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USAGE OF USER STORIES IN REQUIREMENTS DEFINITION

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BACHELOR´S THESIS-ABSTRACT

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USAGE OF USER STORIES IN REQUIREMENTS DEFINITION

The objective of this thesis was to create a requirements definition for nonconformance management of the Valmet Automotive new quality system. This definition was meant to be used in the quotation process for system providers. The requirements definition was carried out with Agile user stories and the suitability of user stories for requirement definition was evaluated in general.

The work was started by a current state analysis, continued with process definition and lastly the user stories were created. In the current state analysis, the process was described and their weaknesses and strengths were listed. These findings were used as a basis for the later phases.

The new process description was defined by a work group taking into account that it can be used as story map for user stories. In addition, this new process description was used as part of the requirements definition.

The user stories were created by teams from different departments. Members were selected in such a way that they were owners or users of the nonconformance process in their area. That means that these team members had knowledge and capabilities to create good stories. The process description was used as story map to guide their work.

As a result, the process description and user stories were used as requirements attached in the quotation for potential system providers according to objective. Additionally, it was concluded that user stories alone do not describe the system requirements clearly enough, but together with the story map, they give a rather clear picture for the requirements.

KEYWORDS:

Nonconformance management, User stories, Agile, Story map.

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Kimmo Lassila

KÄYTTÄJÄKERTOMUSTEN SOVELTAMINEN VAATIMUSMÄÄRITTELYYN

Opinnäytetyön tavoitteena oli luoda vaatimusmäärittely poikkeaman hallintaprosessia varten Valmet Automotiven uuteen laatujärjestelmään. Vaatimusmäärittelyä oli tarkoitus käyttää järjestelmän toimittajien tarjouspyyntöprosessissa. Vaatimusmäärittely tehtiin ketterän ohjelmistokehityksen käyttäjätarinoiden avulla. Lisäksi arvioitiin käyttäjätarinoiden soveltuvuutta vaatimusmäärittelyyn yleensä.

Työ aloitettiin nykytilan analysoinnilla, jatkettiin prosessimäärittelyllä ja viimein luotiin käyttäjätarinat. Nykytilan analyysissä kuvattiin prosessit ja analysoitiin heikkoudet ja vahvuudet. Näitä havaintoja käytettiin prosessikehityksen ja käyttäjätarinoiden luomisen tukena.

Työryhmässä määriteltiin uusi prosessikuvaus ottaen huomioon, että sitä voidaan käyttää käyttäjätarinoiden tarinakarttana (engl. Story Map). Lisäksi tätä uutta prosessikuvausta käytettiin osana vaatimusten määrittelyä.

Eri osastot loivat käyttäjätarinat omissa ryhmissään. Ryhmien jäsenet valittiin siten, että he olivat osastonsa poikkeamahallistaprosessin omistajia tai käyttäjiä. Näin ollen heillä oli tietoa ja kykyä luoda hyviä tarinoita. Uutta prosessikuvausta käytettiin tarinakarttana tarinoiden luomisen ohjaamisessa.

Työn tuloksena prosessikuvausta ja käyttäjätarinoita käytettiin vaatimusmäärittelynä tarjouspyynnön liitteessä, jotka lähetettiin potentiaalisille järjestelmätoimittajille. Lisäksi todettiin, että käyttäjätarinat yksin eivät kuvaa järjestelmävaatimuksia riittävän selvästi, mutta yhdessä tarinakartan kanssa ne antavat melko selkeän kuvan vaatimuksista.

ASIASANAT:

Poikkeaman hallinta, käyttäjätarinat, Ketterä ohjelmistokehitys, Story map.

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LIST OF ABBREVIATIONS

CAPA	Corrective and Preventive Actions
CSA	Current State Analysis
MES	Manufacturing Execution System
NCM	Nonconformance Management
QCR	Quality Complaint Report (to supplier)
RFQ	Request for Quotation
ROI	Return of Investment
SCM	Supply Chain Management
VAPSS	Valmet Automotive Production Support System
VIN	Vehicle Identification Number

1 INTRODUCTION

Valmet Automotive has long history of car manufacturing and that is really the core of the business. As car industry is in many instances referred as benchmark for quality processes, so does Valmet Automotive need continuous development in order to maintain its position in hard competition. That is why Valmet Automotive launched a project for new production support system. Part of this production support system was the quality section, where one part was nonconformance management. A nonconformance can be any deviation in the process, part or product from quality specifications, operational or regulatory requirements. And nonconformance management is the process, whereby the organization manages nonconformances.

The purpose of this work was to define the expectations of the shareholders. In order to have a good basis for the analysis, the current status of the nonconformance process was analyzed. In current state analysis current processes are identified and evaluated. Based on the current state analysis, the new process was defined. The new process itself was used as a story map for the user stories.

The target for the work was to help the VAPSS (Valmet Automotive Production Support System) project to describe user's expectation in a way that all needs are covered. These needs were then attached to official RFQ (Request for Quotation) for potential service providers.

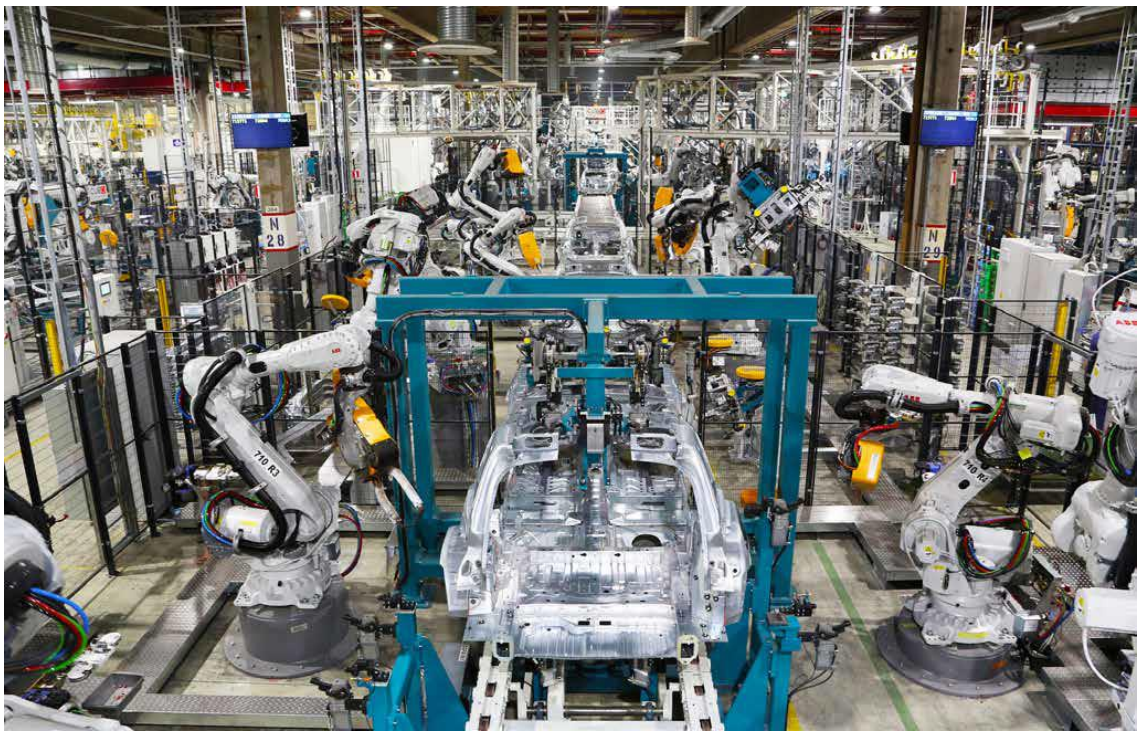
In this work, the main focus was on user stories theory, creation process and in the challenges related to that. The work ended when user stories were created. In order to further process the user stories, there would be needed to continue development with the service provider, but that part is not covered in this work.

