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Virtual Team Leadership and Operation in the Automotive Industry: Profile of a Research Case Study

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Abstract – **The impact of digitalisation on industry and society at large is huge and has parallels with the advent of the internet more than twenty years ago. In the automotive sector, companies are also confronted with the implications of the so-called megatrends of connected car, autonomous vehicles, sharing/subscription, and electrification, which are challenging current business models and working practices. This has brought about new approaches to project management practices, notably those relating to collaborating over distance between and within dispersed teams. Researchers and practitioners have started to think more comprehensively about the complexity of projects with virtual teams, and how best to manage them. This article is the result of the distillation of relevant literature relating to virtual teams and the analysis of in-depth interviews undertaken with industry experts. It puts forward a model (V-CORPS) for virtual team leadership and management. The authors believe these results can be of value in providing guidance for practitioners working in virtual teams, and as an analytical framework for further research studies in this field.**

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

I. INTRODUCTION

Recent research set out a provisional model for virtual project leadership in the automotive industry [1]. Here, this model – the V-CORPS model (Virtual – Create the team; Organise the team; Relationship building; Performance evaluation; Sign-off and closure) - is developed in more detail, and particular focus is put on the underpinning research process. The model is of particular relevance because of the globalisation of the automotive industry and the dramatic changes in underlying business models and ways of working that are impacting the companies in this sector. This has brought working in virtual teams to the fore, presenting new challenges for project management, such as projects being led from a distance, with dispersed team members. This has given rise to the concept of "virtual leadership" (or "e-leadership"), which focuses on the social influencing capabilities of leaders of virtual teams.

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 research project reported on here had 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. Deloitte [6] see this as consisting of four main trends - **C**onnected car, **A**utonomous vehicles, **S**haring/subscription, and **E**lectrification - for which the acronym CASE is often used. This is leading to major changes in many aspects of the industry's operations, where issues need to be resolved in parallel and at speed, often in different geographical locations. Effective operation through virtual teams will become of increasing significance.

This paper is structured around five main sections. Following this Introduction, Section 2 outlines the research methodology and positions the two research objectives addressed in this article. Section 3 then reports the critical success factors (CSFs) drawn from current literature relevant to the research aim. Subsequently, Section 4 discusses the development of the initial V-CORPS framework, which was mainly based on concepts from the extant literature. Section 5 then outlines how the model was further developed, enhanced, and validated through a series of expert interviews carried out between October 2020 to April 2021. The final section provides an overall conclusion to the issues discussed in the paper and suggests how the model could be further developed and enhanced.

II. RESEARCH METHODOLGY

Research design represents the structure that guides the appropriate research methods for the execution of data collection, and the subsequent analysis of the gathered data. In an initial stage, available literature in the automotive industry and in other industry sectors was investigated to ascertain current thinking on the leading and management of virtual

teams working on specific projects. Concepts and ideas from other disciplines were evaluated and adopted if deemed of value for leading virtual teams in the automotive industry. This was an integrative review [7] which aimed to synthesize areas of conceptual knowledge that could contribute to a better understanding of virtual team leadership and management, and lead to the development of an operational model.

An integrative literature review 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. This 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 models or methods.

The review of existing literature 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, which has now been progressed through primary research based on in-depth interviews with industry practitioners. A model of virtual project leadership in the automotive industry does not yet exist, and this research aimed to address this gap in the literature and in practice.
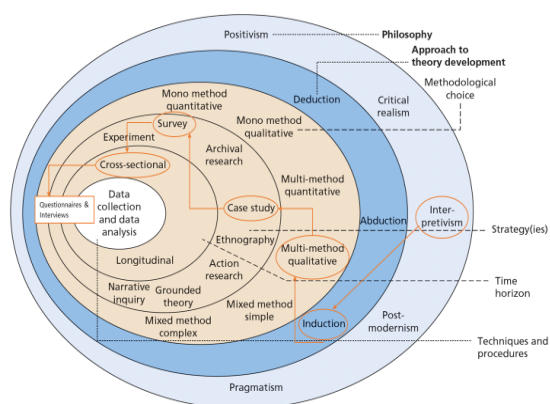

