Potentials of Digitized Sampling

The aim of this study is to determine the benefits of an initial sampling with a Supply Chain Collaboration Platform for manufacturers, suppliers and laboratories.

Prof. Dr. H. Tuczek | August 2022

TCC Management

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Preamble

The initial sampling or first article inspection (FAI) process in the automotive industry regulates the approval of products and associated production processes within the supply chain up to the Original Equipment Manufacturer (OEM). It forms the basis for guaranteeing product properties, including product safety and is described in German Association of the Automotive Industry or VDA Volume 2 - Production Process and Product Approval (PPA). Material testing is a major part of this FAI process.

material.one supports companies in material testing and FAI through digital networking following the recommendations of the VDA. Their focus is on the web-based platform material.one, which acts as a central link between manufacturers, suppliers, and laboratories. It ensures project-related communication, data transmission and cross-company process control. As a result, the initial sampling of vehicle components can be significantly accelerated.

This approach enables the smooth handling of these processes, and thereby makes a significant contribution in the very time-critical product development process in the automotive industry. The processing workload for FAI can also be significantly reduced, leading to significant cost savings. The generated digital material data records can then be used in a variety of ways, for example to analyze the initial sampling process, to analyze the realized product properties and the associated requirements, or to generate a digital twin.

Procedure and Conduct of This Study

Procedure

The study was conducted with employees/decision makers from the involved departments at the OEM and supplier. First, the functionalities of the platform were worked out with the operator of the platform material.one and compiled in a questionnaire. Furthermore, a detailed procedure for material initial sampling was created which allows an evaluation of the individual work steps according to relevance and workload. This became a basis for moderated workshops and web meetings to be held. The results were then documented in the questionnaires and in the sequence plan.

Conduct

The study was carried out by Prof. Dr. Tuczek. Dr. Tuczek teaches at the University of Applied Sciences Landshut in the fields of international procurement and quality management, as well as leadership in the digital age. He draws on 25 years of leadership experience in quality management as well as international business management (Daimler AG and GF of the Dräxlmaier Group, an international automotive supplier). He holds a bachelor's degree in electrical engineering (Dipl.-Ing.) from the Technical University of Munich (TU München), where he also completed his doctorate in "Computer Integrated Production".

experts from in house teams of leading OEMs and Suppliers

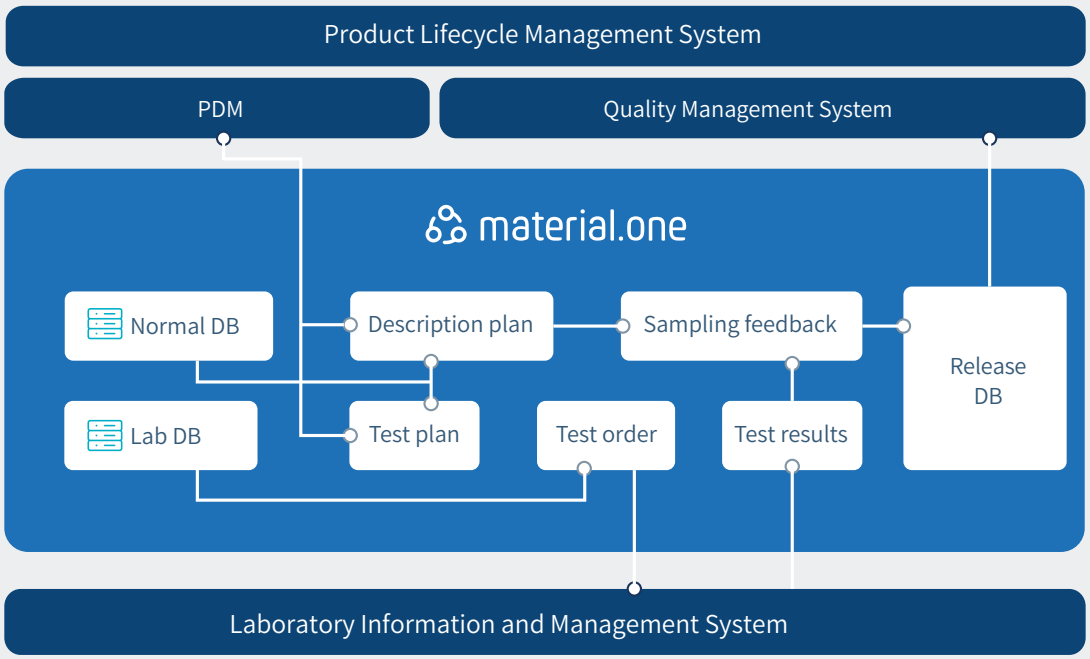
6 months of workshops and questionnaires analysing the sampling process

Prof. Dr. H. Tuczek teaches management and leadership at the University of Landshut

