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Effective Vehicle Attribute Delivery at Jaguar Land Rover

EngD Innovation Report

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17/11/2017

Declaration

The information documented in this report is the result of my own research. Where material is included from other sources it is acknowledged and the details provided in the references.

This work has not been submitted for a degree at another university.

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Glossary

AQI	Al Qaeda in Iraq
ARN	Agile Research Network
DST	Dissipative Structure Theory
GTM	Grounded Theory Methodology
JLR	Jaguar Land Rover
LRV	Law of Requisite Variety
MBI	Minimum Business Increment
OCAI	Organizational Culture Assessment Instrument
PI	Program Increment
POC	Proof Of Concept
RO-AR	Research Oriented Action Research
SARFIT	Structural Alignment to Regain Fit
SCT	Structural Contingency Theory
SDT	Self Determination Theory
SEs	Social Ecological Systems
TOC	Theory of Constraints
VeD	Vehicle Dynamics
V-NVH	Vehicle Noise Vibration and Harshness
WIP	Work In Progress
WSJF	Weighted Shortest Job First

Abstract

The objective of this research is to enhance the effectiveness of the new product development at Jaguar Land Rover by attending to the incongruities between the perceived organisational culture and the ecosystem in which the teams operate. The inquiry is aligned with both Donaldson's structural contingency theory (2001) and Syed's (2015) reflections regarding psychological alignment. The contention of the research is that an alternative operating model enables the teams to thrive and relish the uncertain, complex environment in which they now operate and hence improve their satisfaction and wellbeing whilst delivering increased value for both the business and the consumers (Davis, 2016a).

This paper describes the rationale and the approach taken to embed an operating model which liberates the capabilities of the 'knowledge worker' community (Drucker, 1999) as opposed to the apparent Scientific Management (Taylor, 1914) bureaucratic efficiency model, which had previously been relevant.

The research methodology incorporates Research Oriented Action Research (Eden and Huxham, 1996) in order to accommodate the unknowable outcomes and embedded paradoxes. The incorporation of a neurological metaphor attends to the innate human behaviours and social dynamics, whilst Dissipative Structure Theory (Prigogine and Allen, 1982) and the concept of panarchy (Garmestani et al., 2008) expands the traditional hierarchical perspective.

The joint inquiry undertaken during an internship at Airbus Defence and Space corroborated the notion that an agile operating model could be realised for the creation of complex systems with significant hardware content and long lead times. The investigation also merges the constructive lean/agile values and principles from other sectors that are facing similar disruption in their ecosystems. The adoption of the principles that support self-determination (Ryan and Deci, 2000) result in reframing the participants' beliefs or "*theories of action*" (Argyris, 1995) by revising their experiences, hence a reduction in the observable stress and a verifiable increase in the delivery of valuable outcomes.

The implications of the research spans both academic interest and real world utility regarding the co-creation of valuable knowledge through the alignment of the social dynamics of the participants and the methodology for progressing volatile problem situations with the ecosystems in which they find themselves.

1.0 Introduction

This research project was initiated in response to the increased demand for more diverse product offerings and the associated complexity that was experienced within the Jaguar Land Rover (JLR) operating environment (Davis, 2014). Childress (1995) and subsequently Cameron and Quinn (2011) emphasised the significance of Peter Drucker's quote that *"We are in one of those great historical periods that occur every 200 to 300 years when people don't understand the world anymore, and the past is not sufficient to explain the future."* A review of the automotive industry ecosystem that JLR inhabits substantiated this claim (Davis, 2017c).

The diagnostic inquiry (Davis, 2016a) revealed a disparity between many of the exiting modes of operation that were evident at Jaguar Land Rover (JLR) and the complex, unpredictable environment in which it now operates (Davis, 2017c). Donaldson (2006) associated such incongruence with declining organisational performance. The diagnostic inquiry confirmed the belief that that the nature of the social interactions was fundamental to JLR's organisational effectiveness (Davis, 2016a) and acknowledged that such relations may paradoxically be both constructive and detrimental. Additionally Whyte et al. (1989) asserted that *"the way we think about problems is shaped to a considerable extent by the social setting in which we find ourselves"*. The ability to generate creative solutions was therefore considered to be dependent on the human capacity for adaptation and expansion of the organisational and intellectual rubrics.

The research questions that emerged from the discovery phase of the research, as described in section 3.2, were stated as follows (Davis, 2016a):

- How does the embedded culture within JLR influence the effective delivery of the desired vehicle character given the contemporary operating environment?
- What strategies can be implemented to preserve the constructive factors and mitigate the detrimental influences?
- Can the proposed strategies be scaled to influence the entire Product Engineering culture, or indeed the entire organisation?

These questions were supported by the research contention that *"a revised way of working would allow the JLR attribute teams to thrive and relish the uncertain,*

complex product creation space hence improve their satisfaction, throughput and quality of delivery” (Davis, 2016a).

This research project was aligned with Donaldson’s (2001) concept of fit between the organisation and the environment in which it is operating rather than succumb to population ecologist’s view of the futility of adaptation, as articulated by Hannan and Freeman (1977). The feedback received during the discovery phase of the inquiry (Davis, 2016a) implied that, in spite of the increase in both the size of the organisation and its product ambitions (Davis, 2014), JLR operated within a traditional command and control model, albeit with sub-cultures that have protected some traits of a *“small cottage industry”* (Davis, 2016a). The dominant paradigm was regarded as a ‘large machine like’ bureaucracy that developed in order to enhance efficiency, reduce variation and emphasise control, with the formal power being centred at the top (Mintzberg, 1981). Such a model was considered effective for the efficient production of consistent product, but unsuitable for adaptation to changing circumstances and innovation. Donaldson (2001) observed that a more organic, participative operating model was associated with enhanced performance in complex uncertain environments. This was supported within the literature that asserted that the adoption of an inappropriate, mechanistic structure in an unstable environment routinely resulted in a reduction in effectiveness due to an inability to innovate (Burns and Stalker, 1961). Mintzberg (1981) described a ‘professional bureaucracy’, which was closely aligned to the JLR ‘Product Creation’ environment. Whilst being more suitable for a complex environment, it also generated stability seeking, orthodox processes. Such standardisation is paradoxically a strength and weakness because the repeated practice that enables the professionals to hone their skills (Kahneman, 2011 cited in Davis, 2017e) also creates problems of inflexibility. Mintzberg (1981) asserted that *“This is not a structure to innovate but one to perfect what is already known.”* Within this dissertation, a shift towards adhocracy was advocated as a catalyst for panarchy (Walker et al., 2004) in order to utilise the capacity for innovation in such complex, uncertain domains. In this paradigm co-ordination and control are realised through interaction and communication of competent experts rather than the reliance of mechanistic processes. The contention that the proposed approach complemented the systems engineering

philosophy, embedded within the JLR product engineering discipline, was supported by Emes et al. (2012) who commented that *"When the environment in which we work changes, the old rules no longer apply. When this happens, we rely on underlying principles to guide us. We don't want our systems engineers or even our specialist engineers to become unquestioning cogs in a machine. Engineers are capable of great creativity, and they should be empowered to apply this creativity to processes as well as the products they design."*

Kotter (2012) asserted that many adhocracies are highly vulnerable and tend to be associated with 'start ups' arguing that those that avoid extinction frequently evolve to a more formal structure. Kotter (2014) also suggested that the desired adaptive paradigm is routinely experienced during the transition from a small agile start up and a large controlled bureaucracy. The challenge was therefore to identify the positive characteristics of this 'transitional' phase and embed them into a sustainable, adaptive operating model.

The research was centred on the effectiveness of the vehicle attribute teams, with an expectation that the outcomes would be scalable to the wider JLR 'knowledge worker' context (Drucker, 1999). The attribute teams are responsible for engineering the distinctive character into the JLR products that distinguishes them from their competitors. The main contributors to the research were from the Vehicle Dynamics (VeD) team, who tune the comfort and response of the vehicles and the Vehicle Noise Vibration and Harshness (V-NVH) team, who eliminate the undesirable noise and vibration whilst emphasising the desirable sound quality. Whilst the attribute teams do not have release responsibility, they are routinely on the critical path for the overall programme delivery. In accordance with Goldratt's (1990) Theory of Constraints (TOC), the intention of this research was to elevate the attribute teams as a constraint and hence optimise their capacity to enhance the overall throughput of the development process given:

$$\text{Throughput} = \text{Bottleneck Utilisation} \times \text{Bottleneck Rate}$$

(Hopp and Spearman, 2011)

The overall transformation process was guided by Lewin's (1947) 3 step process of unfreezing the current state, progressing to a new state and refreezing the norms and values based on that new state (Davis, 2017f). A review of the current best practice within parallel industries was undertaken to inform the progression

to a new state. This was conducted during an internship with Airbus Defence and Space in Munich (Davis, 2016e). This study confirmed the potential utility of an operating structure that incorporated the lean agile values and principles, whilst enabling sufficient context specific adaptability to afford an appropriate response to the complex, uncertain environment in which both Airbus and JLR are operating. The accommodation of the substantial hardware content, involving long lead times, within the complex systems presented particular challenges that were not considered within the agile software literature. Central to this notion was the elaboration of the SAFe® scaled agile framework (Leffingwell, 2014). This framework was revised to incorporate the experiences of Koehnemann (2015) regarding the deployment of scaled agility and the foundational lean principles within large complex systems development. These enhancements were ultimately released as SAFe® for Lean Enterprises (Leffingwell, 2017), which provided a framework for the Action Research (Davis, 2017f).

In order to ensure the interventions were both appropriate, sustainable and founded on rich insights, it was essential to involve the participants to ensure the interventions addressed the issues that genuinely concerned them (Whyte, 1991 cited in Eden and Huxham, 1996). The research was configured around the 'Responsive Process Theory' (Stacey, 2011) in order to preserve the innovative freedom of the participants. Within this paradigm the role of the researcher was as a 'participative coach' rather than assuming a consultative or change management role (Kotter, 1996).

1.3 Agile Mind-Set

The research itself respected the agile ideologies of learning and adaptation. The original intent was for a process improvement project, incorporating the lean systems engineering best practice within the Vehicle Dynamics Team (VeD) (Davis, 2014). Following the research methodology exploration (Davis, 2015a) and the diagnostic inquiry (Davis, 2016a) the project was revised to be founded on an ethnographic study that encompassed the social dynamics, within a scaled agile deployment, to enhance the wellbeing and effectiveness of the Vehicle Noise and Vibration and Harshness (V-NVH) Team (Davis, 2017f).

2.0 Innovation and Academic Significance

During the course of the research project the following innovative constructs emerged:

- In accord with Tushman's (1997) contention that the ability to innovate is affected more by the organisation and management rather than the technological capabilities, this research was intended to redress the notion that the management innovations do not gain the same degree of attention that is given to the technical domain (Steiber, 2014). This was the case at JLR, where the emphasis was on the significant amount of technical research that was undertaken.
- The exploitation of the affinity between the Dissipative Structure Theory (Prigogine and Stengers, 1997), the nuances of human cognition (Goldberg, 2009) and the subtleties of the Complex Process of Relating (Stacey et al., 2000) as a catalyst for a resilient, agile operating model. This was founded on the social construction of an organisation and emergence of novelty rather than a formative causality (Stacey, 2011). This enabled the exploration of the contention of human creativity being considered as an evolutionary complex system (Flood, 2002).
- The expansion of the notion of hierarchy to accommodate the paradox of control and emancipation enabled the participative, adaptive, resilient archetype by incorporating the concepts of panarchy (Walker et al., 2004). This was in contrast to Garmestani et al's (2008) observation that *"its use remains primarily descriptive and abstract."*
- The neurological appreciation and the adoption of the brain as a metaphor for a complex network that enabled effective communication and data processing was considered innovative as it also placed the human characteristics at the centre of the interventions. This significantly extended the routinely articulated platitudes of 'success through people' with an awareness of human behaviour in terms of both cognition and interaction.
- Psychological alignment was used as a catalyst for organisational effectiveness by consciously moderating the stimuli for the observed survival responses (Davis, 2016a). Such defensive routines divert the

- constrained cognitive capability away from the conscious knowledge generating processes (LeDoux, 2012); (Webb, 2016).
- Generating an environment of open disclosure that enabled both the timely identification of issues (Syed, 2015), and the exposure of different interpretations of reality. This can prompt algorithmic thinking, reveal errors of judgement (Kahneman, 2011) and enhance collaborative innovation (Hill et al., 2014).
 - The incorporation of an appreciation of the ethics of coercive persuasion (Schein, 1999) leading to the operationalisation of the theory of Complex Responsive Processes (Stacey et al., 2000) as a catalyst for sustained, organic cultural transformation rather than managed change (Kotter, 1996).
 - The incorporation of Self Determination Theory (Ryan and Deci, 2000), into both the action research and the proposed operating model, with particular emphasis on the preservation of the intrinsic motivators and the creation of a climate that enabled the internalisation of extrinsic regulation.
 - Conscious application of the SARFIT model to achieve alignment of the operating model with the complex, unpredictable environment in which JLR operates (Donaldson, 1987).
 - The formal implementation of rolling wave planning within JLR as a participative, collaborative act to disrupt the planning fallacy (Buehler et al., 1994); (Kahneman and Tversky, 1977) and increase the predictability of delivery by reframing issues as they progress from the complex to the complicated time domain (Snowden, 2010); (McChrystal et al., 2015). This approach respected JLRs inherent strengths whilst accommodating complexity and uncertainty within its ecosystem.
 - The adaptation and exploitation of the lean values and principles in the complex, unpredictable creative environment at JLR (Thomke and Reinertsen, 2012).
 - The application of SAFe® (Leffingwell, 2017) to inform the enactment of the lean agile values and principles at scale. This was an unusual application as it was in a non-software domain that contains 'long lead'

hardware components and had a significant physical test content. It was also the first scaled agile implementation within JLR.

- Whilst appreciating the necessity for two distinct modes of operation in a creative environment, the concept of a 'bimodal' (Whitemore, 2016) or 'dual operating system' (Kotter, 2014) was reframed. This enabled the divergent nature of the issues to be recognised using the Cynefin model (Snowden and Boone, 2007), so that an appropriate response could be provided by the same team. This was significant in terms of the both the capacity for learning from the diverse issues and participant motivation by ensuring a balance between routine and fulfilling tasks (Csikszentmihalyi, 1997); (Ryan and Deci, 2017).
- This research spanned both the rigour and recoverability required for academic credibility (Checkland, 1999a) and the practical utility within a large automotive organisation (Barroca et al., 2015); (Kuusinen et al., 2016a); (Gregory et al., 2014) and in doing so reported both the benefits and challenges in order to provide a balanced account of the interventions (Gregory et al., 2016).

3.0 Methodology

The complex unknowable nature of the subject matter (Davis, 2017c) and the need to protect the potential for innovation was more aligned with an emergent adaptive approach that was founded on a transformative teleology rather than the ontology of realism that was prevalent at JLR. The existent norms tended to manifest themselves as a formative, scientific, reductionist approach (Stacey et al., 2000). In spite of the relativist paradigm, the research incorporated reductionism as a means of explanation in terms of smaller, more straightforward concepts that were previously understood (Markóczy and Goldberg, 1998). This did, however, respect Drucker's (1959) configuration perspective that system outcomes were *"not the result of its parts, not equal to the sum of its parts, and not identifiable, knowable, measurable, predictable effective or meaningful through identifying, knowing, measuring, predicting, moving or understanding the parts."*

The adopted approach was founded on the notion of addressing 'wicked problems', which Churchman (1967) referred to as being *"that class of social*

system problems which are ill-formulated, where the information is confusing, where there are many clients and decision makers with conflicting values, and where the ramifications in the whole system are thoroughly confusing.” The approach taken was consistent with Checkland’s (1999a) ‘soft systems’ approach of exploring the alternative ‘worldviews’ in order to formulate a culturally acceptable perspective that enabled purposeful action and hence progression to a new state of learning.

3.1 Research Approach

The research methodology was defined in advance (Davis, 2015a) in order to preserve academic rigour whilst addressing the challenges that were significant within an industrial context (Gregory et al., 2016). The accommodation of such paradoxes became a central tenet of the research in recognition that the multiple apparent contradictions could not be resolved and therefore must be accommodated. The ethnographic approach enabled the emergence of both the research contentions and the context specific proposal by capturing the current best practice, whilst moderating the detrimental biases and heuristics that were embedded in the existing organisational norms (Kahneman, 2011).

The Research Oriented Action Research (RO-AR) (Eden and Huxham, 1996) was adopted as the basis of the research as it incorporated the collective best practice of the many methodologies that have emerged from Lewin’s (1946) initial action research concept. The term ‘action research’ had become a hypernym for approaches such as Participatory Action Research (Whyte et al., 1989), Soft Systems Methodology (Checkland, 1999b) and Action Science (Argyris, 1995), each of which provided useful insights. The RO-AR approach accommodated the paradox of ‘real world’ relevance and the academic standards of rigour (Argyris and Schön, 1989); (Barroca et al., 2015). This research therefore observed Eden and Huxham’s (1996) recommendations to ensure that the research outcomes may be considered *“good science, though not in a way which depends necessarily upon meeting all the tenets of traditional scientific method.”*

A similar action research approach was advocated by the Agile Research Network (ARN) for such research projects (Gregory et al., 2014), although this particular research project was undertaken from the industrial perspective because the researcher was already embedded within JLR. This was in contrast

to the ARN, which operated from an academic standpoint that necessitated prearranged contact with their industrial partners. Concerns associated with the predetermined access were confirmed by Barroca et al. (2015) who recounted timing issues due to stakeholder availability. The fact that the researcher was embedded within JLR enabled the direction of the inquiry to change rapidly as new information emerged and the trajectory of the research was adjusted rather than being constrained to a preordained design or schedule. However, the incorporation of the fundamental premise of adaptive agility into the investigation presented a challenge to the validity of the research. This was due to the modification of the context resulting from the enactment of the interventions in a transformative rather than a rationalist, formative teleology (Stacey, 2011). The emphasis was therefore on the recoverability of the research (Checkland, 1999a), guided by the assertion of Phillips (1992) that appropriate arguments and evidence are required to maintain the credibility of such research. The following sections describe the three studies that were integrated within the overall research project.

3.2 Ethnographic case study and theory building

The first study encompassed the discovery phase of the research project and reflected a significant paradigm change from realism to a relativist ontology hence the adoption of an emic perspective.

The objective of this study was to gain an appreciation of the significant constructs that required attention in order to enhance the effectiveness of the vehicle attribute development teams, hence provided the basis of the research project. This was addressed by responding to the question:

- What are the significant beliefs that need to be transformed in order to increase the efficacy of the product creation activities at JLR?

3.3 Data Collection

The phenomenological study was undertaken, using diverse informants and multiple data collection instruments in order to increase the richness of the data (Davis, 2016a) for the subsequent inductive reasoning and theory building.