Figure 1. The research onion (based on Saunders et al. [8])

In terms of the methodological choices made for the primary research undertaken in the study, the "research onion" developed by Saunders et al. [8] provides a useful structure and guide to record elements of the methodology. The onion is separated into layers, each relating to an element of research method (Figure 1). The outer layer of the research onion refers to the philosophical position of the researcher, which in this case is interpretivist. This position allows the integration of humanistic qualitative methods and interests in a study [9], this being appropriate for research that considered the opinions and experiences of experts in the automotive field.

The next layer of the research onion indicates the approach used for theory development. Here, the inductive approach was chosen. Inductive reasoning is used when collective observations and experiences, including knowledge attained from other individuals and working practices, are combined to establish a "general truth" or acknowledged fact. The inductive approach was adopted in the analysis of empirical data, which was appropriate here because the model was built upon existing methods, experiences, and working practices relating to virtual team building and leading in the automotive industry.

TABLE I. ROLES AND RESPONSIBILITIES OF INTERVIEWEES

1. **Head of Product Innovation:** 25 years of work experience as a director of product development, with different teams and 22 product patents.
2. **Head of Project Management:** 26 years of work experience as project manager in the automotive industry.
3. **President EMEA:** 15 years of work experience as a Plant and Project Manager
4. **Vice President:** 21 years of work experience as a Product costing analyst
5. **Project Manager:** 7 years of work experience as a Project Manager
6. **Product Manager:** 6 years of work experience as a Product Manager in China
7. **Head of Product Innovation:** 18 years of work experience as Project and Product Manager.
8. **Vice President Business Development:** 20 years of work experience in sales and project development.
9. **President and CEO:** 30 years of work experience in Product development and strategic Project Management.
10. **Project Manager**: 15 years of work experience as a Project Manager in the automotive industry.
11. **Senior Key Account Manager:** 15 years of work experience in the sales sector.
12. **Product Certification Manager:** 19 years of work experience in programme management and product certification in the European and Japanese regions.
13. **Agile Coach:** 22 years of work experience in Project Management.
14. **Project Manager:** 10 years of work experience in the automotive area.
15. **COO EMEA Region:** 20 years of work experience in automotive engineering, and 10 years as a Managing director.
16. **Development Director:** 22 years of work experience in automotive engineering, and 16 years product development responsible
17. **Industry Representative in EMEA and CIS region:** 17 years of work experience, and 13 years in project management
18. **Product Manager:** 7 years of work experience as a Product Manager in CIS region

The aim was to create a model for virtual team building and leadership. A qualitative multi-methods investigation was pursued, which has its challenges, as different methodological traditions bring with them different communication traditions that are associated with different technical, rhetorical, and aesthetic criteria and norms. In an initial survey of views and perspectives, eighteen senior staff (Table 1) from a single automotive supplier were requested to complete a questionnaire, containing questions regarding the initial model and some open-ended questions. This was followed-up by semi-structured interviews to clarify the findings from the questionnaire. Yin [10] considers the interview as an important source for data collection, although the way in which an interview is conducted can be structured in several different formats. Here, the first step of this process involved the completion of a questionnaire by the interviewee, while

the second step used the questionnaire responses as the basis for discussion during the face-to-face interviews.

Using feedback from the initial round of interviews, the V-CORPS model was developed and enhanced. The model and the proposed activities and actions were then fed back to the interviewees, allowing the model to be refined and validated in a second round of interviews. In this sense, this was a research case study focusing on a single automotive supplier in Germany. The timeline was cross-sectional (commonly referred to as a "snapshot") and provided an insight into the current automotive working environment. The company is a part of a supply chain of a larger group, and is primarily responsible for the **E**urope, **M**iddle **E**ast, and **A**frica (EMEA) region. In 2018, the company had approximately 50,000 employees distributed over 98 production sites in 25 countries worldwide, with a turnover of €7.5 billion, as well as an annual investment in research and development of circa €1.2 billion. The company's language is English, and it works as a matrix organisation across a large geographical area and thus leadership over distance is of the utmost importance.

