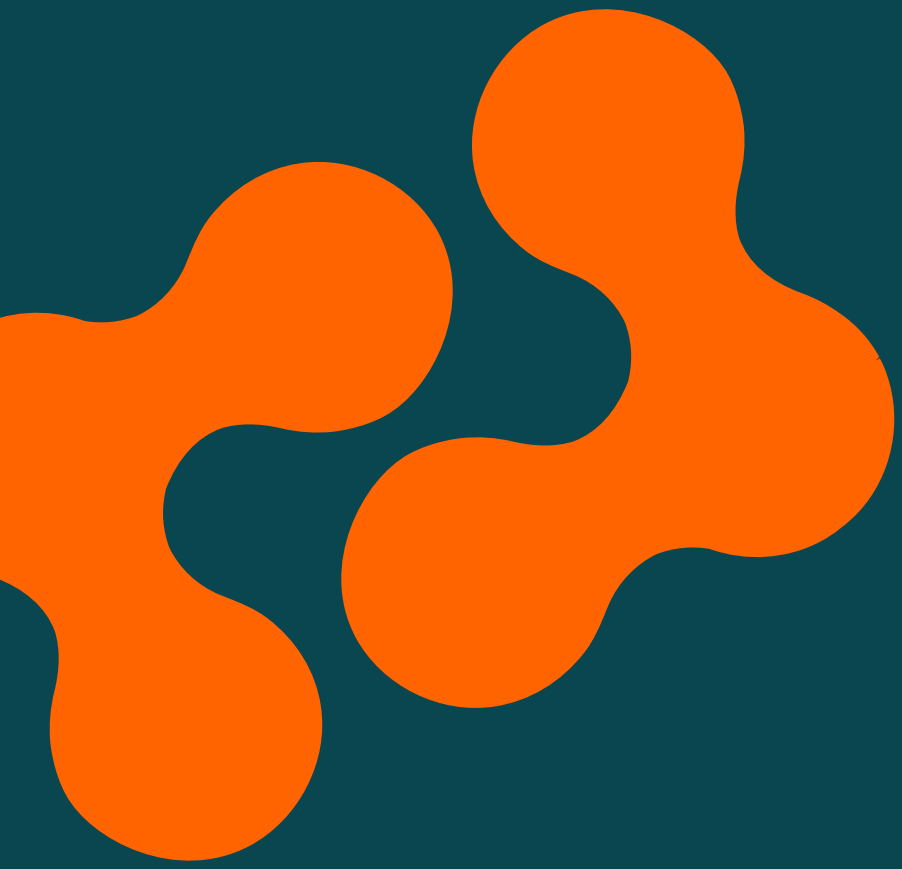

Collaboration Engineering

The ultimate solution or increased complexity?

November 2023

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The automotive industry is currently in a state of change. With the provision of different drive platforms, the sharp increase in software complexity and networking (software defined vehicle) and the further development of ADAS (Advanced Driver Assistance System) functions, many development organizations are at their limits. Added to this is the demand for greater development speed (Chinese speed). This development motivates new, expanded, deeper collaborations between equal partners (e.g. two OEMs) that go beyond a classic OEM-supplier relationship to be able to respond to current challenges and position themselves strategically by pooling knowledge and resources. By focusing jointly on a project objective, burdens (e.g. development costs) can ideally be shared equally between several shoulders and innovative solutions can be developed through concentrated know-how.

