers. Moreover, it requires strategists to overcome traditional thinking of internal sub-units as functions and departments and think instead in a modular fashion in terms of *enterprise modules*.

The first phase study produced a list of 35 validated propositions concerning Collaborative Enterprise Governance, as shown in Table 2, grouped under the five headings of: industrial impact; enterprise design; enterprise management; competence as contingency factor; and enterprise competitiveness.

Table 2: 1st phase propositions - Collaborative Enterprise Governance (Binder and Clegg, 2007)

No.	First Phase Propositions
1	Change in the automotive industry is driven by a combination of internal company issues and general industrial forces
2	Increasing complexity, cost pressure and shorter development lead times have led to more product modularisation
3	Car manufacturers are changing their adversarial pricing policies in supplier selection towards more collaborative strategic sourcing policies
	Enterprise design
4	Different relationships and collaborative practices exist for different inter-company (car manufacturer and supplier) projects in the supply network
5	Relationships between companies in the supply network change over time
6	An individual company can collaborate in more than one project within the supply network at the same time
7	Different projects in the supply network have to be managed differently
8	Part of a company can act autonomously from other parts of the same company

9	The role of an organisation in the supply network is determined by what competencies are offered by it
10	The role of an organisation in the supply network is partly determined by the stages of the product development process
11	Structure of the supply network is determined by the strategy of the car manufacturer
12	For each new inter-firm project a new appropriate supply base has to be selected and managed
13	Competencies of separate organisations need to be linked via cross-company projects within the supply network
14	Product modularization affects how a supply network is structured
	Enterprise management
15	The main challenge for a collaborative supply network is to maintain competitive prices without applying adversarial forces
16	An inter-firm collaboration in the supply network is formed on the basis of technical competencies and mutual exchange of knowledge
17	Strategic and long term thinking for the whole supply network increases the chance of successful inter-firm collaboration
18	The boundaries of responsibilities between collaborating parties need to be clearly defined to deliver a successful inter-firm project within the supply network
19	Early and intense integration of strategic collaborators facilitates the successful delivery of a project
20	At early stages of the collaboration process, competencies rather than prices have to be measured and compared
21	Functional thinking within an organization produces sub-optimization for the supply network
22	Overly stable relationships between companies in the supply network can lead to a loss of innovation
23	Focusing on core competencies is becoming increasingly important in order to drive the development of inter-firm collaboration in the supply network
24	There is the need for a coordinator and leader within the supply network who has the competence to evaluate and manage the interfaces
25	The co-ordinator of the supply network should have its own core competencies and encourage those of other organizations to participate
26	To become more influential in the supply network a company must take responsibility for integrating other companies and their products
27	Car manufacturers still retain overall responsibility for the management of the whole supply network
	Competence as contingency factor
28	To operate autonomously, parts of an organization must have both unique resources and common interfaces
29	The more advanced and unique a competence is, the more potential value it can create for the supply network
30	Competencies can be deployed through collaboration with other companies
	Enterprise competitiveness
31	The short term motivation for inter-firm collaboration in the supply network is to reduce cost and lead time
32	The long term motivation for inter-firm collaboration in the supply network is to improve quality and innovation
33	Establishing inter-firm collaboration is an effective way of reducing lead times and cost
34	New inter-firm collaborations produce innovative solutions
35	There is a positive correlation between the extent of inter-firm collaboration in a supply network and the success of individual companies within it

The empirical evidence of the first phase research suggests that a balance of different types of inter-organizational architectures is necessary in order to minimize commercial risk for short-term success whilst simultaneously encouraging innovation and quality improvements for long-term success of the enterprise. In turn this facilitates the success of each individual value member participating within the collaborative enterprise. As a result, three distinct architectures for the successful governance of collaborative enterprises were identified. They are termed the *virtual enterprise*, the *extended enterprise* and the *vertically integrated enterprise*. Their main characteristics are described in Table 3.

Table 3: 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-opetition)	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

These three architectures do not result from completely different strategies, but are better thought of as a continuous spectrum of strategies focused on multiple simultaneous inter-organizational collaborations. The *vertically integrated enterprise* most closely approximates the traditional single legal entity company and could be seen as a kind of proto-institution that emerges from a high level of embeddedness and integration of the partners (cf. Lawrence *et al*., 2002).

Thereby, the frequency and type of *enterprise engagements* for any one company is closely aligned with the value proposition portrayed by its competences and the capability of deploying them within an enterprise. This is referred to as *engageability* of the competence in the enterprise and is dependent upon various exogenous and endogenous factors that influence the value proposition of the competence within an enterprise module.