The company, in 2021, is engaged in more than twenty projects operating across the EMEA region, and with the increasing complexity of vehicles resulting in more complex and extensive projects, an expansion of different suppliers for vehicle projects overall is required for the OEMs. A centralised project work scheme is more time efficient for the OEMs, so that suppliers and sub-suppliers will be able to work according to the same project standards. This time efficiency is necessary due to the rigid time limits of development projects, which usually last for approximately 2 to 2.5 years, as both the complexity of the vehicles and component requirements have increased significantly.

In this context, the research objectives (ROs) addressed in the research and reported on here 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. 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 collectively 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. These may be seen as key concepts emerging from the integrative 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.

These CSFs are as follows:

Build trust: A number of authors, including Maes and Weldy [11] and Ford et al. [12], have emphasised that trust between leaders and their team members, as well as amongst 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 cohesion, and the gaining of trust is part of social influence for distance-led team members, as discussed by Scheunemann and Bühlmann [13]. 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 [11] [14]. Ford et al. [12] describe trust as the key to a capable virtual team.

Create a team structure: A team operating virtually, at a distance, needs to be underpinned and supported by a clear team structure. A team structure can engender intra-team communications 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 them to pursue individual and project objectives effectively. Klitmøller and Lauring [15] found that communication and knowledge sharing were more challenging in a virtual team environment than with face-to-face counterparts, and that a clear team structure was essential in overcoming these challenges.

Overcome 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. [16] 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 [13]. 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.

Manage 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, 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: Virtual teams are frequently multi-functional, composed of individuals and specialists drawn from different departments, with virtual leaders who often have no direct line management authority. Influencing skills are thus 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] discussed 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. BUILDING THE V-CORPS MODEL

The automotive industry operates globally and working with virtual teams has become an inevitability. Building a team that has to work virtually requires the main focus to be on people. The integrative literature review suggests that virtual team development and leadership can usefully be based on the team development stages defined by Tuckman [22] and Tuckman and Jensen [23] for small co-located teams.
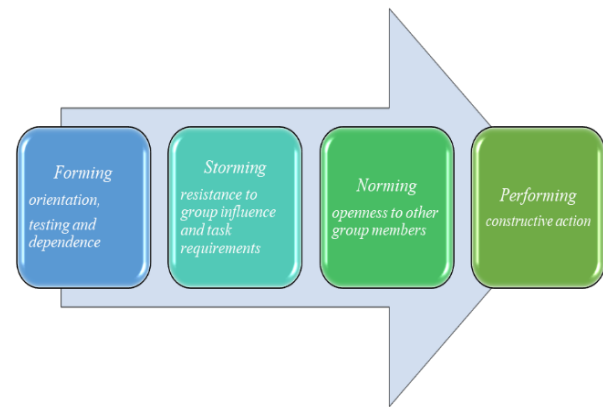

Figure 2. Stages of team development (after Tuckman [22])

The four stages depicted in Figure 2 can be seen as the group developmental process for interpersonal relationships between team members of co-located teams. In the first part of the model's development, interpersonal relationships and task activities are considered, resulting in a four-stage model in which each stage needs to be successfully navigated in order to reach effective group functioning [22].

TABLE II. TUCKMAN AND JENSEN'S GROUP STRUCTURE AND TASK ACTIVITIES [25]

Stages	Group structure	Task activity
Forming	Testing and dependence	Orientation of the task
Storming	Intragroup conflict	Emotional response to task demands
Norming	In-group feeling and cohesiveness development; new standards evolve, and new roles are adopted	Open exchange of relevant interpretations; personal opinions are expressed
Performing	Roles become flexible and functional; structural issues have been resolved; structure can support task performance	Interpersonal structure becomes the tool of task activities; group energy is channelled into the task; solutions can emerge

	Anxiety about separation and termination; sadness; feelings; towards the leader and group members	
Adjourning		Self-evaluation

