LEARNING HOW TO EAT AN ELEPHANT: IMPLEMENTING SUPPLY CHAIN MANAGEMENT PRINCIPLES

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There have been a range of calls for the construction industry to address perceived structural failings and adopt supply chain management best practice models. However, many studies in the construction sector report poor uptake. A possible reason for this is a failure of companies to implement their supply chain improvement programmes effectively. Such changes may involve companies adopting new approaches, new processes and new ways of working. In order to manage this daunting undertaking, the role of managing new knowledge and sequencing activities is important. Hence, the purpose of this paper is to investigate the anatomy of a long term supply chain improvement programme in the construction industry. Building on established supply chain management principles, and models of supply chain learning, a longitudinal case study is analysed. Insight is given into the role of learning and the sequencing of activities. The paper contributes by refining established supply chain management frameworks.

Keywords: supply chain management, learning organisation, sequencing, implementation, change management.

INTRODUCTION

Researchers have shown that close integration of supply chains is strongly associated with performance improvement (Frohlich and Westbrook 2001). However, there are very few 'exemplars' of good supply chain practice to be found, even across industry sectors (Childerhouse and Towill 2011). Typically, such exemplars show evidence of moving towards a 'seamless' supply chain, whereby barriers to integration are removed through process improvement (Love *et al.* 2004, Towill 1997a). Many of the arguments for integration have been grounded in business process improvement literature (Frohlich *et al.* 2001), such as business process systems engineering (Watson 1994) and lean thinking (Womack and Jones 1996). In practice, however, the success rate of improvement initiatives are less than encouraging (Kotter 1995).

A common problem is that a complex challenge is dismembered into a series of seemingly simple 'quick fixes'. Poorly thought out local improvement initiatives may

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actually decrease overall system performance (Owen and Huang 2007). Such studies highlight the danger of extrapolating results from simple systems to more complex ones without appropriate understanding and learning. As de Treville *et al.* (2004) strongly emphasize, dramatic failures often result from ambitious attempts to 'run before learning to walk'. Given the above challenging prognosis, careful thought is required by practitioners as to how they design and implement change programmes, and act as a warning to those enthusiastically seeking to apply reform agendas.

In the construction sector, discourses of change have gathered momentum through successive government reports and academic literature (Egan 1998, Latham 1994). Reform agendas for improving supply chains have been central to these calls for change, through notions of partnering and teamworking, and learning from other sectors. The actual uptake of supply chain management practices within construction appears to be very slow (O'brian *et al.* 2009) . A possible reason for this poor uptake is a failure of companies to implement their supply chain improvement programmes effectively. As noted by Bresnan *et al.* (2006), there remain significant gaps in our understanding of the problems associated with implementation of effective change and learning in construction project organisations to support such radical transformations. Hence, the purpose of this paper is to investigate the anatomy of a long term supply chain improvement programme in the construction industry. To undertake such a dissection, a set of SCM principles that have previously been developed and tested in a range of make-to-stock scenarios (Towill 1997b) and a model of supply chain learning (Bessant *et al.* 2003) are exploited and extended.

LITERATURE REVIEW

Defining the elephant – modifying the 'FORRIDGE' Principles

It has been argued that many modern supply chain principles may be traced back to the classic production distribution systems simulations by Jay Forrester (1961). Furthermore, by integrating the methodologies of industrial dynamics (Forrester 1961), and material flow control (Burbidge 1961), a set of system operation principles have been developed (Towill 1997b). The latter looked to provide a foundation for sound supply chain design, and in doing so established a set of fundamental rules for enabling smooth and seamless material flow. The 'FORRIDGE' principles, a phrase derived from combining the key intellectual influences of Forrester and Burbidge, were originally defined as; control system principle, time compression principle, information transparency principle and echelon elimination principle. A previously implied fifth 'synchronization' principle was later made explicit by Geary *et al.* (2006). Since publication in 1997, the principles have been shown to offer a powerful guide for engineering effective supply chains.