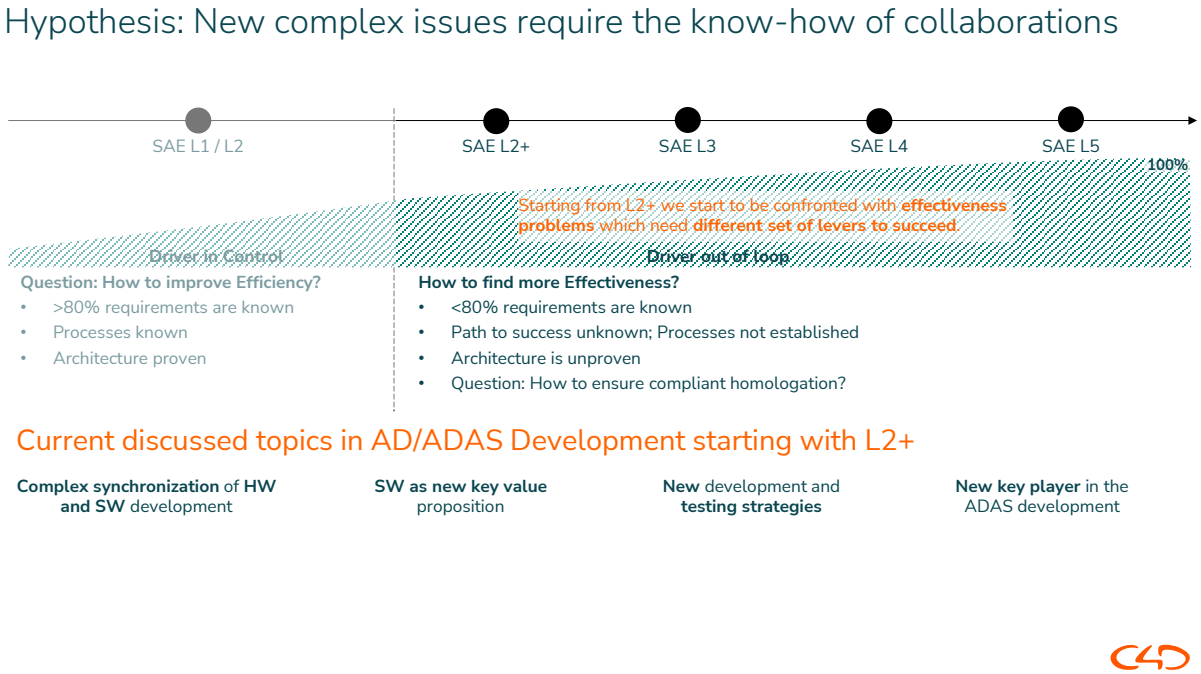


Figure 1: Challenges related to AD/ADAS development

With the electrification of vehicles, new car manufacturers are entering the market and development times are being drastically shortened. In addition, customer needs are changing towards the experience and less in relation to the installed hardware or the gap dimensions. These factors are forcing the industry to rethink. But what makes AD/ADAS development or new drive variants so complex and creates such a strong demand to collaborate with competitors? With the start of the development of automated cars, a new development path has begun for traditional OEMs. In this new world, the driver no longer has complete control, and the question of liability must therefore be redefined. The development as well as the associated verification and validation of vehicles requires new innovative approaches.

In addition, questions arise regarding implementation options for the synchronization of hardware and software development or how development can do justice to the new significance of driving functions.

In general, the requirements for components and functions are not fully known at the start of a vehicle development project and therefore cannot be formulated in a classic specification sheet when it comes to mapping a classic supplier relationship.

The increasing demand for innovative, new development solutions is encouraging a rethink towards the formation of collaborative partnerships at eye level and away from traditional OEM-TierX supplier relationships, in which the focus is on processing traditional specifications. The joint struggle for the best solution can represent a clear competitive advantage.

The aim of this white paper is to work out which levers are conducive to successful collaboration and which factors can lead to the failure of collaboration. Through our C4D project work, we have found that it is usually not a lack of knowledge carriers that makes a project a success, but rather that the knowledge carriers are not capable of working together. Based on the analysis of the background, we present the C4D collaboration toolkit derived from this, which presents a wide range of methods and collaboration models as levers for successful collaboration that we have successfully tested in many projects.

The origin of collaboration engineering

At the beginning of the paper, the history of collaboration engineering is examined, because collaboration engineering has not only existed since today - but an also brief excerpt on the development of various definitions is presented below (Figure 2).

The collaboration of people has occupied researchers from different disciplines for decades. It is therefore difficult to find a universally valid definition that covers all research approaches. Based on the evaluation of 331 publications and studies on the topic of collaboration engineering, De Vreede and Briggs[1] have succeeded in developing a definition that reflects the approach of previous research in the field of collaboration engineering.

> "**Collaboration Engineering** is an approach for the **design** and **deployment** of repeatable collaborative work practices that can **be executed by domain experts without the ongoing support** of external collaboration professionals."[2]

[1] Gert-Jan de Vreede & Robert O. Briggs (2019) A Program of Collaboration Engineering Research and Practice: Contributions, Insights, and Future Directions, Journal of Management Information Systems, 36:1, 74-119, DOI: 10.1080/07421222.2018.1550552
[2] Ibid.

This definition describes that collaboration engineering can be used for the development and application of repeatable tasks.

In addition, according to De Vreede and Briggs, no experts are needed in the field of collaboration, as the working practices can be learned independently of experts and then implemented and passed on.

This original definition emerged with the improvement of internal collaboration and team structures in companies. External collaboration experts supported the teams and thus generated value and celebrated successes together with the teams by applying the methods.