Platform Classification

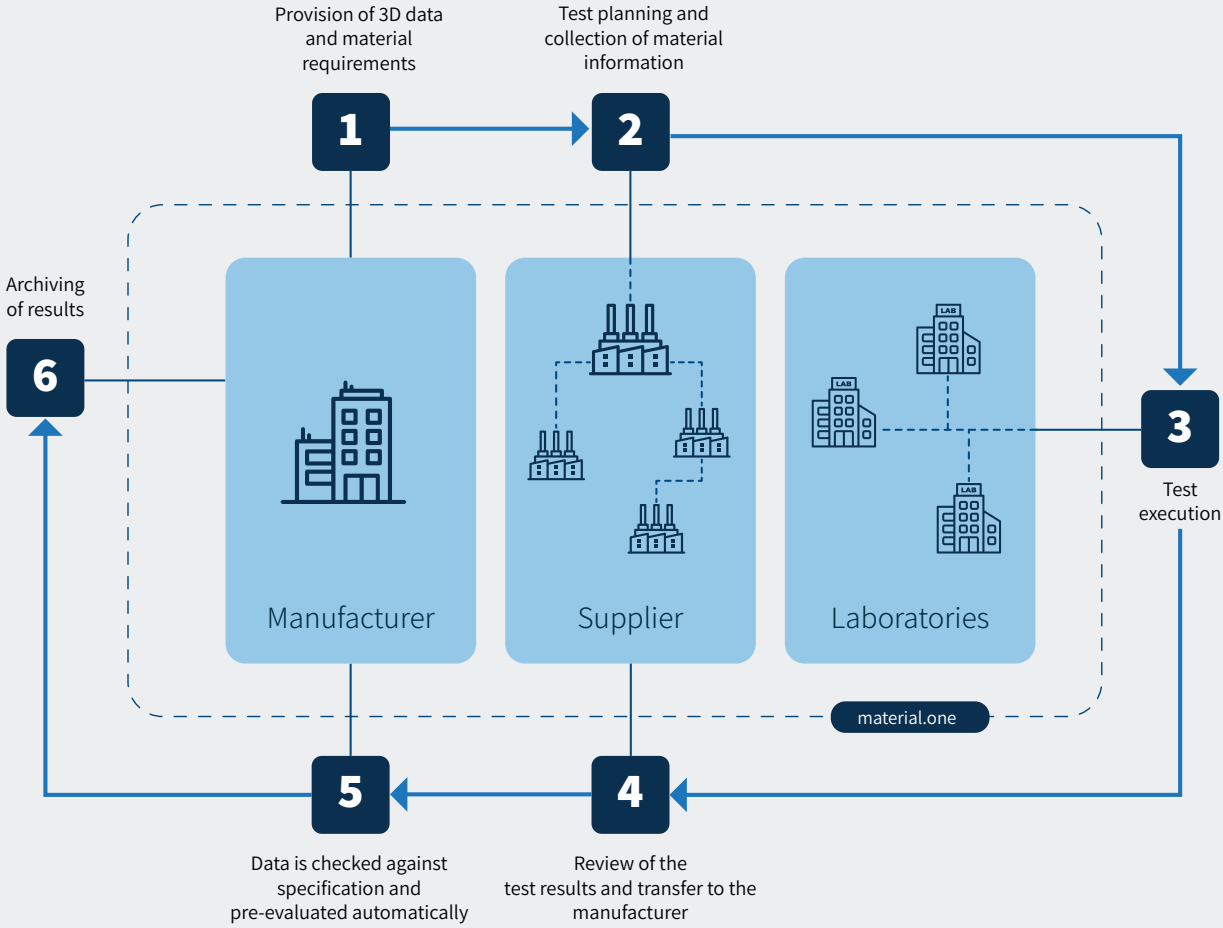
The Supply Chain Collaboration Platform material.one is to be assigned to the system landscape of the product development process. In the development process, so-called Product Life Cycle (PLM) systems (for example Teamcenter from Siemens AG) are used in which all information that arises during the life cycle of a product is integrated and managed. The product data is created and managed in the Product Data Management system (PDM) or the CAD/CAM/CAE system (some common examples are CatiaV5 or NX). The Quality Management System contains and controls the data of the quality process. The platform material.one obtains the 3D data of the product from the PDM system and enters the results of the inspection process archived in the QMS system.

System landscape in the product development process



The material.one platform maintains a database on available laboratories with their competences and capacities as well as manufacturers requirements and standards. When linked to the product data, this results in a control plan (information on the process, supplier, etc. – sometimes also referred to as test plan header) and a test plan. The test order is transferred to the Laboratory Information and Management System (LIMS) of the respective laboratory. The test results are then reported back to the material.one platform and stored in a approval database.

Process Flow via Platform



1 Uploading a JT file that not only contains versioned drawings with all the necessary component and material data, but also defines the requirements (standards).

2 The supplier inspects the pre-evaluated test results and passes them on to his client. The first-Tier supplier arranges for complete feedback of the sampling data to the OEM.

3 Semi-automated creation of control and test plans based on the standards contained in the JT file. The description plans of the components are provided by the supply chain.

