Collaboration through Virtual Teams: Towards an Operational Model for Virtual Project Leadership in the Automotive Industry

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Abstract – **Companies from various sectors of the economy are confronted with the new phenomena of digitalization and globalization and are faced with the challenges of formulating and implementing new business models, updated strategies and different ways of working. In the automotive sector, globalisation has required new developments in project management practices and support technologies, notably those relating to the challenges of collaborating over distance between and within dispersed teams. Researchers and practitioners have started to think more comprehensively about the complexity of projects with dispersed teams, and how best to manage them. This interim paper is the result of the distillation of relevant literature relating to virtual teams. It presents a set of critical success factors for virtual teams and outlines a provisional model for virtual team leadership and management. This model is currently being evaluated and developed through in-depth interviews with field practitioners working in the automotive sector. The confirmed model will provide operational guidance for practitioners and an analytical framework for further research studies.**

Keywords – Project management; virtual teams; virtual leadership; German automotive industry; V-CORPS model

I. INTRODUCTION

The globalisation of automotive companies has brought new challenges for project management, such as projects being led from a distance, with dispersed team members and teams. Lipnack and Stamps [1] noted that twenty-first-century problems require twenty-first-century organisation and innovation. Researchers and practitioners have started to think more comprehensively about the complexity of projects with dispersed teams, and the new possibilities for project management and required changes in processes, technology support and people competencies. This has given rise to the concept of "virtual leadership" or "e-leadership", which are more or less synonymous, focusing on the social influencing capabilities of leaders of dispersed (or "virtual") teams, whereby collaboration and communication technologies are of heightened significance in the pursuit of project goals.

Jugdev et al. [2] concluded that project management can be seen as a holistic discipline for achieving organisational efficiency, effectiveness, and innovation. Team leading plays a key role here. An examination of the extant literature on virtual leadership reveals issues relating to project complexity, social process, value creation, conceptualisation and practitioner development [3]. Virtual teams face a number of issues that can impede effective project delivery – different time zones, different cultures, lack of face-to-face meetings, reduced productivity and increased miscommunication [4].

The current research project has the goal of rethinking project management leadership for dispersed teams in the automotive industry, looking particularly at team leading from a distance and its influence on team members. As recently noted in the National Instruments Research Handbook [5] "within the next 10 years, we will see remarkable change in the automotive industry from improved engine efficiency to autonomous vehicles to electrification" and virtual project management will likely be of increasing importance in an industry undergoing rapid and radical change. Berlin et al. [6] see this as consisting of four main trends - Connectivity, Autonomous Driving, Shared Services and Electric, for which the acronym CASE is often used. This is leading to major changes in many aspects of the industry's operations [7], where issues need to be resolved in parallel and at speed, often in different geographical locations. Effective operation through virtual teams is thus essential.

An examination and analysis of the available literature provides the basis for the development of a conceptual and operational model for future automotive projects led from a distance. This model can act as a framework for the building and leading of dispersed teams, and is currently being evaluated through practitioner interviews. The model will enable the identification of those elements of virtual leadership which can be adapted to the automotive sector, and how such elements can be used to more effectively influence people from a distance.

This paper is structured around five main sections. Following this Introduction, Section 2 outlines the research methodology and positions the two research questions addressed in this paper. Section 3 then reports the Critical Success Factors (CSFs) drawn from current literature relevant to the research aim. This is followed in Section 4 by a discussion of the provisional model for virtual team leadership based on concepts drawn from the extant literature, but amended to reflect the realities of virtual team operations. The final Section 5 provides an overall conclusion to the issues

 ISBN: 978-1-61208-797-9

discussed in the paper and briefly outlines future work that will be done to further develop the model.

II. RESEARCH METHODOLGY

The research methodology is based on a qualitative inductive approach, using a conceptual literature review and case study methodology employing semi-structured interviews. The epistemological position is interpretivist. There are several stages to the project which are currently ongoing.

Available literature in the automotive industry and in other industry sectors has been investigated to ascertain current thinking on the leading and management virtual teams working on specific projects. This has established whether concepts and ideas can be adopted from other sectors and whether these can be of value for leading virtual teams in the automotive industry. This is a conceptual review which aims to synthesize areas of conceptual knowledge that can contribute to a better understanding of virtual team leadership and management, and lead to the development of an operational model.

A conceptual literature review has many benefits. It can provide an overview of the literature in a given field, encompassing the foremost ideas, models and debates, especially the concept that is not explicitly stated before – in this case the dynamics of virtual team leadership and management. It can provide the basis for a summary of the existing evidence concerning this theme, and identify gaps in the current literature that may highlight possible areas for further investigation. It can also help build a framework or model for new research activities. A conceptual review is particularly suitable when the research area is in the early stages of development, where key questions remain unanswered and an accurate picture of current thinking and evidence to date is required to promote the development of new methodologies [8] [9].