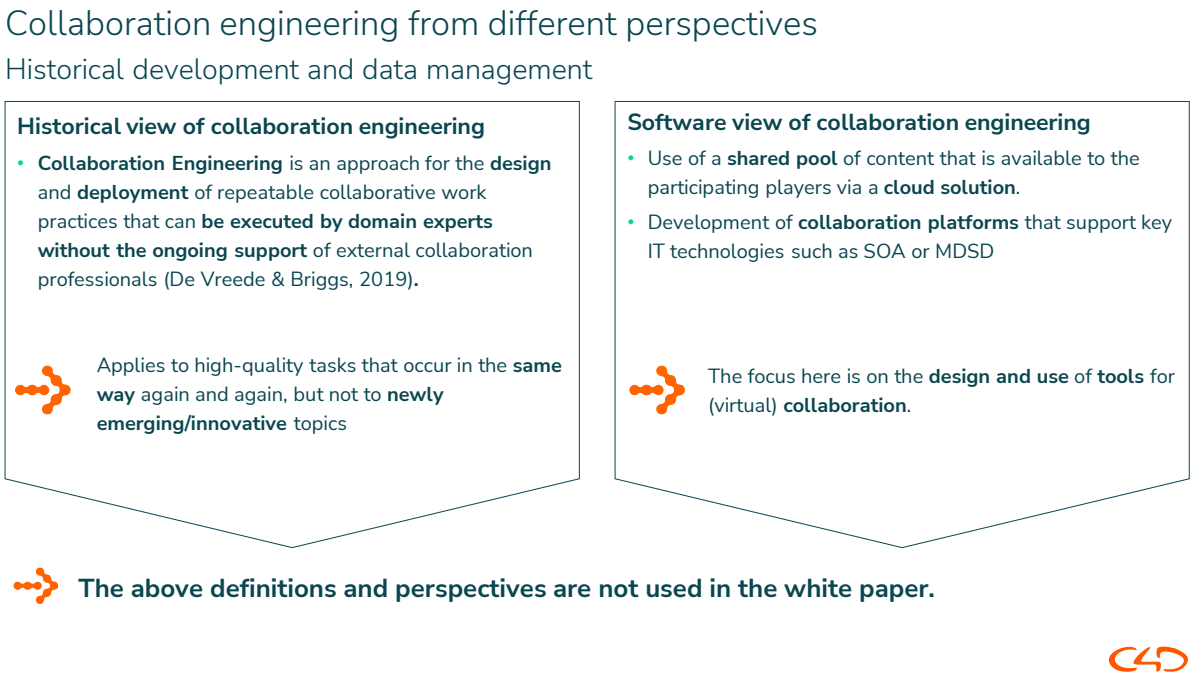


Figure 2: Different definitions of collaboration engineering

The know-how and qualifications of collaboration experts made it difficult for companies to employ them. As a result, approaches were developed to anchor collaboration engineering in the company even without the permanent support of experts in the teams, which also gave rise to the definition above.[3]

However, the individual components of the above definition cannot be applied without restriction. According to De Vreede and Briggs, collaboration engineering is the development and application of practices in repetitive (and known) activities. This condition does not fit with constantly changing innovative issues that arise, for example, in the context of AD/ADAS development or regarding the transformation related to vehicle electrification.

[3] Gert-Jan de Vreede & Robert O. Briggs (2019) A Program of Collaboration Engineering Research and Practice: Contributions, Insights, and Future Directions, Journal of Management Information Systems, 36:1, 74-119, DOI: 10.1080/07421222.2018.1550552

In most cases, companies are not familiar with the tasks that arise here, which requires them to adopt new approaches. The focus is therefore by no means only on repetitive and recurring activities. For the planning, testing and implementation of collaboration processes for one-time tasks, however, the relatively high effort required for collaboration engineering [according to the definition above] would be disproportionate. This results in the need for a more extensive definition that is tailored to the innovative and volatile requirements in the automotive industry.

Collaboration engineering from a software perspective

Developments during digitalization and Industry 4.0 have had a major impact on almost all areas of daily life as well as on companies and their working methods. As a result, collaboration engineering has also been expanded to include the "software" component due to the spread of new digital technologies. Collaboration engineering refers to special software that is used as a collaboration tool. Cloud solutions are used to store content in one place that can be used by all participants. This shared pool of content simplifies collaboration between stakeholders from different companies and locations. The use of key IT technologies drives the development of collaboration platforms and thus also facilitates data management during collaboration. The model maintenance of a future product can serve as an example, in which the "digital twin" technology is used during development, the test phase and maintenance. The data exchange and information about this product are available to those involved in real time and can be accessed as required.

Further definition for innovative issues

As a basis for the further procedure in this white paper, it is necessary to introduce a definition for narrowing down the topic of collaboration engineering from the perspective of C4D. The basis for this is the definition from a study conducted by the Federal Ministry for Economic Affairs and Climate Protection as part of the PAiCE technology program:

> "Collaborative engineering is a special form of **cross-company cooperation** that can take place in different phases of the life cycle of engineering systems, products, services and processes. Collaborative engineering is characterized by the **parallel, joint work of several players** (engineers, technicians, and computer scientists), who are usually distributed across **different companies.** The typical motivation of collaborating companies is to **gain a competitive advantage** in terms of **innovation or efficiency**.