Figure 1 gives a vision for each of the FORRIDGE principles. It is important to note that they provide a set of guiding principles for companies. They may be interpreted and achieved in a range of different ways across industry sectors. We argue that in addition to the five principles documented in the existing literature, a sixth 'Design for X' (DfX) principle, which relates specifically to project related supply chains where complex bespoke products are 'engineered to order' (Gosling and Naim 2009). DfX has become an umbrella term used to imply effective design principles (Kuo *et al.* 2001). Approaches such as design for assembly, design for manufacturing, design for buildability, and design for life cycle are all included in this umbrella (Asiedu and Gu 1998). An integrated design process should enable all elements of the design to be 'fit

for purpose' and 'right first time'. Two enablers of training and learning, as well as supply chain integration have been added.

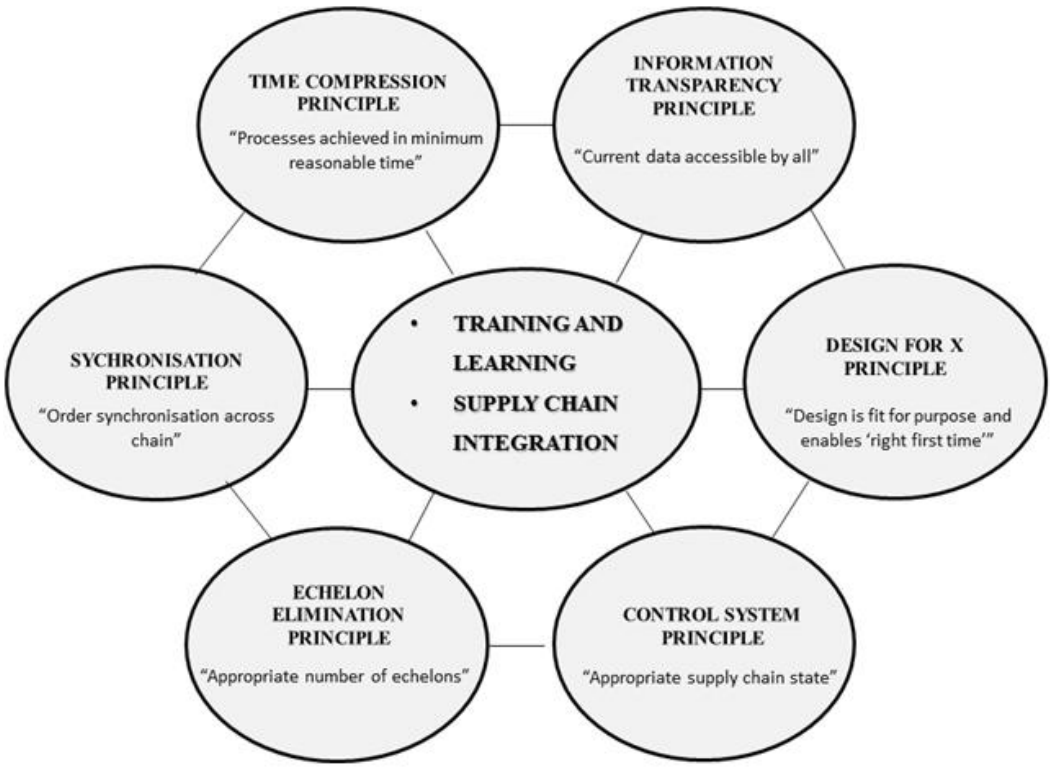

Figure 1: The FORRIDGE principles

Forrester (1961) emphasized the role of feedback and disturbances in manufacturing systems, establishing that the more extended the chain, the worse the dynamic behaviour. At around the same time John Burbidge was developing ideas relating to material flow control exploiting cycle time compression, synchronization of orders throughout the supply chain, simplified product structures and streamlined component flows within the factory (Burbidge 1961). The FORRIDGE principles united these different intellectual threads into a succinct set of principles (Geary *et al.* 2006, Towill 1997b, Towill and Childerhouse 2006).

Individual principles have been substantiated by many researchers, including time compression (Treville *et al.* 2004), information transparency (Smaros *et al.* 2003) and control (Dejonckheere *et al.* 2003). McCullen and Towill (2001) have comprehensively shown that the application of the principles as core features within a business process re-engineering (BPR) programme have substantially reduced demand volatility in a real world supply chain. Furthermore, there has been simultaneous reduction in inventory levels and variability. These principles have since been incorporated into a vision-principles toolbox model, and subjected to statistical testing across a range of real world supply chains (Towill *et al.* 2006).