This review has allowed the identification of critical success factors for the successful leading of virtual teams, and the construction of a provisional model for virtual team leading and management. A model of virtual project leadership in the automotive industry does not yet exist, and this research aims to address this gap in the literature and in practice. The Research Objectives (ROs) addressed in this paper are:

RO1. To review existing literature on virtual leadership and virtual teams and identify critical success factors for the e-leadership of virtual teams in the automotive industry.

RO2. Through a conceptual review, to develop a new operational model for the e-leadership of virtual teams that minimises personal contact and optimises project outcomes in the automotive industry.

III. CRITICAL SUCCESS FACTORS

Project management has become more versatile and complex, in terms of people and project leading, over the past few decades, especially when project teams are geographically dispersed. This has been done with the support of a variety of project management methods and concepts and the use of faster and cheaper communication technology, which have facilitated the achievement of project goals and milestones more effectively. Whether these methods would also work for virtually-managed teams in the automotive industry is a gap in the literature. A review of the extant literature suggests a number of factors as critical to the building and leadership of virtual teams (Figure 1). These may be seen as key concepts emerging from the literature search on project management and team development, which the authors have considered of particular relevance to virtual team leadership and management. They are taken from the literature on both the automotive industry and other different industry sectors, and the relevant elements of project management methodologies.

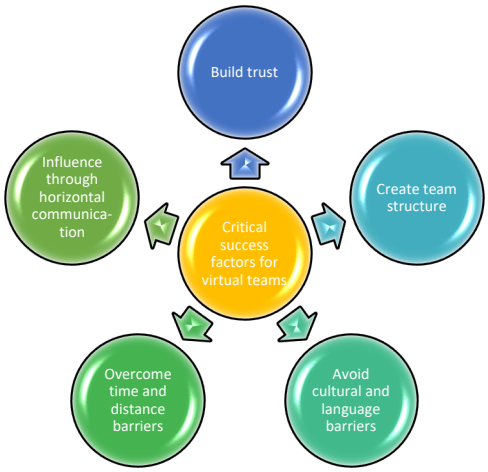

Figure 1. Critical Success Factors for virtual team building and leading

These CSFs are as follows:

Build trust: A number of authors, including Maes and Weldy [10] and Ford, et al. [11], have emphasised that trust between leaders and their team members, as well as among team members themselves, is the most important aspect for leading from a distance, and that it is possible to see trust as a key starting point for working with virtual teams. The building of trust is a pre-requisite for team cohesiveness, and the gaining of trust is part of social influence for distance-led team members, as discussed by Scheunemann and Bühlmann [12]. It is a major challenge in overcoming distance and time barriers, and winning over team members. Building trust is an essential and challenging aspect for leading, and this is highlighted in the literature [10] [13]. Ford et al. [11] describe trust as the key to a capable virtual team.

Create a team structure: Working with team members in a number of locations entails a different work attitude and way of working. To achieve this, the creation of a team structure that can support virtual working is essential, to connect the team members and foster a collective, shared approach to the working behaviour of the team. This structure can be viewed as a contract for team members that allows

 ISBN: 978-1-61208-797-9

them to pursue individual and project objectives effectively. Klitmøller and Lauring [14] note that the team structure is essential when it comes to communication and knowledge sharing, because these are more challenging in a virtual team environment than with face-to-face counterparts.

Avoid cultural and language barriers: The avoidance of the possible negative impact of cultural differences is a necessary preventive measure to mitigate possible bias between the different team members. Nader et al. [15] note that cultural barriers are a serious impediment to the effectiveness of virtual teams. It is essential that the general understanding and respect of culture is recognised by the leader, and that neither origin nor gender plays a role in the team, with only ability and merit counting.

Language barriers are an important issue which cannot be underestimated. Due to the fact that the members of virtual teams often do not speak the same language, many companies opt for mutual understanding through English [12]. It is essential that the leader considers this issue and accommodates language differences during complex negotiations. Team members may need to develop agreed procedures for avoiding misunderstandings and time wasting through misinterpreted instructions or information.

Overcome time and distance barriers: One of the most important pre-requisites for successful virtual working is the effective management of time and distance barriers. The "follow the sun methodology" allows the phased deployment of teams around the globe, and the increased use of collaboration and communication tools can facilitate more autonomous work, and yet also allow all team members to be in one virtual space during critical situations. Effective communication across time and distance barriers is essential to give team members a form of security (the feeling that they are not alone), and can be seen as the "project life-blood" of the team. Layng [4] found that communication was a key factor in the success of virtual teams.