This definition outlines the most important principles of cross-company collaboration and the joint work of various players to achieve competitive advantages and efficiency gains.

Based on this definition, C4D's understanding of collaboration engineering is also justified:

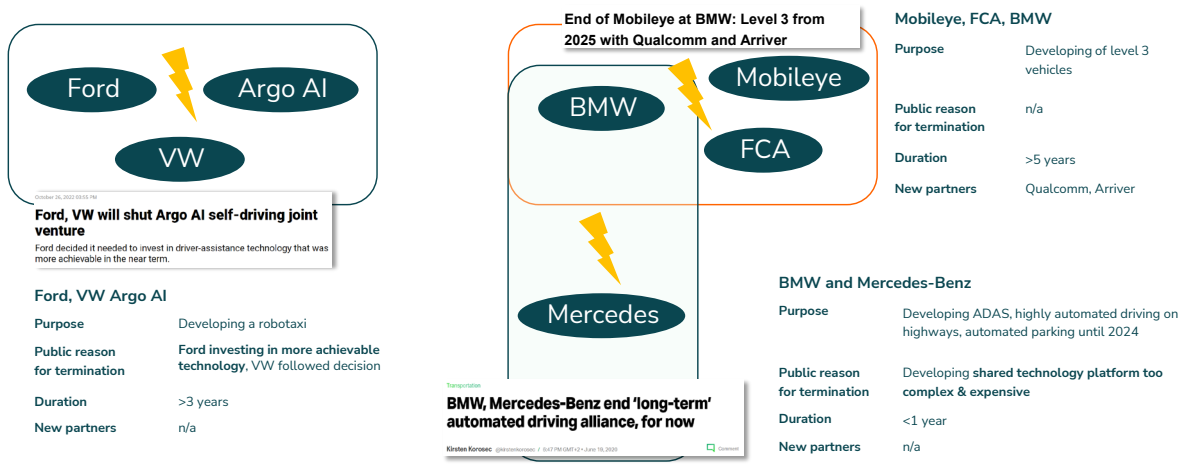
"For C4D, **collaborative engineering** is the development of a **joint business model** between at least **two partners with joint projects** and an equal say in terms of content."

Reasons for the failure of collaborations

Although there have been and still are many successful collaborations in the automotive industry that have led to innovations and new developments, the past also shows that collaborations dissolve without having achieved the publicly set goal.

Collaborations are no guarantee of success

Examples of failed collaborations in the AD/ADAS sector



Source: https://europe.autonews.com/automakers/ford-vw-will-shut-argo-ai-self-driving-joint-venture, https://techcrunch.com/2022/10/26/ford-takes-2-7b-hit-on-argo-shutdown-shifts-its-bet-to-driver-assist-tech/, https://t3n.de/news/fuer-mobileye-bmw-level-3-ab-1458912/, https://techcrunch.com/2020/06/19/bmw-mercedes-benz-end-long-term-automated-driving-alliance-for-now/

Figure 3: Overview of failed collaborations in the AD/ADAS area[4]

As depicted in figure 3, OEMs have formed collaborations with partners from various industries in the past. By sharing know-how and resources in particular, the partners involved hope to achieve leaps in development in the field of autonomous driving.

However, even if the collaborations - as shown in figure 3 - lasted for several years in some cases, the partners decided to end the collaboration. The reasons for the termination of the partnerships, publicly disclosed, are manifold.

[4] Sources for the illustration: https://europe.autonews.com/automakers/ford-vw-will-shut-argo-ai-self-driving-joint-venture
https://techcrunch.com/2022/10/26/ford-takes-2-7b-hit-on-argo-shutdown-shifts-its-bet-to-driver-assist-tech/
https://t3n.de/news/fuer-mobileye-bmw-level-3-ab-1458912/
https://techcrunch.com/2020/06/19/bmw-mercedes-benz-end-long-term-automated-driving-alliance-for-now/

The main factors for failure described below, which have been identified based on C4D project experience, by conducting expert interviews and through secondary research (figure 4), summarize the most important ones.

Figure 4: Reasons for failed collaborations

Disagreement on goals and strategies

One of the main reasons why collaborations do not work is the lack of a coherent strategy, both internally and together with the collaboration partner. If the collaboration partners pursue different interests and **no common development goal** with a resulting product and a long-term planned business model, a possible result is that the **collaboration** was **entered into by one side for political reasons** and is dissolved after a know-how transfer has taken place without achieving the actual collaboration goal. It is of course still possible to enter a collaboration without a common goal and with different interests if the discrepancy between the partners was communicated transparently in advance.