For instance, if the specificity of a competence (an endogenous factor) is **high** due to specific knowledge of one particular value member the transferability of this know-how within the collaborative activity is **low** (negative impact) resulting in a **low** engageability of the competence in the collaborative activity and hence the enterprise. However, the transferability and hence engageability of the competence can be increased as value members become more integrated over time and transaction frequency (endogenous factor) between them increases (positive impact). Similarly, a **low** marketability of a new competence (exogenous factor) due to its untested market value will result in a **low** attractiveness and hence a **low** engageability (positive impact). However, this market value can for example be increased through further advancement and sophistication of the competence (e.g. new technology) (endogenous factor) leading to a **higher** maturity (positive impact), **less** risk of deployment (negative impact) and therefore **higher** market value and engageability of the competence.

However, the initial phase showed that the determination of an appropriate enterprise architecture should not only be based on the current value and engageability of a competence (which only contributes to the current competitiveness of the enterprise and its value members) but also on its future value and engageability (which contributes to the future competitiveness of the enterprise and its value members).

Figure 1 summarizes this argument in the form of the Dynamic Enterprise Reference Grid which shows current and future types of competences and their engageability (indicated simply as 'high' or 'low'). In each of the quadrants the best suited enterprise architecture, depending on the prevailing current and future engageability of the competences, is given.

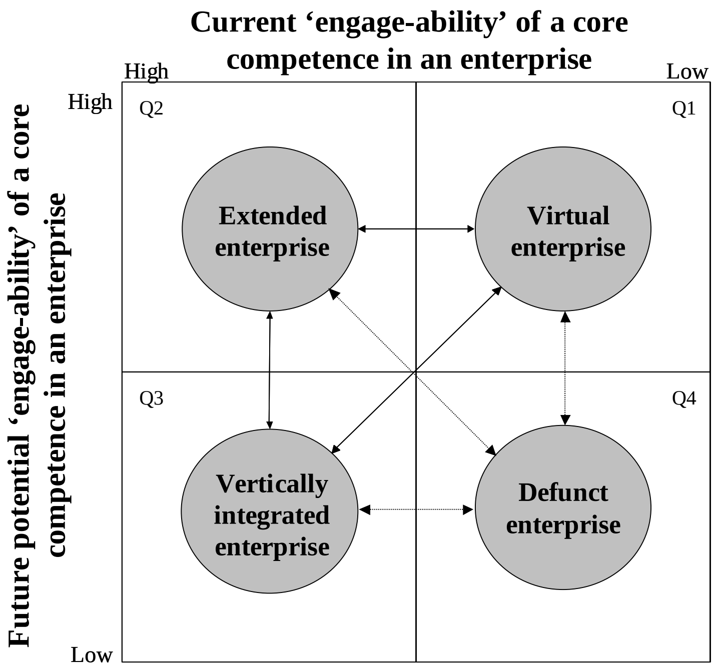

Figure 1: Dynamic Enterprise Reference Grid – A Portfolio of Enterprise Architectures

This is a two-way dependency as the enterprise architecture will affect the development of future potential competences just as the development and deployment of competences will influence the emergence of different enterprise architectures. The conduct and outcome of partnership-like relationships and the related governance architectures are context dependent and not an absolute concept that will be 'fit for purpose' in all supply circumstances.

Insights from the first phase research recognize that inter-organizational relationships have to adapt and evolve (as the collaborative project moves through its life cycle) whilst maintaining the core ideals on which the relationship is built.

Based on MacBeth (2002), each of these architectures is considered to be in a 'dynamic equilibrium' around which collaborative activities cluster for a certain period until morphing into another type. Moreover, planned change from one structure to another can be in either direction (as shown by the two-way unbroken arrows in Figure 1). However, the anti-clockwise cyclical pattern from *virtual enterprise* through *extended enterprise* to a *vertically integrated enterprise* is believed to be the most common and likely evolution for achieving successful technology industrialization. The dotted two-way arrows show unplanned moves towards inappropriate enterprise architecture and associated recovery paths.

2nd PHASE: FOCUS ON TECHNOLOGY AND INDUSTRIALIZATION

The methodology used in the second phase is similar to the first. The second phase 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.

An interview guide based on the propositions from the first phase was adapted to the context of these cases; it was piloted with volunteer managers from JLR (who were not formally taking part in the second phase research) and was subsequently refined to ensure the elicitation of the appropriate data. The interviews were conducted during August and September 2009, each lasted 1-1½ hours. They were recorded and transcribed (200 pages resulted) (as per McCutcheon & Meredith 1993).

The confirmatory transfer study in the second phase considered how the above propositions impact upon the success of *technology based projects* in an enterprise. As with the initial phase, the data were analyzed using the principles of grounded theory (Glaser 1992; Strauss and Corbin 1997; Strauss and Corbin 1998). The authors conducted the 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 4 (to distinguish these from the initial phase propositions, they are referred to using Roman numerals).