This data collection was one of the mechanisms that was used to protect the academic rigour by satisfying the requirement for triangulation as a “*dialectical*

device that powerfully facilitates the incremental development of development of theoretical constructs" (Eden and Huxham, 1996). The data collection methods included semi structured interviews, integrative workshops (Ramsey, 2014), repertory grids (Kelly, 1955), and the provocation of open dialogue in focus groups (Bohm, 2013).

3.4 Emergence of the Central Themes

The discovery phase of the project incorporated the use of Grounded Theory Methodology (GTM) for the theory building. This was employed to both aid the comprehension of the emergent complexity of the organisational context and to preserve the recoverability of the research.

The adopted GTM approach tended towards the Glaserian perspective of emergence (Glaser, 1978), but was also influenced by process of induction, deduction and verification (Strauss and Corbin, 1990). The data was captured and analysed utilising memo writing in the NVIVO software application in order to produce a defensible data set (Davis, 2018a). It was recognised that the GTM analysis was intended to inform the action research by providing *"a conceptual explanation of a latent pattern of behaviour that holds significance within the social setting under study"* (Holton, 2007) rather than ascribing specific meaning to the information.

3.5 Outcomes from Ethnographic Case Studies

The principal finding of this study was the observation that the perceptible technical and process capability at JLR was constrained by the existing social norms such as an expectation of retribution for unanticipated outcomes (Davis, 2016a). This emphasised the impact of the human interactions and organisational culture on the effectiveness and wellbeing of the teams as illustrated in Figure 1. This was consistent with Syed (2015), who suggested that rather than a lack of motivation or attentiveness many organisational issues arise out of *"a system insensitive to the limitations of human psychology"*.

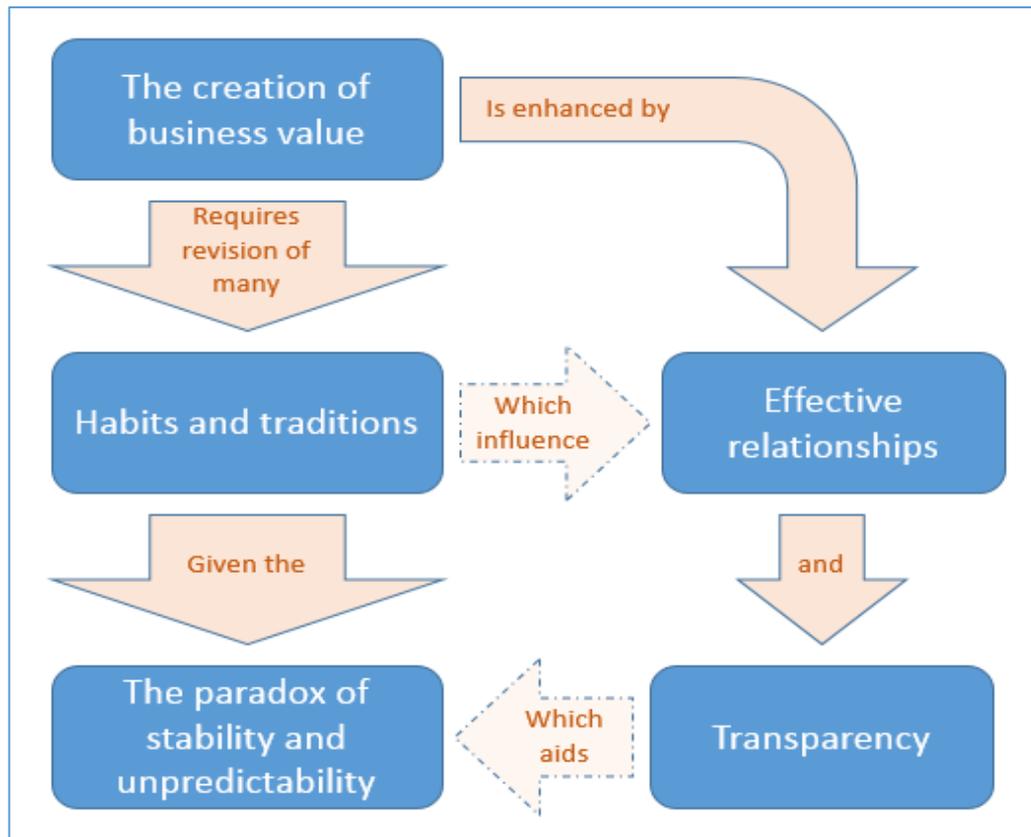


Figure 1. Visual Representation of the Research Proposition
 (Davis, 2016a)

The emergent theme inferred that the employee interaction and the observed social norms were more influential than any technical or process deficiencies. This informed the need to attend to the operating model as an instrument to revise the organisational culture as opposed to the generation of a revised delivery process. This outcome informed the questions that were presented in section 1.0 to guide the research.

The cultural adaptation was substantiated with the use of an established Organisational Culture Assessment Instrument (OCAI) (Cameron and Quinn, 2011)

3.6 Organisational Culture Assessment

The second research study involved the deployment and analysis of the OCAI survey instrument (Cameron and Quinn, 2011 cited in Davis, 2015a). Initially the survey was carried out across the entire Vehicle Engineering community in order to gain insights as to the cultural norms that were both experienced and desired (Davis, 2016a). Consistent with the migration to an emic ontology, however, this data was ultimately used as an instrument to quantify the cultural evolution as

opposed to being deployed as a diagnostic device. This was in concert with the assertion that surveys may constrain responses to the extent that they might obscure the actual matters of concern within the specific context (Schein, 2009 cited in Davis, 2015a). This Competing Values Framework (Cameron and Quinn, 2011), on which the OCAI was based, must be understood as a sense making model. Organisational culture is a complex phenomenon and enhancing it is a “wicked” problem (Churchman, 1967) for which there is neither a correct answer nor a suggestion of relative worth. Each of the quadrants may be unfavourable in the extreme as illustrated in Figure 2

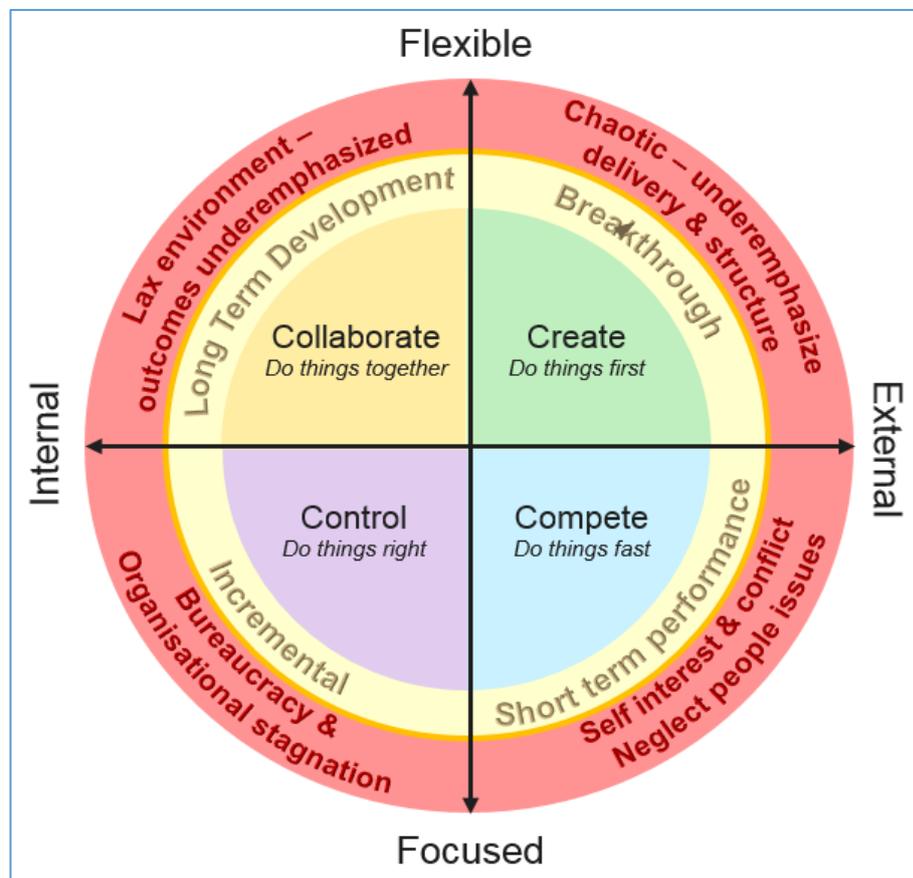


Figure 2. The Competing Values Framework Traits
 (Adapted from Cameron and Quinn, 2011 cited in Davis, 2016a)

The objective of this survey was therefore to gain an appreciation of any perceived changes to the V-NVH organisational culture and compare the results with those of a control group that were not part of the ongoing intervention. This addressed the question as to whether the interventions would result in a quantifiable change to the perceived cultural dimensions as defined in the Competing Values Framework (Cameron and Quinn, 2011 cited in Davis, 2016a).

3.7 OCAI Data collection and analysis

The cultural assessment was founded on the Competing Values Framework and the associated OCAI. This was adopted to evaluate the cultural dimensions as its academic validity was widely reported and accepted within the peer reviewed literature (Cameron and Quinn, 2011).

The survey was deployed in 2015 prior to the action research, in order to provide the baseline data and an appraisal relating to differing work types, across different teams and at varying levels of the hierarchy. The survey was then repeated over the transition between 2017 and 2018 for the both the participating teams and a similar control group in order to gain an appreciation of any changes in the perceptions that resulted from the research interventions. The Vehicle Dynamics (VeD) team were used as the control group as they performed similar work and experienced similar constraints, environmental and organisational issues that may have had an impact on the respondent's perceptions.

The examination incorporated both mean and median analysis in order to demonstrate that the outcomes were not significantly affected by the outermost data. The analysis was conducted in accordance with the guidance offered by Cameron and Quinn (2011). The '2-sample t-test' routine, within the Minitab statistical software suite (Davis, 2015a), was used in order to understand if there had been a statistically significant change in the cultural dimensions. The null hypothesis was that there was no change in the cultural characteristics, hence the means of the populations for the two sets of data would have remained the same.

3.8 Findings from the culture survey

The culture survey data signalled a desirable change to the perceptions of the action research participants. This was in contrast to the VeD community that were studied as a control group. The data for the V-NVH team indicated a statistically noteworthy change at the 5% level of significance for the team's perceptions regarding the 'control' dimension with a $\Delta\mu = 0.8$ and P value = 0.02, 'collaborate' with a $\Delta\mu = 0.6$ and P value = 0.03 and 'create' with a $\Delta\mu = 0.5$ and P value = 0.05 compared to the control group results that implied that the 'control' dimension was the only factor where the null hypothesis could be rejected having a $\Delta\mu = -0.4$ and a P value = 0.02. Further detail is provided in section 9.2. These

findings substantiated the assertion that the changes to the operating model resulted in an improvement in the perceived organisational culture.

3.9 Action Research Interventions

The third study incorporated the Research Oriented Action Research (Eden and Huxham, 1996) that embodied the evolution and implementation of the revised operating paradigm. This study had the objective of enhancing the throughput of valuable outcomes whilst improving the satisfaction and wellbeing of the participants.

As described in section 3.0, the emic epistemology inferred an emergent, participative approach to the research. Checkland and Holwell (1998) maintained that because the object of this type of research was not homogeneous with respect to time, any claims of repeatability and refutation would be unsound. It was therefore inappropriate to use hypothesis testing in such a social inquiry. The following contention was therefore used to guide this exploratory research:

- A revised operating paradigm would allow the Jaguar Land Rover attribute delivery teams to thrive and relish the uncertain, complex product creation context in which they operate and hence improve their satisfaction and wellbeing, whilst delivering increased value for both the business and the consumers (Davis, 2016a).

The specific research questions that were used to explore the association between the social norms and the development of an effective operation model, were (Davis, 2016a):

- How does the embedded culture within JLR influence the effective delivery of the desired vehicle character given the contemporary operating environment?
- What strategies can be implemented to preserve the constructive factors and mitigate the detrimental influences?
- Could the proposed strategies be scaled to influence the entire Product Engineering community and ultimately the entire JLR organisation?

3.10 Action Research Methodology

A participative action research approach was adopted in order to respect Stacey et al's (2000) censure of an external expert designing an operating model in

favour of the emergence of an iterative, socially constructed approach (Hatch, 1997 cited in Burnes, 2004). This resultant paradigm of “*operational autonomy*” (Ahmed, 1998) afforded the freedom for participants to generate solutions whilst accepting that the strategic intent was preordained.

The approach taken to both resolving the specific issues and enacting the transformation was based on Schein’s (2010) “*Psycho-Social Dynamics of Organizational Change*” which was an evolution of Lewin’s (1947) Three-step Procedure:

- Unfreezing
- Learning
- Refreezing

The significance of the participative approach was evident in all three of these phases. Prior attempts to articulate the issues were countered by defensive reasoning which inhibited learning (Argyris, 1991). In contrast, the disconfirmation resulting from the personal reflection supported the principles of Self Determination (Ryan and Deci, 2017) and experiential learning. Baets (1998) argued that this was as an essential attribute of successful organisations. This approach was also consistent with Wittrock’s (1992) model of comprehension, a processes by which connections are formed between new information and previous experiences in order to both comprehend and respond to the perceived situation. The refreezing or cognitive redefinition, required to ensure any change would be sustained, also required individual adjustment of their own mental models which was in contrast to the notion of learning as a basic process of storage and retrieval of information.

Whilst not explicitly stated, in order to present only the relevant information in a readily accessible form (Gregory et al., 2014), all of the concepts that were presented in section 2.0 influenced the research.

3.11 Primary Findings from the Action Research

The emergent operating model that reflected an appreciation the psychological alignment of the participants enabled an improvement in the team members’ satisfaction and apparent welfare whilst improving the throughput of valuable outcomes for the business. Consideration of the social dynamics specifically enriched the self-determination (Ryan & Deci, 2000) and enabled a safe

environment for open dialogue (Bohm, 2013). This supported innovation and application of the Theory of Constraints (Goldratt, 1990) in order to deliver the most important units of value for the business with reduced timescales.

This was significant as it presented a fundamental challenge to the embedded traditional operating model. The findings were aligned with the contingency theorists, who argued that the paradigm directed towards stability and efficiency is no longer appropriate for the volatile operating ecosystem in which most organisations now operate (Donaldson, 2001).

The Research Oriented Action Research (RO-AR) methodology was effective in attending to the tension between real world relevance and recoverable academic rigour (Gregory et al., 2014).

3.12 Dissemination of Theories and Reporting

Both the knowledge sharing and the reporting of the findings presented a dichotomy in itself. The needs of the JLR organisation diverged significantly from those required to demonstrate academic rigour and recoverability (Eden and Huxham, 1996 cited in Davis, 2015a). Barroca et al. (2015) argued that research outputs require thorough exploration if they are to be of worth and that this may not be compatible with the pressures experienced within a commercial organisation. The need for corporate pragmatism in identifying solutions to the prevailing challenges generally undermined the evaluation of the solutions. Barroca et al. (2015) also argued that *“Rigour and timeliness are two sides of the same argument, and are closely inter-twined”*, thus presenting a further paradox that must be accommodated. When sharing information, in line with the guidance from Gregory et al. (2014), particular attention was paid to both the relevance and presentation of the concepts to ensure they were imparted in a way that was readily accessible.

A paradox also existed between the volume of material that was generated in order to demonstrate the rigour of the research and the agile manifesto, which recommended *“Working software over comprehensive documentation”* (Beck, 2001). This was further clarified by Highsmith (2001) who reiterated that *“We embrace documentation, but not hundreds of pages of never-maintained and rarely used tomes”*. This was rationalised on the basis that the primary value of

the academic documentation was as an instrument for erudition rather than a document for use within the industrial context.

3.13 Transformation Approach

The complex, interconnected nature of the organisational network (Davis, 2017e) was also acknowledged by Dawson (1994); Pettigrew and Whipp (1993); and Wilson (1994) who maintained that a planned approach was excessively prescriptive, asserting that the simplified cause and effect assumptions on which they were routinely based signalled inadequate conceptual analysis. In contrast to the typical managed approach for organisational change (Kotter, 1996); (Schein, 1985); (Cameron and Quinn, 2011), a participatory methodology that was configured around the complex responsive processes of human interaction was adopted (Stacey, 2012 cited in Davis, 2017c); (Davis, 2017f). This conformed to the notion of socially constructed organisations, as posited by Hatch (1997) cited in Burnes (2004), that such an approach supports innovation and self-determination (Gagné and Deci, 2005) rather than domination and compliance because it is the participants that do the constructing.

The fundamental approach was founded on Lewin's (1947) three step process of unfreezing, making a change and refreezing, as introduced in section 3.10. The issue of organisational effectiveness, however, was recognised as a 'wicked' problem (Churchman, 1967), as discussed in section 3, hence the interventions generated a new state of learning that then required further action rather than a final solution (Checkland, 1999c). The transformation was therefore an action oriented continuous learning cycle based on action, observation, retrospection and revision as shown in Figure 3. This cycle incorporated the best practice contained within Shewhart's 'Plan Do Study Act' cycle, Deming's 'Plan Do Check Act' cycle (Moen and Norman, 2006) along with Boyd's 'Observe Orient Decide Act' process (Angerman, 2004) and Kim's (1998) 'Observe Assess Design Implement' cycle (Davis, 2017e), all of which generate a relentless cycle of feedback and adaptation.

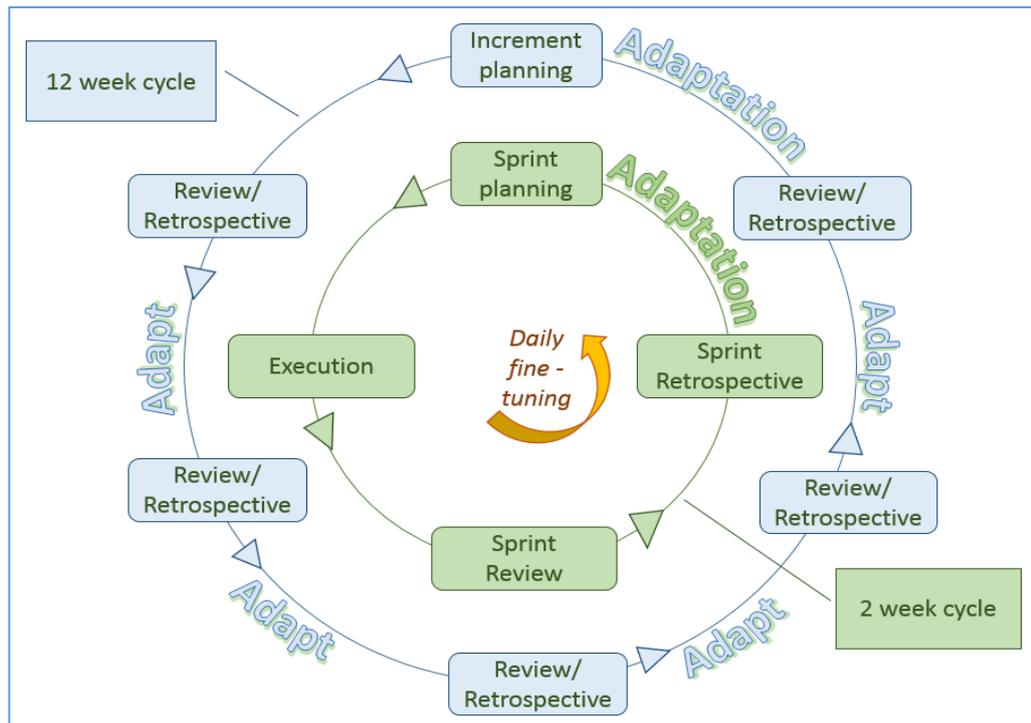


Figure 3. Continuous Inspect and Adapt Cycle

Recognising the established traditional norms and values that existed within the V-NVH team, the Lean Agile implementation emphasised the values and principles over specific practices. This encouraged open dialogue that enabled participants to examine their ‘theories in use’ (Argyris, 1995) and facilitated the alignment with the current context as necessary (Donaldson, 2001).