The **early planning of a budget** at the beginning of a collaboration is often not considered. Instead, there is an expectation that the project should start as soon as the contract is signed. However, if no budget is planned for resources and the necessary new collaboration tools, there will be delays right at the start, which will damage a trusting working relationship.

Lack of communication and coordination

Practical experience and project experience have shown that a lack of communication and coordination in collaboration can lead to the failure of a project. The **lack of clarification of responsibilities** and no binding **designation of topic owners** who are responsible for a topic is a key factor in ineffective collaboration. It is often not considered that new communication channels must be developed between the parties and that these must also be sufficiently practiced by all project members.

Failure to schedule project coordinators often means that there is no improvement in compliance with the new communication channels and a lack of transparency regarding the progress of tasks.

Lack of transparency and trust

Collaborations are based on a partnership with at least one other partner, usually initiated by the management. However, the operational work takes place at working level between the two partners. This is a challenge if the **working level does not communicate with the management level** in **a trusting manner** and the necessary early escalations do not take place. It is also noticeable that there is often a lack of common understanding about the progress of the project, as **meaningful KPIs** have not been **jointly developed.** As a result, there is no transparency about the project status, which means that both early recognition of obstacles and a joint, consistent escalation to the management of both parties are not possible. The **lack of beacons in management** who actively promote the collaboration needs within the respective company and are strategically behind the project is a further amplifier here.

The **corporate culture** also has a central influence on trust and transparency. If the corporate culture of one or both partners is characterized by mutual blame and therefore without a "problem solving culture", this also has an impact on openly addressing problems within the collaboration. Instead of talking openly and at an early stage about challenges and hurdles to find a solution together, regardless of who initially triggered the problem, there tends to be mutual "ammunition".

Lack of ability to adapt to new requirements

Innovative projects that require the collaboration of several companies operate in a **rapidly changing and volatile world** today. To survive here, companies need to be **able to adapt and react quickly.** If one (or more) company has problems with this, whether due to slow or outdated processes, long decision-making processes, or a lack of willingness to react quickly, collaborations can fail. To adapt to constant changes and ever faster product development cycles, a company must acquire special know-how and **anticipate** emerging **trends**. Partnerships dedicated to the development of innovative products can only succeed under these conditions.

Introducing new collaboration models without considering the right tools, processes and skills.

New and unfamiliar collaboration models are often introduced for companies at the start of partnerships. It is particularly important to **adapt** these models to the specific situation and the concrete project ~~and~~ to pick up the employees who are to use these models. Collaboration models in large projects can only work if the **right tools and processes** are used to ensure maximum tool-side support.

The introduction of new collaboration models therefore requires holistic preparation - new processes must be developed both internally and with the collaboration partner and joint tools must be established as a "single point of truth". However, project practice shows that **not enough time** is invested **in the preparation** and therefore an effective tool set-up and collaboration processes are lacking.

In addition, when selecting **project members,** it is often not considered that they **not only** have to **contribute professionally**, but that the introduction of a collaboration project also makes them part of a major change project and therefore **requires soft skills**, such as the flexibility to adapt to new processes and internalize them.

Success factors in collaboration engineering

To address and circumvent the challenges in collaborative partnerships at an early stage, a number of tried and tested elements for collaboration projects can be derived from practice, which strongly favor successful collaboration.