Table 4: Second phase propositions specifically 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

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

Three different Technology Cases

To illustrate the *Collaborative Enterprise Governance* concept the product development histories of each case are now briefly described using terms from the Dynamic Enterprise Reference Grid (*cf.* Figure 1). The most significant difference between the three case studies was the final outcome. Case RS was successfully implemented in production vehicles whereas Case 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. These cases (see Table

5) are thought to be "polar types" making it easier to observe their characteristics (Eisenhardt, 1989). Due to confidentiality reasons the full cases are not given here but can be explained fuller in the presentation.

	Case A – Rotary Shifter	**Case B – Dual View Screen**	**Case C – My Connected World**
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 1automotive 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 5: Summary of JLR technology Cases

Table 6 shows how each case can be characterized by different governance architecture at various stages of the new product development lifecycle.

Table 6: Provenance of the conceptual framework based on findings and examples

Conceptualization of Collaborative Enterprise Governance		Cases
Type	**Characteristics**	
Q 1 VE	• 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)	**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. **Case B.1; The Dual View Screen (DVS).** Started off as one VE with one group of suppliers . **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)
Q 2 EE	• 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	**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. **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. **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.
Q 3 VIE	• 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)	**Case C.1: The My Connected World (MCW)**. This started off as Vertically Integrated structure between Ford's Research Departments and JLR Research.
Q 4 Defunct Enterprise	• 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)	**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)

Explaining Governance Architectures with the Dynamic Enterprise Reference Grid

The reasoning behind the architectures adopted and choices made is set out in this section, using the propositions from the both phases (Tables 2 and 4). There was a distinct difference between the enterprise structures of technology projects while 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 (No. iv). In all three cases, internal JLR and external groups worked together in a flexible way to deliver the technologies to IR (Nos. 29 & 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 (Nos. 4, i & ii).

In the RS case, initially specific suppliers were brought into the enterprise to undertake specific work-packages (Nos. 12, 13, 20, 30, 33 & 34) and then were no longer involved (Nos. 5 30, & 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 (Nos. 10 & 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 (Nos. 4 & xii), and they worked in a flexible/informal way (Kaihara and Fujii 2008).

In all cases, when the technology reached IR a production supplier was chosen and the technology lead transferred to JLR Electrical Engineering (Nos. 10 & i). The enterprise structure changed as JLR work exclusively with tier 1 suppliers to industrialize the technology (Nos. 3, 10, 11 26, ii, iii & v). There are no longer many companies involved delivering specific work-packages but instead JLR works exclusively with a tier 1 supplier (Nos. 3, 9, 10 & 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 (Nos. 17 & 21) and this is one of the basic principles of Collaborative Enterprise Governance (Nos. 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 (Nos. 3 15 & 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 (Nos. 29, 33, 34, & 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 (Nos. 15, viii & xv).

In terms of the Dynamic Enterprise Reference Grid, these cases validate the earlier work in that extended enterprise structures occur where enterprise modules have high current and future engageability (Nos. ii). However, truly extended enterprises at JLR may not be realized if there are issues with relationships and/or trust between members (Nos. 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 (Nos. 16, 19 & 35). 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 No. 14). 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 (No. xi). This introduces a disconnect 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 (No. 9).

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 because alternative suppliers had already been chosen to supply the replacement commodities when the current ones reached their end of life (Nos. 27, i & ii). 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 (No. 34).

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 (a development of proposition no.10). 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 2 shows the actual enterprise paths for each case based on the generic Dynamic Enterprise Reference Grid shown in Figure 1.