In the work the current state analysis was created by the thesis author. The process was defined in co-operation with the project team, but thesis author worked as the main coordinator. The user stories themselves were created by project teams where the structure and idea of the stories was created, while the support and coaching was taken care by the thesis author.

2 VALMET-AUTOMOTIVE AS A COMPANY

In 1968 the Saab-Valmet joint venture was founded in Uusikaupunki, Finland. Just a year later, the first passenger cars Saab 96 was delivered. This Saab-Valmet relationship continued over 30 years. In 1995 the company changed its name to Valmet Automotive. Four years later, the Finnish technology concern, Metso, become the sole owner of Valmet Automotive. In 1997 the building of the Porsche Boxster began in Uusikaupunki, and the Porsche Cayman came along in 2005. After Porsche, company built the battery-powered city car THINK City. In 2010 the Finnish investment companies Pontos Group and Tesi came aboard as shareholders. In 2015 they purchased the remaining Metso shares. In 2013 manufacturing of the Mercedes-Benz A-Class began with 200 robots for body in white work alone. Four years later, the GLC was added. In 2017 Valmet Automotive and Contemporary Amperex Technology Limited (CATL), China's leading manufacturer of electric vehicle battery cells, begin a strategic partnership. The owners of Valmet Automotive are now Pontos Group, Tesi (38,46% each) and CATL (23,08%). In 2017 Valmet Automotive took over the German automobile technology locations of the Swedish company Semcon, with some 800 employees. The Valmet Automotive group also consists of product development of convertibles and kinematic systems technology center in Osnabrück, Germany and the factory in Zary/Poland for roof and kinematic systems. The current company sites are in Finland, Poland, Germany and Spain (Picture 1.) (Valmet Automotive, 2019)

Picture 1. Locations of Valmet Automotive. (Valmet Automotive, 2019)



Picture 2. View to GLC body shop. (Valmet Automotive, 2019)

By 2019 the largest automation deal in Finland was signed for the GLC body shop by Valmet Automotive. More than 300 robots were assembled in the plant (Picture 2.). (Valmet Automotive, 2019)

3 ANALYSING THE CURRENT STATUS

The CSA (Current State Analysis) was started by describing the current NCM (Nonconformance Management) process. These processes are something which Valmet Automotive is used to work with, and for the moment there is no decision to essentially change these processes in new system. The new system should anyhow support better reporting, root cause analysis, CAPA (Corrective and Preventive Actions) and creation of checklist by linking the NCM tools to MES (Manufacturing Execution System) and other relevant systems. In the hectic production environment, the NCM system should provide smooth user experience. Thus the usage should be logical and straightforward.

3.1 Current NCM processes

The current main NCM processes are listed Table 1, which shortly describes the function and additionally the related IT system.

Table 1. Current NCM processes.

NCM Processes at Valmet Automotive				
Process:	**Delivery Stop process**	**Severe and Systematic defects**	**Market Feedback process**	**Prio 3 faults follow-up**
Short description:	For critical or a severe defects to stop the approval of the cars till corrective actions are done.	Used to initiate corrective actions to prevent the progress of defects and ensure repairs. Covers all manufacturing lines.	Management of customer complaints and customer quality reports.	Light follow-up procedure for priority 3 failures including reason for fault and corrective actions.
System:	In Lotus Notes	In Lotus Notes	In SharePoint	In SharePoint

3.1.1 Delivery stop process

A delivery stop is used to stop the approval of cars and the shipments out of the factory until the necessary corrective actions are completed (Table 2). This process is used for Prio 1 faults or when critical or a severe defect noted in production or product audit or product is not fulfilling legal requirements or is directly related to safety or vehicle reliability that has been noted in the market. The process is managed in Lotus Notes and contains the defect description section and the solution section. Response is required within two weeks. The process is run at Lotus Notes, which does not support statistical reporting e.g., for fault types, response times or responsible departments. Statistics are carried out with Excel, for example. The Process requires usage of checklist and these checklists are generated manually from the MES system Hunter. Furthermore, a general issue for all processes running at Lotus Notes is that reminders are not sent for responses that are late.

Table 2. Description of delivery stop process.

Delivery stop process					
Process step:	**Critical defect**	**Launch of the Delivery Stop**	**Meeting**	**Corrective actions**	**Reporting**
Linkages to other systems:	Error reporting	Hunter		QCR	
Remarks:	Normally defect is reported in error reporting system.	Block suspected products in MES.		In case of material defect QCR is initiated.	

3.1.2 Severe and systematic defects process

The purpose of the severe and systematic defects process is to initiate corrective actions in all manufacturing stages to prevent the progress of severe and systematic defects in

the production process and to ensure the repair of already manufactured products (Table 3). This process covers all manufacturing lines. This process is used for Prio 2 and systematic Prio 3 faults. The process is managed in Lotus Notes and contains the defect description section and the solution section. In the solution section there is integrated the light 4M analysis (Man, Method, Machine, Material), where relevant reasons are selected. The response is required within one week. Similar to the delivery stop process, Notes does not support statistical reporting or creation and management of checklists. In addition, there are cases where faults are found in approved cars. This initiates the delivery stop process, and for that purpose completely a new template needs to be created in Lotus Notes.

Table 3. Description of Severe defects process.

Handling of Severe and systematic defects ("Vakava Virhe")					
Process step:	**Severe defect**	**Launch of the process**	**Inspection of cars**	**Corrective actions**	**Reporting**
Linkages to other systems:	Error reporting	Hunter		QCR	
Remarks:	Normally defect is reported in error reporting system.	Identify the 25 + 25 cars to be inspected	Move to delivery stop process if faults in vehicles approved to delivery.	In case of material defect QCR is initiated.	

3.1.3 Market feedback process

The market feedback process covers customer complaints, customer quality reports and relevant systematic market feedback for all product lines. Customer complaints are any type of feedback after the final approval by Valmet-Automotive, from the first customer vehicle inspection onwards. The market feedback process data is analyzed at Valmet Automotive and based on analysis, different internal reports and feedback to customers are compiled. Fixed templates are used for reporting and feedback. This process is running at Microsoft SharePoint Workspace.

3.1.4 Prio3 faults follow-up

Faults are followed in Microsoft Workspace and linked to images taken in product audit. Each image has a column where the responsible person is adding the reason(s) for the fault and corrective actions. The system does not support statistical reporting and does not send reminders. On the other hand, the system is very simple to use.