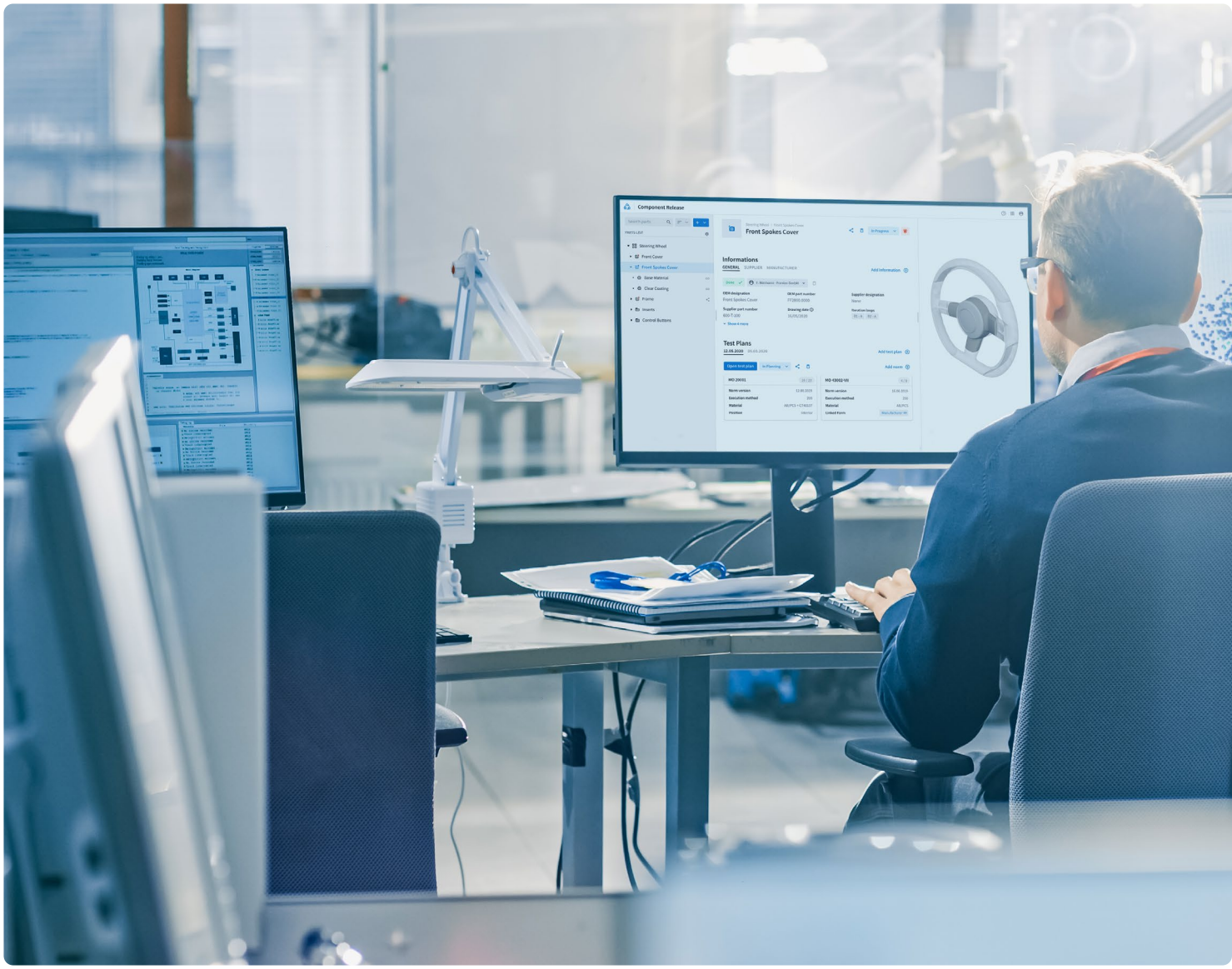
4 The OEM receives a complete overview of the pre-evaluations of all test results and uses this as a basis for deciding on the approval of the components.

5 Laboratories are proposed according to competence and capacity and commissioned by the responsible supplier (1 to n-Tier). The laboratory then completes the testing according to the plans.

6 The approval decision and all sampling data are transferred to the OEM‘s system and archived.

Platform Functionalities

The desired target state of digital processing of the initial sampling process on the platform was discussed and evaluated with the participants from OEM and Tier-1. The results are summarized below.



The material FAI is carried out based on the 3D model.

An integrated 3D model, which is loaded into the system and already contains all inspection information, represents the ideal state. From today's point of view, the integration of geometric data (product structure in 2D/3D) and the separate material sampling data must take place in the platform (if necessary, only supplementing the missing information).

- → Large lists of inspection information, which are difficult to record, are no longer required.
- → Extraction of various pieces of information from the system is possible (for example IMDS).

The manufacturer (OEM) provides of the current 3D model including the material requirements.

The "drawing status" according to the OEM forms the contractual basis for the inspection of a purchased part. This status of the approved 3D model is then "frozen". To ensure that exactly this 3D data set is used and not any subsequent change statuses from the supplier the OEM must be the exclusive provider of the data set.

- → An unequivical dataset is the foundation for FAI.

The current standards are always available to all process participants in digital form.

The standards are digitally stored on the platform and the test contents with the nominal values are made available to the participants from Tier-1 to n and the laboratories on a „need-to-know" basis.

- → Large lists of inspection information, which are difficult to record, are no longer required.
- → The requirements from the standards are available in digital form.
- → The latest revision statuses are ensured to be applied in each case.

Based on the requirements and standards of the manufacturer, the platform creates a questionnaire for the supply chain to describe the materials and manufacturing processes.

The respective requirements for the inspection information (control plan) are queried by the system. Particularly in the case of new Tier suppliers or personnel changes, there is a risk that the Tier supplier will be overwhelmed by the diverse requirements of the respective OEMs. A corresponding questionnaire helps to provide the necessary information along the entire supply chain in a complete and timely manner. Some of the necessary information for generating the control plans can be proposed by the platform and then adopted by the user.