This approach required a leadership model of curiosity, humility and emergence to create a climate that was conducive to the desired transformative teleology (Stacey et al., 2000 cited in Davis, 2015a). This included the exploration within the disconfirmation phase. Prior efforts to generate a ‘burning platform’ (Arthur, 2011) were met with resistance rather than acceptance. Schein (1999) acknowledged that such messages may routinely be interpreted as the way employees have conducted themselves for decades was inadequate and they would have to learn completely new concepts, behaviours and skills if they wished to preserve their employment. Schein (1999) suggested, however, that the level of ‘survival anxiety’ needs to be sufficient to instigate the cognitive redefinition and double loop learning (Argyris, 2000 cited in Davis, 2017e). This conundrum was compounded at JLR given the existent competitive norms and the apparent contradiction for the need for teamwork and collaboration, given the

emphasis that was placed on the individual performance and the remuneration process (Ewenstein et al., 2016 cited in Davis, 2017b).

This proposed operating model therefore had to provide sufficient governance and alignment to maintain the strategic direction for the business, whilst providing the required innovative freedom and open collaborative tension and dialogue within the teams (Bungay, 2011); (Hill et al., 2014); (Senge, 2006). The primary constituents of the intervention were described in section 8.0.

4.0 Accommodation of Complexity and Uncertainty

The examination of the factors that contributed to the uncertainty and unpredictability within the automotive industry's ecosystem (Davis, 2017c) corroborated Drucker's assertion, made in section 1.0 and confirmed that JLR operates in a volatile, unpredictable environment. The following section considers the alignment of the existing operating practices with the environment in which JLR finds itself.

4.1 Structural Contingency Theory

This research was based on Adaptionist theories, which recognised the competitive advantage afforded by an organisation's capacity for adaptation to external factors, rather than being resigned to the Darwinian Environmental Selection theories (Hannan and Freeman, 1977). Donaldson (2001) argued that *"organizational effectiveness results from fitting characteristics of the organisation, such as structure, to contingencies that reflect the situation of the organisation"*. The relevant contingencies in the JLR context included the stability of the environment (Burns and Stalker, 1961); organisational strategy (Chandler, 1966); organisational size and rate of technological change (Donaldson, 2001). Both Child (1972) and Donaldson (1987) observed that changes to these variables resulted in a disparity between contingency and the organisational structure. Such a mismatch routinely generated a deterioration in the effectiveness of the organisation by means of a variety of dysfunctional behaviours, described by Bungay (2011) cited in Davis (2017c), including delayed decision-making, inadequate communication, and demotivation that ultimately resulted in reduced economic performance. Such a deterioration generated an impetus for change in the form of both structural adaptation and

alternative ways of working in order to restore effectiveness. Without timely detection and intervention extinction was routinely observed.

The Structural Alignment to Regain Fit (SARFIT) model was used to uncover patterns in the organisational dynamics of the JLR organisation by revealing the disparity between the desired performance and the contingencies of the technological revolution, strategic intent, task uncertainty, organisational size and the instability within the automotive ecosystem (Davis, 2016a). The SARFIT model, illustrated in Figure 4, was an evolution of Structural Contingency Theory (SCT) that incorporated the dynamic nature of the variation in contingencies and the observation that the research demonstrated an overwhelming propensity for realignment of the structure to the contingency, rather than the contingency to the structure (Donaldson, 1987).

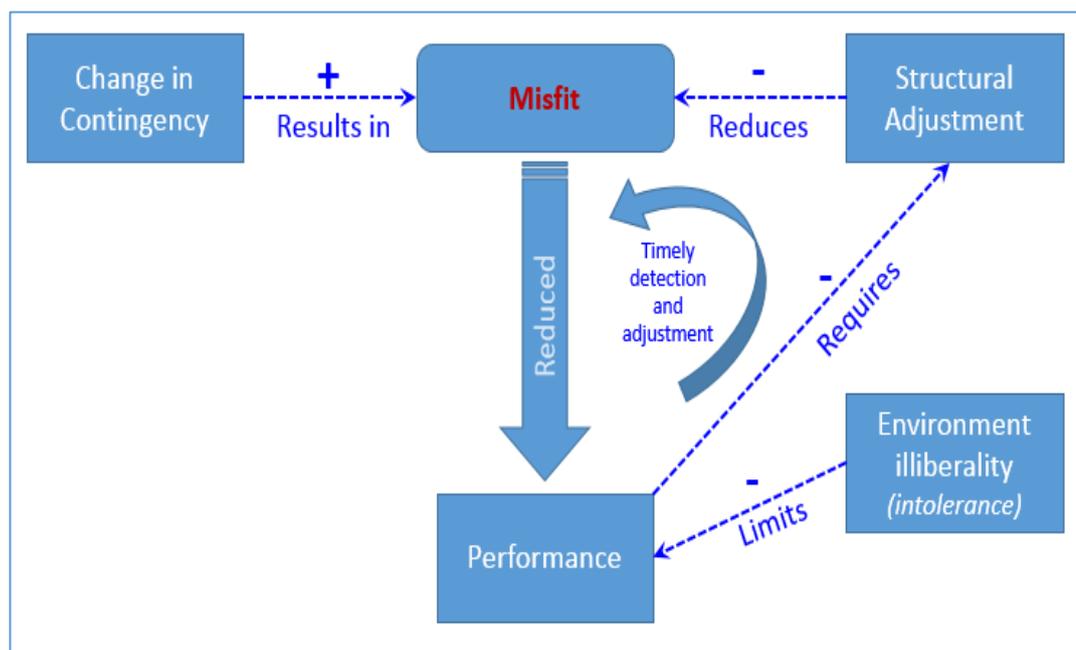


Figure 4. Structural Alignment to Regain Fit SARFIT Model
 Derived from (Donaldson, 1987)

Donaldson (2001) asserted that the levels of complexity and unpredictability, such as those experienced at JLR (Davis, 2017c), were in conflict with the operating model that was designed to yield efficiency within a more stable environment. He advocated a participative organic configuration for an organisation in order to realise enhanced performance in the presence of the high levels of uncertainty being experienced in the automotive industry (Davis, 2017c). This was counter to the mechanistic, efficiency oriented, centrally controlled structure that was perceived at JLR (Davis, 2016a).

4.2 Resilience and Panarchy

The resilience paradigm was emphasised in order to counter many current organisational norms as it is based on a humble recognition of the limitations of an individual's knowledge and the reconciliation of the unexpected. McChrystal et al. (2015) proposed resilience thinking as being the counterpoint for predictive hubris. They also provided a graphic example of the need for organisational resilience by citing the technological and social advances that enabled the effective transfer of information and the plasticity of Al Qaeda in Iraq's (AQI) networked operation. This generated the disconfirmation required by the American Special Forces to transform their operating model.

Walker et al. (2004) further elaborated on the notion of resilience in the 'social ecological systems' context (SEs) as *"the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks"*.

The accommodation of the limitations of existing knowledge and environmental uncertainty facilitated the instigation of double loop learning in individuals rather than resorting to the observed defensive behaviour (Argyris, 2000 cited in Davis, 2017e). The intent was the enablement of the teams in developing systems that can accommodate or exploit emergent patterns and hence gain competitive advantage. This notion was aligned with the aspirations of this research.

Walker et al. (2004) suggest resilience has four elements:

- Latitude - The degree to which the system can be distorted before retrieval becomes especially challenging or impossible.
- Resistance - The level of hostility towards the change, as discussed in section 10.4.
- Precariousness – The proximity of the system to a disruptive position. The communication from the Senior Manager that had been previously shared with the team implied the team were in a precarious position (Hankinson, 2016) although this perspective was not universally accepted.
- Panarchy – the capacity for the sub systems to be affected by factors at the equivalent level, above or below themselves.

Given that the senior management's association with the research was at a level of interest, rather than engagement, the notion of 'panarchy' was of particular

interest. This was significant regarding both the change process that was adopted, as described in section 3.13 and the interventions that explored the paradox of emancipation and hierarchical control. Garmestani et al (2008) defined panarchy as *“a framework that characterizes complex systems of people and nature as dynamically organized and structured within and across scales of space and time.”* Using this definition, panarchy in this context was used as an abstraction for a systems approach that respected the hierarchical structure in order to understand the dynamics of the social ecosystem at JLR. The significant departure from the traditional perspective of a hierarchy was that control was not merely imposed in a ‘top-down’ paradigm, but may also be originated from bottom-up activities or small-scale initiatives, such as this research. The enablement of the bottom up influence was emphasised within the action research along with the notion of dynamic adaptive cycles, in the form of regular retrospect and adapt cycles that prevented stagnation and hence generated a climate for innovative renewal.

The potential influence of small changes at any level in the hierarchy confirmed the combination of the panarchy concept and Prigogine and Allen’s (1982) Dissipative Structure Theory (DST) as an appropriate conceptual model for organisational changes described in the next section.

5.0 Dissipative Structure Theory and Organisational Change

The Dissipative Structure Theory (DST) was selected from the complexity sciences as a suitable abstraction for the organisational change as it incorporated the self-selection and the unknowable nature of complex systems (Davis, 2017c). The distinguishing characteristics of DST were the concepts of bifurcation and spontaneous choice (Prigogine and Allen, 1982). A primary construct within DST was the presence of noise or small fluctuations within the system environment or in the objects within the system. Where the system was close to equilibrium, these small variations were damped, therefore inconsequential. As the system was considered to be away from equilibrium, signalled by the disconfirmation (Schein, 2010 cited in Davis, 2017f), the small fluctuations had the potential to amplify and instigate a change in direction.

When the system is at the edge of stability it approaches a bifurcation point. At this moment the system chooses from a variety of potential behaviours because

the system itself has the capacity to migrate from one attractor to another (Prigogine and Stengers, 1985). This self-selection and the impact of small fluctuations in the generation of emergent behaviour made this a persuasive metaphor for the organisational change in the complex, uncertain environment (Davis, 2017c).

This interpretation supported the cultural beliefs that were revealed in discovery phase of the research (Davis, 2016a). The potential for emergent outcomes was provided by the variations in the perspectives of the participants and their interactions within the complex process of human relating (Stacey, 2012). Stacey et al. (2000) also argued that where the requirement was for a novel outcome, the rubrics and circumstances that could generate the desired result are by definition previously unknowable. This supported the notion of emergence rather than the linear delivery model, which was evident at JLR, which progressed to a predetermined outcome. Stacey et al. (2000) defined this development to a preordained form as a 'formative teleology'. Acknowledging innovation was contingent on small variations, they proposed the 'transformative teleology' as an effective alternative, recognising that it was not possible to detect, specify or measure the constituents of innovation with sufficient precision in advance.

The potentially transformative effect of small fluctuations also reinforced the need for openness and transparency, as discussed in section 8.11. Attending to the 'small signals', that were otherwise obscured in a blame culture, was observed to have significant implications (Syed, 2015); (Davis, 2016a).

In the DST concept, whilst the system's transformation was not caused by the fluctuations, Prigogine and Stengers (1985) suggested "*the fact that the fluctuation evades control does not mean that we cannot locate the reasons for the instability and its amplification causes.*" The following section explored the potential sources of the fluctuations in the complex, dynamic social context that constitutes an organisation.

5.1 Social Patterns as a Source of Fluctuation

In considering the DST abstraction, it was important to identify the potential sources of variation that may be a catalyst for change. The research incorporated the interpretation of the organisation as an emergent phenomenon that was socially constructed as a result of exchanges with other contributors rather than

being designed. Stacey (2011) argued *“every explanation people put forward of any phenomenon is a socially constructed account, not a straightforward description of reality.”* Nahapiet and Ghoshal (2000) emphasised the relevance of social capital as being essential for the comprehension of the organisational dynamics, innovation and the generation of value. Lin et al. (2001) clarified that this incorporated both the social network and the resources that are embedded within that network. The notion of social construction was further refined by Gergen (1999) who suggested that *“what we take to be the truth about the world importantly depends on the social relationships of which we are part.”* These social relationships themselves are a complex process that are also subject to variation, described by Goldberg (2009) who emphasised the significance of the executive processes, which are associated with the activation of the medial and lateral inferior prefrontal cortex. Goldberg infers that this activity underpins successful social networks by suggesting that *“The capacity for insight into other people’s mental states is fundamental to social interactions”*. These social interactions may be paradoxically perceived as collaborative, adversarial or both. It was also necessary to accept the recognition that our experiences may also be subject to inconsistencies because they are a personal electrochemical rendering of the patterns sensory information as opposed to a definitive record (Eagleman, 2016 cited in Davis, 2017e). When these factors were combined with what Stacey (2011) developed from the ‘responsive process thinking’ paradigm, the sources of fluctuation increased significantly. Goldberg (2009) explained that social interaction involves not only the individual’s intentions, but also an interpretation of the other party’s plan, recognising the other party will have also developed a rendering of the initiator’s mental processes. The generation of such a ‘theory of mind’ can also paradoxically generate tension, creativity, alignment or misunderstanding. The outcomes depend on the accuracy of these representations and the resultant responses.

The increase in the size and complexity of the JLR organisation has inevitably increased the size and complexity of the social network. This necessitates the instigation of interactions that have the potential for a greater diversity of responses within this multidimensional process of unhindered gesturing and responding. The ‘many-to-many’ relationships further increased this complexity

and therefore increased the potential for the fluctuations that may be either damped or amplified when the system is away from equilibrium. This was the basis for the action research because the disconfirming evidence (Davis, 2016a); (Schein, 2010) indicated that the organisation was at a bifurcation point. It was therefore anticipated that the participant's capacity for self-selection had the potential to amplify the aforementioned fluctuations and initiate a change along a constructive trajectory.

6.0 Human Interaction and Relating

The importance placed on the *"individuals and interactions over processes and tools"* within the agile manifesto (Beck, 2000) was supported by the recognition that the nuances of human interaction was so much more than the content of the words. The exchange of gesture and response also relies on intonation and body language which increased the richness of the dialogue. Stacey (2012) suggested that meaning arises in the interaction between the communicating parties and not within the individuals or the actual dissemination of information. This had significant implications within JLR because variations in interpretation were routinely observed, regardless of the clarity of the message. In order to understand the importance of the nuances of social interactions on the effectiveness of the organisation, Stacey's (2012) 'complex process of relating' was considered to be influential within this research project. This developed Elias (1978) observation that *"It is the order of interweaving human impulses and strivings, the social order, which determines the course of historical change"*. The paradoxical nature of human relating was also identified by Elias who suggested that the *"plans and actions, the emotional and rational impulses of individual people, constantly interweave in a friendly or hostile way"*.

The participative action research approach, described in section 3.1 (Davis, 2015a), recognised that the participants were engaged in a relationship with other contributors both within a group and power structure. Stacey (2012) accepted that the participants may decide upon their own actions. However, they cannot determine the actions of others and that it was this wider interplay of such actions that dictated the overall outcomes. This further substantiated the utility of both the DST abstraction and the neurological metaphor. Particular attention was

therefore paid to the subtleties of the interactions between the participants that shaped the emergent order.

7.0 Psychological Alignment

The participative, emergent approach was also aligned with the Self Determination Theory (SDT), proposed by Gagné and Deci (2005) who advocated attending to the fundamental psychological needs of the employees, including creating a climate that was conducive to the internalisation of extrinsic controls and the preservation of intrinsic motivation. They argued that doing so would increase the potential for:

- A sustained change in behaviour.
- Enhanced performance, in the form of cognitive flexibility, conceptual reasoning and creativity.
- Enhanced employee satisfaction.
- A constructive attitude towards the organisation.
- Personal psychological fitness and regulation.

SDT acknowledged the motivational benefits of free will and “*endorsing ones actions at the highest level of reflection*” (Dworkin, 1988). Gagné and Deci (2005) additionally accommodated the notion of ‘internalised’ extrinsic motivators that can have a substantial positive influence. This occurred when individuals embraced the values, perspectives or regulatory structures to the extent that they became self-regulating regardless of the perception of an external authority. Schein (1999) however questioned the ethics of how this may be achieved as discussed within section 8.13.

7.1 Human Psychology and Organisational Networks

The research emphasised the significance of the innate patterns of human behaviour when considering both the proposal for the operating model and the means of its implementation in order to address the contention that many operating systems are “*insensitive to the limitations of human psychology*” (Syed, 2015) as proposed in section 3.5.

7.2 Neurological Metaphor

The similarities, as identified by Goldberg (2009) between the entwined complex networks, interactions and patterns that exist within both the brain and organisations was used to provide an informative metaphor for the social interactions that influence the effectiveness of the establishment.

Goldberg (2009) observed that *“Both the evolution of the brain itself and the evolution of our theories about the brain were characterised by a paradigm shift from modular to interactive”*. A contention of this research was that this also reflected the patterns that were emerging in the organisational operating models and structure. Despite the open declarations regarding ‘pulling down the silos’, JLR was perceived as being largely functional (Davis, 2016a). The brain metaphor also integrated speed and pragmatism afforded by intuitive judgements and the constrained cognitive effort required for ‘knowledge work’ (Drucker, 1999). This was in alignment with both Kahneman’s (2011) two systems thinking model and the analogous bi-modal organisation that was advocated by Gartner (2014) and Kotter (2014)

7.3 Two Systems Operation

The parallel between the intended operating model, that needed to support the processing of vast amounts of data whilst reserving sufficient capacity for innovation and the enormous capacity of the human brain for managing data, further extended the metaphor.

An immense amount of sensory data is processed by the human brain using a ‘two systems’ approach (Stanovich and West, 2000) that enables the slower, ‘deliberate’ system to engage in the demanding reasoning that is required for cognitive novelty, or tasks that do not have a readily available solution. In contrast, the faster ‘automatic’ system handles enormous volumes of information using simplification and intuition, based on prior experience. This paradox of optimising the utilisation of constrained, rational, cognitive capacity and prolific intuition, as clarified by Kahneman (2011) provided an appreciation of the limited capacity within the deliberate system and the deficiencies that may be observed in the spontaneous judgement that can undermine effective delivery (Davis, 2016a). It was considered unwise to distrust the human ‘automatic system’ given its capacity for processing an incomprehensible volume of data. The appreciation

of our biases and an awareness of the fallibility of human intuition, however, prompted the support of what Kahneman (2011) referred to as ‘watercooler’ conversations in order to reveal any intuitive errors.