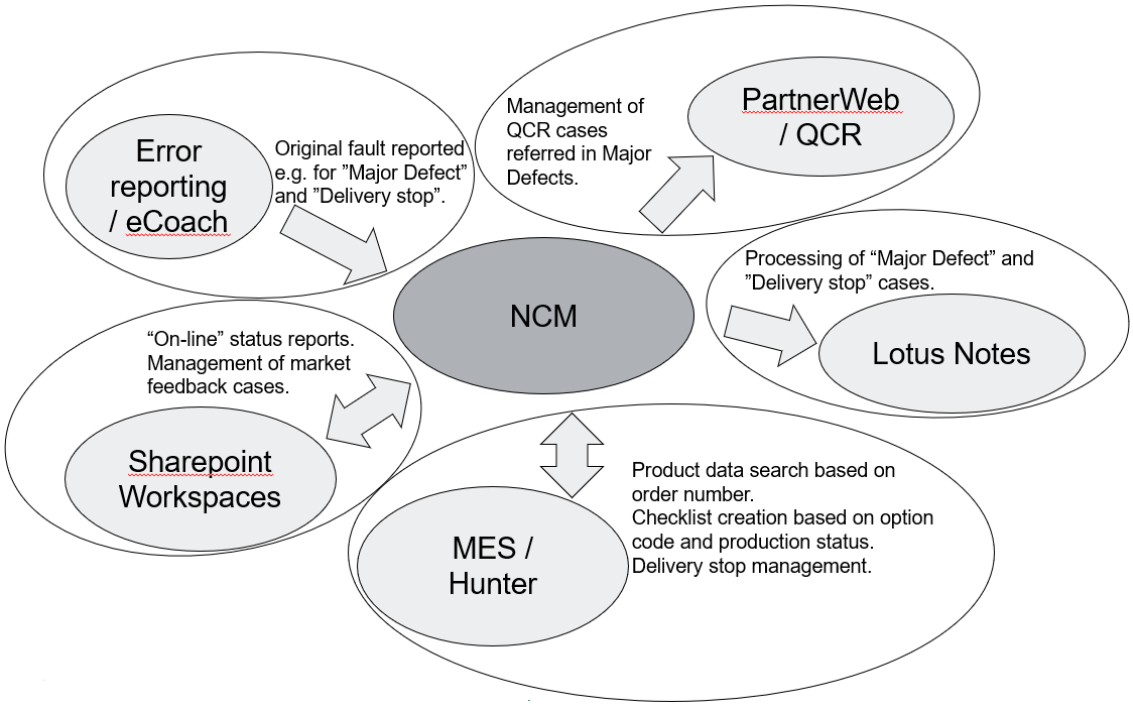
3.2 Defect categorization

Valmet Automotive is using customer defined defect categorization. The corrective actions and approach to manage nonconformances are defined based on defect seriousness.

The severity classes are presented at Appendix 2.

3.3 Connections to external systems

The Valmet Automotive NCM system is currently covering different systems (Picture 3.), which are described in this chapter.



Picture 3. Current systems linked to NCM.

Error reporting / eCoach: This system used for error reporting. Developed by Predisys. Linked to Access database

Partner Web: The Partner Web is the Valmet Automotive customer/supplier portal, where complaints to customers are generated (QCR, Quality Complaint Reports).

Lotus Notes: This IBM-developed Collaborative client-server software platform is used for Severe Defect and Delivery Stop process management in NCM.

MES/Hunter: Hunter is the Valmet Automotive used MES (Manufacturing Execution System), where vehicles are defined for delivery stop.

SharePoint Workspaces: In NCM Microsoft SharePoint is used for Market feedback management and reporting.

3.4 Weaknesses and strengths of the current system

In the list below, the current system weaknesses and strengths are identified. The goal is to improve the situation in the new NCM.

Weaknesses:

- NCM is in Notes, which does not have connections to external systems or reporting functionalities.
- All reporting and analysis needs to be carried out/implemented in external systems.
- No templates are available for reporting purposes.
- There is limited visibility to ongoing issues and statuses (e.g. no deadline follow-up)
- It is difficult to analyze cases from history.
- There is no connection to manufacturing systems (e.g. **MES)**.
    - All data needs to be filled in manually.
    - Checklist creation and follow-up not integrated.
- There is no connection to the **error reporting, eCoach,** system.
- There is high risk to input wrong data in manual insertion.
- There is no automatic follow-up for failures for originator, only for responsible person.
- Maintenance for workflows is complicated.
- There are no integrated root cause analysis tools except 4M.
- It is not possible to use existing cases as templates. Every new case starts from 0.
- It is not possible to use other than the existing process. For example, in the Pre-series, a lighter system is needed.

- There is no automatic case number generation. It needs to be created manually.
- In material fault cases, supplier management is carried out via QCR. No link to **QCR**.
- Preventive actions effectivity follow-up is not supported. There is no verification.
- There is ´no access to old car data like VIN (Vehicle Identification Number) numbers, test data.
- It is not possible to make error reporting in mobile devices
- NCM is spread to several systems.

Strengths of the current system

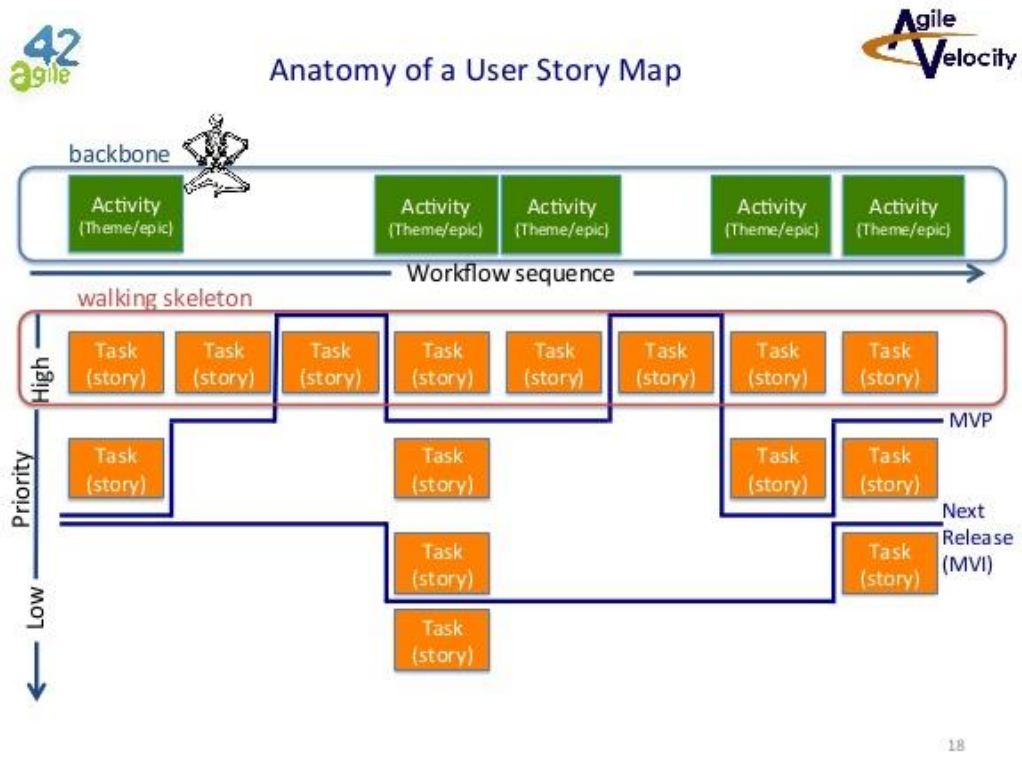
- It is familiar
- It is a robust system without malfunctions.
- Custom tailoring is possible.

4 DEFINING THE NON-CONFORMACE PROCESS

4.1 Story Map

In the thesis work the Nonconformance process was used as a high-level story map (Patton, 2008). Or to be precise backbone of a story map.

In story map activities and tasks at a higher goal level give the story map it's structure. The backbone is arranged in a narrative flow. Smaller sub-tasks, details and variations hang down to form the ribs connected to the backbone or walking skeleton like in picture 4. (Patton & Associates, 2015) The technique was developed by Jeff Patton from 2005 to 2014 to address the risk of projects flooded with very detailed user stories that distract from realizing the product's main objectives. (Patton, 2008)



Picture 4. Example of Story map. (AgileVelocity, 2020)

User story mapping uses workshops with users to identify first the main business activities. Each of these main activities may involve several kind of users or personas (Patton & Peter, 2014).

The horizontal cross-cutting narrative line is then drawn by identifying the main tasks of the individual user involved in these business activities. The line is kept throughout the project. More detailed user stories are gathered and collected as usual with the user story practice. But each new user story is either inserted into the narrative flow or related vertically to a main tasks (Cockburn, 2013).