- → The platform guides the user along the required information ensuring the correct input of the basic inspection data.
- → Mandatory fields ensure the completeness of the information.
- → Subsequent corrections, which involve workload and delay, can thus be avoided.

Platform Functionalities

Test plans are automatically generated based on OEM requirements and standards.

If one creates an inspection plan manually, one cannot ensure that all the required inspections are always carried out. The agreed inspection plans are then usually available in an individual format that cannot be read by all process participants.

An overarching OEM software solution for generating inspection plans avoids individual solutions and sets a generally valid standard that enables systematic tracking and documentation. If all standards for the process have been correctly recorded, the completeness of the tests can be checked automatically.

- → Reduced workload for the supply chain through automatic creation of inspection plans.
- → Standardized format of test plans is ensured, which facilitates evaluation and documentation of test contents.
- → The completeness of the tests can be checked by the system.

The platform informs about quotations for testing and capacity of the laboratories.

An automated solution creates transparency for the possible contact points and gives laboratories the opportunity to present themselves. Consistent capacity planning secures the timeline in the development process.

- → Available laboratories and corresponding capacities are transparent.
- → Simplifies the assignment process.
- → Ensures that the time schedule is adhered to.
- → Laboratories can present themselves and highlight their competencies.

The requests for quotation and commissioning of laboratories are carried out via the platform.

The assignment of inspection orders can be controlled via the platform with corresponding additional functionality.

- → Acceleration of the assignment process.
- → Framework agreements can be managed via the platform.

The test results are entered into the platform by the laboratory in a falsification-proof and digitally processable manner.

This is the basis for the digitalization of the processes and ensures the correctness of the examination contents.

- → No costly double tests of OEM and Tier-1.

The set test results are automatically checked against the nominal values.

Deviations are pointed out and, if necessary, proposals for corrective measures are given.

- → Time saving for measures in case of non-conformance with the given nominal values.
- → In the long term, this allows for faster initial sampling by the OEM, as the submitted data better meets the requirements and no further testing is necessary.

Each supplier in the supply chain checks the pre-evaluated results and approvals them for its client.

This way, the responsibility of each member in the supply chain is maintained. The multi-client capability of the system is thus ensured.

→ The system supports suppliers, but the responsibility remains with the people and suppliers.

Tier-1 suppliers and manufacturers (OEM) automatically receive an overall assessment of the component.

If necessary, a reference should be made from the individual part to the relevant assembly, since many tests are carried out in the assembly.

→ Transparency and oversight are the result.
→ This saves time and costs.

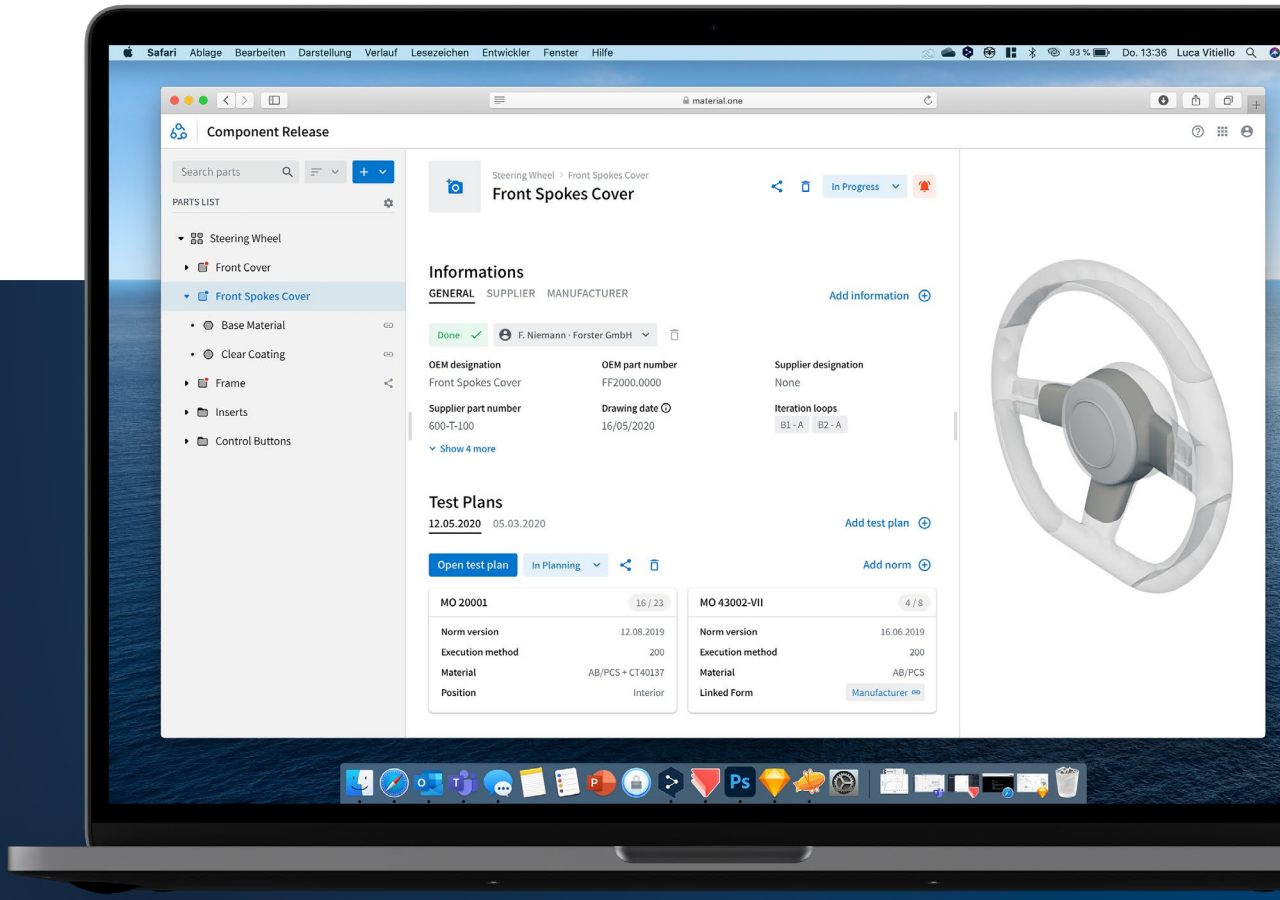
All the information in an operation can be transferred to the quality management systems.