Tuckman and Jenson [23] added one further stage – Adjourning - as a separate and distinct final stage in which separation of team members would be considered. The stages of development are not seen as a process, but more as a life cycle (Figure 3) for spin-off and reintegration of team members. Tuckman and Jensen [23] found that in groups where substantial amounts of activity take place, interpersonal relationships are developed, and group dissolution becomes an extremely important issue for many of the members. The authors developed the model to indicate, for each stage, a description of their associated group structures and task activities (Table 2). The group structures were seen as "the pattern of interpersonal relationships - the way members act and relate to one another", whilst task activities were "the content of interaction as related to the task at hand" [25].

Tuckman's model has some limitations. It was developed with therapeutic groups in mind, and its interpretation and application in other working environments is challenging. Cassidy [26] notes that the Storming stage in particular may not be clearly defined for practitioners outside of therapeutic groups. It is thus difficult to apply directly to daily working lives and needs to be customised for individual team development situations. The model also does not consider how team personnel may change over time and the steps that must be taken to introduce and integrate new team members, which is particularly challenging when a project is at an advanced stage [27]. The objective of the research, therefore, was to attempt to adapt this model to the automotive industry, and at the same time to interweave the CSFs discussed above into a new adapted framework, customised for this industry sector.
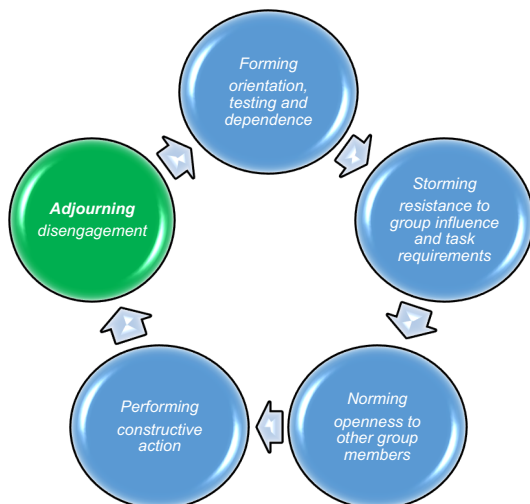

Figure 3. Tuckman and Jensen's Group Development Lifecycle [23]

The initial framework (Table 3) looked to build upon the CSFs identified in the literature and incorporate some of the thinking evident in Tuckman's model. In addition, elements of project management methodologies were incorporated into the five-stage model, which also takes into consideration a number of management challenges for virtual teams – such as differences in employment and occupational health legislation across different countries, norms regarding social interaction, a lack of mutual knowledge of context and access to dispersed knowledge, stress and fatigue issues, and data security [28] [29].

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 [30], 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. [31] 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 [30] 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 underpinned the development of the initial 5-stage model for virtual leadership and management of virtual teams. Using indicators evident in the existing literature, some initial key activities were assigned to each cell in the 5x5 matrix (Table 3). The stages in the model 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 consideration 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. The project manager has to make a pre-analysis of the team members and speak to their line mangers to get an impression

TABLE III. THE INITIAL 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
Overcome 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
Manage 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

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 [32].

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.

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 [33] 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 [34].

Organising the team: 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 [17].

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 [35]. 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 [36]. 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 [37] [38]. 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 [32]. 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 [39] 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 [40] 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.   MODEL DEVELOPMENT AND VALIDATION

The V-CORPS model was developed and refined in a series of stages. A questionnaire was designed to reflect the initial V-CORPS model and emailed to eighteen experts, all with relevant experience in project management (Table 1). The questionnaire contained eight questions relating to the initial model and respondents were asked to give their views on its contents. Some used a Likert scale [8] allowing respondents to register their level of agreement or