Learning to eat the elephant - managing and implementing change

Innovation of the scale encouraged by the FORRIDGE principles is often disruptive. A primary concern in effecting change in supply chains is that the level of co-operation required between organisations in the supply chain is often far from guaranteed (Towill and Childerhouse 2011, Treville *et al.* 2004). A proposed starting

point is to perfect processes under direct control (Treville *et al.* 2004). Operationalising this requires separating internal initiatives, which do not require any collaboration, and external initiatives, which require substantial collaboration. Once the knowledge is developed from internal initiatives, it is then possible to move more confidently onto external activities and interfaces (Towill *et al.* 2011).

Furthermore, companies often have limited resources and investment available for effecting such changes. One suggestion is to limit an innovation programme to no more than 2-3 major efforts at a time (Hammer 2004). The logic here is that undertaking all planned activities at the same time, eating the elephant in one go, would consume too many resources and create too much disruption. Similarly, a protracted implementation period with small activities performed sequentially over a long time period, gives 'opponents' an extended opportunity to sabotage efforts. Breaking a large scale implementation into a series of 'limited releases' creates momentum and dispels scepticism (Hammer 2004). Figure 2 integrates the above thinking to identify a range of sequencing options for implementing a supply chain improvement programme. The proposition advanced is that our metaphorical supply chain 'elephant' is best eaten in an optimal array of bite size chunks.

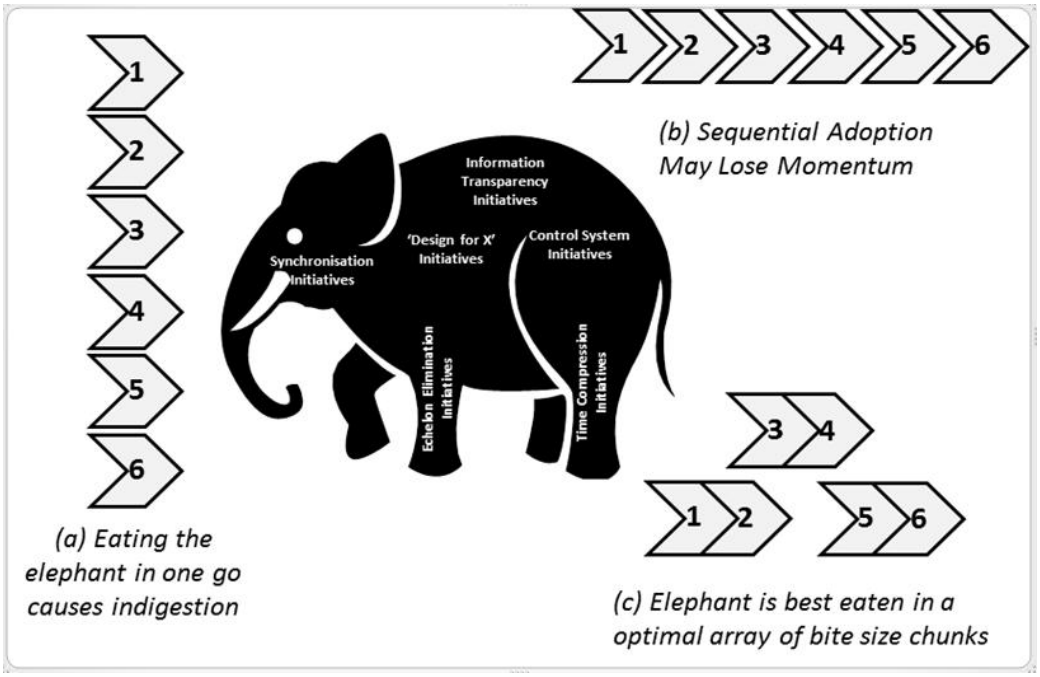

Figure 2: Possible approaches to 'eating the elephant'

Werr *et al.* (1997) showed that the learning organisation is integral feature of international change management consultancy methods. Organisational theorists have studied learning for some time. Early work by Argyris (1992) emphasized modes of learning and single and double loop learning, and Peter Senge (1990) proposed a range of core disciplines for building the learning organisation. However, a more recent seminal analysis by Ortenblad (2007) showed that Learning Organisation citations were taking quite different, and often conflicting, interpretations of its meaning. Garvin (1993) offers a clear and concise definition to exploit: "creating, acquiring, transferring knowledge and exploiting this to modify behaviour".