These errors of judgement can also be exacerbated by the influence of prior learning as our insights are dominated by prior representations in the mind rather than the processing of sensory information. Eagleman (2016) explained this phenomena by using a study that demonstrated a tenfold difference in the connections passing from the visual cortex to the thalamus, compared to the anticipated diffusion of sensory data from the thalamus to the visual cortex. This supported the observed tendency to rely on prior beliefs whilst enabling vast amounts of data to be processed. This is possible because the thalamus regulates the processing activity in cases where the prior expectation and the sensory data are aligned. The process may however generate dissimilar representations of encounters, even between individuals that share the same experience, as described in section 5.1

8.0 Participatory Process of Experimentation and Feedback

Following the discovery phase of the research, the V-NVH team were selected for the action research as they reflected a microcosm of the JLR Product Engineering community. Their characteristics could be generalised to established, traditional teams operating in a complex, uncertain ecosystem. The primary characteristics that informed the decision were the nature of the knowledge work that was undertaken and the diverse attitudes and social norms exhibited within the team (Davis, 2017f). This contributed to the RO-AR criteria for rigour in terms of *“commitment of the researcher to advance a field of knowledge in a manner that has some general implications.”*

8.1 The Lean Agile Deployment Within V-NVH

The concepts that underpinned the action research encompassed the relevant current best practice from the lean, agile and systems engineering communities and enveloped them within the social fabric of the organisation by accommodating and exploiting the subtleties of human relating as illustrated in Figure 5 (Davis, 2016e).

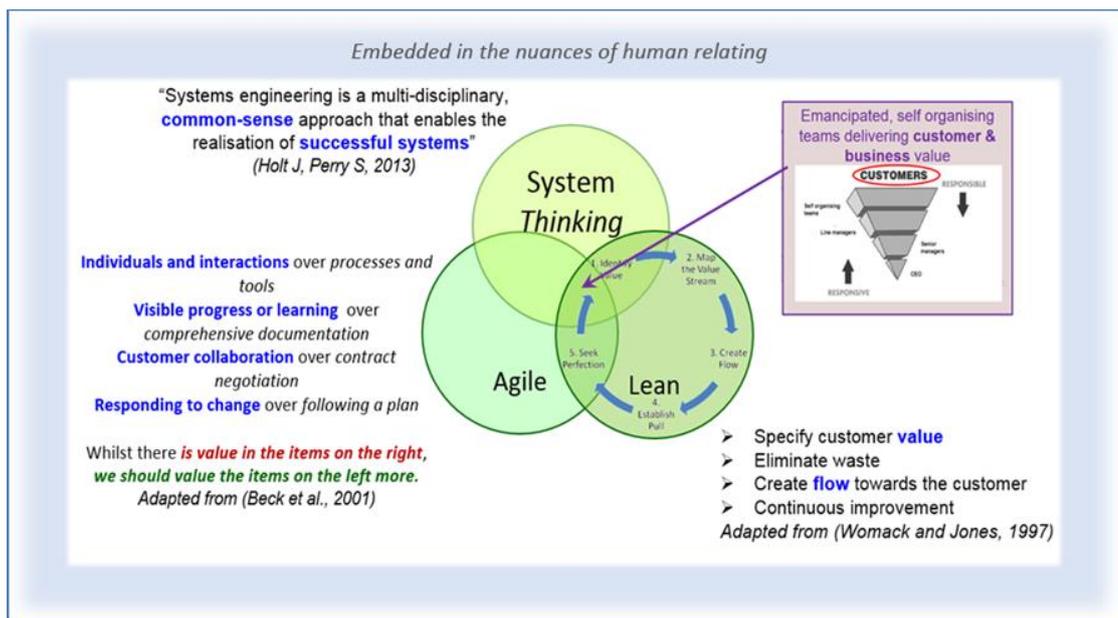


Figure 5. Integration of Paradigms
(Davis, 2016e)

The diverse schema that influenced the Lean/Agile deployment within the action research included the learning that was accumulated from understanding both the similarities and differences observed in warfare (Bungay, 2011); (McChrystal et al., 2015), sports (Kerr, 2013); (Takeuchi and Nonaka, 1986), healthcare and aviation (Syed, 2015), lean manufacturing, for example (Liker and Convis, 2011); (Womack and Jones, 1997); (Thomke and Reinertsen, 2012) and (Ohno, 1988) software, for example (Poppendieck and Poppendieck, 2003); (Beck, 2001); (Highsmith, 2001); and (Kniberg, 2011) Systems Engineering (Koehnemann, 2015); (Dove and LaBarge, 2014) and the construction industry (Ballard, 2000); (Mossman, 2013).

Whilst the literature from these sectors informed the research, it became apparent that many of the participants did not share the interest in the rigorous research behind the interventions and hence only essential constructs were widely shared. The reference material that supported the SAFe® for Lean Systems Engineering (Leffingwell, 2017) was used to articulate the overall scaled agile concept and provided easily accessible articles regarding many specific topics that were of interest to the participants (Gregory et al., 2014).

The dialogue with the Proof Of Concept (POC) research participants was initiated using the essential SAFe® configuration (Leffingwell, 2017) in order to facilitate the emergence of a context specific solution, as shown in Figure 6.

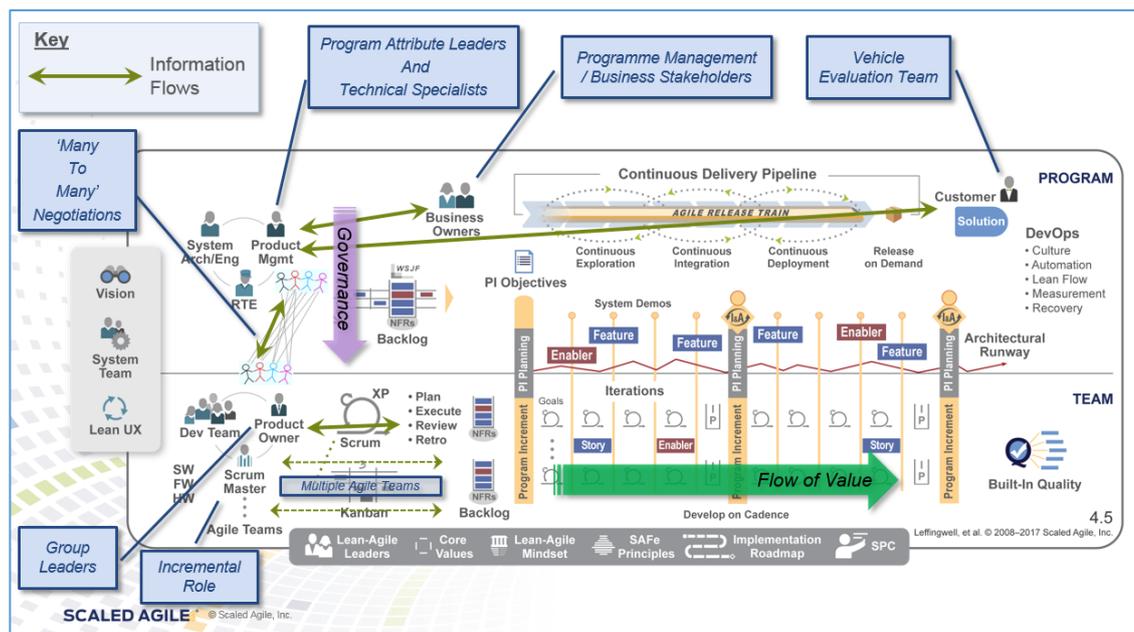


Figure 6. V-NVH POC Interpretation of the Essential SAFe® Framework
Adapted from Leffingwell, 2017

An appreciation of the primary constituents that were deployed within the Jaguar Land Rover V-NVH context, was provided in following sections.

8.2 Rolling Wave Planning

The inability of JLR as a whole and the V-NVH community in particular to deliver against their plans was widely reported as an issue during the discovery phase of the research (Davis, 2016a). This had multiple causal links including predictive hubris (McChrystal et al., 2015), the planning fallacy (Kahneman and Tversky, 1977) and reactive norms, as inferred from the dialogue that were discussed in section 8.15.

Given that JLR's strategic investment plans were configured around the achievement of both the timing and cost targets for all of the projects, the importance of timely delivery gained continuous attention. To put this issue into context, the cost of delay for an average vehicle programme, inferred from Clark et al. (1987) cited in Davis (2017b), was conservatively estimated to be in the region of £2x10⁶ per day.

The approach taken to align the delivery with an appropriate timing horizon was an adaptation of the SAFe® Program Increment (PI) Planning (Leffingwell et al., 2016) and the Last Planner System (Ballard, 2000) that was used in the construction industry as illustrated in Figure 7 (Davis, 2017f).

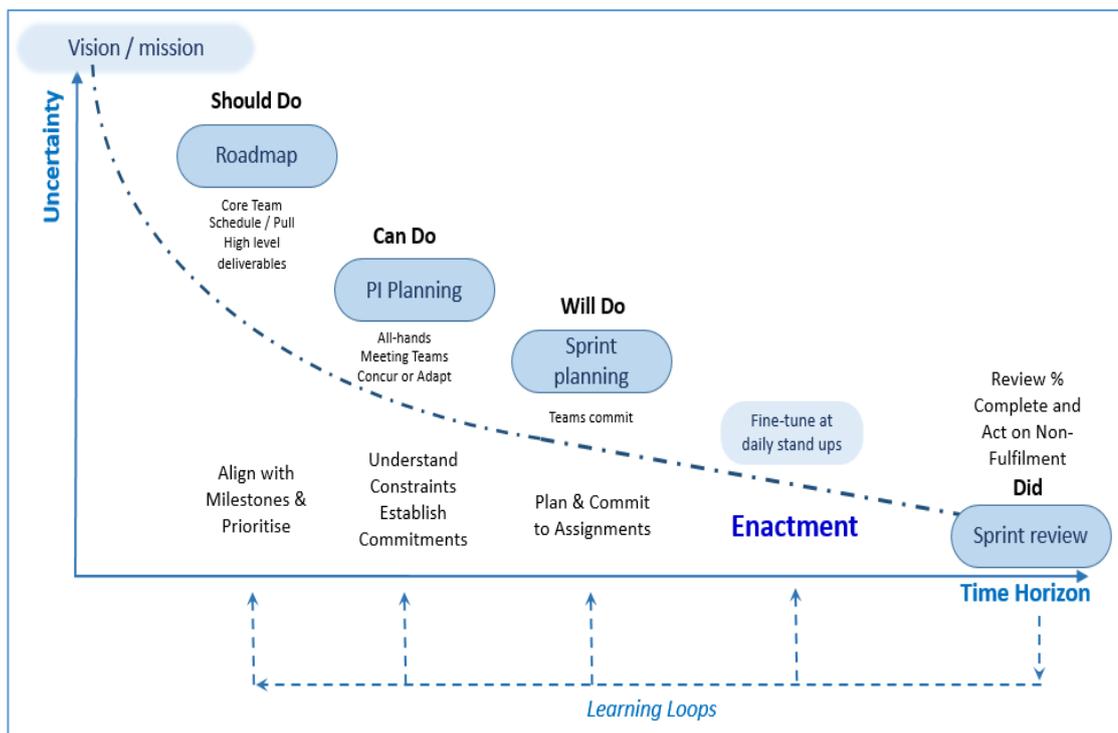


Figure 7. V-NVH Deployment of Rolling Wave Planning
 (Davis, 2017f)

This process ensured strategic alignment with the JLR goals as the Senior Manager shared the vision and strategic priorities at the start of each planning cycle. The accommodation of the complexity and uncertainty was achieved by formalising the guidance offered by Field Marshall Von (Moltke, 1869) cited in (Bungay, 2011) of *“Not commanding more than is strictly necessary, nor planning beyond the circumstances you can foresee”*, as discussed further in section 8.8. The overall intention was to match both the effort expended and granularity, to the degree of certainty that may be reasonably expected. This was aligned with McChrystal et al’s (2015) assertion that there was a relationship between uncertainty and the timespan. It was therefore possible to incorporate the time dimension on the ‘reasonably foreseeable’ to the ‘unpredictable’ continuum. He illustrated this by suggesting that it is possible to predict rainfall, with relative certainty, in a specific area the following day, but not in six months. The planning process therefore accommodated long term uncertainty whilst utilising short-term predictability.

The PI planning process was conducted on a 12 week cycle. The core group proposed a prioritised ‘roadmap’ of high level deliverables that were considered to be achievable within the next increment. The approach for defining this ‘feature

backlog' was described in the next section. These features were then shared with the teams so that they could conduct sufficient planning to assess their confidence in being able to deliver this backlog and adjust as necessary to ensure the workload was matched to their capacity as discussed in section 8.4.

A primary benefit realised in the PI planning day was the opportunity to develop the social network around specific items of work to ensure alignment, challenge each other's assumptions and identify any dependencies or constraints as they arose (Stacey et al., 2000); (Kahneman, 2011). The dialogue that took place also contributed to the 'people centric' approach (Steiber, 2014), hence the generation of a climate of accountability and engagement through self-determination (Ryan and Deci, 2000), as described in section 8.9.

The teams then planned and executed on a two weekly schedule, seeking to achieve predictable delivery as described in section 8.5 by committing and delivering as a team and adjusting as required, based on the daily stand up.

The plans and assumptions are adapted as required when new information emerged.

8.3 Economic Alignment Around Value

Recognising that there was a finite capacity available within the teams, it was essential to align the activities of the participants around the items that were considered to deliver the greatest value for the business. Shalloway (2017) emphasised the importance of identifying the 'Minimum Business Increments' (MBI) that represented a realisable unit of value. The distinction was drawn between MBIs and features or stories. Whilst these may represent smaller units of worth, they may require other items to be delivered before that value could be appreciated. Alignment around the MBIs therefore encouraged the teams to focus on the items that were necessary to realise the greatest value. He also proposed a scheme for coordinating the work across the sub teams to ensure the MBIs could be released within the shortest possible time span (Shalloway, 2012). This was particularly important in the scaled agile context, but proved challenging to embed within the 'Product Manager' and 'Product Owner' community as described in section 10.4.

Attempts to prioritise the work streams was initially problematic due to the divergent perspectives and power stances regarding the work (Davis, 2016a). An

algorithmic approach was therefore required in order to enhance the intuitive judgements (Kahneman, 2011). (Reinertsen, 2009 cited in Davis, 2017b) proposed the Weighted Shortest Job First (WSJF) methodology. This method considered the business impact, time criticality, risk reduction and task duration in order to schedule the work to release the greatest economic benefit within the shortest possible time. The scheduling scenarios shown in Figure 8 illustrated that whilst delivering the equivalent value, the incurred costs can be reduced significantly by ‘cost of delay’ based prioritisation. Reinertsen constructed this methodology on an economic model that enabled the decisions to be taken using a common metric of \$/day.

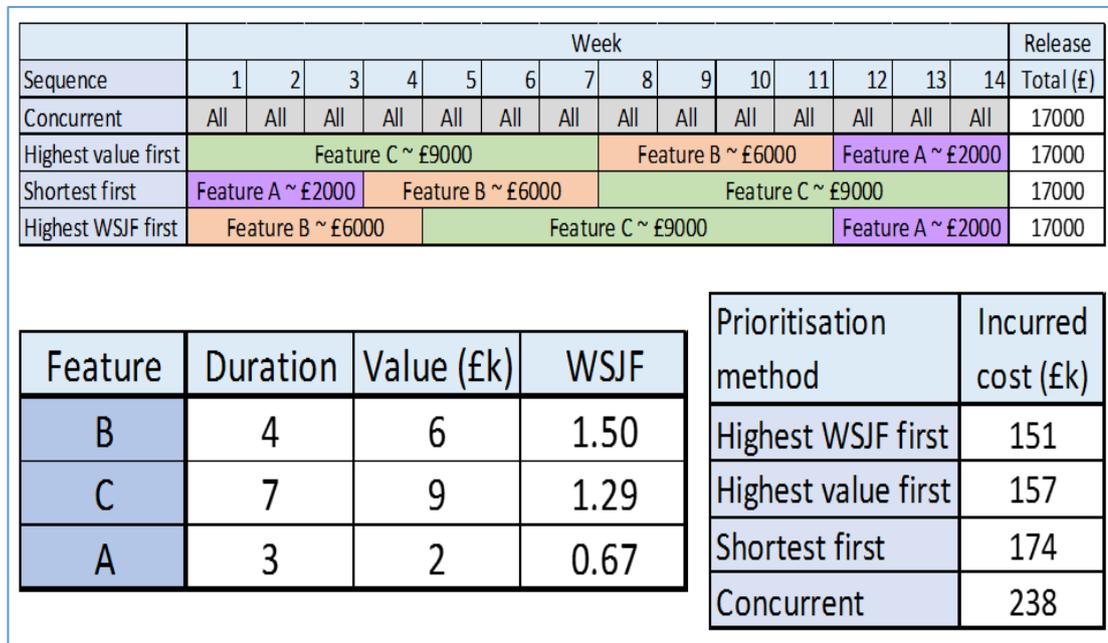


Figure 8. Sensitivity of Incurred Cost to Scheduling (Davis, 2017b)

Whilst Reinertsen (2016) opposed any similar process that did not use an economic model with units of ‘currency’ per day suggesting that they are meaningless, to gain acceptance within the team, a more pragmatic solution was required (Gregory et al., 2014). Based on the assertion of Hubbard (2014) cited in Davis (2017b) that any metric that reduces risk may be considered a valid metric, a relative ranking methodology was considered appropriate (Leffingwell et al., 2016) as shown in Figure 9.

$$WSJF = \frac{\text{Cost of Delay}}{\text{Job size}}$$

$$= \frac{\text{User or Business value} + \text{Risk Reduction or Opportunity enablement} + \text{Time Criticality}}{\text{Duration or Job Size}}$$

Feature	U/BV	RR/OE	TC	CoD	Job Size	WSJF
	↓	↓	↓	Σ	↓	CoD/JS
	↓	↓	↓	Σ	↓	CoD/JS
	↓	↓	↓	Σ	↓	CoD/JS
Smallest	8	Notes: Every column must have a 'Small' Relative estimates ~ work column by column				
Small	13					
Med	20					
Large	40					
XL	100					

Figure 9. Application of WSJF at JLR
 (Davis, 2015c)

Initially the ratings were agreed by the core group, using ‘planning poker’ (Grenning, 2002) to structure the dialogue, in order to identify a reference set of MBIs. These then enabled subsequent relative ratings to be proposed by the teams. The inclusion of the ‘risk reduction and opportunity enabler’ category provided equivalent weight to the strategic or improvement projects to those that directly delivered product. This was important as projects such as ‘methods development’ assignments can be more effective in reducing the cost of delay in the longer term when compared to direct action on the programmes, as discussed in section 8.7. This needed to be balanced against the time criticality of the live programmes.