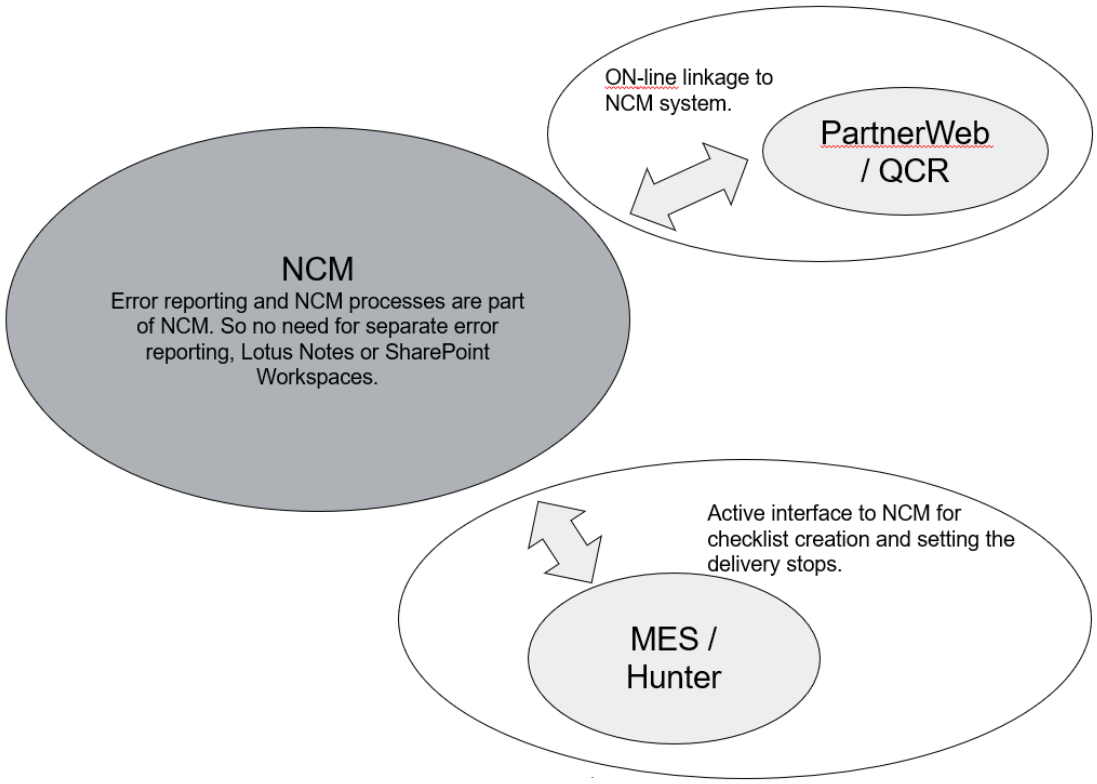
The horizontal axis corresponds to the coverage of the product objectives, and the vertical axis to the needs of the individual users (Cockburn, 2013).

4.2 Creation of the new NCM process

Process description was mainly defined by Product Quality Manager and thesis author in cooperation with team members from different departments. During the development process there were two main versions, where second one had in addition the defect repair function.

In user story creation phase this process description was used as story mapping backbone. And user stories then were walking skeleton. Naturally there was no different releases or evolution on the mapping, as this was only used in quotation process.

In process definition the weaknesses found at CSA was taken in account. Especially the verification of the corrective actions. In general, it was found, that many times the corrective actions were defined, but after certain period the same issue occurred again. This verification may require new resources, but should prevent the issue re-occurrence, and thus compensate the additional work.



Picture 5. Targeted new NCM system.

As mentioned in CSA study, current process works in several systems, like described in Picture 3. Thus the clear requirement was, that new system shall combine these earlier separate systems. New system proposal is described Picture 5.

In process definition it was defined the different users for the system, who were various departments in this case. Each department shall then execute same functions at high level, but in detail they naturally vary. And these details were then described at user stories. In practice thesis author guided the department workgroups to categorize user stories according to functions. This categorization would clearly ease the system provider to understand each department needs, and maybe in addition to help to combine the stories.

4.3 Introduction of the new process

Nonconformance Process (Picture 6.) steps aligned with the structure of the user stories are:

Defect detection: Process phase where nonconformance is detected in product or material.

Input to system: Supplier defects are reported by SCM and customer complaints by Product Quality. Defect description, source, responsibility and severity are defined at this point.

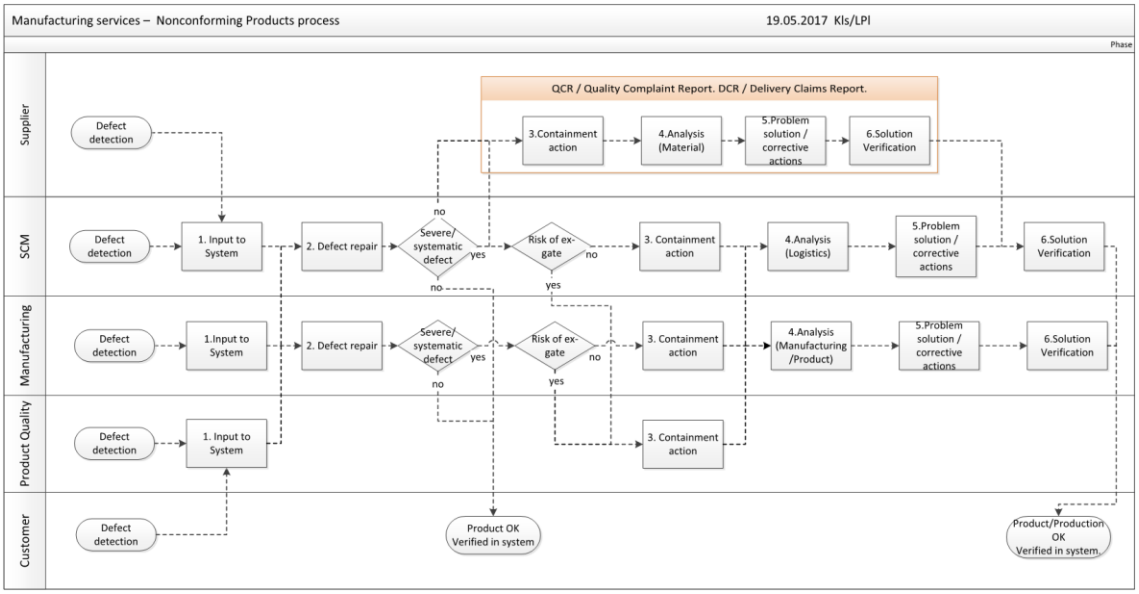
Defect repair: Single defects on the product are corrected and marked as Ok in the system.

Containment action: Inspection of parts/products and isolating the defect.

Analysis: Root cause analysis. Quality tools usage (4M, 5 Why, Brainstorming-Fishbone, SPC, Process capability)

Problem solution / corrective actions: Solution definition and implementation of long-term corrective actions.

Solution verification: Each responsible unit verifies its own corrective actions and verification can be added for other responsible parties along the value chain.



Picture 6. Nonconformance Process.

Process chart was designed in a way, that each function which will use the NCM, is separated into its own entity. Below description of each function.

Supplier: Supplier is external function from the company, and primary interface to supplier is the SCM (Supply Chain Management). In practice this means that internal functions will input the defects related to supplier to the system. Supplier corrective actions shall enter to NCM system via supplier portal.

SCM: This function includes supplier quality organization and internal and external logistics organization.

Manufacturing: Function includes body shop, paint shop and assembly shop. Due to different processes from robots made car body welding, painting to manual assembly the requirements for NCM are somewhat different, but the aim was to standardize the requirements in user stories.

Product quality: This organization is responsible for the finished product quality, thus they input defects that may be related to any other function.

Customer: Market feedback defects from customer are inserted to system by product quality organization. In addition product quality reports corrective actions back to customer, even actions are taken by other functions.

5 USER STORIES

In following chapters has been analyzed the creation process of the user stories. User stories are part of Agile software development method, which have been described below.