The variety of interfaces, corresponding formats, and standardization must be taken into account.

→ The transfer of inspection data to the relevant systems takes place automatically.

General Aspects

In general, the use of uniform formats for standard content, initial sampling information, test plans and test results can be provided via the material.one platform for a variety of evaluation options. For example, the test history can be tracked, different tests can be compared with one another, and test results can be compared with results from the field. In addition, the use of artificial intelligence makes it possible to expand the platform into a self-learning system. Sampling information and test plans can be automatically pre-populated in relation to the respective commodity. In addition, test results can be interpreted and differentiated recommendations can be derived.



Cost Reduction Enabled by the material.one Platform

The material.one platform is meant to be a "digital assistant" for FAI specialists.

It does not replace the employees but can support them significantly and thus free up time for qualified tasks. A typical vehicle manufacturer requires 15,000 to 20,000 samples per year; this highlights the fact that initial sampling is a very complex process which is also extremely time-critical due to its relevance for the approval of series production of the vehicle.

The scope of initial sampling and the associated support by the specialist personnel can vary greatly, depending on the component.

Therefore a determination of the time and workload saved by using the sampling platform that is universally applicable is not possible.

The competence and experience of the companies involved in the supply chain and their employees also play an important role. In order to address this problem, an evaluation of the average amount of work to be expected for the individual work steps was carried out methodologically using defined categories.

Categories of workload assessment (LOE)

0 No workload	**1** Significant workload in the man-hour range	**2** Elevated workload about one man-day	**3** Considerable workload exceeding a one man-day

This classification enables estimation of the general workload and associated potentials can also be derived. In the sense of the "Digital Assistant", the respective workload is not taken over completely by the platform, but as a rule proportionally related to the respective work step.

The workload is listed in the table on the next page for each work step in the initial sampling process for a sampling group, i.e. a component with its respective variants. It should be noted that the determination of the sampling scope and the coordination between the OEM and Tier-1 supplier in the inspection planning discussion involves an elevated or considerable workload. For Tier-1, this process must also be carried out in a similar manner with the Tier-2 suppliers. This is reflected in step 2, which involves significant, and even elevated to considerable expense for Tier-1.

In addition, there is the selection/assignment and tracking/communication with the laboratories, each of which involves significant workload. The handling of the test results usually means a great deal of additional workload for Tier-1, whereby the fulfilling of specific OEM specifications is of particular importance. During the final evaluation of the component the manufacturer is faced with significant to high costs, whereby a possible re-sampling with high additional costs is incurred. The archiving of the data in the OEM system takes place automatically via an interface without further workload.

The workloads of Tier-2 to Tier-n are added in the same logic. The workload of the laboratories is not considered in this study.

Workload Evaluation of the Work Steps

1 Provision of 3D data and material requirementsd

Determination of the scope of sampling	OEM	0 1 2 **3**
Coordination of the scope of sampling with Tier-1	Tier-1	0 1 2 **3**
	OEM	0 1 **2** 3

2 Test planning and collection of material information

Compilation of component / material information	Tier1-n	0 1 **2** 3
Coordination of component / material information with the next Tier	Tier1-n	0 1 **2** 3
Addition of Tier1-n requirements to the sample scope	Tier1-n	0 **1** 2 3
Viewing the component / material information of the next Tier	Tier1-n	0 1 2 **3**
Communication with next	Tier1-n	0 **1** 2 3
Preparation of the test plan	Tier1-n	0 1 **2** 3
Coordination of the test plan with the next Tier	Tier1-n	0 **1** 2 3
Selection of laboratories and time scheduling	Tier1-n	0 **1** 2 3
Assignment of laboratories	Tier1-n	0 **1** 2 3
Tracking of the laboratories	Tier1-n	0 **1** 2 3
Communication with the laboratories	Tier1-n	0 **1** 2 3

3 Execution of tests

Transfer of the inspection plan to LIMS	Laboratory
Transmission of results	Laboratory