In addition to a ranked list of MBIs, the advantage of this process was the structured dialogue (Bohm, 2013) that was generated within the ‘planning poker’ rounds. Not only did this enable tacit assumptions to be revealed and challenged it also eliminated the political power or the ‘HIPPO’ trait (Lakhani, 2016). Without such techniques it was not uncommon for the decision to be made on the basis of the “*Highest Paid Persons Opinion*” (Lakhani, 2016) which may also be subject to the errors of rationality or the fallibility of heuristics and biases (Kahneman, 2011); (Sutherland, 1992).

8.4 Conscious Queue Management

A characteristic that was evident within JLR was the aspiration to achieve full utilisation of the employees. Based on a longitudinal survey, Reinertsen (2009) cited in Davis (2017b) reported that development processes are habitually loaded

to 98.5%. At the extreme, some managers at JLR disclosed that they planned their team's capacity to 110%, assuming the availability of overtime. Not only does this result in the reports of the teams feeling overwhelmed (Davis, 2016a), but also results in a significant deterioration in their overall effectiveness.

Smith (2007) made use of queuing theory to challenge the notion of high utilisation. The straightforward M/M/1/∞ example was used to illustrate the issue, as shown in Figure 10. This case assumed a Markovian exponential distribution of work arrivals, with one participant executing the tasks and no limit to the queue length. It was accepted that this underestimated the reality because the development processes at JLR tend to result in 'bulk arrivals' of work items.

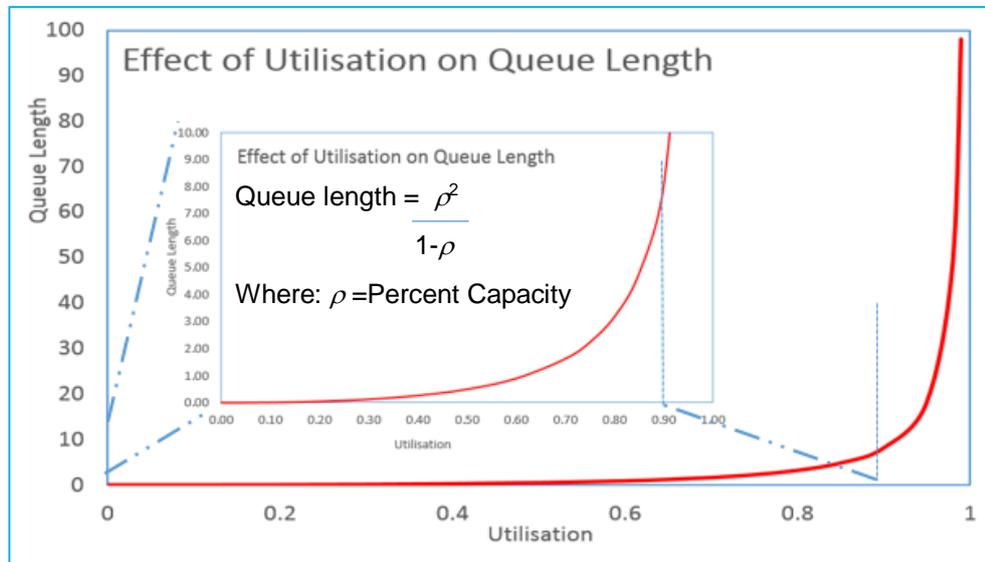


Figure 10. Effect of Capacity Utilisation, Including a 90% Inlay (Davis, 2017b)

The corollary of this characteristic was that when the utilisation was increased from 60 to 80%, the queue is seen to approximately double, with a further doubling between 90 and 95%. It should be noted that the growth is exponential as 100% utilisation is approached (Davis, 2017b). The queue length has a direct impact on the effectiveness because a task that would usually take 1 hour to complete would require 2 hours if the employee had 50% availability, 4 hours when 75% utilised and 20 hours if 95% occupied, as shown in Figure 11. The exponential nature of the trend towards 100% utilisation explains why many tasks never seemed to get done.

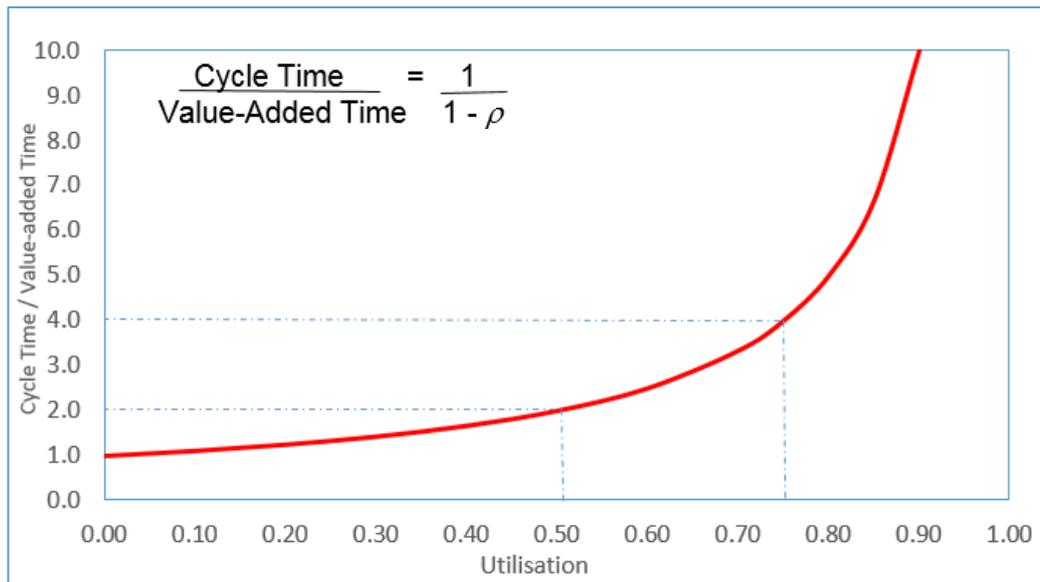


Figure 11. Relationship Between Utilisation and Cycle Time
(Davis, 2017b)

This was compounded when multiple individuals were involved in a process and it was demonstrated to have a significant impact on the process efficiency by considering a work item that required 4 employees, each of whom had to complete a 1 hour task as shown in Table 1.

Table 1. Relationship between Utilisation and Process Cycle efficiency
(Davis, 2017b)

Utilisation	Wait Time (per contributor)	Total Wait Time	Total Cycle Time	Process Cycle Efficiency
50%	2	8	12	0.33
75%	4	16	20	0.20
95%	20	80	84	0.05

Where:
$$\text{Process Cycle Efficiency} = \frac{\text{Average Time worked}}{\text{Total Cycle Time}}$$

If Reinertsen’s (2009) assertion that employees are typically loaded to 95% was accepted, the above 4 hour task would take over 2 weeks to complete.

It was considered neither culturally acceptable (Checkland, 1999a) nor feasible to manage the employee utilisation at JLR with sufficient accuracy to optimise the queue length, hence the tactic of managing the work intake in order to improve the employee utilisation was adopted, as described in section 8.2.

When the 12500 JLR Product Engineering employees (Martin, 2018) were considered, at an average cost of £75000 per year (Duffy, 2018), a cost reduction of £140x10⁶ could be achieved by managing the queue length to reduce the effective utilisation of the employees from 95 to 75%.

When the work product of the 'knowledge work' was appreciated as being the information that is generated, Reinertsen (2009) referred to this waiting work as the 'invisible inventory'. This was in recognition that there was a significant investment in producing it, although it does not appear on any balance sheets, and routinely therefore remains obscured. The additional costs associated with the waiting work may also be considered as a form of lean waste (Womack and Jones, 1997) because the information may be 'perishable' due to a misalignment if alternative information changes the direction of the inquiry, as described in section 5.0, or errors remain undetected for longer periods of time increasing the rework required (Davis, 2016e).

In addition to the economic benefits, the counterproductive stress induced by the feelings of being overwhelmed or the positive feeling of achievement should not be underestimated in terms of employee engagement and wellbeing (Webb, 2016).

8.5 Predictable Delivery

The business need for predictable delivery was associated with the paradox of planning in a volatile, complex environment (Davis, 2017c), as discussed in section 8.2. Whilst it was accepted that the delivery in a creative environment could not be considered as deterministic, the assumptions that underpinned Littles Law were used to increase the predictability of the outcomes.

Littles Law asserts that $L=\lambda W$

(Little, 2011)

Where;

- L = The average number of items in the queuing system.
- λ = The average arrival rate of work items into the system.
- W = The average waiting time of the items in the system.

or as rearranged by Hopp and Spearman (2011)

$$\text{Throughput (TP)} = \frac{\text{Work In Progress (WIP)}}{\text{Cycle Time (CT)}}$$

Where:

- Throughput is the average output of the process per unit time
- Work In Progress (WIP) is the inventory between the start and end points of the workflow
- The cycle time is the time the job spends in progress.

In addition to constraining the WIP, the following assumptions were also emphasised (Davis, 2017f);

- The average arrival rate is equal to the average exit rate.
- All work items that enter the system progresses to completion.
- There is neither an increase nor decrease in the average age of the WIP.
- The total amount of WIP at the beginning of the time period is approximately equal to that at the end.

Once the workflow within the V-NVH POC was made visible, it was clear that these assumptions were not realised. A conscious effort was therefore made to align with them in order to improve the predictability of the delivery.

8.6 The Perils of Temporary High Utilisation

The case study feedback confirmed that it was not uncommon for focused effort and “*heroics*” to be applied to a particular project when it was perceived to be significantly away from its targets (Davis, 2016a). This was reported to be as a result of the optimism bias (Kahneman, 2011) or complacency that may occur when a project was considered to be ‘simple’. Snowden and Boone (2007) intentionally placed the ‘simple’ and ‘chaotic’ domains adjacent to each other within the Cynefin Framework in order to reflect the sudden collapse into chaos that may occur when prior achievement results in complacency, as illustrated in section 8.16. Once positioned within the chaotic domain, the teams enter a ‘firefighting’ mode that generally results in increased utilisation and the neglect of other, potentially equally valuable work streams.

Repenning et al. (2001) acknowledged that, due to the fundamentally unknowable nature of product development, such firefighting was likely to occur. They generated systems dynamics models to illustrate the detrimental systemic

effect of excessive firefighting and identified a tipping point, in the form of a threshold beyond which the “*disease becomes an epidemic*” (Repenning et al., 2001). This exploration asserted that even a temporary increase in workload can cause an enduring deterioration in the systems performance. They illustrated their findings using a phase plot, as illustrated in Figure 12, which considered the likely completion of the ‘up front’ conceptual work required for successful project delivery.

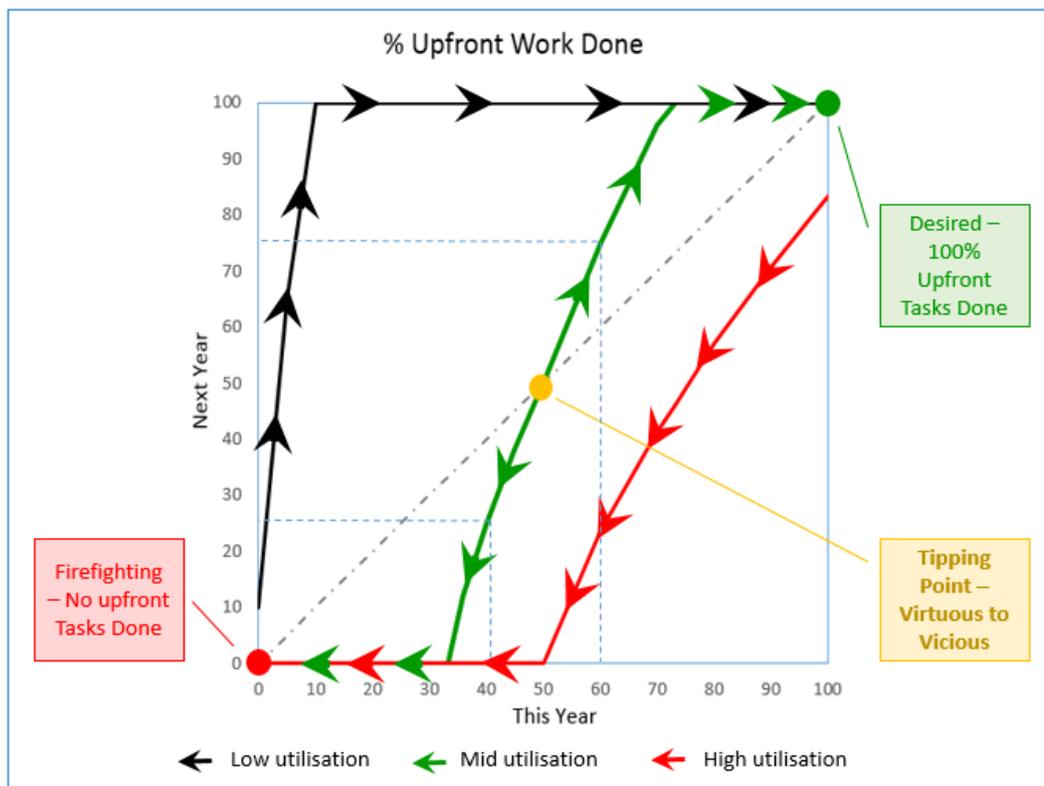


Figure 12. The Fire Fighting Tipping Point
 Adapted from (Repenning et al., 2001)

The ‘x’ axis represented the proportion of the work that was done in the current year and the ‘y’ axis the quantity of ‘up front’ activity that will be completed the following year. The solid green line therefore showed how the work would evolve year on year by relating what happened in the current period to what was likely to happen in the following year. By way of illustration, if 60% of the work was completed in the current year, the model suggests 75% will be achieved the following year and the system is operating in a virtuous cycle. Below the tipping point, where the trend crossed the 45° line, for example if only 40% of the planned work could be accomplished because of the increased downstream defect rate, it was likely that only 25% of the necessary activity would be achieved in the

following year and the system was considered to be in a vicious cycle of a decreasing focus on the up-front work that resulted in an increased number of defects in the design work.

The models exhibited a high degree of sensitivity as to the extent of the temporary increase that could be tolerated before the system ‘tipped’ into a state of reduced latitude, as discussed in section 4.2. This demonstrated that a small temporary overload can trigger a self-reinforcing cycle of firefighting that whilst resolving the short term problem, endangered development undertaking in the longer term. The portfolio planning process, described in section 8.2 was consistent with Repenning et al’s (2001) assertion that there was *“no substitute for a portfolio-level plan that matches the number of ongoing projects to available development resources.”* Their findings were also compatible with both the DST abstraction Prigogine and Allen (1982), described in section 5.0 and the aforementioned queuing theory. A fully utilized product development system was found to be constantly on the threshold of degenerating into a firefighting cycle as shown by the red trend in Figure 12. The late delivery of the V-NVH work and the reported feelings of being overwhelmed (Davis, 2016a) may be explained using the DST concept. As the workload increased, smaller fluctuations were observed to potentially initiate the destructive cycle of an increasing number of emerging issues and a lack of resources to prevent them. This presented a dilemma in terms of executing the planned work along with the ability to accommodate unanticipated instability in the resource requirements without resorting to firefighting. In the extreme, Repenning et al. (2001) cautioned that organisations that fall back on firefighting for some projects find that this mode of operation completely replaces the intended development process. They argued that the *“organizational pathology that, left unchecked, can significantly degrade an organization’s ability to create high-quality products”*. This reactive way of working was apparent within some subcultures at JLR (Davis, 2016a), as discussed in section 8.15. To disrupt this trend within the V-NVH POC, the teams initially worked with the ‘product owners’ and ‘scrum masters’ to plan only 50% of their capacity within the scaled agile process so that they could absorb a degree of fluctuation. The unplanned urgent requests were then closely monitored with a view to reducing it. The resultant data was an effective catalyst for constructive

discussions which highlighted the disruptive impact of the reactive work. This in turn initiated a virtuous cycle whereby the teams were able to enhance the predictability of their delivery and the requesters, who experienced an improved service, reduced the number of ‘unplanned urgent’ requests.

Another strategy that was integrated for avoiding the firefighting cycle, as suggested by Repenning et al. (2001) was a substantial revision to the ‘Vehicle Statement of Intent’ authoring process (Davis, 2017d). This was significant in that it necessitated an increased level of transparent dialogue, thus ensuring greater alignment between the Design, Marketing and Engineering departments prior to the projects entering the product development process (Davis, 2017a). This has prevented commercially problematic or unfeasible projects from entering the downstream product development process which previously would have distracted the scarce engineering resource. The other significant intervention was that a weekly check point was introduced, within the POC, to sense any small signals that may indicate a project was experiencing unanticipated problems. This enabled deliberate adaptation of the plan rather than attempting to recover the situation via the instigation and rewarding of heroic action (Repenning et al., 2001).

8.7 Reducing the Cost of Delay

A generalised indicator of the cost of delay was provided in section 8.2, rather than the actual JLR financial information, due to the sensitive nature of the data. A more accurate economic model was used within the POC, as a means of disconfirmation (Schein, 2009), to emphasise the consequences of the late delivery of the work streams.

A crucial outcome of the PI planning and retrospective process, which was introduced in section 8.2, was the identification of the constraints that could potentially undermine the timely delivery of the required outcomes at a ‘team of teams’ V-NVH level. The process is consistent with Berlow’s (2010) concept of visualising the complexity of the entire system and then identifying and responding to the limited number of nodes that have the most influence on the system. Contrary to the localised optimisation, that was reportedly a trait of JLR’s development processes (Davis, 2016a), the wider team then responded by using the principles of the Theory Of Constraints (TOC) (Goldratt, 1990), accepting that

any team that was not on the critical path for the high priority items should seek opportunities to exploit the constraint and subordinate their activities to that constraint until all feasible actions have been explored (Davis, 2017f). This concept was not initially accepted because it was counter to the established cultural norms. However, once acknowledged, the teams willingly reallocated equipment, developed routines to automate transcription tasks and shared resource to support the constrained team.

Consistent with the importance placed on the 'up front' conceptual work, it was essential to give equivalent consideration to the strategic or improvement projects as the tangible product delivery work. The risk 'reduction and opportunity enablement' rating was therefore incorporated into the WSJF prioritisation process, as described in section 8.3, in order to ensure strategic projects were also equitably considered. Such projects were then protected because they ultimately have a greater impact on the cost of delay when they reduce the transaction costs, hence provide sustainable benefits across a number of projects (Reinertsen, 2015).

8.8 Distributed Governance

Oosterwal (2010) challenged the effectiveness of the 'stage gate' governance process such as the Product Creation and Development System that was deployed at JLR (JLR, 2015). He identified a positive correlation between effective delivery and exploratory learning cycles with an R^2 coefficient of 0.99. He also demonstrated that achievement at gateways was not a valid predictor of successful project delivery by commenting that "*the data even suggested that the inverse may be true*".