The importance of learning does not stop at the boundaries of a single organisation (Bessant *et al.* 2003). This notion is especially important in the context of construction projects, where there is a complex flow of knowledge between project firms.

Performance, therefore, is heavily dependent on inter-organisational learning and development. Bessant *et al.* (2003) coined the phrase 'supply chain learning' to refer to this. They propose a two by two matrix to rationalise different learning types and modes in supply chains. Learning mechanisms can be simple, referring to incremental additions or improvements, through to complex, which are new approaches requiring experimentation and adaptation. They also distinguish between one-to-one dyadic relationships and multi form groupings, which they refer to as network.

RESEARCH METHODOLOGY

There have been a range of calls for more longitudinal research in supply chain management research (Boyer and Swink 2008), as well for a more sophisticated understanding of the impact of time related intervals in the research process (Zaheer *et al.* 1999). Longitudinal research is a "family of research methods which tell us about change" and is concerned with "temporal evolution" (Ruspini 2002: p10). Clearly, a long term initiative of the sort described in the literature review is not small a single event, but a long series of discrete intricately connected episodes that occur over a long time period. Pettigrew (1990) refers to the empirical study of such change programmes as 'catching reality in flight', involving horizontal and vertical levels of analysis.

The most commonly used longitudinal designs are, repeated cross sectional studies, prospective longitudinal studies and retrospective longitudinal studies (Ruspini 2002). In prospective longitudinal studies, the same subjects are repeatedly interviewed over a period of time at discrete points. In retrospective interviewees are asked to remember, and reconstruct events or aspects of events. The focus is often placed on specific 'events' and 'trajectories', which are of interest to the study. In this paper, we focus as an event as a process change or initiative which forms part of a broader trajectory to improve the supply chain. This paper reports the investigation of the supply chain improvement activities of an international consultancy and construction company employing over 3,000 people, operating across 65 countries and with a turnover of £850m (in 2010).

The company was formed in1990, and decided to reform its approach to operations and supply chain management in 2000 in response to a range of different drivers. Pettigrew (1990) suggests choosing a site to demonstrate high or low performance is appropriate justification for studying a change programme. The company has maintained impressive growth since 2000, even during the recession, and has won a range of awards relating to its supply chain practices. Time events were captured through a combination of retrospective and real time analysis, thereby combining two of the designs described above. The research team have been actively researching with the case company since 2007, allowing real time observation of initiatives since this time. Prior to this point, initiatives were captured via retrospective identification.

Data was collected by interviews, observations and archival data. Through a series of interviews and meetings with the operations and supply chain director, informal questioning was used to reveal how and why initiatives were established. A chronology was then established to order and present ideas as a narrative. Feedback on the timeline was then gathered through follow up interviews. The primary focus was on identifying and understanding initiatives that were 'transparently observable'. Observations during company visits were recorded over the period between 2007 and 2012, which formed the basis of a draft timeline of initiatives. This was used to inform

interview questions. Archival data, such as project case studies, internal process documents, and IT systems were examined to give further background.

CASE STUDY FINDINGS

Figure 3 shows the chronology of supply chain initiatives undertaken by the focal company since 2000. The different activities have been classified, as per the colour coding, according to the primary FORRDGE principle that they relate to. It also shows some of the key drivers and influences that have shaped these initiatives over the time period. For the Time Compression Principle, standard bid templates were introduced to reduce workload and lead times for the bid process. Promotion and adoption of modular design principles, as well as offsite pre-assembly sought to reduce process times. Synchronisation principle initiatives include JIT systems developed with suppliers over a number of years to synchronise deliveries with site progress. Cluster management workshops were set up to encourage suppliers to integrate work in more effective ways.