disagreement with certain statements relating to the model. The questionnaire concluded with questions aimed at identifying whether or not some CSFs were necessary for the final build of the model, and to further understand the value of these CSFs in the experts' opinion. This feedback provided an indicator of support or otherwise for the general direction of travel embodied in the model, and of the possible future development of the activities at each stage (Table 4). It gave a clear picture of the views of the experts regarding the challenges of virtual project management, and the obstacles of virtual team building and leadership in the automotive industry. In addition, it also became clear that secondary aspects such as capacity bottlenecks and time-critical project milestones are particularly important in a virtual environment and can undermine project success. The answers in the questionnaire also highlighted how strongly the experts felt a duty towards their team members and their commitment to playing the main role in a functioning project.
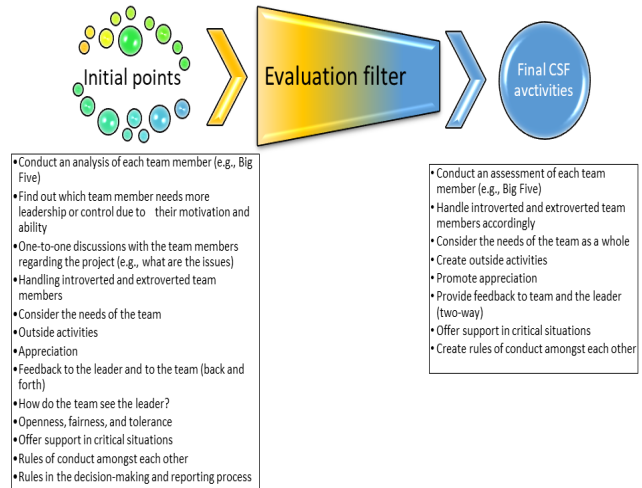
TABLE IV. INITIAL QUESTIONNAIRE FINDINGS: ORGANISATION STAGE

Question	Outcome	Finding	Research action
Organisation Stage			
1.	94.4% positive feedback 5.6% negative feedback	A clearly-defined role in a team for each team member promotes team cohesion and trust improvement	Definition of roles in a team is a part of trust building which must be implemented in the model
2.	100% positive feedback	Adherence to project rules and procedures is important	To be implemented in the model and considered as a critical factor
3.	100% positive feedback	Team has to know how to escalate when necessary	The model must indicate that the leader needs to clarify the escalation process
4.	94.4% positive feedback 5.6% negative feedback	The definition of working guidelines is important in virtual teams	This must be evidenced in the model
5.	88.3% positive feedback 5.9% no opinion 5.9% negative feedback	Emphasising the team is one unit is important for the team in the early stages	Clarify regarding this CSF in the model

Overall, the experts showed a keen interest on the V-CORPS model, and this provided a basis for subsequent discussion in one-to-one interviews to flesh out further suggestions and recommendations relating to each cell in the matrix – trying to garner as many ideas as possible for activities that would typically be required across a virtual project. This produced a significant number of new ideas and activities for each cell in the matrix, which were recorded in the model, cell by cell. In a second round of interviews, this material was then presented back to interviewees for discussion and prioritisation, thereby providing the basis for a filtering process (Figure 4), which identified the activities that were generally supported by the experts for each stage in the model. The final operational V-CORPS model (Table 5) was again returned to interviewees for final comment and ratification.

Figure 4. Example of activity reduction in the relationship Building Trust stage for the Building Trust CSF

This represented the final step in a research process that comprised six interlinked steps, each of which was undertaken sequentially (Figure 5). Research was based on a survey conducted in a single company, but due to the selection of experts (from line management to the CEO) a wide range of data was obtained. The interviews were analysed through data reduction and coding. These were summarised in the form of statements and implemented in the model's development. The conceptual framework was validated through a survey and semi-structured interviews with eighteen experts. These data were used to create a preliminary operational V-CORPS model, which was then tested and validated via a follow-up survey with six experts.
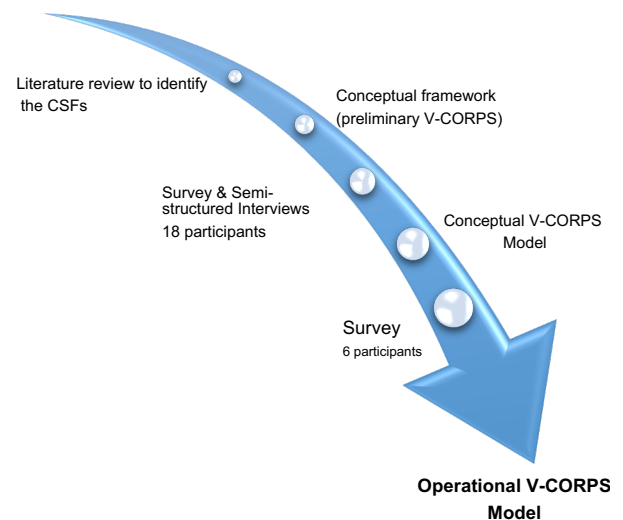