Hamel (2009) argued that "*control has to come mostly from organizational norms, not sclerotic review procedures.*" This section therefore challenged the existing control mechanisms which were routinely observed to counter innovation and agility (Davis, 2017b). Influencing the governance paradigm at an enterprise level, towards a more appropriate 'beyond budgeting' model (Hope and Fraser, 2003 cited in Davis, 2017b), was outside the scope of the research.

The recognition of the ethos of Ashby's (1968) Law of Requisite Variety influenced the governance within the V-NVH programmes. The Law of Requisite Variety suggested that in order to enable target achievement, the variety in the

governance or decision making system must be greater or equal to the variety of the environment divided by the goal's diversity (Morlidge, 2017b). This notion substantiated the observed issues associated with attempting to reduce variety in the governance processes through standardisation. The paradox of the desire for diversity in the governance process and a climate of accountability, whilst maintaining control needed to be accommodated. Connors and Smith (2011) supported the lean ideal of reducing the dependence on inspection (Deming, 1981). This represented a migration from the paradigm whereby the programme managers monitored the variance from a predetermined plan to the teams themselves examining and responding to any disparity between the actual and desired outcomes (Bungay, 2011). The research therefore emphasised the importance of 'lean leadership' (Mann, 2009) and the 'leader-leader' model (Marquet, 2012).

The concepts that underpin this distributed accountability exemplar date back to the direction offered by Field Marshall Von Moltke (1869) cited in Bungay (2011):

- “Not commanding more than is strictly necessary, nor planning beyond the circumstances you can foresee”.
- “An order should contain all, but also only, what subordinates cannot determine for themselves to achieve a particular purpose”.
- It was the responsibility of every officer to liberate the greatest advantage from the specific situation for the benefit of the entire mission.

These were considered equally relevant in the current complex environment and were aligned with the adopted agile concept of the 'Connextra' user story format of as a <role> I want <outcome> so that <rationale / purpose> (Cohn, 2004). This was used to frame the work items as it encouraged both appropriate dialogue regarding the intent and the freedom of the practitioners to define the appropriate means of fulfilment.

8.9 A Climate of Accountability, Innovation and Agility

Ahmed (1998) argued that in addition to available resources and decentralised dialogue, it was also essential to have a climate that was conducive to creativity, maintaining that innovation is “*a pervasive attitude that allows businesses to see beyond the present and create the future.*” He acknowledged that employees have a symbiotic association with the organisational environment, both shaping

it and being shaped by it. Schneider et al. (1996) cited in Davis (2017f) identified four facets of organisational climate that were considered within this research project:

- Nature of relationships
- Nature of hierarchy
- Nature of the work
- Nature of rewards

Schneider et al. (1996) held that it is from these determinants that employees make inferences about the organisational environment and their position within it. They also suggested that employees also infer their priorities from their perception of the culture within the context of the management values. Ahmed (1998) suggests that the management challenge is to ensure the employees make the appropriate attributions, given the variation in potential interpretation discussed in section 5.1, as failing to do so routinely results in chaos and confusion. However, in order to confront the demands of an unpredictable future, the need for an alternative to Scientific Management (Taylor, 1914) was specifically recognised by the group of business leaders listed in appendix 1 (Hamel, 2009).

8.10 Management Challenges

The research focus, in this respect, was on what Nonaka (1988) referred to as “*middle-up-down management*”, which confronted the paradox of the visionary, but at times, abstract organisational direction and the more detailed and experience based concepts within the domain of the practitioners. One of the specific leadership challenges that the management thinkers, identified in appendix 1, was the creation of an environment in which every employee has the opportunity to thrive, collaborate and innovate, without “*Positional bias*”. The collective wisdom of the whole organisation and ecosystem may then be exploited. They maintained that such a management system must appreciate diversity, disagreement and nonconformity with the same fervour as conformance, cohesion and consensus within a high trust, low fear culture. In this paradigm the contributors respected the social architects “*whose emotional equity is invested in the future not the past*” and those who can mobilise others, without formal authority. This complemented Marquet’s (2012) ‘leader-leader’

model. Connors and Smith (2011) also supported this notion by distinguishing between constructive cultures where the employees ‘feel’ accountable both to each other and to the organisation compared to the detrimental ethos where employees are ‘held’ accountable, especially when unexpected outcomes emerge. They suggested that such a blame culture stifles innovation and obstructs change because it reduces employee willingness to explore alternatives and embrace accountability. The notion of accountability also had significant implications for openness and transparency that enabled the capitalisation of small signals, as discussed in section 5.0.

8.11 Climate of Open Disclosure

Syed (2015) illustrated the importance of an open climate by describing the contrast between the healthcare and aviation industries that became apparent during an investigation of a fatal error that occurred during a routine operation. The victim was the wife of an airline pilot. Based on his experiences of open disclosure in the aviation industry, he insisted on an investigation that revealed significant differences between the two fields. Syed (2015) described a culture of openness and the examination of ‘near misses’ and accidents as being central to the improvements observed in the aerospace safety record. This was contrasted with the accepted norm that the only commitment for investigation in the healthcare profession was based on litigation. This limited the available data that could be used for improvement. A contributory distinction, emphasised by Syed, was the belief within the aviation industry that failure was not usually associated with condemnation of the pilot, but an opportunity for wider industry to learn. This was not seen as the case within healthcare sector where the culture insinuated that senior clinicians were faultless, hence errors were stigmatised and the information systems obscured the data rather than being a catalyst for learning. This consequence of Connors and Smith’s (2011) distinction between being held accountable and feeling accountable, resonated with the observations of Mozas Alves (2015) cited in Davis (2016a) during her internship at JLR, hence this trait was identified as requiring attention during the research.

Consistent with the agile notion of transparency or what McChrystal et al. (2015) referred to as “*shared consciousness*” Hamel (2009) argued that those on the front lines require both the “*freedom to act quickly*” and the “*data to act*

intelligently”, without having to ask permission, in order to generate organisational resilience. Another identified facet, which was also emphasised within this action research project was the need for focused, disciplined execution in order to exploit adaptation and innovation.

8.12 Fundamental Linkages

Geertz (1973) argued that culture entails socially constructed meaning that informs people’s actions and through which such action becomes understandable. He maintained that it cannot be defined by rules or algorithms and that culture is articulated through social action.

Connors and Smith (2011) offered a straightforward archetype for organisational change by suggesting that participant’s experiences shape their beliefs that then guide their actions in order to achieve the desired results. This was refined, as shown in Figure 13 to incorporate the complex interplay of communication, gestures and interpretation (Goldberg, 2009); (Stacey et al., 2000), as described in section 6.0.

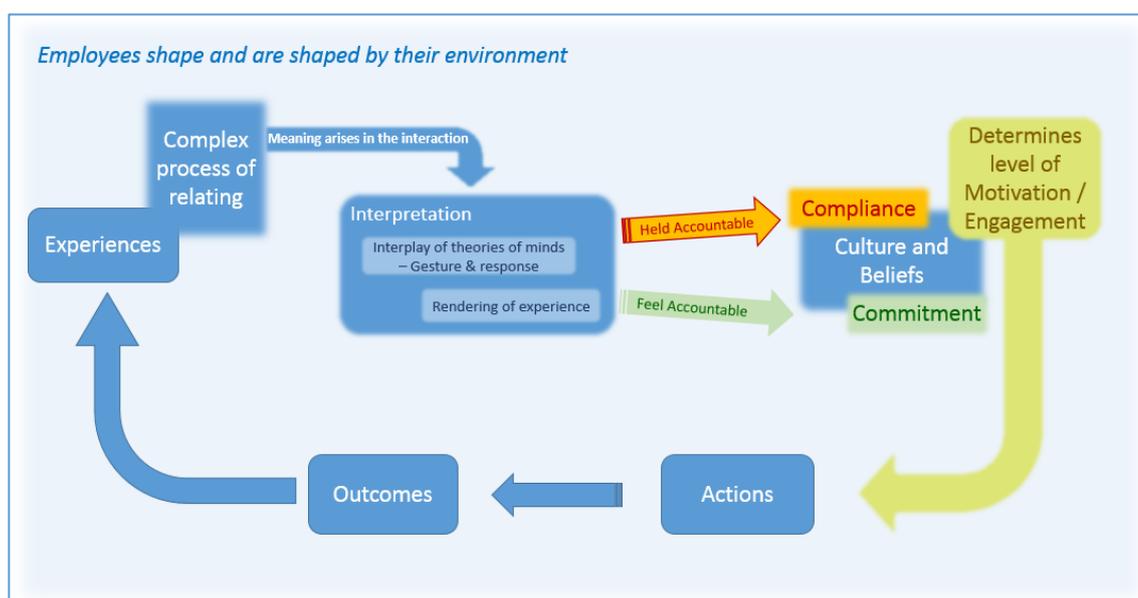


Figure 13. Creating a Climate of Accountability and Engagement

Connors and Smith (2011) maintained that effective change implementation is achieved by engaging the workforce in embracing personal change. They advocate encouraging the participants to revise their mental models in order to embed the transformation rather than being reliant on the established change management methods, for example Kotter (1996).

Whilst such experiential learning is recognised as an essential attribute of successful organisations (Baets, 1998; Kim, 1998) the question of engagement and ethics also required attention, as discussed in section 8.13.

Schein (1999) differentiated between organisationally driven learning, which he argued may be considered to be indoctrination. Individually motivated learning was regarded as creativity if aligned with the organisational norms or non-conformity or sabotage in the case of novel propositions. Recognising the divergent perspectives that are generated as a result of our interpretation and the cognitive rendering of our experiences (Eagleman, 2016), sabotage in one context may be perceived as disruptive creativity in another.

8.13 Ethics of Cultural alignment

Schein (1999) argued that targeted organisational learning is “*de facto coercive persuasion*”, suggesting that individual learning should allow free choice of exit if cognitive redefinition becomes distressing. Cook and Yanow (1993) suggested the cultural perspective of learning was complementary to the cognitive view rather than being an alternative. This social view acknowledged the limitation that an organisation, as an entity, cannot engage in cognition. This also reinforced the significance of social interaction and the nuances of human relating (Davis, 2017e), in translating individual learning into corporate action. The ideal of aligning the individual learning to the organisational ambitions therefore involved cautious leadership, which Schein (1999) considered to be a variant of coercive persuasion. He suggested that this is necessary if participants are to reframe their situation as well as change their behaviours in order to achieve sustained change. However, he questioned the ethics of such persuasion when taken to the extreme, drawing parallels with the methods of brainwashing and peer pressure that were used in the concentration camps during World War II.

The challenge remained as to how to secure alignment around the approach whilst engaging the participants in a process of exploration or learning.

The adopted approach provided a clear vision, support and objectives, but accommodated varying rates of engagement, accepting that localised ‘peer to peer’ learning and persuasion was taking place. This paradoxically proved to be both valuable and detrimental, in that one team who were initially openly resistant became an exemplar once they had internalised the proposal. Yet another group

remained passively engaged as described in section 10.4. In one case a particular team, whose work was less integrated with the wider community, exercised their 'right to exit', hence their work was moved out of the main software instance to reinforce their 'freewill'. It was deemed important to demonstrate that they were not restrained in order to dissociate the adoption from coercive persuasion and achieve ownership and accountability through self-determination rather than compliance (Schein, 1999). They have subsequently reengaged having observed the benefits that have been realised in other areas. The accommodation of the ability to internalise both the need to change and the essential governance structures, whilst preserving the individual teams sense of identity and intrinsic motivation was aligned with the SDT motivation theory (Gagné and Deci, 2005 cited in Davis, 2017e) and considered essential for sustained change.

8.14 Bimodal Enactment

The neurological metaphor also reflected the team structure within the V-NVH area with the notion of discrete frontal lobe activity within the brain. Goldberg et al. (1994) proposed the novelty–routinization paradigm as an alternative to the linguistic characterisation of hemispheric specialisation model (Hayward and Tarr, 1995). In this concept the right hemisphere was considered central to enactment regarding cognitive novelty, whilst established routine interpretations and regular cognitive strategies were considered to be processed in the left hemisphere. This theory, which Goldberg et al. (1994) asserted was tested and supported with a body of evidence, infers a highly effective, dynamic pattern of hemispheric specialisation that depends on the state of the particular individual's development. As a specific skill develops, the cortical control migrates from the right to the left hemisphere.

The significance for this research was the visualisation of both the team and task structure as described below.

8.15 V-NVH Team Structure

A challenge that had to be overcome was one of the allocation of work items that required divergent aptitudes or specialist skills. A core assumption of implementing scrum in the software domain was that the developers were able to select the work from the top of the backlog (Gunther, 2016), this was not

generally the case within the V-NVH context as there was a strong view that the platform and specific domain knowledge was key to the effectiveness of the teams.

The visualisation, shown in Figure 14, was developed in conjunction with the team’s Group Leaders in order to represent the challenges. The emergent theme was that a more networked, negotiative approach was required during the early stages of a project. In comparison the teams that were in the delivery phase felt that they could demand priority because of the time criticality and business focus, with one such leader claiming they had “*a loaded gun*”. This attitude generated a lot of reactive work as the delivery teams worked on a short timescale. This resulted in disquiet for the ‘intelligence corps’ as they felt resource tended to be directed to the ‘firefighting’, as discussed in section 8.6, rather than the necessary strategic or enablement projects.

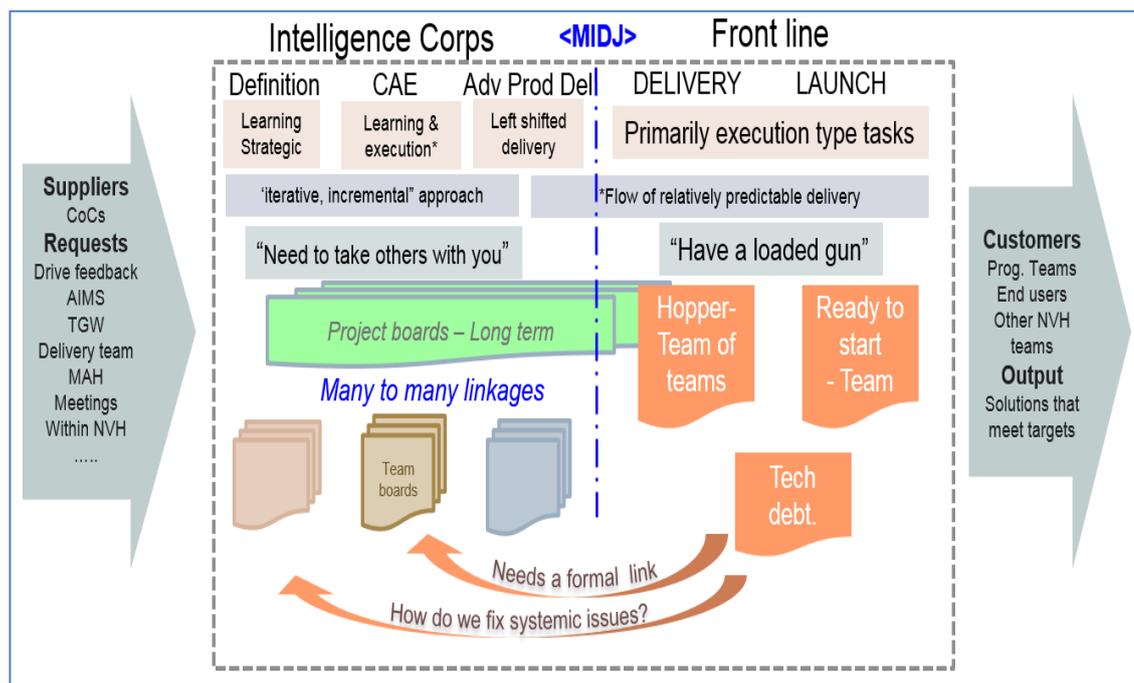


Figure 14. Visualisation of Work Type Dilemma
 (Davis, 2016b)

The requirement for an effective means of flowing the work between the teams was also emphasised as some teams were feeling overwhelmed, resulting in localised stress (Lin et al., 2013 cited in Davis, 2017e) and recognised they were becoming a constraint on the overall workflow as discussed in section 8.7 (Goldratt, 1990 cited in Davis, 2017f).

Consistent with Goldberg et al's (1994) notion of the novelty–routinisation paradigm the workflow was considered to progress from the Advanced Programme Delivery Team, who had an aptitude for conceptual work and negotiation through to the Delivery Teams who had a talent for managing the routine validation activities and were able to respond rapidly to unanticipated outcomes, as illustrated in Figure 15.

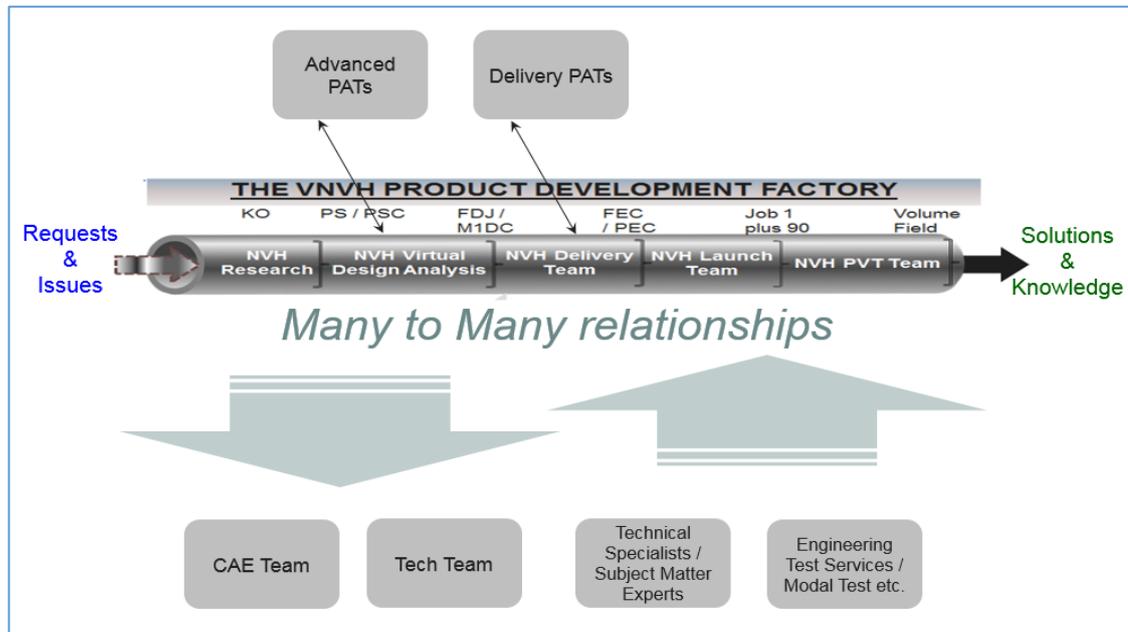


Figure 15. Workflow and Team Relationships
 (Davis, 2016d)

Regardless of the aptitudes of the teams and consistent with the notion of the operation of the left hemisphere, a conscious effort was made to streamline, standardise, divert or minimise the routine work items using predefined templates in order to preserve the intellectual capacity for the more demanding cognitive novelty.