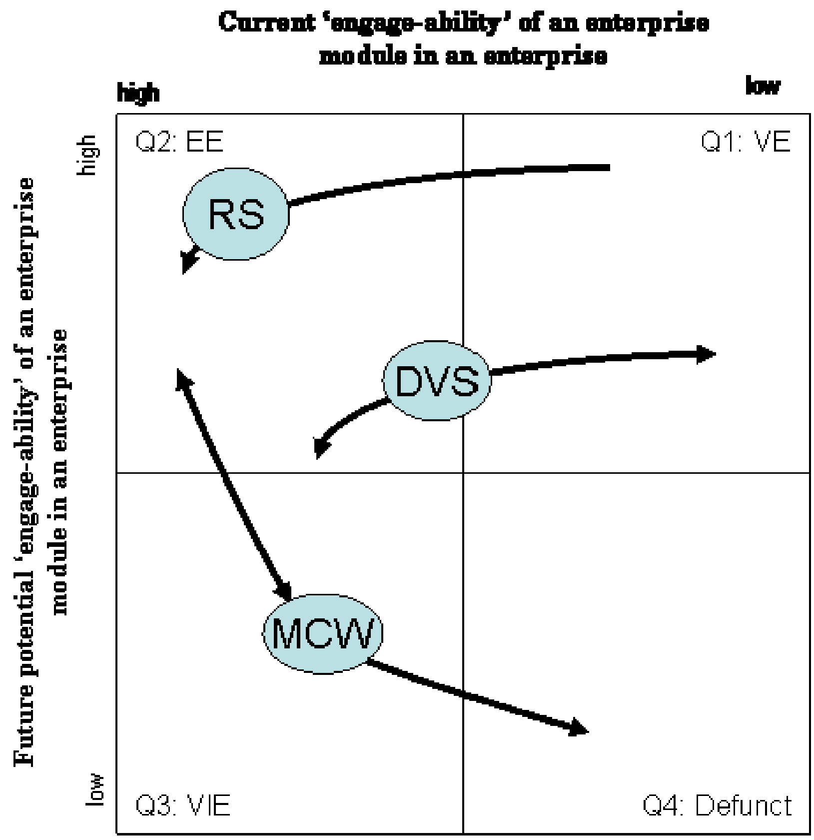

Figure 2: Enterprise Dynamics for the 3 Cases

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 (going against proposition no. 18). 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’.

Many other issues were revealed in this study about the relationship between enterprise structures and new product innovation; these can be discussed in the presentation and are still subject of on-going research.

DISCUSSION

The JLR study was more specific than the initial phase research in two respects, being concerned with a single OEM and focusing on R&D projects involving new electrical technologies. The concepts of Collaborative Enterprise Governance and the Dynamic Enterprise Reference Grid were originally developed on the basis of supply relationships for the automotive industry based on the OEMs in one country (Germany, whereas JLR is based in the UK). Of the 35 propositions from the first study, 24 were seen to be of direct relevance in the JLR cases, including at least one under each of the five headings (industrial impact; enterprise design; enterprise management; competence as contingency factor; and enterprise competitiveness). The second phase showed that the issues relating to trust, communication, vision and marketability were most relevant. The concept was also extended into more technical engineering issues around product platforms, components and technical interface specifications.

Therefore, the second phase has confirmed the Concept and Grid to be useful in a different and more specific context. The Dynamic Enterprise Reference Grid can be used in two ways. The first is to help managers plan R&D projects. The JLR cases highlight the Dynamic nature of the Grid, and the iterative structure of the Collaborative Enterprise Governance concept

(Binder and Edwards, 2010). They especially bring out the need to plan for potentially different architectures in different stages of the project and to work at the levels of the enterprise and enterprise module, not the whole organization (nor the component level). For example, in each of the three cases there is a clear need for a change in architecture at the point JLR call Implemention Readiness, where the lead transfers from a technical research department to a mainstream engineering department (different enterprise modules, although both part of JLR). The Dynamic Enterprise Reference Grid 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 Dynamic Enterprise Reference Grid 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). A brief overview of the main portfolio approaches on inter-organizational relationship governance in the extant literature can be provided by contacting the authors; a similar overview can be found in 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 Dynamic Enterprise Reference Grid. These are:

- Focus on Competence Rather than Product
- Consideration of the Stages of the R&D Process
- Multiplicity of Relationships
- Dynamic Evolution and Reconfiguration of Relationships
- Linking Formal Governance and Informal Relationships
- Leadership
- Competences and Knowledge Exchange**.**

Further explanation of these factors can be given by contacting the authors.

CONCLUSION

This paper has reported on research into the concept of Collaborative Enterprise Governance, 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 dealing with a single OEM (Jaguar Land Rover, based in the UK) and focuses on R&D projects involving new electrical technologies. This was carried out, like the original automotive study, using the grounded theory method, in order to allow for independent validation of the underlying propositions.

The results of the JLR study broadly supported the set of 35 propositions that ground the overall Collaborative Enterprise Governance 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 Collaborative Enterprise Governance concept, the Dynamic Enterprise Reference Grid. Comparison of the actual paths followed by the three case study projects (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 Dynamic Enterprise Reference Grid 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.

This paper has demonstrated how the Dynamic Enterprise Reference Grid, the central part of the Collaborative Enterprise Governance concept may be used to understand how architectures develop in the course of a collaborative R&D project and how this impacts on project success through three case studies from Jaguar Land Rover. These have shown the value of specific practical models for practitioners (OEMs and suppliers).

It is suggested that this dependency is sufficient to use the Dynamic Enterprise Reference Grid as a decision support tool for the pro-active management of inter-organizational architectures. Further research is currently investigating the implications for information systems management.

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