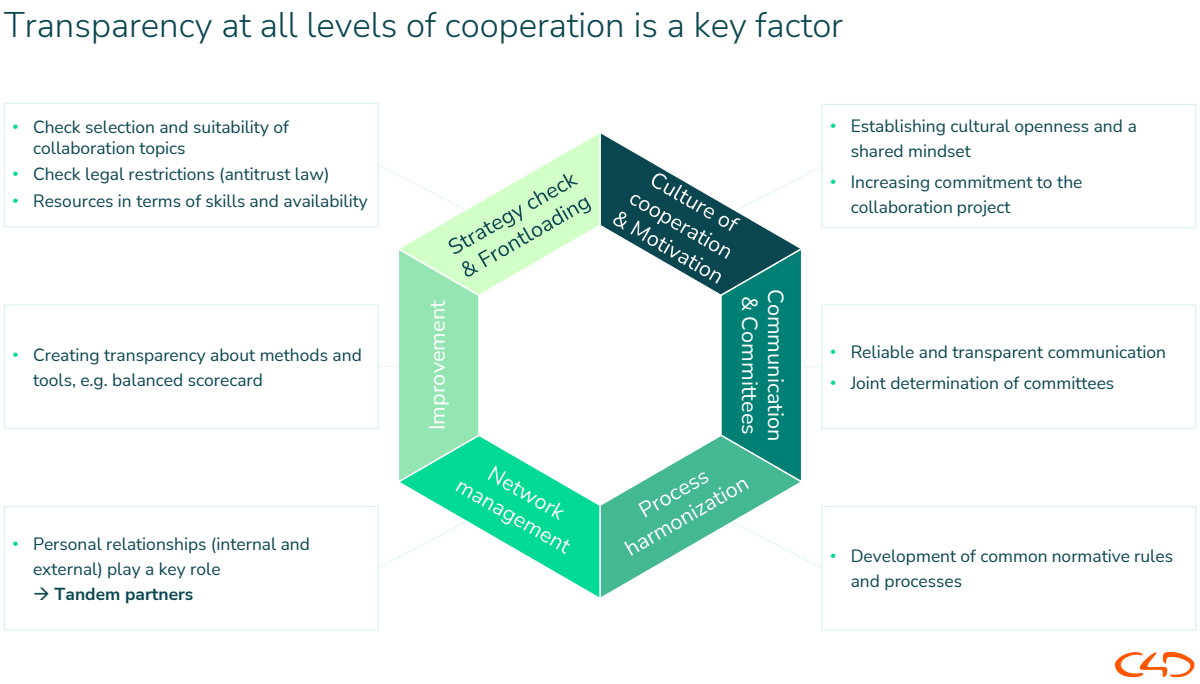


Figure 5: Recipes for success for collaboration projects

Strategy check & frontloading

To start a collaboration **successfully** right away, it is advisable to carry out a **strategy check.** This involves analyzing the collaboration topic(s) and assessing their suitability.

An important task here is to define the collaboration topic to create a **transparent and clear basis for cooperation.** Legal issues, such as antitrust requirements, must also be considered when collaborating between groups or correspondingly large companies.

Within the company and between the partners, the necessary framework conditions and topics should be defined as far as possible at the start of the project. One example of this is the topic of project resources - here, emphasis should be placed on special know-how and skills that a company already possesses and can contribute to the partnership. It is also essential to **clarify availabilities** in order to start planning the collaboration and ensure transparency regarding the time horizon of the project. To ensure that **responsibilities** are **defined** at an early stage, it is advisable to clarify the definition of required roles and **the job split** directly at the start of the project or during the contract phase. The job split can be carried out using the classic RASI creation method.

Motivation and culture of cooperation

Another key factor that can contribute to the success of a collaboration project is the **motivation of all those involved and the establishment and intensification of a culture of cooperation** between the partner companies. Involving employees of the project partners in the planning of a collaborative project at an early stage has a positive effect on motivation. Employees' questions can be considered, which increases their commitment to the collaboration project. The development of **cultural openness** is also essential for **trusting collaboration on an equal footing.** This means that companies are prepared to adopt and integrate parts of the collaboration partner's culture to develop a **common mindset** that promotes joint collaboration and mutual trust in the projects.

Communication and committee management

Effective collaboration between partners requires **reliable and transparent communication** not only between the partners, but also within the company. Sharing information is necessary to direct the focus of those involved towards the **shared vision.**

In this context, the formation and **joint definition of committees** also plays a decisive role. Here, communication about the **objective of a committee, its participants and its powers** are of essential importance. When defining the area of responsibility of a committee, it is necessary to differentiate between discussion meetings and decision-making meetings to ensure efficient work.

Part of the committee formation is the consideration of effective escalation management within the partnership.

The aim here is to establish an escalation management system that offers rapid support and can make the necessary decisions in a targeted manner, thus **avoiding apportionment of blame**.

The defined responsibilities and roles are a key input variable in the structure of committee and escalation management.

Process harmonization

When two previously independent companies enter a partnership, they have different processes and procedures at the beginning. As part of the collaboration, it is important that the partners agree on which processes need to be jointly defined, work these out at an early stage and clarify how they are to be implemented in the project team.

In addition, internal company processes must also be adapted, as a new stakeholder enters the process world with a collaboration and the interfaces to the internal processes must be redefined.

Network management

When people work together, **personal relationships** play a key role. This can be applied to work in collaborative projects with different partners. Project progress is based on trusting and transparent cooperation between the partners as well as internally. Establishing **tandem partners** in the respective partner company makes a positive contribution to networking and intensifying personal relationships. In addition, options must be analyzed within the company as to how an effective organizational connection of the various business units can be achieved so that the collaboration goal is given priority throughout the company.