The ‘many-to-many’ service providers provided the catalyst for the necessary intrinsic experiential learning within the NVH team with the PAT teams and Technical Specialists reinforcing the connections with the wider business by disseminating the knowledge to the stakeholders (Kuusinen et al., 2016b).

Through a process of conscious prioritisation, as discussed in section 8.3, capacity was preserved to protect the strategic or enabler projects. The engagement of the Delivery Programme Attribute Teams (PAT) in the agile implementation remained an ongoing issue as described in section 10.4.

8.16 Nature of Work

As identified within the previous section, at a high level, the nature of the work was recognised during the dialogue. However, the significance and granularity of the work types was not previously appreciated. Snowden and Boone (2007) proposed the Cynefin framework, as shown in Figure 16, as a suitable ‘sense making’ model (Snowden, 2010). When required, this exploration aligned the team around an agreement as to the nature of the issue. This prompted an appropriate response to the concern as opposed to the routinely observed ‘socially constructed’ reaction which was selected as it suited the individual’s preference for enactment (Grint, 2005 cited in Davis, 2017c).

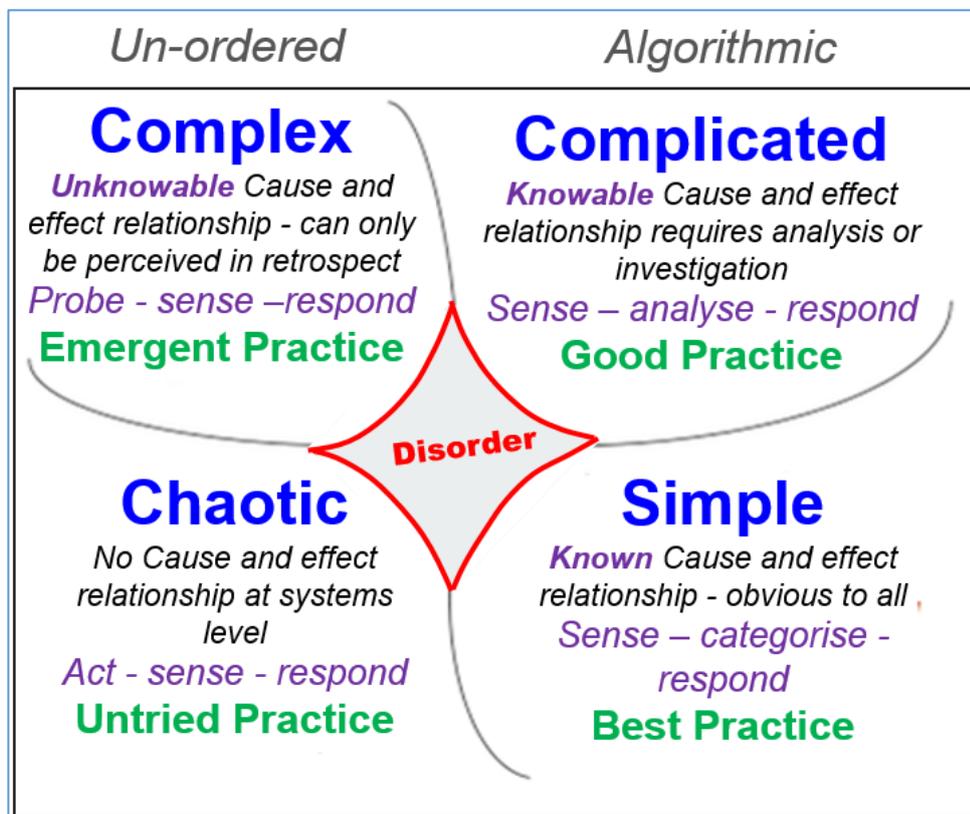


Figure 16. Cynefin Sense Making Model for Issues
(Davis, 2015b adapted from Snowden, 2000)

By considering the ‘novelty–routinisation’ paradigm an operating model emerged that respected the aptitudes of the teams, but also ensured that all participants were exposed to fulfilling work as this contributes to the achievement of cognitive flow (Csikszentmihalyi, 1997) and self-determination (Ryan and Deci, 2017), both of which support motivation and engagement.

The abstraction of the brain's 'automatic system' also confirmed the importance of preserving an environment for the development of expertise to enable the pragmatic processing of vast amounts of data. Taken to the extreme, excessive generalisation undermines the sustained practice considered necessary for the development of 'expert intuition' (Dreyfus et al., 2000); (Simon, 1992). Kahneman and Klein (2009) substantiated this notion by converging on the belief that it is prudent to assess the provenance of the contributor rather than the outcome in order to judge the legitimacy of any expert intuition.

This concept for accommodating the 'novelty – routinisation' paradox negated many of the criticisms that arose from forming two distinct organisations to handle the repetitive, maintenance type tasks and a different group to conduct the innovative, creative work as advocated by the bimodal concept (Whitemore, 2016) or the dual operating systems (Kotter, 2014) that were used in other sectors (Davis, 2017f).

9.0 Retrospective

Consistent with agile good practice, in addition to the illustrations provided within this paper, the following examples were included to provide an appreciation of the status of the implementation at the end of the POC.

9.1 Target Achievement

As shown in Figure 17, the aspirations of both the V-MVH core team and the Sponsoring Senior Manager were not entirely achieved. Nevertheless the progress made towards these targets was recognised as having had a significant impact on both the predictable delivery of valuable outcomes and the satisfaction and wellbeing of the teams.

The recommendation of the participants at the core team PI planning event was to continue with the scaled agile implementation, whilst recognising further adaptation, engagement and improvements were required in order to achieve the targets. One of the key recommendations of the group was to expand the implementation to include the collaborating departments in recognition that many of the issues were now experienced at these interfaces. There was also confidence within the teams that the approach was scalable.

This agile mind-set has also been confirmed as being fundamental to realising the potential of the JLR NVH centre that is currently under construction and is scheduled for commissioning in 2019 (Darlington, 2018).

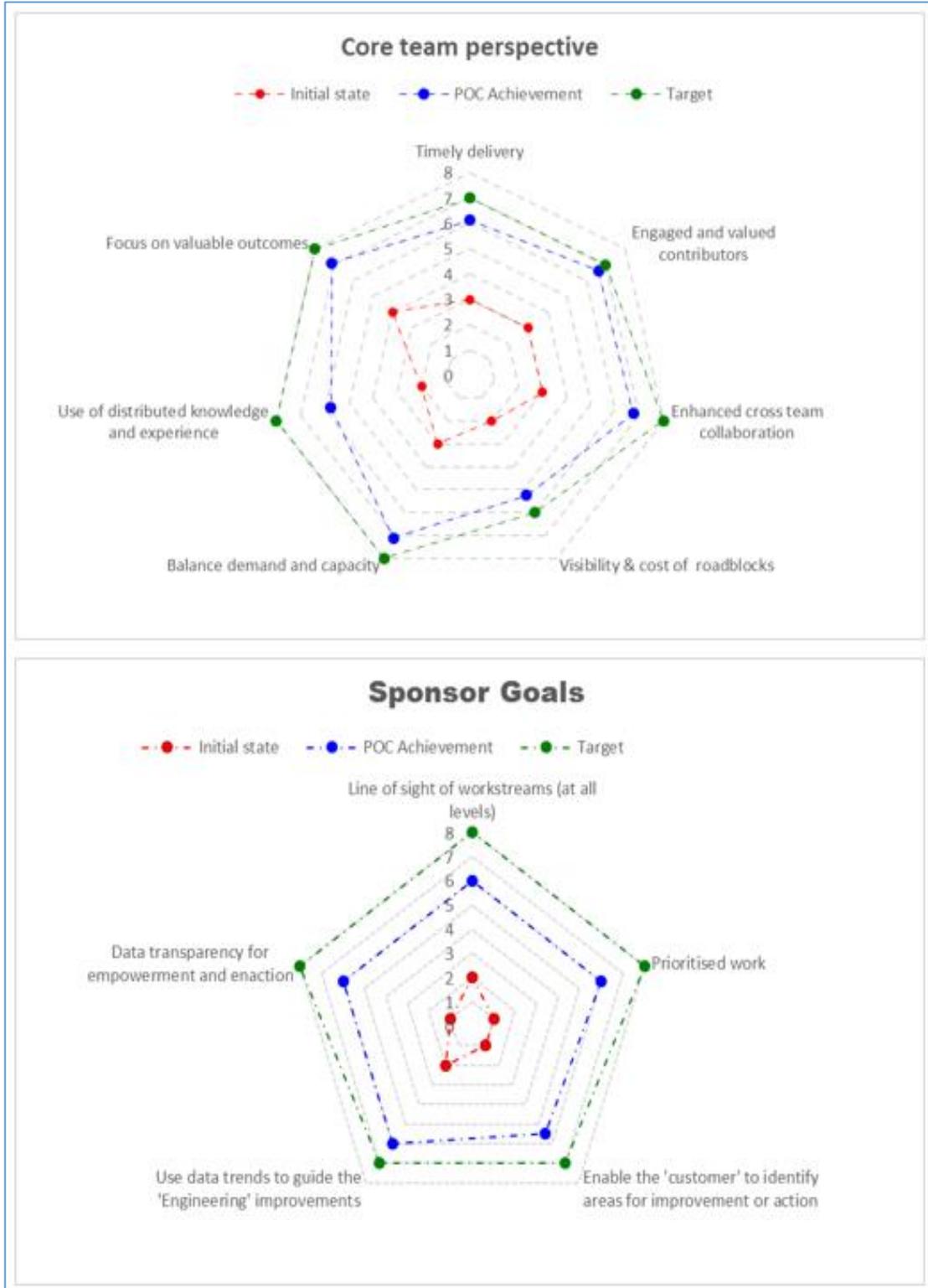


Figure 17. Achievement against Target (Davis, 2017f)

9.2 Cultural Shift

This section summarised the outcomes of the Organizational Culture Assessment (OCAI) survey instrument (Cameron and Quinn, 2011 cited in Davis, 2015a) that was deployed to gain an appreciation of the cultural changes resulting from the research, as described in section 3.6.

A statistically significant difference was observed, at 5% level of significance, within the V-NVH team for the ‘control’, ‘collaborate’ and ‘create’ cultural dimensions as shown in Figure 18 (Davis, 2017f). The data indicated progression towards desired state.

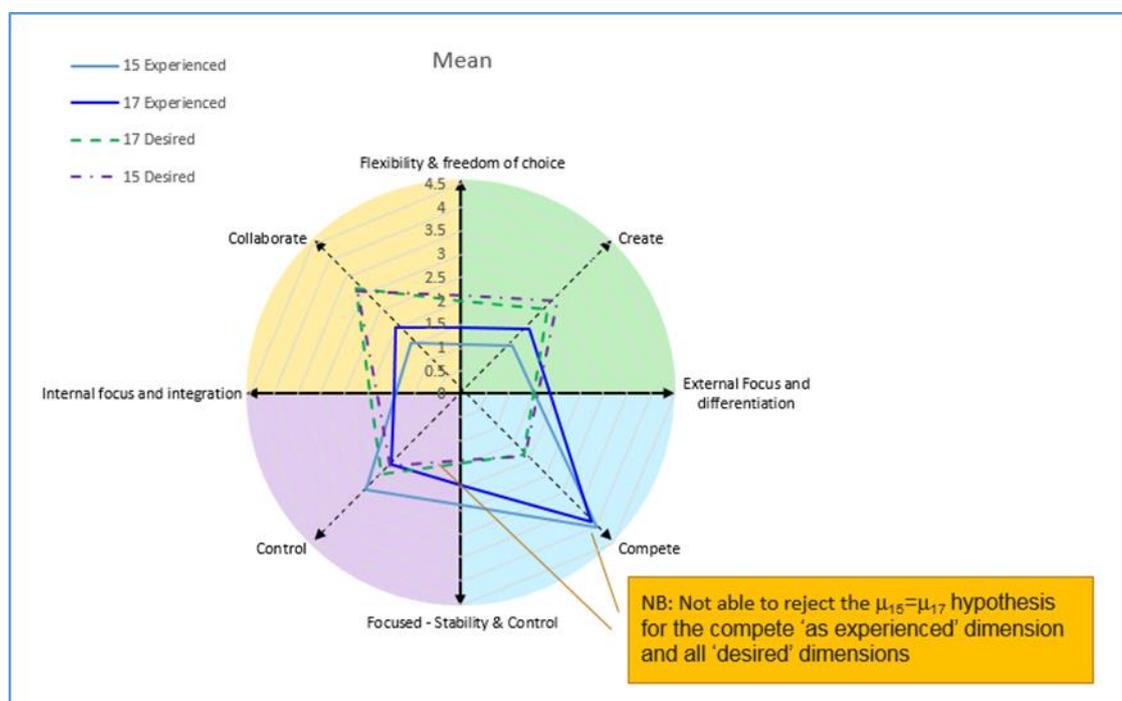


Figure 18. V-NVH OCAI data
(Davis, 2017f)

The null hypothesis of $H_0: \mu_{15}=\mu_{17}$ could not be rejected for the ‘compete’ dimension or the desired states which implied there was insufficient evidence for rejecting the notion that the means were consistent between 2015 and 2017.

The VeD team were also surveyed as a control group because they were subject to similar organisational and environmental factors. The only cultural dimension that suggested the null hypothesis could be rejected in this case was ‘control’.

The data therefore indicated a stronger statistical signal supporting a desirable change to the perceptions of the culture within the participants of the action research and less so for the VeD community as shown in Table 2 (Davis, 2017f).

Table 2. Comparison of 2017 and 2015 OCAI Data (2 Sample T-test)
(Davis, 2017f)

	Vehicle Dynamics (n=42)				Vehicle Noise, Refinement & Harshness (n=24)			
	Experienced		Desired		Experienced		Desired	
Dimension	Mean difference	P-Value	Mean difference	P-Value	Mean difference	P-Value	Mean difference	P-Value
Collaborate	-0.179	0.318	-0.201	0.241	0.59	0.029	0.079	0.755
Create	0.288	0.098	0.076	0.571	0.538	0.047	-0.309	0.247
Compete	0.402	0.176	0.215	0.19	-0.239	0.655	-0.074	0.766
Control	-0.372	0.019	-0.09	0.56	-0.823	0.018	0.304	0.199

9.3 Business Impact

The following data was provided as an indication of the throughput and cost of delay metric improvements as advocated by Reinertsen (2009) cited in Davis (2017b). Whilst the actual financial data was not published due to the sensitive nature of the information, the action research resulted in a reduction in the number of deliverables that incurred a notable cost of delay from 23% to 3%.

It was also worthy of note that, in spite of the developing PI planning process, the conscious bottleneck and queue management resulted in an improvement in throughput as indicated in Table 3 (Davis, 2017f).

Table 3. Throughput Metrics
(Davis, 2017f)

Increment Name	Weeks	Completed (Points)		Closed Backlog Items	
		Increment	Per week	Increment	Per week
2017 Qtr 4	10	3303	330	577	58
2018 1st	12	4747	396	1009	84
2018 2nd	3*	1327	442	267	89
* 2nd increment in progress					

The business stakeholder also commented that the research had *“Moved the NVH team more in the last 12 months than anyone else in the last 3/5 years”*, acknowledging that *“This is not an easy task as change is uncomfortable for many, compounded in this case due to a lack problem awareness across the team.”* The rigour of the approach was also recognised as being conducted with

“a clear focus on value and the end goal” with the result being that the work had “been able to motivate the team to change with a supportive, inclusive but challenging approach.” (JLR Success Factors, 2018).

9.4 Metaphors and Abstractions

Whilst not openly articulated, respecting the needs of the participants (Gregory et al., 2014), the notion of using human brain as a metaphor for the organisation was particularly informative because both must be able to process a large volume of diverse data via complex network of interactions (Goldberg, 2009), the organisational counterpart being Stacey’s (2012) notion of the complex process of relating, whereby human interactions can produce patterns of behaviour that can generate both stability and innovation. Of particular note within this paradigm was the understanding of self-organising systems, informed by the abstraction of DST as opposed to an externally managed change process

9.5 Organisational Learning and Resistance to Change

In order to accommodate the challenge presented by some participants it was necessary to not only respect their opinions, many of which contained valid arguments, but also acknowledged that generative learning and change involves questioning an individual’s basic assumptions. Schein (1999) recognised that this may provoke anxiety and resistance.

Nahapiet and Ghoshal’s (2000) contemplation of intellectual capital as a social construct also received continued attention. Informed by Dashchenko’s (2006) assertion that that the sharing of knowledge forms the foundation of social order and collaboration and Kuusinen et al’s (2016b) observation that the agile methodologies tend to focus on learning within the team, deliberate action was taken both within the wider team and with the interfacing stakeholders to appropriately disseminate learning. Nahapiet and Ghoshal (2000) recognised the symbiotic relationship between the social capital, which encouraged the expansion of the intellectual capital and vice versa. This substantiated Cook and Yanow’s (1993) notion of a cultural perspective of organisational learning, as discussed in section 8.13, which paradoxically both accelerated and restrained the engagement with the action research.

Where discrepancies in reasoning (Sutherland, 1992); (Kahneman, 2011) or misaligned ‘espoused values’ and ‘theories in use’ remained undetected or

suppressed, individuals and groups portrayed their perspectives (Eagleman, 2016); (Goldberg, 2009) in ways that undermined reflection and ‘double loop learning’ (Argyris, 2000 cited in Davis, 2017e). The corollary of this was defensive reasoning and reinforcement of obstructive attitudes, blame and destructive disputes that worked against the aspiration of action research (Argyris, 2000). The surfacing of the inherent blind spots (Kahneman, 2011), for both the researcher and participants remained an ongoing open dialogue (Bohm, 2013); (Checkland, 1999b) which was progressing to a culture of collaborative tension. The emergence of the climate of psychological safety, open disclosure and dialogue significantly increased the levels of collaboration as well as identifying the shortcomings of any unfounded assumptions. Cautious observation also revealed the disparities between individuals espoused values and theories in use (Argyris, 1991), which were now more likely to be confronted within the teams.

9.6 Retrospective Feedback

The following comments were offered as a subset of the retrospective feedback in order to indicate the sentiment of the teams. There was a continuum of feedback that appeared to correlate with the degree of engagement of the particular teams.

The positive feedback reinforced the benefits of the visibility of the entire portfolio of requests, the transparency of the workload and the alignment of the V-NVH community around the agreed priorities, for example *“We’re making great progress on running the sessions, we shared a lot of learning, and the ability to describe the next two weeks work was great! I really enjoyed it!”* and *“it is becoming really valuable for all of us. It is much more than just writing down our tasks - I think as a team it is helping us see the wood in all the trees.”* This contrasted with the feedback from participants at the other extreme who remained disengaged and resisted the approach, for example *“it is a significant admin overhead with no added value.”* The same team also commented that *“It has just highlighted our relatively limited day to day interaction with wider NVH”*, which other team members perceived as an issue in itself.