There is a range of available technologies to support communication and co-working in virtual teams [16], which have seen increased deployment in the lockdown periods brought in as a response to the coronavirus pandemic. In addition to standard phone, texting and email, there are more sophisticated messaging services like Microsoft Teams, WhatsApp and Facebook Messenger. Video conferencing and meeting tools such as Skype and Zoom support virtual meetings across time and distance boundaries, and many of the standard project and document management tools will be used by virtual teams. Similarly, if virtual teams are interacting with the customer, shared access to customer files (probably via a customer relationship management system) will be necessary. The use of the Cloud to provide shared access to these software systems is an option.

Influence through horizontal communication: Many project leaders work with multi-functional teams drawn from different departments, without direct line management authority. Influencing skills thus come to be of particular importance, especially in virtual teams when there are limited opportunities for face-to-face meetings. The influencing of team members can take place through adopting elements of nonviolent communication (Observations, Feelings, Needs/Values, and Requests) to minimise escalation of disagreements and minor disputes among team members. Alistoun and Upfold [17] discuss how virtual team leaders can be trained to successfully influence team members, deploying computer-mediated communication, building trust, shortening subjective distance, sharing information, processing gains and losses, dealing with feelings of isolation, encouraging participation, and enhancing coordination and cohesion. If the leader can appear to communicate on the same hierarchical level as team members (horizontal communication), the leader is seen to be on the "same wavelength" as the team members, only revealing their true hierarchical position in urgent or emergency situations. Influencing team members is a topic which has an impact on team and work behaviour, and must be considered before and during the project, and constantly being improved upon by getting to know the team members.

To have social influence on team members, virtual team leaders need to use a range different communication technology to ensure a social presence [18]. The use of communication technology makes the virtual socialisation of team members possible, allowing leaders to assess their teams' capabilities, and receive, provide and accept feedback from their team members. For team members, it promotes a sense of connectedness to leaders, as well as allowing leaders to create a social presence [19].

These CSFs suggest the key issues for establishing a successful virtual team, but also indicate which factors are necessary for successful virtual leading. The tendency to work virtually is growing [10], and recent research reports an improvement in the effectiveness of virtual teams from less than 30% in 2006 [20] to 68% in 2016 [21].

IV. DEVELOPMENT OF THE V-CORPS MODEL

Based on the conceptual review of extant literature, this section presents an initial model for virtual leadership of teams in the automotive industry. It builds upon the Tuckman and Jensen [22] model for co-located teams which has been adapted to the realities of virtual leadership through the incorporation of new technical and human working aspects. In addition, elements of project management methodologies are incorporated into the five-stage model (Table 1). This takes into account a number of management challenges for virtual teams, including differences in employment and, occupational health legislation, norms regarding social interaction, a lack of mutual knowledge of context and access to dispersed knowledge, stress and fatigue issues, and data security [23] [24].

It is important to note the differences between co-located and virtual teams, and how they communicate to reach their goals. As pointed out by Berry [25], a co-located team is a group of individuals who interact interdependently and who are brought together or come together voluntarily to achieve

certain outcomes or accomplish particular tasks, and are able to have face-to-face conversations or meetings at any time. Virtual teams could theoretically comprise the same individuals as co-located teams, with the premise of working over the world and communicating through the use of information and communications technology. Virtual team members consist of individuals spread across geographies, cultures and time zones.

Managing virtual teams is different to, and more complex than, managing face-to-face teams. Virtual teams are groups of individuals that still share most of the characteristics and dynamics found in traditional teams. The challenge for virtual teams is in cultural differences, mentalities, work-settings etc., which are of significance for the virtual leader when influencing team members from a distance. Cortellazzo et al. [26] state that when focusing on behavioural norms, it is particularly important for virtual teams to have a clear definition of the norms pertaining to their use of communication tools, through which information flows and activities are performed. Berry [25] suggests that the effective management of virtual teams requires knowledge and understanding of the fundamental principles of team dynamics, regardless of the time, space, and communication differences between virtual and face-to-face working environments.

These considerations and the CSFs discussed above underpin the development of a 5-stage model for virtual leadership and management of virtual teams. The stages in the model (given the acronym V-CORPS) are outlined below.