Improvement

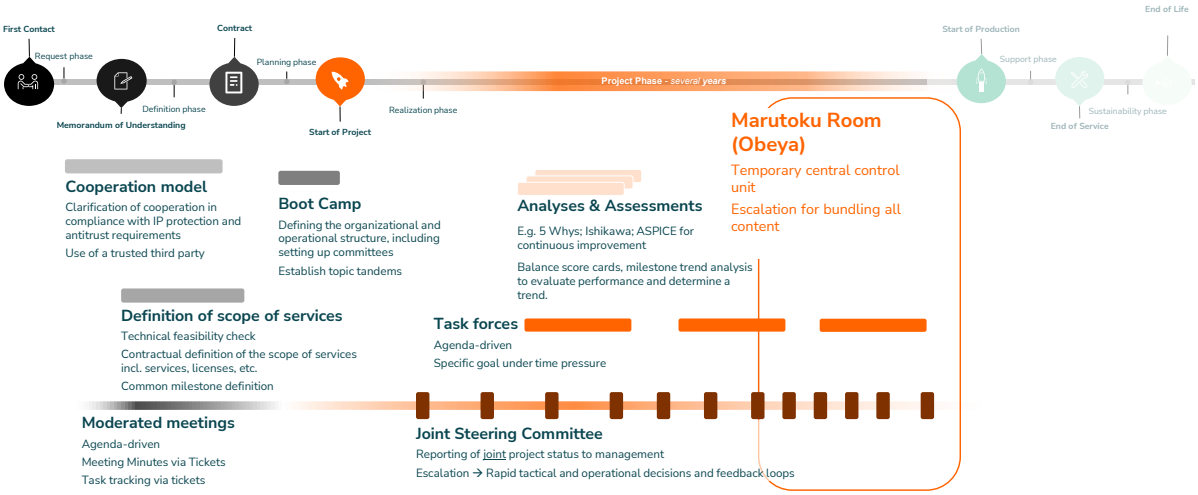
The fact that a collaboration always contains something new, whether in terms of content, collaboration level, or process, means that the introduction of methods for **continuous improvement** is a success factor to strengthen the current collaboration on the one hand and to improve new collaborations on the other. A one-time Lessons Learned is usually not expedient here, as only a section can be considered due to the scope and duration. Regular feedback loops or retrospectives and constant implementation of the Lessons Learned are much more effective. By determining the quality of the current development product (e.g. a software release), it is possible to determine whether improvements urgently need to be implemented. The methodology of a balance score card can be used here, for example.

The C4D collaboration kit

How can the seven core elements for successful collaboration described above be put into practice? This is where C4D can provide targeted support with the collaboration toolkit we have developed. The toolkit is structured according to the phases of a collaboration lifecycle. It begins with initial discussions in the early phase of collaboration, followed by an official letter of intent and contract negotiations.

The project is then implemented and executed - this is where the services set out in the contract are developed and, if necessary, services are modified or supplemented. This phase ends with the official start of series production, in which the services developed in the project phase are incorporated or fully defined. After the start of production, a collaboration is usually not yet finished, but continues into the delivery phase and service phase until the end of production. This is where communication channels and processes between the partners involved need to be established. In the C4D toolkit, the focus is primarily on collaboration during the development phase.

C4D construction kit for methods and collaboration models



Application of C4D modular components depending on the project phases and criticality

Figure 6: Collaboration life cycle

The modular elements have been developed based on our practical experience and support the establishment of new collaborations, improve collaboration, or offer immediate help if an existing collaboration no longer works effectively.

To enable collaboration based on trust, it is essential to establish a framework. It is important to draw up a contract that covers the most important scope of services, including topics such as license models or service scopes.

A common understanding of the framework conditions, which services are possible and in which areas there are restrictions, promotes a cooperative partnership in project implementation. In accordance with the principle of frontloading, a split of responsibilities, including the deliverables and tasks to be performed, must be defined in as much detail as possible. Furthermore, antitrust requirements and the handling of IP protection must be considered. Using a trusted 3rd party as a gatekeeper can be a target-oriented model.

After the final contract has been signed, a **boot camp is a** good way to **start the project phase and** establish a binding operational structure and process organization in **an intensive two to four weeks** (depending on the complexity of the project).

Topics include the **operational cooperation model**, which coordination teams including regular meetings, which escalation meetings and decision-making bodies are required, and the composition of the respective group of participants. The extent to which on-site collaboration makes sense should also be clarified. The meeting landscape may change over the course of the project, but it makes sense to define it initially so that the project members can adapt to it. Forming topic tandems between the parties involved is a good way to establish fast and meaningful communication channels. In a customer project between a European Tier 1 and a Japanese OEM, C4D was able to successfully introduce different coordination levels and consistently separate the scope of the respective teams through a respective mission statement. Another component of the boot camp is the development of a **common tool landscape as a "single point of truth"**. It must be determined how data and documents are to be exchanged, how task tracking is to be implemented, and how effective error management is to be mapped digitally, e.g. via a Jira ticket system.

Effective committee management is essential in the phase after the start of the project. Building on the definition of initial escalation channels and rules in the boot camp, escalation rules and committee participants should now be refined. It has been shown that external moderation, including preparatory support, contributes significantly to the success of compliance with escalation rules, especially in overarching meetings. Joint steering committees at the first management level are key to passing on a jointly agreed project status from the operational level to management and requesting rapid support.