The benefits of the rolling wave, PI planning approach was generally recognised, for example *“Really Good Event, best planning event ever!!”* and *“Visible ownership of portfolio & priorities by the senior manager”* and *“Whole NVH team*

planning together". The feedback also revealed the potential challenges that required ongoing attention, for example *"PATs seemed to withdraw in the afternoon. Are they proactively owning the features?"* and *"Very optimistic delivery plan - not enough time planned in for external influences"*.

The alignment around a core backlog also attracted feedback in terms of balancing the workload. In addition to the management of constraints, as described in section 8.5 (Goldratt, 1990 cited in Davis, 2017f), participants also reported a collective benefit to the disclosure and recognition of the risks and issues in other areas that had been previously obscured, for example *"Glad there was open discussion about risks - helps the team understand the sub team pressures"*.

The external view of the teams that had embraced the process was also positive, with one manager observing that *"the tech team appear to be more in control as well as appearing calmer"*. There was also stakeholder feedback that confirmed the increase in throughput, for example *"I'm not sure if it is anything to do with the POC, but more stuff seems to get done now"*.

9.7 Agility in a Crisis

In spite of the stated intent of the POC to be focused on the ideology, values and principles of alternative operating models, there was a notable amount of feedback regarding the VersionOne software instance. An opportunity presented itself that reinforced the utility of the proposed lean agile methodology in isolation. As described in section 8.6, a project was elevated to 'taskforce' working as it was perceived to be in distress. This incorporated a cross functional team, who met daily to discuss the project and review progress against a time based plan. This was not being run as part of the POC as many of the contributors were outside of the selected group. However, when accountability and adaptation issues were highlighted, the format of the meetings was adjusted and a 'manual board' was constructed and using the experience gained within the POC, as shown in Figure 19. These enhancements clarified the ownership, information flow and progress as well as enabling the visualisation of any impediments across all of the contributing teams. The learning was captured, as it emerged, in a form that enabled theories to be eliminated or prioritised and incorporated as appropriate.

Owner	Backlog	Ready	In Progress	Blocked	Outcomes (Done)		Won't do
					No effect	Follow up	
P-Train							
PTSQ							
Road Noise							
Adv Tech							
.....							

Figure 19. Task Force Board
(Davis, 2018b)

The feedback from the participants and the beneficiaries confirmed the throughput centred approach was a more effective way of running a taskforce when compared to the previous time based tactics. This has increased the interest in this research in adjacent departments and substantiated the utility of the values and principles of the methodology independently of the software instance.

10.0 Discussion

This section summarises the primary findings and limitations of the research in the context of the knowledge work undertaken during the product creation activity at JLR. The assertion was that a revised operating model would allow the participants to thrive and relish the volatile, complex ecosystem in which JLR now operates. The expected outcome being an improvement in employee satisfaction and wellbeing whilst delivering increased value for both the business and the end users (Davis, 2016a).

The discovery phase of the project indicated that certain aspects of the operating culture and social norms were a significant constraint on the effectiveness of the delivery rather than the technical capability and process orientation that was evident at JLR (Davis, 2016a). This research project was therefore directed to changing the participants' experiences, hence provoking a revision to their beliefs

in order enable cognitive redefinition and sustained culture change to a form that was both sensitive to the “limitations of human psychology” Syed (2015) and compatible with a volatile, complex environment. This was consistent with the approach advocated by the contingency theorists (Donaldson, 2006).

The change was achieved by developing a resilient operating model that engaged the knowledge worker community in a structure that supported self-determination in terms of both motivation and internalised regulation (Ryan and Deci, 2017).

The research approach challenged the Population Ecologists assertion of “*environmental selection*” as being an appropriate model for organisational evolution (Hannan and Freeman, 1977) by demonstrating that the “*organisational inertia*” can be overcome as a constraint on such transformations. This was a manifestation of the Adaptionist movement’s perspective that “*organisational effectiveness results from fitting characteristics of the organisation, to contingencies that reflect the situation of the organisation*” (Donaldson, 2001).

The emergent operating model respected both the social dynamics and psychological alignment of the participants. This supported an improvement in the satisfaction and apparent welfare of the contributors, whilst improving the throughput of the most important items of value with reduced timescales that enabled adaptation in response to timely feedback.

The improvements were quantifiable in terms of a statistically significant signal of an enhancement to the cultural dimensions by the OCAI data (Cameron and Quinn, 2011) as explained in section 9.2 and throughput and predictability metrics as described in section 9.3.

10.1 Challenges and Limitations

Whilst much of the experience within the action research was considered positive, the following sections provided an appreciation of some ongoing issues that are receiving ongoing attention.

10.2 Evaluation

The application of an emergent exploratory approach, rather than reliance on objective data, was considered a limitation by those within JLR who held a perspective of realism, hence anticipated a quantifiable explanation of reality. This was a corollary of the phenomenological approach that was taken in response to the ‘wicked’ problem that was identified.

The approach was aligned with the relativist ontology whereby the reality was shaped by the context and therefore subject to change in response to the interventions. In addition to the subjective feedback, the quantification of the benefits was therefore also subject to adaptation as new knowledge emerged. This resulted in a progression to throughput metrics as a leading objective indicator of effectiveness.

Difficulty was experienced in isolating data regarding employee wellbeing. The Chief Medical Officer theorised that this was likely to be due to the apparent stigma associated with attributing absence to stress.

10.3 Pre-existing Biases

The contention that the deployment of agile is software oriented was still articulated by some participants. To counter this assertion a conscious effort was made to emphasise the construction industry, sports and warfare analogies. Additionally, during the April 2018 PI planning event, the discussions regarding the methodology were framed around the All Blacks (Kerr, 2013) and the Last Planner System (Ballard, 2000) to reinforce the team commitment and resilience and its utility within the construction industry.

10.4 Inconsistent Engagement

An ongoing limitation of the POC is related to the engagement of the PAT leaders who fulfil the role of the Programme Managers in the SAFe® methodology as discussed in section 8.1. This was believed to be a result of the cultural norms that existed at JLR regarding the validation and industrialisation of the projects as they approached the launch phase. This was aligned with Coleman's (1990) observation of the detrimental traits of social capital that were founded on embedded, formidable norms and reciprocal relationships resulting in communal blindness and a refusal to consider alternative information or ideas. The tradition of crisis management and taskforces embedded an expectation of management focus that reinforced the belief that they could demand the resource as they felt they had "*a loaded gun*" as illustrated in section 8.15. The detrimental effects, outlined in section 8.6, were not appreciated by this group, hence the engagement in the POC was perceived as adding to their burden whilst providing limited personal benefit given that they were able to achieve their local objectives

regardless of the detriment to the adjacent work. In this case, their activities were intertwined with the effectiveness of the wider V-NVH team, hence it was not appropriate to allow the “*free choice of exit*” (Schein, 1999) that was afforded to the team as described in section 8.13.

Neither the disconfirmation generated by the articulation of the consequences to the wider business (Schein, 2009) nor the survival anxiety the provoked by the management coercion (Schein, 1999) was sufficient to generate the required internalisation and engagement (Ryan and Deci, 2017). Schein (2010) previously observed denial or repression of disconfirming data as a means of managing the psychological anxiety that may exist within organisations. He further asserted that even if the disconfirming data was accepted, the need to relinquish the existing thought processes and habits also provokes learning anxiety. Schein (2010) further reflected that the learning anxiety may be compounded by a fear of the loss of power or position, fear of temporary incompetence, fear of reprisal from that perceived incompetence, fear of a loss of personal identity or a fear of loss of group membership. The interaction of this survival and learning anxiety generated a complex change dynamic that was routinely interpreted as resistance to change.

The disciplined implementation (Hamel, 2009) and engagement of the Delivery PATs was considered essential for the realisation of the operating model as they need to feel accountable for coordinating the sub-teams work (Shalloway, 2012). This ensures the ‘Minimum Business Increments’ are released at the appropriate time. The migration of the taskforce working to a throughput centred approach, as described in section 9.7, eventually initiated a degree of interest within this community. However this remained an area of continued experimentation.

10.5 The Provision of a Suitable Software Environment

Whilst JLR had licences for software environments that supported both scrum and Kanban applications with relatively linear flows, these were found to be limited in terms of visualising the workflows across the various levels within the complex portfolio that was the subject of this research. Whilst it may have been possible to configure these instances with the provision of additional ‘apps’, the initial trials demonstrated the significant risk and distraction associated with this activity.

A significant limitation with the use of the VersionOne instance, was the constraints that were imposed by JLR in order to authorise its use as a POC to circumvent the protracted approval process that would otherwise have precluded its use within the research. This included the limitations to the number of users and the nature of the information that could be contained within the data set in order to ensure the preservation of the intellectual property (Davis, 2016c).

The lack of agility in providing a suitable enterprise solution remains a matter that requires resolution as it is placing a significant restriction to the expansion of the Lean/Agile constructs. In spite of the growing interest in the research and the potential business benefits, access requests from adjacent collaborators have to be declined due to the number of available licences and the agreement that a production instance would need to be fully approved and completely independent to the POC.

11.0 Future Intentions and Recommendations

Humble et al. (2014) asserted that in order to capitalise on the advantages of the lean agile methodologies, an enterprise implementation is essential. The intention is therefore to expand the approach, which has proven its utility within the V-NVH environment, to progressively encompass the wider business. This will enable the evolution of the core concepts through their application in other domains. Particular emphasis will be placed on integrating the strategic leadership into the framework to ensure alignment across the enterprise.

Consistent with both the iterative learning approach (Koehnemann, 2015) and the Theory of Constraints (Goldratt, 1990), an organic expansion is suggested so that sustainable, context specific solutions can be implemented that address the limitations in a priority order.

11.1 Executive Engagement

Whilst this research was conducted on the basis of the curiosity of the senior management as opposed to engagement it was accepted that increased engagement would be valuable in order to accelerate the transformation and utilise the ideal of panarchy. This would enable the influence and contributions to result from an increased number of levels within the hierarchy. The outcomes of the POC will be widely shared in order to gain greater senior engagement and

hence also exploit the constructive facets of such sponsorship that was recognised in the alternative change models for example (Cameron and Quinn, 2011); (Kotter, 1996); (Connors and Smith, 2011).

11.2 Addressing the Agile ‘Anti-Patterns’

Brown and Duguid (2000) referred to ethnographic studies when he acknowledged the divergence between the organisation’s intended working practices and what actually happens. Both the feedback during the discovery phase (Davis, 2016a) and the experiences during the research project confirmed this to be the case at JLR. It was also recognised that a number of the practices that were implemented for efficient control (Taylor, 1914); (Weber et al., 1968) are no longer suited to the complex, rapidly evolving and unpredictable environment (Donaldson, 2001). Many existing practices, such as the annual budgeting process (Hope and Fraser, 2003) and annual performance and remuneration practices (Ewenstein et al., 2016) inhibit rather than encourage adaptive, collaborative innovation. Consideration should therefore be given to throughput governance models (Goldratt, 1990), for example the Beyond Budgeting philosophy (Morlidge, 2017a); (Hope and Fraser, 2003) in order to underpin the necessary adaptability and resilience within the organisation.

11.3 Economic Decision Model

Having explored the benefits of a proxy for an economic decision framework to inform the decisions regarding the cost of delay (Davis, 2017b) consideration should be given to developing an economic decision framework, which could be made available to the employees to ensure a consistent approach to decision making (Reinertsen, 2009 cited in Davis, 2017b). Such an approach not only decentralises the accountability for decisions, it informs the decisions on the basis of the economic benefit for the business, in order to provide a consistent approach regardless of the phase of the project or the proximity to a local target (Reinertsen, 1997).

11.4 Enterprise Software Solution

Urgent consideration should be given to the provision of an enterprise agile environment or integrated suite of solutions at JLR, in response to the emerging demand as the adoption of the methodologies becomes more widespread. In the

absence of a recognised solution that is capable of managing the complex workflows, a number of teams are developing or procuring local solutions. Not only does this undermine the ability of JLR to negotiate economic licencing and support agreements, it also presents security and interoperability challenges as the groups expand their collaborative network.

11.5 Experiential Learning

Based on the experience of the V-NVH POC, recognising that some of the participants became overwhelmed by the number of interventions, the intention for the next engagement will be a more iterative approach. This would incorporate the sharing of the vision of scaled agility and the visualisation of the magnitude of the portfolio in order to generate the necessary survival anxiety (Schein, 2010). Initially, however, physical Kanban boards would be used to instigate the throughput based paradigm. The exploration of the concepts such as scrum, WSJF and PI planning will be introduced, as required, in response to the specific challenges that are experienced by the teams. Kniberg (2011) described this as a strategy for gaining engagement and an understanding of the core values and principles whilst enabling the teams to readily adapt the format. He reported that this exploratory process accelerated the engagement with the Swedish Police as the interventions were pulled into the process by the participants as opposed to an 'expert' pushing the concepts. This method will also enable the interventions to start without the limitation of the software, as discussed in section 11.4, and provide a pull to reinforce the business need for an enterprise solution.

12.0 Conclusion

The research methodology, that included the participative Research Oriented Action Research approach, was effective in attending to the tension between real world relevance and recoverable academic rigour (Gregory et al., 2014) as it fulfilled the criteria proposed by Eden and Huxham (1996) cited in Davis (2015a), whilst generating an effective intervention for Jaguar Land Rover.

The phenomenological discovery phase supported emergent theory building, using Grounded Theory Methodology (Charmaz, 2006) to respond to the research question *"How does the embedded culture within JLR influence the effective delivery of the desired vehicle character given the contemporary*

operating environment?” (Davis, 2016a). The findings were further reinforced by the exploration of the alignment of the apparent *modus operandi* and the complex ecosystem in which JLR operates. This inquiry confirmed an incompatibility between the perceived operating model and the volatile, complex environment. This informed the trajectory of the research in accordance with Donaldson’s (2006) assertion that such a disparity is routinely associated with declining performance.

The participative action research attended to the research question “*What strategies can be implemented to preserve the constructive factors and mitigate the detrimental influences?*” This was achieved by introducing a series of interventions, using an iterative experimental approach, to generate the resultant operating model. This revised paradigm not only measurably improved the throughput of business value, but also enhanced the experiences of the participants, thus enabling cognitive redefinition and a statistically significant revision to the operating culture (Davis, 2017f) from that of command and control to one that is building self-determination (Ryan and Deci, 2017) as the foundation of “*operational autonomy*” (Ahmed, 1998). This provided the latitude for participants to generate solutions whilst accepting that the strategic intent was preordained.

When considering the research question “*Can the proposed strategies be scaled to influence the entire Product Engineering culture, or indeed the entire organisation?*” it was necessary to respect fact that the generalisation of the relativist ontology is inappropriate as the experience is context dependant. The research did however encompass the perspectives of a diverse population to ensure the findings were transferable to any complex, unpredictable problem situation.

The primary findings centred on the recognition of the significance and subsequent alignment of the delivery system with both the innate characteristics of those who operate within it and the ecosystem in which it operates. This was pivotal as it presented a fundamental challenge to the embedded traditional operating model. The findings were aligned with the contingency theorists, who argued that the paradigm that was directed towards stability and efficiency is no longer appropriate for the volatile operating ecosystem in which most

organisations now operate (Donaldson, 2001). The consequences of both the nature of the issues that are now encountered and the nuances of human interactions were incorporated. These were observed to paradoxically enhance or undermine the contributions made by the participants without either party being aware of their influence.

The evidence that supports the research contention *“that an alternative operating model enables the teams to thrive and relish the uncertain, complex environment in which they now operate and hence improve their satisfaction and wellbeing whilst delivering increased value for both the business and the consumers”* (Davis, 2016a) was described in section 9.2. The OCAI survey data provided a signal that was indicative of a desirable change to the perceptions of the culture within the action research participants. This was in contrast VeD community that were studied as a control group and did not indicate such an improvement. This substantiated the contention that the reported changes to the operating model gave rise to a change to the perceived organisational culture.

Whilst significant improvements in the effectiveness of the V-NVH team were recognised, as outlined in section 9.3, the transformation was accepted as a ‘wicked’ problem (Churchman, 1967) and therefore the resultant archetype incorporated an ongoing process of learning and reflection (Checkland, 1999c) that will continue into the future, supported by an integrated process of retrospection.

The abstraction of the Dissipative Structure Theory (Prigogine and Allen, 1982) and the neurological metaphor (Goldberg, 2009) in combination with the complex process of relating (Stacey et al, 2000), provided an informative construct on which to base the emergence of a context specific operating model. The resultant operating model was aligned with both the complex, uncertain environment and the human patterns of behaviour.

The incorporation of Goldberg et al.’s, (1994) novelty–routinization paradigm recognised the aptitudes of the various teams and ensured all participants had the potential to achieve cognitive flow (Csikszentmihalyi, 1997) and self-determination (Ryan and Deci, 2017) through the provision an element of fulfilling work in order to preserve both motivation and engagement.

The emerging psychological safety afforded by the climate of open disclosure (Syed, 2015), dialogue (Bohm, 2013) and self-determination (Ryan and Deci, 2017) is contributing to the progression towards reflective practice and double loop learning (Argyris, 2000).

The incorporation of the concept of panarchy changed the notion of hierarchical control to accommodate contributions from small interventions at any level (Walker et al., 2004) has been effective in liberating the distributed intelligence within the teams.

The Dissipative Structure Theory abstraction reinforced the need to be alert to small signals emerging from the product, ecosystem and the employees because when the system is away from equilibrium, minor fluctuations may initiate the 'self-selection' by the system, of an alternative trajectory that may be paradoxically advantageous, detrimental or both.

The alignment of the V-NVH community around a prioritised backlog of work, that was matched to the available capacity of the teams has resulted in an improvement in throughput that was consistent with queuing theory (Little, 2011); (Smith, 2007). The deliberate queue management was embedded as a means of evading the vicious firefighting cycle (Repenning et al., 2001) therefore improving throughput, quality, employee satisfaction and wellbeing.

The SAFe® for Lean Systems Engineering (Leffingwell et al., 2017) provided an informative basis for the emergence of the scaled lean agile values and principles within a complex systems context that included a significant hardware content.

The approach taken within this research challenged Schein's (1999) contention that organisations must endure painful periods of coercive persuasion or restart with new employees and managers that hold the desired assumptions. In this case, the transition was initiated through an aligned, collaborative adaptive operating model within an established team that had previously exhibited localised competition through traditional scientific management norms and practices.

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Appendix 1

'Moonshots' for Management Contributors

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Kevin Kelly, *Wired*

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Ed Lawler, USC's Marshall School of Business

John Mackey, Whole Foods Market

Tom Malone, MIT's Sloan School of Management

Marissa Mayer, Google

Andrew McAfee, Harvard Business School

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Henry Mintzberg, McGill University

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Tom Stewart, Booz & Company

James Surowiecki, author of *The Wisdom of Crowds*

Hal Varian, University of California, Berkeley

Steven Weber, University of California, Berkeley

David Wolfe, Wolfe Resources Group

Shoshana Zuboff, Harvard Business School (retired)