Creating the team: To support virtual team members in achieving a high level of performance, some key considerations need to be taken into account in the creation of the team. The choice of the appropriate team members is vital – not only those that have the relevant work experience for project requirements, but also those that are able to work remotely, being self-motivated and independent [12]. The project manager has to make a pre-analysis of the team members and speak to their line mangers to get an impression of their ability to work in a virtual environment. This pre-analysis is essential prior to taking the next steps of team member selection, since virtual teams tend to be more sensitive to trust issues and the need for communication [27]. Caulat [20] concludes that people who are very process-oriented and structure-driven might be effective when managing the virtual process of communication between the members during a project, but might find it challenging to facilitate and participate in virtual meetings where spontaneity is required.

TABLE I. CSFS IN THE V-CORPS MODEL

CSF/ V-CORPS Stage	Creation	Organisation	Relationship Building	Performance Evaluation	Sign-off & Closure
Build trust	First impressions – preferably via a face-to-face meeting – are important in building trust.	Clearly define project tasks and responsibilities and assign roles for individual team members.	Conduct the "Big Five" analysis of each team member. Offer support in critical situations.	Performance evaluation underlines mutual dependence of team members in achieving successful project outcomes.	Acknowledgement of lessons learned and reflection on team leading can reinforce mutual trust and respect.
Create team structure	Explain and apply corporate policies for team working. Clarify expected outcomes.	Define and agree terms and conditions, project rules and team composition.	Introduce 'team working contract' and a team chat/forum to facilitate team communication.	Highlight the importance of the team structure in achieving project success.	Team dissolution. Creation of long-lasting relationships.
Avoid cultural and language barriers	Establish whether any cultural or language barriers exist.	Clarify support actions and steps to be taken in the event of language or cultural issues. Provide a common understanding of working posture and customer requirements	Equal treatment and support during breakdown of communication. Explain how and when to escalate properly to avoid time wasting.	Stress the importance of a standard work-culture across the team. Ensure that team performance comes before individuality.	Private contact data exchange (if desirable). Stay in touch with team members after project closure.
Overcome time and distance barriers	Investigate and evaluate implications of geographical differences and discuss how to overcome them.	Define ways of working to accommodate time and distance issues. Establish technology platforms to be used for virtual team operations.	Show dependencies between tasks and team members. Implement simulation procedures to avoid unnecessary product testing.	Review impacts of time and distance differences across the team. Adjust working practices accordingly. Provide appropriate training.	Avoid anxiety about separation and project closure.
Influence through horizontal communication	Round of interviews. Project manager treats team members as equals.	Highlight the importance of teamwork and the value of the project to the company.	Intervene only when necessary e.g., key decisions, supportive role, problem escalation.	Create a relaxed environment while focusing the team on specific project milestones. Avoid coercion.	Project evaluation. Encourage mutual support. Team members leave the project feeling appreciated.

 ISBN: 978-1-61208-797-9

Cross-cultural awareness is also necessary for team cohesion, influence and trust promotion. It is essential that the project manager be in place as the first team-building measure, with an overview of team member actions and reactions, especially during the team creation period. The project manager can assess how team members score against the project CSFs. Building trust, as Seshadri and Elangovan [28] note, is an interpersonal challenge faced by managers to foster collaboration with team members through communication and building relationships. Caulat [20] argued that, by working with cultures as diverse as Japanese, Indian, Swedish and Russian, she realised that cross-cultural awareness may help in understanding each other, but that it is certainly not sufficient for establishing a sound basis for the development of trust within the team. Although the pre-investigation of team members is essential, it is the first meeting where the project manager meets his team face-to-face, and can leave a positive, lasting impression, which can establish the tone and *modus operandi* for future project procedures [29].

Organisational structure implementation: Maintaining a uniform team structure before and during the project is an essential factor in avoiding time-consuming discussions regarding the *modus operandi* of the team. The organisation of virtual team structures needs special consideration, not only for the establishment of working procedures, but also regarding social aspects, and the avoidance of miscommunication or misunderstandings which can affect the entire team's behaviour. It is essential to sensitise each team member to the potential impact of social behaviour. This structure is significant in facilitating communication and knowledge sharing, which is more challenging than with face-to-face counterparts [14]. A clear organizational structure is also of particular importance when dealing with a complicated project environment that includes challenges in language, political climates, organisational policies, time zones, and cultures [30]. To counteract these challenges, it is essential to outline the CSFs for the project through the organisation stage and discuss each of them with the team members, to define rules for working with each other. The project manager may need to act as a moderator between the team members and intervene in critical situations (e.g. escalations between team members).

It is also essential to consider the language skills of the team members before and during the project process, because virtual workers with low language proficiency invoke apprehension and uncertainty in individuals [31]. The organisational structure can be used as the framework, within which issues can be tackled and team cohesion enhanced, and through which the project manager can discuss and explain what he/she expects from team members.