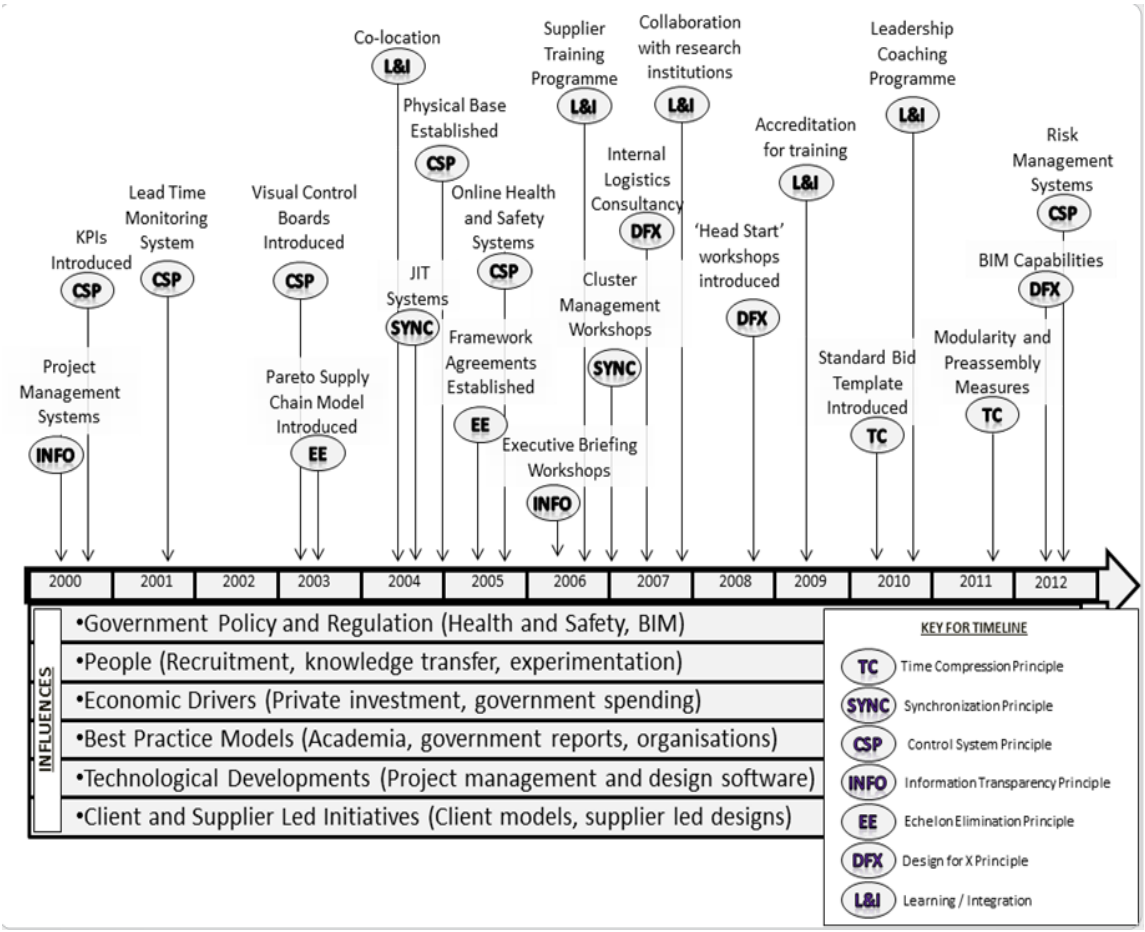

Figure 3: Timeline of supply chain initiatives classified according to the modified FORRIDGE principles

Initiatives that relate to the Control Systems Principle include the design and implementation of a Key Performance Indicator (KPI) System with accompanying visual control boards. IT systems were developed to monitor supplier and project lead times, as well as manage Health and Safety protocols. Importantly, a physical base was established to collate best practice, monitor training and implement best practice across the organisation and supply chain. Finally, more recently, in response to the recession, risk management systems have been implemented. Information

transparency has been improved in a number of ways. Project management systems were implemented early in the timeline, allowing suppliers to see up to date project plans and drawings. These have developed as technology and uptake have got better. Executive briefing workshops were also initiated to give information about upcoming projects and work that may be available in the coming months, therefore allowing supplier to forecast and gain a better understanding of market outlook.