Workload Evaluation of the Work Steps

4 Review of the test results and transmission to the OEM

Evaluation of laboratory results	Tier1-n	0 1 **2** 3
Communication with next Tier	Tier1-n	0 **1** 2 3
Review and evaluation of the results of the next Tier	Tier1-n	0 1 **2** 3
Aggregation of all responses and laboratory results	Tier-1	0 1 **2** 3
Handling of deviations	OEM Tier-1	0 **1** 2 3 0 1 **2** 3
(Filling the OEM templates (e.g. burning test	Tier-1	0 1 2 **3**
Transmission of the results to the OEM	Tier-1	0 1 **2** 3

5 Checking the data against specifications and evaluating the component

Checking the component/material information for completeness	OEM	0 **1** 2 3
Check inspection results for completeness	OEM	0 1 **2** 3
Content check of component / material information and comparison of target and actual values	OEM	0 1 **2** 3
Compilation of findings	OEM	0 **1** 2 3
Evaluation of the component	OEM	0 **1** 2 3
Communication with Tier-1	OEM	0 **1** 2 3
Follow-up sampling	OEM	0 1 **2** 3

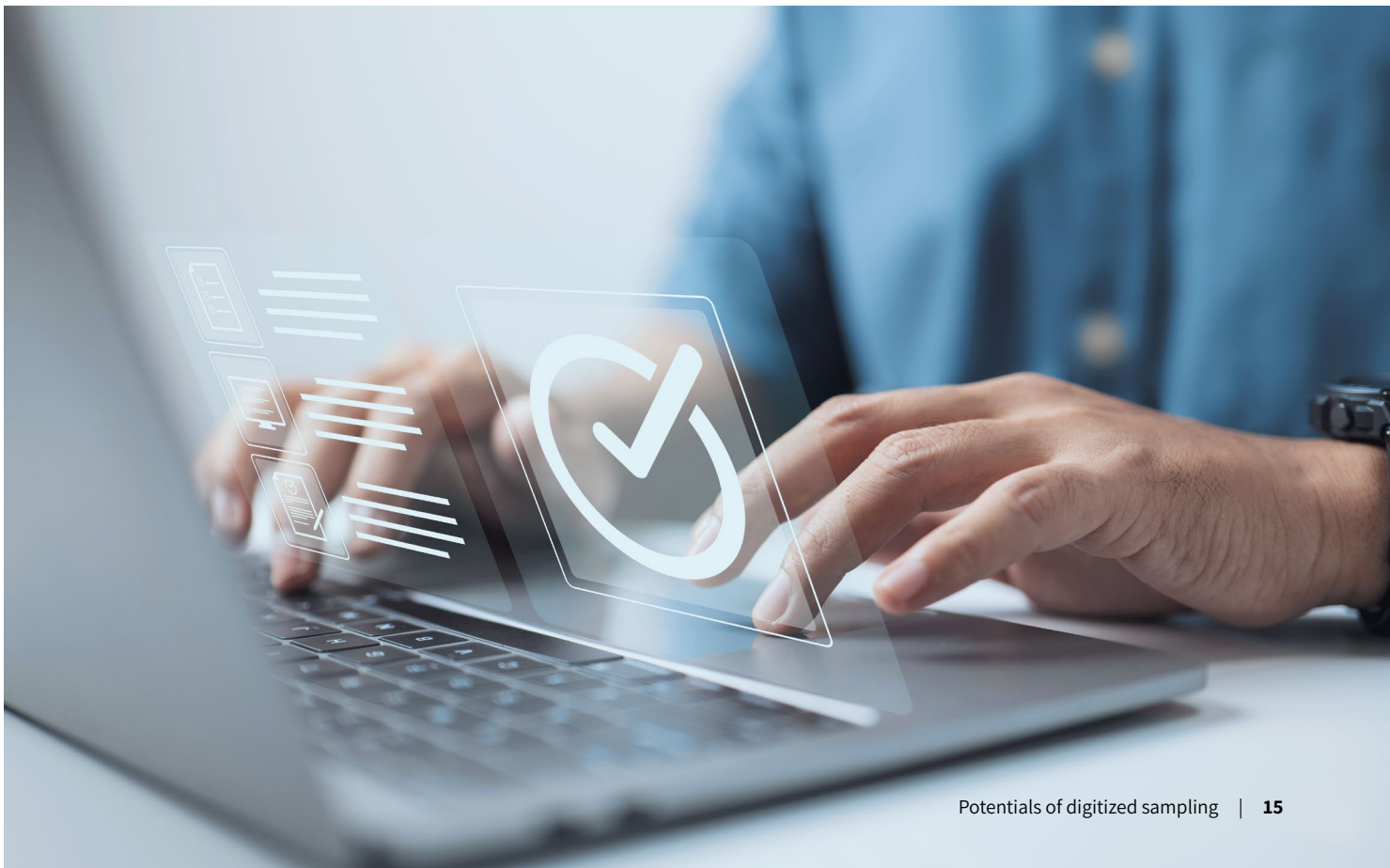
6 Archiving of results

Archiving results in the OEM system	OEM	**0** 1 2 3

Evaluation of the Workload Assessment

For the above reasons, the evaluation of the total costs of sampling in monetary terms must always be an estimate that is inherently subject to inaccuracy. However, in order to develop a rough estimation, an approach may be attempted as follows:

Using the average hourly wage in the automotive industry in 2018 of just under 50€ according to Statista 2019, monetary values can be approximated for the categories of the cost evaluation.