Relationship building: The team organization structure provides the starting point for relationship building between the project manager and the team members. Building relationships is the foundation of all teamwork, especially for virtual teams, and can help counteract the multiple negative aspects of working over distance [4]. It is necessary to confront prejudices about the working performances of the different nationalities of team members.

It is advisable that communication between the individual team members takes place at least two weeks before the start of the project [4], as this will, in the best case, enable the group to become more socially grounded through a personal meeting or by participating in "virtual water cooler communication", thereby increasing their loyalty to the group [32] [33]. This will support relationship building and similarities between the team members can be found before the project starts. It is important for virtual leading teams to create a social environment to promote team cohesion, which will be established through interpersonal challenges for the project manager and ensure that team members communicate with each other, build relationships and foster trust [27]. This builds commonalities, which creates sympathy, trust and encourage team spirit.

In the relationship building phase, a number of techniques can be used, such as Goldberg's Big Five model [34] for assessing and understanding personality traits. Project managers can try to analyse themselves and the team members to find out what kind of leadership is right for each member, and how to employ the right team member in the right position. This model is also useful for relationship building between team members, for working from a distance and improving mutual influencing effectiveness. The leader must not neglect the social behaviour of the team members, and one possible tactic here is to book a short slot at the beginning of each team meeting to speak about non-project themes. This gives an added value of trust, which can greatly improve team effectiveness and relationship building.

Performance evaluation: Leading a team during a project is an evolving and ongoing process. It is essential to update the team regularly and be responsible for enabling communication.

The more team members are up to date, the better their performance is, and the fewer miscommunications and misunderstandings there are. It is advisable to try to bring more personality and dependency to the virtual world.

It is also important to make clear to team members that their performance levels depend on each other, and to get them to consider what kind of impact their performance has on project outcomes and the company.

The quality and effectiveness of information exchange also impacts on team performance – used correctly, it can empower individuals, alter behaviour, and help develop a cohesive team.

The same is true for decision-taking, where team performance counts. Care taken by the project manager (for example in including all team members in certain decisions) can enhance the overall performance of the whole team. In virtual teams, language and mental barriers must be considered. Shared understanding of key decision options is important. Horizontal communication is essential, where team members get the feeling that they are on the same working level and can contribute to a discussion and decision.

Sign-off and closure: The bonding between team members during the project phases can create a form of psychological contract, which will reflect the social team influence of the

project manager, and that of the team members themselves. The dissolution of this contract is a key element of the project sign-off and closure stage, and it is an important aspect for the possible future creation of new virtual teams. King [35] defines a psychological contract as an individual's belief in the perception of reciprocal obligations between that person and another party. For working in a virtual team, this can be considered as a contract between team members, which is unofficial, but essential for the project.

The disbanding of the psychological contract will likely involve a meeting between the project manager and the entire team on site, when project completion meetings can be held with each team member. Project disbandment can be done in a virtual way, but psychological effectiveness, in terms of the appreciation of individual team members, is not as valuable as when there is a local presence face-to-face. In the final discussion, both positive and negative aspects of the project can be reviewed, and the further growth of the team in subsequent projects can be discussed. The project manager should also have their team ready at the end of the project to give some reflection and feedback on the project management process, so that negative aspects can be aired and reviewed.

V. CONCLUSION AND FUTURE WORK

In the final analysis, as Tuckman [36] concluded in his studies of group development, the outcomes from the performance evaluation stage will be critical to final project results. Nevertheless, other stages in the formation of a virtual team – for example, team structure development and promoting team cohesion – are an important part of the leadership process. This means, for the leader, that they have to bring the team to the most effective performance level to fulfil the project requirements [37]. It is also important that virtual teams are equipped with the process capability to respond to changes quickly and effectively [38].

This paper has built upon concepts discussed in the existing literature to identify five critical success factors for virtual teams and develop a provisional model (V-CORPS) for virtual team leadership and management, based on an adaptation of Tuckman's model for co-located teams to the virtual world. The CSFs have relevance to each of the five stages in the V-CORPS model (Table 1), and this can be used as a guideline and point of departure for those assembling and leading virtual teams. Future research will now apply, test and refine this framework. The model is being further developed through semi-structured interviews with 18 interviewees who are experienced project managers in the automotive industry (vice president, director, head of project management) as well as a number of team members (from, for example, purchasing, quality assurance and product development departments) working on international and global projects. In conjunction with the assessment of relevant literature, the analysis of the expert interviews will be the basis for the confirmation of critical success factors and validation of the model for leading virtual projects over distance.

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 ISBN: 978-1-61208-797-9