In the project phase, **task forces** can be set up as required to provide support for **specific tasks and objectives that** need to be completed under **time pressure.** In general, **KPI-based reporting** is helpful to create a common project status based on data and to ensure transparency regarding the progress of the project. The KPIs must be selected jointly, and the calculation logic and origin of the data must be clearly defined.

Additional **analyses and assessments** accompany the project team during the project phase to identify challenges at an early stage and initiate countermeasures or analyze past problems to learn from them and to adapt processes if necessary.

An example of this is a customer project in which the software quality was inadequate, but the cause was unclear.

In a methodically sound analysis - in this example - with the creation of an Ishikawa diagram, it was determined that the origin of the problem was not on the tool or skills side, but rather due to inadequate communication between the experts from the different domains. With this insight, the establishment of a cross-functional team was initiated to carry out effective error analyses and thus implement faster solutions.

With today's complexity, time bottlenecks and risks regarding the achievability of the defined targets can occur during the project despite good preparation. The **C4D Marutoku Room** combines all the building blocks into a **tactical control model** to contribute the necessary speed to ensure the success of the project in such situations.

This allows tactical project decisions to be made daily and target compromises to be effectively negotiated between the collaborating parties.

Marutoku Room - Key Elements

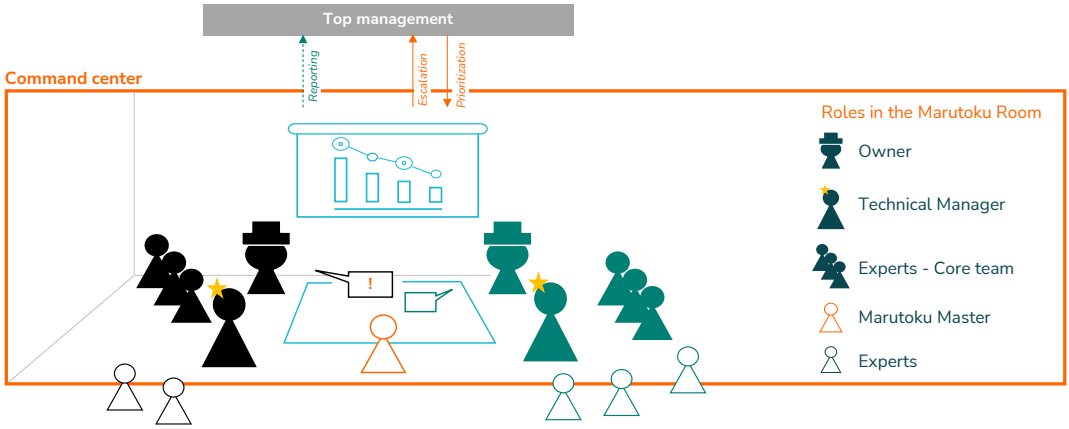


Figure 7: Roles in the Marutoku Room

To set up the Marutoku Room, each collaboration party provides a **Marutoku Room Owner** who is authorized by the organization to **negotiate** the necessary **tactical decisions**. Short communication channels in the Marutoku Room between the Marutoku Room Owners provide the necessary speed. A **core team** provided by each party is also necessary, which takes part in the daily control meetings and acts as an **advisory expert voice**. For complex products in which various disciplines are involved and an overarching view is required, the role of the **technical Marutoku Room Manager** is also necessary.

This person supports the owner with technical recommendations. Once the team has been put together, the next step is to set up the **Marutoku Room KPIs** and rules together. The KPIs are quantitative inputs for decision-making and should be available visually in the room and, if possible, updated daily.

The Marutoku Room works according to a strict daily schedule, which includes both a daily and a closing, expert sessions to analyze and solve problems at certain scheduled time slots during the day and a weekly retrospective, always at the same time and in the same place. In general, the Marutoku Room appointments have priority, as the Marutoku Room determines which topics currently have priority. The **Marutoku Masters**, who moderate and document the meetings, help to **establish, and implement the Marutoku Room rules** and the daily schedule.

In a complex vehicle development project in the AD/ADAS area, C4D was able to successfully implement the Marutoku Room concept between the two collaborating parties involved. At the beginning of the Marutoku Room, the required scope of delivery for planned test milestones with top management was not feasible with the required functions, quality and time.

Using the Marutoku Room, an effective compromise was negotiated as to which solution was acceptable to the customer and which could be made possible by the supplier through various acceleration measures. Thanks to the structured approach, the consistent involvement of experts and the empowerment of the Marutoku Room owners, this compromise was acceptable and technically feasible in the respective organizations. As the Marutoku Room Master, C4D was able to provide significant support through solution-oriented moderation in the process of finding a compromise.

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