13x

Significant workload

one man-hour:
1h x 50€ = 50€

650€

12x

Elevated workload

One man-day 1MD:
8h x 50€ = 400€

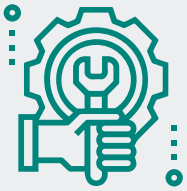
4.800€

4x

Considerable workload

Average 2.5 PT:
2.5 x 8h x 50€ = 1000€

4.000€



Workload for an FAI process

for OEM and Tier-1

9.450€

Since the expenses of the Tier2-n suppliers and laboratories are not included, the sum of 10,000€ for the administrative steps of sampling is a rather conservative estimate.

The next step is to classify the proportion of automated processes on the platform. This depends on the sophistication of the platform and the corresponding scope of the digitized work steps. Assuming a potential of 50% of the automatable processes, this results in a sum of 5,000€ per sampling process, which can, in principle, be saved by operating a platform like material.one. From this approximate value, profitability considerations for the development and operation of the platform can be derived. Basically, though, it can be stated that the use of such a software solution seems to make the most sense due to the diverse potentials for optimizing the sampling process. In addition to the reduction of workload in the form of man-days, the reduction of throughput times should also be considered as an important argument. It is recommended to implement the platform concept as a structured implementation planning according to the Lean Startup concept. For this purpose, the most important process steps should be defined with the pilot customers, which should be mapped in a first implementation version of the platform. It is important to ensure that the platform is fully functional at every stage of implementation so that users can experience smooth integration of the software solution. In particular, interfaces for the import or export of data must be considered in order to avoid double data entry. The pricing model can be based on the degree of automation of the version level used as described above. Additional functionality offers higher utility that can be included in the benefit calculation.

Relevance of the Strategic Aspects of the Platform

The average assessment of the strategic aspects of the platform is presented here. These were evaluated by various interview partners from Manufacturers and Tier-1 on a scale from “not important” to “very important” (1 to 5).

Global availability of material and approvalinformation

Information can be called up at any time by all users according to the need-to-know principle.

5

IoT connection of testing and documentation systems

Data is transmitted directly to the platform.

3

Digital Twin

Provision of all data for the construction of a Digital Twin.

3

Optimization of specifications

Test results from the platform are used for the adaptation of the material requirements.

5

Further development of materials

Test results and approval information can be used for the further development.

4

Shorten throughput time

The use of a platform reduces the time required for sampling.

5

Data integrity

Test results recorded on the platform cannot be falsified.

5

Selection of materials

Component developers can use test results and approval information for material selection.

5

Feedback of field information

Feedback (e.g., complaints) from the field and production can be taken into account for the optimization of specifications and the selection and further development of materials.

4

Project control and tracking

As a result of the transparency in every single sampling processe, the control and tracking of the project is simplified..

3

Transparency in the process

Through the clearly structured process flow, processes become transparent.

5

Laboratory management

Central capacity planning for laboratories enables potential delays to be identified at an early stage.

3

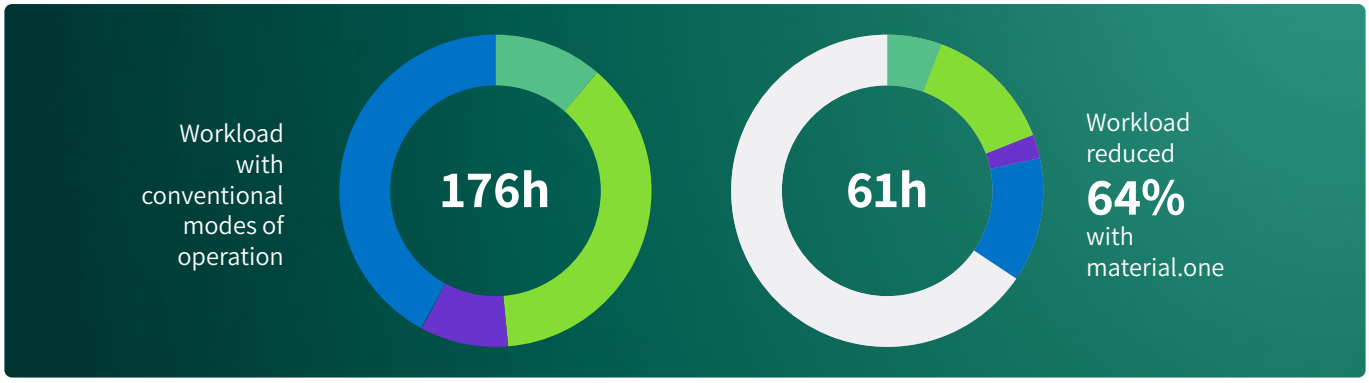
Standards and data timeliness

Central data storage guarantees that standards and data are up-to-date and consistent.

4

Results Overview

The results from the study “Potentials of digitized sampling” show also the benefits of the digital evidence.



Match requirements

The coordination is done on the CAD model. The model is broken down down to the material level and the manufacturer‘s requirements are attached at each level. The digitalized requirements ensure that all specifications are up-to-date.

Plan proof of conformity

The digitalized requirements enable an automated inspection plan proposal. This ensures completeness. The inspection plans can then be shared with sub-suppliers. This balances the overall planning effort across the supply chain.

Record evidence of conformity

Digital capture ensures the integrity of the data. It is no longer necessary to open and interpret a multitude of different documents. In addition, APIs can be used to transfer test results from QMS and LIMS to the platform.