Figure 5. The V-CORPS model development and evaluation research process

VI. CONCLUSION

The research project reported upon here has now successfully addressed the two main research objectives noted above. Analysis of the existing literature was used as the basis for the development of five CSFs for virtual teams. Then, by taking some of the principles and concepts from Tuckman's staged model for group facilitation [22], and combining them with the CSFs, a new model for virtual team operation in the digital era was developed, refined, and validated. The CSFs have relevance to each of the five stages on the V-CORPS model, which can be used as a guideline and point of departure for those assembling and leading virtual teams. This will require new ways of working and a change in management culture and can best be viewed as what Chan Kim and Mauborgne [41] call "non-disruptive creation." They suggest that, compared with disruptive change in business models, "non-disruptive creation opens a less threatening path to innovation for established companies", and that "it doesn't directly challenge the existing order or the people who make their livelihoods based on it" (p.9).

All stages on the V-CORPS model are important, but as Tuckman [25] concluded in his studies of group development, the outcomes from the performance evaluation stage will be critical to final project results. This means, from the leader's perspective, it is necessary to bring the team to the most effective performance level to fulfil the project requirements. Team creation, team organisation and relationship building are all of significance in supporting and progressing this objective. It is also important that virtual teams are equipped with the process capability and technology support to respond to changes quickly and effectively [42].

This research clearly has its limitations. It is based primarily on a set of interviews from one company in the automotive supply chain, and project realities in other industry sectors will vary in some regards. This suggests testing and development of the model in other corporate environments, in which virtual projects play a significant role, would be worthwhile. This could include not only other automotive companies, but also other industries involved in product development using globally dispersed resources. As globalisation and the widening application of digital technologies changes working practices, frameworks like the V-CORPS model that provide guidance on the process and people aspects of change management will be of increasing relevance and value.