5.1 Agile software development in general

Agile software development contains various approaches to develop software. Requirements and solutions are developed co-operation with self-organizing and cross-functional teams and their customers / end user (Collier, 2011). It includes adaptive planning, evolutionary development, early delivery, and continual improvement. (Agile Alliance, 2020)

Incremental software development methods have been traced back to 1957. In 1974, it was introduced an adaptive software development process. So-called "lightweight" software development methods evolved in the mid-1990s as a reaction against "heavyweight" methods, which were characterized by their critics as a heavily regulated, regimented, micromanaged, waterfall model of development. (Alam & Chandra, 2014)

In 2001, seventeen software developers met at a resort in Snowbird, Utah to discuss lightweight development methods. As outcome they published *Manifesto for Agile Software Development.* (Agile Manifesto Authors, 2020)

We are uncovering better ways of developing

software by doing it and helping others do it.

Through this work we have come to value:

Individuals and interactions *over processes and tools*

Working software *over comprehensive documentation*

Customer collaboration *over contract negotiation*

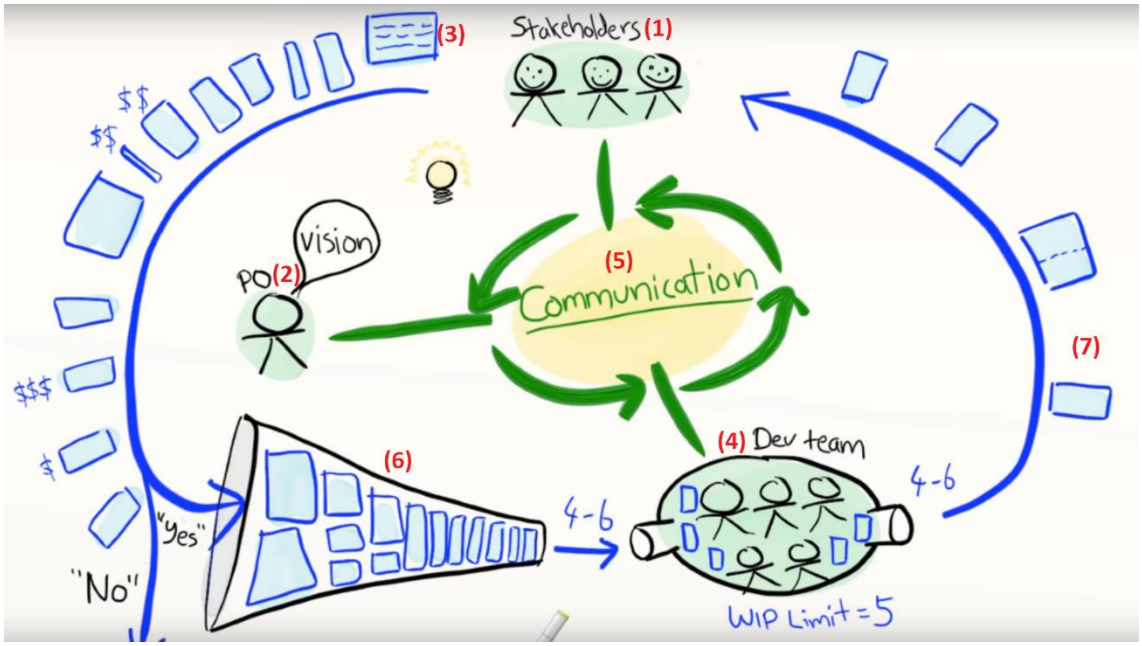
Responding to change *over following a plan*

That is, while there is value in the items on

the right, we value the items on the left more.

5.2 Agile software development elements

Agile software development project consists typically elements which are described below. Numbers in brackets after each topic refer to Picture 7.



Picture 7. Description of Agile project. (Kniberg, 2012).

Stakeholders (1): Writers of the user stories. Can include including clients, users, managers, or development team members. (Dimitrijević;Jovanović;& Devedžić, 2015)

Product Owner (2): Represents stakeholders and is available for developers to answer questions throughout the iteration. Helps the stakeholders to create concrete user stories and limits the development team work according their capacity (McGreal & Jocham, 2018)

User stories (3): Informal, natural language description of one or more features of a software system. Depending on the project, user stories may be written by various stakeholders including clients, users, managers, or development team members. They help software teams organize their understanding of the system and its context. (Dimitrijević;Jovanović;& Devedžić, 2015)

Development team (4): The team of self-organizing professionals, which is responsible to transfer the content of product backlog into publishable working software. (Kniberg, 2012)

Communication (5): According Agile Manifesto “Individuals and interactions over processes and tools”, therefore Communications and effective feedback loop between Product owner, stakeholders and development team is core of Agile. Contains product backlog grooming (Kniberg, 2012)

Product backlog (6): A product backlog is a prioritized list of work for the development team that is derived e.g. from user stories and use cases. Prioritization and selection items to backlog is done by product owner. (Kniberg, 2012)

Releases (7): Ready-made tested releases (Kniberg, 2012).

Product Backlog grooming : Defining the value and size of the user stories, prioritizing and splitting user stories. Driving by Product owner, but with the team of developers and product owners. (Kniberg, 2012)

At the end of each iteration, stakeholders and the customer representative review progress and re-evaluate priorities with a view to optimizing the (ROI) and ensuring alignment with customer needs and company goals

5.3 Principles of user stories

In Agile software development, the complete requirements definition is not done in advance, but requirements are becoming more accurate during the project. Anyhow there needs to be way to start the project, and agile way are user stories. (Poimala & Tolvanen, 2020)

User story is one clear functional requirement, which needs to be supported by the developed system. The text itself is tried to keep as short as possible, but it should

emerge WHO can do WHAT and WHY (Table 4). Quite often there is just talked about users, even system can have several different user groups. (Poimala & Tolvanen, 2020)

Table 4. Example of user story.

Who	What	Why
Basic User	When a delivery stop is activated I can send an email with all the information and a link to this delivery stop document to predefined group of recipients with one click	I do not need to prepare message separately in Email application. Avoid double work and mistakes.

User stories are created in writing sessions, where are participants from becoming users, customer representatives and possible system developers. Target is to create as many stories as possible, without judging if all stories are eventually coming as real functionalities. Stories can be indefinite, and they can be later defined or divided as sub stories. (Poimala & Tolvanen, 2020)

5.3.1 User story characteristics

Good user stories have certain common features (Poimala & Tolvanen, 2020). Those are explained below and in addition in Picture 8.

Picture 8. Good user story features. (Mahapatra, 2020)

Independency: If stories are heavily dependent to each other, prioritization and estimation for required implementation time can become impossible.

Negotiability: Stories are not agreement, but there needs to be room to relax.

Value add: Story must create value add to user, not to developer.

Estimable: As the design is made based on the stories, they have to be estimable.

Short: Long stories are too complicated, and risky to implement. Quite often long stories can be divided to shorter sub-stories.

Testable: It must be possible to test the stories.

User stories are not supposed to be complete requirement definition, but more to remind for the topics that needs to be discussed.

User stories are not only right solution to all situations. In very large projects there can be so many stories, that handling of those becomes impossible. This problem can be eased by creating “high level” stories and group them according to themes.

Stories may not be right choice, if tracing of the stories is important. Anyhow if customer relationship is based on trust, there is no need for this.

User stories are focused to improve internal communication inside of the team, not so much the formal communication. If there is need to communicate to several directions, e.g. several system providers, there is need to enlarge the stories with more formal documentation.

5.4 Creating the user stories

In this project user stories were created in teams. Teams were established based on nonconforming product process structure, described in picture 5. And one team was covering one section. E.g. participants mainly from supplier quality covered the Supplier part, SCM included participants from supplier quality and logistics department, manufacturing participants were from paint shop, body shop and assembly shop. Product quality covered the sections for product quality and customer. Participants background was mainly from quality functions, and they were familiar with the current system and its limitations. Therefore they could include into user stories the needed improvements.