Evaluation and release

Inspection results are automatically compared to product requirements. This pre-assessment facilitates the evaluation of the conformity data. Data from the platform can then be transferred to the release systems (SAP, PLM).

Summary

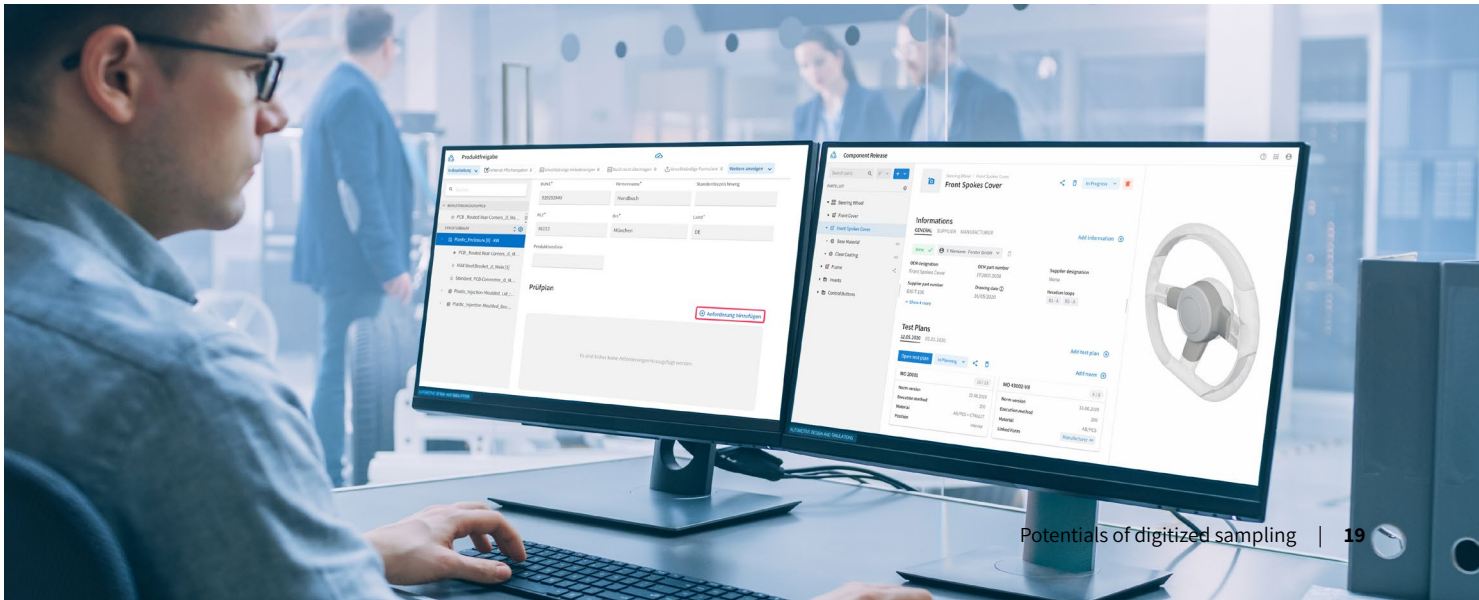
The initial sampling process is a time-consuming and time-critical process that covers the entire supply chain. Due to its variety of requirements and the complexity of processing multi-stage supply chains in an international context, it is particularly suitable for simplification and acceleration by digitizing the work steps. The platform approach of material.one meets the expectations of reducing both manual workload and throughput time.

The use of such a software solution offers a variety of potentials for optimizing the FAI process as a whole.

The platform forms a solid basis for the selection of materials in the development process and for the optimization of specifications.

The transparency of the material and approval information on a global level makes it possible to intervene quickly and specifically. This is a decisive factor, especially for re-sampling.

The data integrity on the platform guarantees the consistency of the data. Just as the central data storage of standards and other specifications ensures that the data is up-to-date and consistent.



The study was conducted by TCC Management on behalf of materiel.one AG.

material.one

The material.one AG is a company within the adesso Group, one of the leading IT service providers in the German-speaking region. The core industries also include automotive end manufacturing industries. Currently, over 8,500 employees work for adesso (FTE).

material.one is a supply chain collaboration platform for product and process approvals. The digital network supports globally operating manufacturers and their suppliers in areas such as quality management, sustainability, and product certification.

material.one eliminates existing process and company boundaries and consistently transfers corporate processes into the supply network.

With material.one, manufacturers, suppliers, and companies in the TIC* sector simplify their collaboration. By consistently digitizing product requirements, all participants in the supply network gain access to digital proof plans and evidence.

*TIC = Testing Inspection Certification

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Prof. Dr. Hubertus C. Tuczek teaches management and leadership at Landshut University in the Faculty of Electrical Engineering/Business Engineering. As part of his research focus, he deals with questions of leadership and change management in digital transformation. He also organizes an annual Leadership Forum for entrepreneurs and experts and is the editor of the Landshut Leadership book series.

Parallel to his university activities, he works in strategy and digitalization consulting, as an author and keynote speaker, and also holds advisory roles. Before joining the university, he spent 25 years in senior management positions in the automotive and aviation industries, including at Daimler AG and as managing director of the internationally operating automotive supplier Dräxlmaier Group.

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