TABLE V. THE VALIDATED V-CORPS MODEL

CSF/ V-CORPS Stage	Creation	Organisation	Relationship Building	Performance Evaluation	Sign-off & Closure
Build trust	• Get first impressions (Face-to-face or video meeting) • Be prepared to answer questions from the team • Facilitate introductions to each other (What am I good at?) • Get to know each other through games (Common first task) • Offer help as requested	• Get a first impression from the respective team members and show appreciation • Show trust in the team and the project • Find out each team member's expectations • Create an outage plan • Promote mutual assistance in the team • Connect through social media • Create a WhatsApp group	• Conduct an assessment of each team member • Handle introverted and extroverted team members accordingly • Consider the needs of the team as a whole • Create outside activities • Promote appreciation • Provide feedback to team and the leader (two-way) • Offer support in critical situations • Create rules of conduct amongst each other	• Outline the importance of reliability between team members and the dependency on performance • Review the concerns of team members identified in the relationship phase (appreciation) • Create commitment • Show the consequences of subtasks for the whole team • Create compatibility • Use Agile project planning tools	• Acknowledge lessons learnt, reporting results into the company • Recognize the team's achievements and celebrate them • Get constructive feedback in both directions (360 ° feedback, no negative emotions) • Leave a positive impression • Admit mistakes openly • Use virtual meetings & Big data analyses
Create team structure	• Address corporate policies • Develop vision and mission • Explain project scope • Address project guidelines and values • Highlight the common goal and the expectations of the team and the leader • Create a team charter, explaining why people are there and what to expect	• Assign roles for individual members • Discuss working methods • Determine meeting culture • Address consequences in case of non-compliance • Provide understanding of exceptions for special cases • Highlight importance of completing tasks on time and communicating when not • Set technology standards, procedures, and guidelines. • Organise standard IT training programme	• Agree working practices • Establish communication channels and technical team communication • Create on-site visits (if possible) • Create regular meetings (15 min stand up meeting if possible) • Promote mutual support • Create virtual face-to-face meetings and a chat/forum • Call instead of email! • Create rules for the decision-making and reporting processes • Present the effectiveness through cloud computing	• Highlight the importance and the effectiveness of the project structure • Create project goals and regular effectiveness reviews • Create measurement and key indicators for the team • Consider retrospective issues (are there points that have crept in that stand in the way) • React to changes quickly! • Reduce reactive work	• Ensure smooth team dissolution • Create a long-lasting relationship • Write letters of recommendation • Show consideration for each individual team function • Build / enlarge network
Overcome cultural and language barriers	• Identify cultural or language barriers and address them • Ensure common language • Organize cultural training – and use as an ice breaker • Build confidence from the first stage	• Observe company guidelines and policies • Define support actions and the steps to be taken should an issue arise • Identify and support language weaknesses • Take away the fear of communicating with the leader • Explain work organization correctly • Emphasise that private views have no place in professional life • Create cross-cultural seminars • Active mobile use	• Develop corporate identity • Intervene in an emergency • Create consequences for certain actions • Appoint a mediator who understands the culture and will support you as a coach • Exemplify professional and equal treatment in the team	• Stress the importance of work-culture • Ensure that performance comes before individuality • Avoid pack formation in the team • Promote team spirit across locations • Characterize discipline • Respect Individuality	• Exchange (if desirable) private contact data • Stay in touch with team members after project end • Create an individual farewell according to cultural customs and norms • Maintain on-going network • Stay connected through social media
Manage time and distance barriers	• Introduce and regulate technology deployment • Investigate means of communication (are we up to date?) • Define communication channels (usual times) • Address hardware and software resources for the team • Develop regular exchange of information (weekly feedback) • Define team planning (how do I use the team members to save my time)	• Define the use of working tools for the project • Define the preparatory work to avoid time loss due to time differences (e.g., Follow the Sun methodology) • Define processes, methods, documents, with templates as appropriate • Make special tools available for certain functions • Define working time windows • Analyze distribution of working hours • Define time for communication • Organize training if necessary • Offer help (mutually)	• Show dependencies between tasks and team members • Ensure that team members can rely on one another • Develop regular results review • Increase promotion of understanding • Offer support with prioritization • Underline that the behaviour of an individual influences team results • Create flowcharts and solution paths • Present Big Data analyses	• Demonstrate ways of working that avoid wasting time • Specify tools for teamwork in detail • Emphasise that methods and procedures must be known and followed • Work on training courses and problems in a team • Work in a way that promotes quality • Present the effectiveness of cloud computing	• Avoid anxiety about separation and ending • Promote contact retention • Offer perspective wherever possible • Give self-confidence • Give outlook for possible future projects and cooperation
Influence through horizontal communication	• Create round of interviews • Champion working in a collaborative way • Develop flat hierarchy • Distribute roles and responsibilities • Show openness for social media • Present Agile Methods	• Highlight the importance of teamwork (One team = One unit) • Develop equality (equal treatment for all team members) • Create understanding and acceptance by the team that the leader has overall responsibility • Develop 'acting as a team' (get through success and failure together) • Give positive feedback where possible • Address errors openly	• Intervene only when crucial e.g., key decision making, supportive roles, and escalating situations • Maintain self-control • Keep calm (no heated actions) • Create a pastoral care function • Be consistent in using the virtual meetings technology	• Create an environment where the team can focus on project milestones • Avoid increased workload • Always motivate to communicate • Establish an environment based on trust • Function as a role model	• Ensure team members leave the project feeling appreciated • Encourage mutual respect after project completion

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