User stories were created in groups, and thesis worker task was to combine the stories in one document. As such there could have been more co-operation and discussions

between the groups, but it was seen to already quite challenging to motivate and make the groups to work according the structure required by Agile user stories (WHO, WHAT,WHY). Thus this further discussion and creation of product backlog remains on actual Agile project.

In order to get the groups to follow the structure defined in NCM process, groups were advised to use the Excel template (Table 5). ID referred to process step in horizontal direction. Unit referred to vertical direction, departments. Who, What and Why are the parts according User Story definition. For Who section user categories were defined during the process to be: Basic user, Key user, Administrator and System. Moreover there was added “additional information” section, as in some cases there was need to give further clarification, especially as these stories were added to RFQ.

Table 5. Template for user story creation.

ID	Unit	Who	What	Why	Additional information

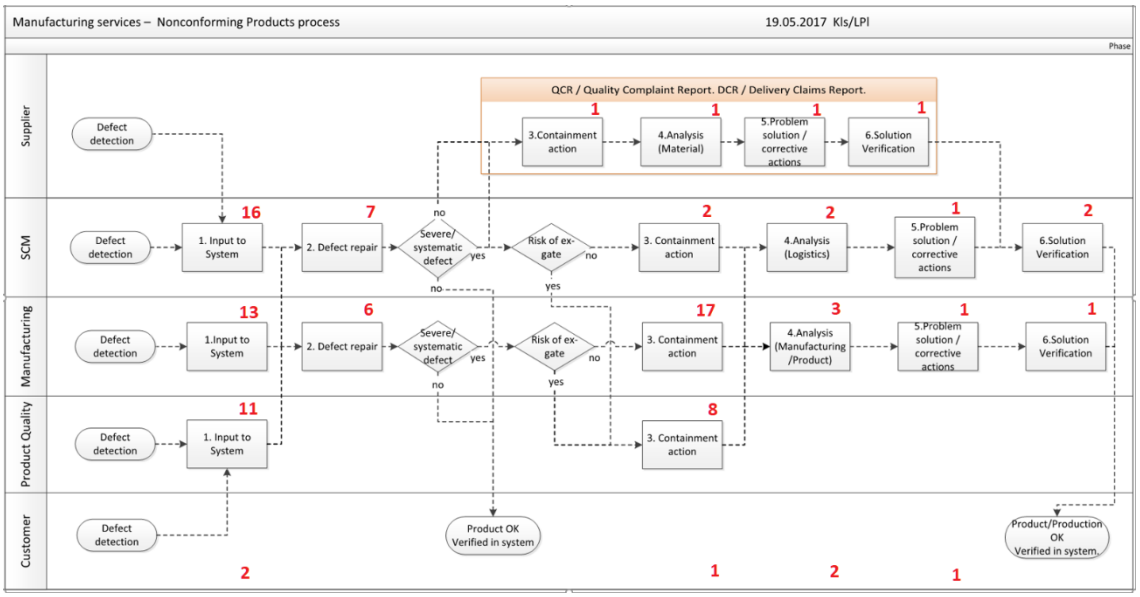
NCM process chart (Picture 6.) in combination with the structure created to Excel template was seen useful in user story creation process. Teams got clear picture for the high level process and understood what is expected from them. By defining the ID, it was later easy to identify which process step is referred to, and check that all steps are covered.

Unit makes it easier to check from which team the story is originated from, and guides to right source, if further discussion is needed. Therefore, it was very clear, that without proper story map, or process description in this case, the creation of stories would have been challenging. Furthermore, it would have been difficult to get the teams to understand the whole idea of user stories.

5.5 User story analysis

In following chapters user stories have been analyzed towards process description and their characteristics has been estimated. Furthermore the continuation of user stories has been considered.

5.5.1 Distribution of the responses



Picture 9. Distribution of the user stories to the NCM process.

As stories were indexed, it is was relatively easy to check, that all process steps have stories, and this helped work groups as well the check that they have covered all areas. From the picture 9 it can be seen, that first process steps have most of the stories. This is somewhat natural, as there are the biggest differences between the departments. When containment actions have been completed, then Analysis, corrective actions and Verification are more straight forward and common to all departments. Furthermore, the natural order of the tasks is guiding the user story amount. Ideas have already consumed at firsts process steps. The Positive finding is that all process steps have been covered in all departments, thus this shows that topics have been analyzed within work groups.

There are also 6 responses counted at the bottom of Picture 5. Those are defined for unit “All”. Consequently, guidance has not been followed 100%, but that is believed to be more like nature of the Agile.

5.5.2 User story characteristics

Section 4.2.1 listed the characteristics of user stories. In Table 6 it has been commented how the different characteristics have been realized.

Table 6. User story characteristics.

Characteristic	**Comment**
Independency	Process chart quid the work groups to focus only on one topic at the time, when creating the user stories. Thus stories became rather independent.
Negotiability	When the time is to discuss with developers, the real negotiation starts. Naturally some stories are more requirements and some stories nice to have features, like improvements from the current system.
Value add	Stories were created by stakeholders, thereby they really know what is the value add to the NCM process.
Estimable	Stories are well understood within story creation team, thus they should be estimable. This shall be done anyhow within development phase.
Short	Majority of the stories remained short. Only one or two sentences. Some stories remained too long and needs to be shortened before entering to product backlog.
Testable	Stories in general are concrete, to testing of them should be feasible.

5.5.3 Continuation

User stories were created by stakeholders from different departments, thus discussion e.g. with development team has not been done at this stage. Therefore when development starts e.g. the prioritization and estimation of the value of the stories needs

to be done before entering the stories to backlog. In addition some stories needs to be combined with others. Anyhow at this stage they give pretty good picture of expectations of the features for the system provider, when used in combination with process description. Unfortunately, discussions with system providers did not enter to stage, that they could have given feedback for the user stories.

6 CONCLUSION

This thesis work was part of the development of the new Valmet Automotive Production Support System and there the Quality part's Nonconformance Management. The system was planned to be subcontracted, therefore, the target was to have NCM requirements presented to potential subcontractors. And in these requirements were decided to be presented in the form of process description and user stories.

The method used in this thesis was to first analyze the current status and its weaknesses. This was used in later phases as support. The process description was developed by a workgroup based on current process but adding some improvements. Based on the process description, the user stories were created by department stakeholders, and thesis author coordinated the work and collected stories in the end.

As a result, the new process description and user stories were created and those were added as such as attachments to quotation requirements for potential system providers. User stories alone do not describe the system requirements clearly enough, but together with the story map, they give a rather clear picture for the requirements.

The set up for the thesis work was interesting, as user stories according their definition are not meant to be used requirement definition, but topics for discussion. The co-ordination work of the teams creating the user stories was somewhat challenging and gave a concrete experience of working with different personalities and how to motivate for the task that was new for them, especially as it was in addition to their normal workload.

This work taught the author much especially for the collection process of the user stories. For example, a proper story map (Process description in this case) was in the key role by easing the work of the team creating the user stories and additionally later the grouping of the stories. This grouping can be furthermore used when later reviewing the stories with system providers or developers. This user story approach gained in addition interest from other groups in VAPSS Quality team, as another team called Quality planning used the same method.

In case the new system is developed with Agile method, the stories are ready to be modified into a product backlog. In case Agile is not the method, the offered system can

be reviewed against the stories and, based on that, it should be possible to estimate how well the offered system matches the topics covered in user stories.