The echelon elimination principle is demonstrated through the development and use of a Pareto supply chain model. This involves supplier rationalisation and a focus on the 20% of suppliers that deliver most of the work for the focal company. Later these are developed into framework agreements: close relationships that apply to both client and supplier relationships. DfX principle initiatives include the setting up of an internal logistics consultancy. This area of the business acts as a consultancy for all projects, and supplier operations. It advises on how to best manage logistics and include such considerations at the design stage. 'Head start' workshops have also been initiated to help design clusters work together more effectively, and, more recently, building information management (BIM) capabilities have started to be developed. Finally, learning and integration enablers have also been identified. Such activities include co-location of project teams, supplier training programmes, collaboration with research institutions, accreditation to deliver formal training, and leadership coaching programmes have been developed.

The initiatives presented are analysed further to give insight into sequencing and scope of supply chain learning. Figure 4 exploits the supply chain learning model proposed by Bessant *et al.* (2003) . In mapping the initiatives from the previous section, an additional organisational dimension has been included. This category includes those activities that are 'internal' to the focal company. The majority of the initiatives are complex, and some span across categories. It is interesting to consider the completed matrix in the light of firstly, capturing project specific learning, and secondly, capturing learning at the organisational level (this complex interplay is well explained in (Gann and Salter 2000)). For individual projects, IT systems help to record KPIs and statistics for individual projects, and documented case studies of key successes and learning points both help to facilitate project learning. At the firm level, the establishment of a department within the organisation responsible for promulgating, capturing and exploiting best practice. This relates strongly to the initiative to establish a physical base to manage knowledge and best practice.