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User stories, part 1

ID	Unit	Who	What	Why	Additional information
1. Input to System	SCM	Basic User	I can enter an observation about defect / damaged material to the system by mobile device	More lean way of working. To get rid of / less paper reports.	There is possibility to attach pictures for respective registered case by integrated mobile device.
1. Input to System	SCM	Basic User	When making QCR / DCR I can get some basic information of the part from the package label by using a bar code reader that is linked to the quality system or, alternatively, by utilizing the camera of the mobile device (?)	To quicken registration. Eliminate errors.	
1. Input to System	SCM	Key User	The follow-up view of the claims is determined by an author.	For example, if Logistics creates a DCR /QCR, its processing steps are visible for logistics responsible persons.	
1. Input to System	SCM	System	The system sends automatically a notice (e-mail?) to Material Quality Inspection after a new QCR / DCR has been registered. The recent made claims are showed e.g. by color code (MQI status).		
1. Input to System	SCM	System	The responsible person for the QCR/DCR will be notified of the new registration (by e-mail?).	To quicken operation. Partly removes a working phase from Material quality inspector.	
1. Input to System	SCM	Administrator	I can create several different templates for different QCR / DCR-types.	User-friendly	
1. Input to System	SCM	System	The mobile device enables a digital signature, which is integrated into the defect logging system.	Signature is required for authentication of external transport damage.	
1. Input to System	SCM	Basic User	I can print the registered DCR / QCR-report out for next process phase.	The suspected parts/packages need to be marked for Material Quality Inspection.	
1. Input to System	SCM	System	Package -caused Transport defects as a separate part in the system	Different functions has to be able to identify their own defects.	
1. Input to System	SCM	System	The system can provide user defined alarms. E.g. three errors occur concerning the same part/task, Analysis is not given within certain time limit or it is a question of high-priced part.		
1. Input to System	All	Administrator	I can create configurable selection lists.	To easy the data review	
1. Input to System	All	Administrator	I can determine mandatory fields for defect registration.	To reduce errors during the defect registration phase	
1. Input to System	SCM	Key User	I can set DCR/QCR as groundless.	For the parts under suspicion that have been found out to be usable after inspection.	As an example cases where damage has been suspected e.g. plastic boxes delivered within each other but the parts have been foud out as an OK by acceptance inspection.
1. Input to System	Manufacturing	Basic User	I have identified the defect and enter it to the mobile device.		
1. Input to System	Manufacturing	Basic User	In advance I have been logged in to system with my personal ID.		
1. Input to System	Manufacturing	System	In defect input process the car under investigation has been identified automatically.		
1. Input to System	Manufacturing	System	The view I have in my application is different based on station and area and is scaled according to my input device properties.		
1. Input to System	Manufacturing	System	Entering the defects into system is fast and easy as I need to input several defects in 2 minutes tack time. So the defects and locations should be selectable from few options.		
1. Input to System	Manufacturing	Basic User	I'm also able to add pictures and exact location of the defect.		
1. Input to System	Manufacturing	Basic User	I have also option to add free text for possible additional needed information.		
1. Input to System	Manufacturing	System	In case the defect is customer relevant, the system gives me option to start the severe/systematic defect process.		
1. Input to System	Manufacturing	System	The device I'm using is targeted to production environment (no changing passwords, durable and easy to use).		
1. Input to System	Manufacturing	System	Also the device enables to scan barcodes.		
1. Input to System		System	Also the device enables taking pictures and attaching defect.		
1. Input to System	Manufacturing	System	Logging into system happends via flexim, fingerprint.		
1. Input to System	Manufacturing	System	The system follows if same faults are repeated during the same shift or fault is severe (certain parts or assembly phases) and can quide me to start severe/systematic defect process.		There has to be possibility to set different kind of triggers for similar kind of defect recognition.
1. Input to System	Manufacturing	Basic User	As I defect reporter, I need to be able to set priority to defect.		
1. Input to System	Product Quality	Basic User	I have identified the defect and enter it to the PC (or mobile device).		
1. Input to System	Product Quality	System	I need fast login to system with normal production authentication.		
1. Input to System	Product Quality	System	System identifies based on production number the vehicle partlist and fills in the needed parameters automatically.		
1. Input to System	Product Quality	System	In case the vehicle under analysis is from competitor, system is able to generate dummy partlist.		
1. Input to System	Product Quality	System	System identifies automatically from production number if vehicle is from normal production or pre-series vehicle. In case competitor vehicle is analysed the information is added manually.		
1. Input to System	Product Quality	System	Entering the defects into system is fast and easy. So the defects and locations should be selectable from input device.		
1. Input to System	Product Quality	Basic User	I'm also able to add pictures and exact location of the defect. I have also option to add free text for possible additional needed information.		
1. Input to System	Product Quality	Basic User	In case the defect is customer relevant, the system gives me option to start the severe/systematic defect process.		
1. Input to System	Product Quality	Basic User	If the defect is from product audit, it must be entered to system as preliminary. Defect must be marked as final only after separate approval step. In preliminary state the defect shall be visible only to defined users and shall not be visible in any reports.		
1. Input to System	Product Quality	Basic User	I should be able to generate vehicle based defect report for presentation.		
1. Input to System	Product Quality	Basic User	In case the defect is originated from customer, I should be able to move directly after defect input to containment action stage.		
1. Input to System	SCM	Basic User	I'm able to combine multiple syncro parts to one QCR / DCR		Production numbers should be listed in QCR / DCR
1. Input to System	SCM	Basic User	I'm able to collect multible batches to a single QCR		QCR is driven by part number
1. Input to System	SCM	System	Show "older QCR" button in QCR creation page	To highlight reoccurring defects and allow to use template	
1. Input to System	SCM	System	Material management team informed if large amount of parts or syncro parts are rejected.		
1. Input to System	SCM	System	Inventory level is updated immediately once a DCR / QCR has been entered.	To keep stock level up to date	Interface with Fidaware (WMS)
2. Defect repair	SCM	Basic User	I can send a remark QCR to supplier if rework is done by Valmet		Reworking hours invoiced from supplier