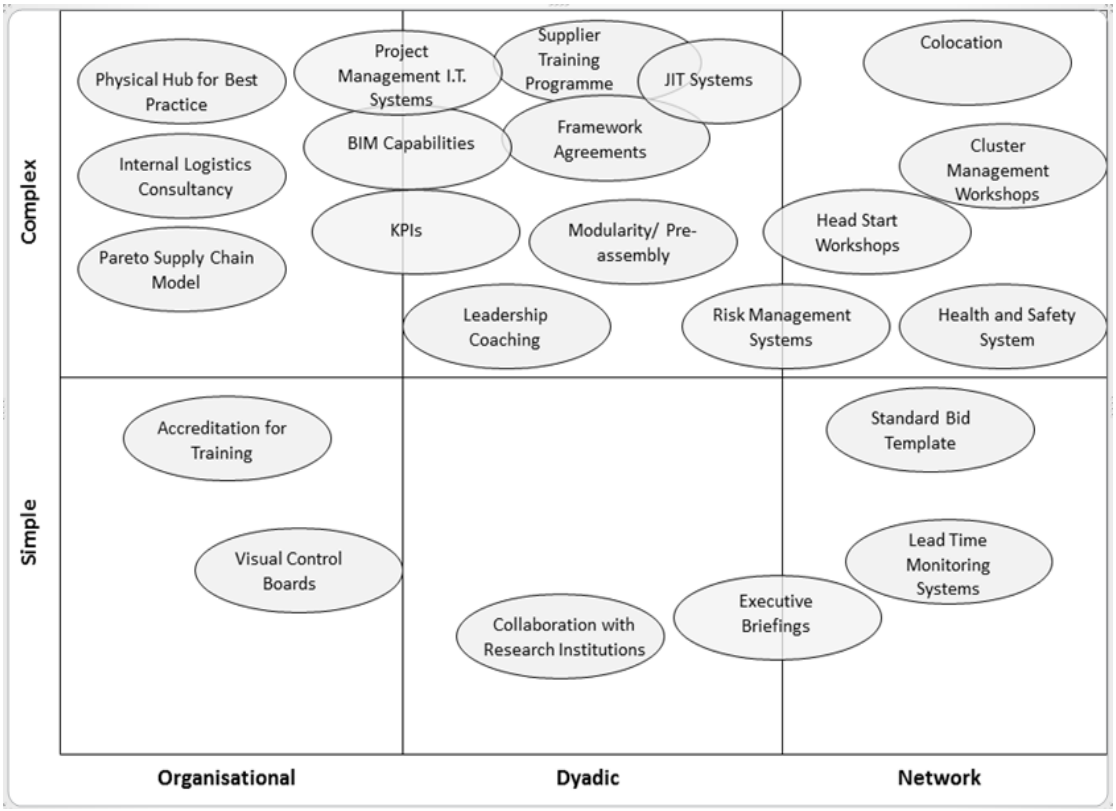

Figure 4: Initiatives mapped onto supply chain learning matrix

An 'idealized pathway' emerges from the figure. Organisations should begin with the internal organisational initiatives identified, as they can be more easily controlled and can be experimented with in a 'safe' environment. Furthermore, the simple activities offer a good platform to learn from before extending to the more complex initiatives. Once the lessons have been learned and the learning form the above has been captured, it may then be possible to move to the dyadic category, where learning can be extended to a selection of close suppliers moving from simple to complex. Finally, network wide initiatives can be targeted.

The final analysis presented in this paper is shown in table 1. It is useful to consider the initiatives in relation to soft systems change models, which categorise issues according to three interacting areas: process, attitudinal and technology (Towill 1991). The initiatives identified are categorised according to these three elements in the table. A large marker denotes a strong relationship and a small marker denotes a weaker relationship. This analysis shows that 16 of the initiatives relate to process, 11 relate to attitudinal, and 5 to technology.

Principle	Initiatives	Process	Attitudinal	Technology
Time Compression principle	Standard Bid Template	✓		
	Modularity / Preassembly	✓	✓	
Synchronization Principle	JIT Systems	✓		
	Cluster Management		✓	
Control System Principle	KPIs	✓		✓
	Lead Time Monitoring	✓		✓
	Visual Control System	✓	✓	
	Physical Base Established	✓		
	Online H & S System	✓		✓
	Risk Management Systems	✓		
Information Transparency Principle	Project Management Systems	✓		✓
	Executive Workshops		✓	
Echelon Elimination Principle	Pareto Model	✓		
	Framework Agreements	✓	✓	
Design for X Principle	Internal Logistics Consultancy	✓		
	Head Start Workshops		✓	
	BIM Capabilities	✓		✓
	Co-location	✓	✓	
Learning /Integration	Supplier Training		✓	
	Research	✓	✓	
	Training Accreditation		✓	
	Leadership Coaching		✓	

Table 1: Table showing classification of initiatives

CONCLUSIONS

A long term supplier improvement programme of a major construction company was investigated and analysed in a number of different ways. The 'anatomy' of this programme was presented as a timeline of improvement initiatives undertaken between 2000 and 2012. These initiatives were related to established supply chain 'FORRRIDGE' principles, which were developed for a construction sector context. The additions to the original FORRIDGE principles help to enrich this established framework. The programme was further analysed by considering it in light of supply chain learning. This gives insight into an idealized pathway for implementing supply chain initiatives, thereby arguing that the elephant should be eaten in bite size chunks, broken up into a series of learning exercises. Finally, the programme was analysed by considering process, attitudinal and technological aspects. Process and attitudinal challenges were the most numerous.

We argue that implementing the FORRIDGE principles, combined with a structured approach to accumulating and capturing supply chain learning, offers considerable opportunity for competitive advantage for those willing to invest. We do acknowledge that there are a range of barriers in achieving the vision that is set out in the FORRIDGE principles, and that the empirical elements of this paper inevitably have limited claims to generalisability, but we do seek to set out an approach to address some of the well documented supply chain failings of the construction industry. The principles may be achieved in a myriad of different ways. It is hoped that the insight given in this paper, the FORRIDGE principles, the initiatives undertaken by a

construction company, and the sequencing method proposed, will be of interest to researchers in the area of construction supply chain management and gives organisations some guidance in designing and implementing their supply chain improvement programmes.

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