User stories, part 2

ID	Unit	Who	What	Why	Additional information
2. Defect repair	SCM	Key User	I can access the needed data and several other documents	Lots of data and documents on different systems	Damage report, Photos, licenceplate numbers, part data, freight invoice, waybill, etc..
2. Defect repair	SCM	System	The system send's invoicing information directly to Finance department		valid for both supplier and transport company.
2. Defect repair	SCM	System	I can get previous QCRs visible when entering part number	Feature would highlight recurring defects	
2. Defect repair	SCM	Basic User	I can define return shipment urgency when creating a supplier QCR		
2. Defect repair	SCM	System	Get tracking number for return shipment automatically from Logistics		
2. Defect repair	Manufacturing	Basic User	With my mobile device via barcode or scanning I need to be able to identify the product I'm working with.		
2. Defect repair	Manufacturing	Basic User	As responsible for repairing the product I need to be able to input to system that product has been corrected or if additional repair actions are needed.		
2. Defect repair	Manufacturing	Basic User	System stores the repair time automatically from starting of the job to marked as done. The time can be modified manually.		
2. Defect repair	Manufacturing	Basic User	Also I need option to add possible comments or memo to system.		
2. Defect repair	Manufacturing	Basic User	From the system I'm able to check possible other faults happened to same material lot or faults marked by other units.		
2. Defect repair	Manufacturing	Basic User	Also I'm able to check other related severe defects from the system.		
2.Defect repair	SCM	Basic User	I'm able to enter additional working hours spent due to noncormance.	Needed for invoicing	
3. Containment action	SCM	Basic User	Inform production how to continue with parts deliverd to production line / warehouse.	To avoid assembling defected parts	Shipment tracking for Syncro parts on product number level.
3. Containment action	Supplier	Basic User	As supplier I have possibility to react quickly and give response to QCR / DCR	To minimize impact to production	
3. Containment action	SCM	System	The system enables the user to monitor quality situation by reports which are automatically updated in real time.	E.g. the user is able to monitor quality incidents according to supervision areas and specific parts	
3. Containment action	Manufacturing	System	I have access to Hunter and Lean systems from where the QMS imports the needed parameters for vehicle in question based on production number or VIN number . System is setting automatically deadline for corrective actions. Also system generates unigue identification number for each case.		
3. Containment action	All	System	System selects automatically predefined template based on users unit. User can change the preference in case needed.		
3. Containment action	Manufacturing	Key User	I'm able to add or modify the content of used templates and deadline settings.		
3. Containment action	Manufacturing	Basic User	I'm able to search for past cases from system with selected paramaters.		
3. Containment action	Manufacturing	Basic User	I'm able to access the MES system to see which products in manufacturing line are using e.g. same defected part.		
3. Containment action	Manufacturing	Basic User	From system I'm able to generate checklist for production line inspection. Checklist can be created based on certain amount of vehicles and including e.g. only products that have same suspected part.		
3. Containment action	Manufacturing	System	System sends reminder for responsible persons for creation, deadlines, responsible changes or processs related needed actions.		
3. Containment action	Manufacturing	Basic User	I'm able to follow the quality status based on different criterias, unit, originator, responsible...		
3. Containment action	Manufacturing	Key User	I'm able to easily manage and create approval flows.		
3. Containment action	Manufacturing	System	System supports also lighter corrective actions process. E.g. in preseries or less severe defects I may just need to keep track on issues and just basic corrective actions. These special cases should be identified in system so that they can be separated from official failure reporting.	Preseries or less severe defects do not need to fulfill all corrective action process requirements.	Process for this has to be defined separately.
3. Containment action	Manufacturing	Basic User	I know from system which parts/products I need to inspect and able to scan the inpected product and mark them as OK/NOK and optionally add measurement result or additional data. The equipment I'm using is portable.		
3. Containment action	Manufacturing	Basic User	The system enables the user to monitor quality situation by reports which are automatically updated in real time.		From the large screen I can see the quality status: Previous day and week.
3. Containment action	Manufacturing	Basic User	The user is able to monitor quality incidents according to supervision areas.		
3. Containment action	Manufacturing	Basic User	It is possible to set specified "alarm limits" for example: 1. three errors occur concerning the same part/task 2. Analysis is not given within certain time limit		

User stories, part 3

ID	Unit	Who	What	Why	Additional information
3. Containment action	Manufacturing	Basic User	I can report the quality status and FTOK and VoCA on request.		
3. Containment action	Manufacturing	Key User	I can set quality targets to the system. System remembers also targets from history.		
3. Containment action	Product Quality	Basic User	As a user who is approved to set vehicles for delivery stop I can set vehicles into a delivery stop state based on many flexible criterias or single vehicle. Criterias should include, but not limit to production numbers, production status, material level criterias e.g. batch number, component codes... This can be done on a PC or a mobile device.		
3. Containment action	Product Quality	Basic User	I can monitor the delivery stop process status in realtime and can drill down into detailed vehicle information.		
3. Containment action	Product Quality	Basic User	Any actions done to a vehicle under delivery stop must leave a history record that consists of a time stamp, what was done and by whom e.g. vehicle added to a delivery stop state, vehicle approved, inspection, rework etc.		
3. Containment action	Product Quality	Basic User	I must be able to attach instructions like rework and checking instructions to a specific delivery stop.		
3. Containment action	Product Quality	Basic User	I must be able to add n amount of steps to a delivery stop that must be marked as done before the delivery stop can be removed - this ensures that all the needed steps like rework and re-testing are done for each vehicle.		
3. Containment action	Product Quality	Basic User	I can add break/dirt/clean point information concerning the delivery stop		
3. Containment action	Product Quality	Basic User	When a delivery stop is activated I can send an email with all the information and a link to this delivery stop document to predefined group of recipients with one click	I do not need to prepare message separately in Email application. Avoid double work and mistakes.	
3. Containment action	Product Quality	Basic User	I can select a predefined group of quality and related persons by e.g. area, department etc. and include them as a responsible/to be informed group for this delivery stop.		
3. Containment action	Manufacturing	Basic User	As vehicle inspector/reworker: • I know from system which parts/products I need to inspect and I'm able to scan the inpected product. • My PC or mobile device opens a list of 1-n delivery stops that concerns this vehicle when I scan or enter the vehicle ID into my PC or mobile device. • I can see the rework and inspection instructions with one click on my PC or mobile device • I can mark the vehicle inspected as OK or NOK by one click • If I am doing a rework I can see the instructions and steps easily and mark a step done by one click • I can add measurement result or additional data.		
3. Containment action	Manufacturing	Basic User	• As a user who is approved to clear a delivery stop state I can approve/remove vehicles from a delivery stop. This can be done on a PC or a mobile device by scanning the vehicle code. • I cannot approve the vehicle if not all required steps are done for a certain delivery stop.		
4. Analysis	Supplier	Basic User	As a supplier, I am able to add root cause analysis, corrective and preventive actions for cases assigned to me.		
4. Analysis	SCM	Basic User	As a user I have option to use the system provided tools for root cause analysis (4M, 5 Why, Brainstorming-Fishbone, SPC, Process capability). Also I can transfer the responsibility if needed. I can also adjust the clean point and suspected faulty products. I have possibility to drill in to other areas or departments memos and error data.		Valmet Automotive internal
4. Analysis	Manufacturing	Basic User	As a user I have option to use the system provided tools for root cause analysis (4M, 5 Why, Brainstorming-Fishbone, SPC, Process capability). Also I can transfer the responsibility if needed. I can also adjust the clean point and suspected faulty products. I have possibility to drill in to other areas or departments memos and error data.		
4. Analysis	Manufacturing	Key User	System enables to define common reporting methods to all departments. Quality data, like weekly FTOK, days trend and LM result, should be on-line available from one location.		
4. Analysis	Manufacturing	Basic User	As a supervisor I have standard template for quality review for analysis, from where I can drill in to quality data and memos.		
4. Analysis	SCM	Key User	I can monitor the total cost development and trends of QCR's/DCR's . Monitoring at daily, weekly and monthly level.		
4. Analysis	All	Basic User	As a analysis responsible, I can asssign analysis tasks to other responsible persons/departments. As a analysis responsible, I can transfer case responsibility to other person/department.	Analysis has to able to be done in separate persons and organizations, if needed.	
4. Analysis	All	Basic User	As a anaysis responsible, I can accept/reject analysis responsibility transferred to me		
5.Problem solution / corrective actions	Supplier	Basic User	As user I can define the solution for the issue and describe the long term corrective actions.		
5.Problem solution / corrective actions	All	Basic User	As a user I can add multiple corrective actions separated to different responsible persons/departments with information of task description, required due date, attacments, etc. I need to be able to track progress of assigned corrective actions.		
5.Problem solution / corrective actions	SCM	Key User	As user I can define the solution for the issue and describe the long term corrective actions.		
5.Problem solution / corrective actions	Manufacturing	Basic User	As user I can define the solution for the issue and describe the long term corrective actions.		
6.Solution Verification	SCM	System	I can get a notification if credit note is created and approved	Keep track on Credit note status	
6.Solution Verification	Supplier	Basic User	I'm able to verify corrective actions.		
6.Solution Verification	SCM	Key User	I'm able to verify corrective actions and I can also add verification for other responsible parties along the value chain.		
6.Solution Verification	Manufacturing	Basic User	I'm able to verify corrective actions and I can also add verification for other responsible parties along the value chain. E.g. body shop asks assembly shop to verify change in product geomentry.		
1. Input to System	Finance	System	System creates the invoice to the invoicing party. In the purchasing contracts there are defined partner function: 'invoicing party' where we want the invoice to be formed.	Supplier get the correct invoicing address etc.	Complaint invoices can be deduct from the suppliers purchase invoices.
1. Input to System	Finance	System	System check from the supplier master data the VAT code (Sales EU/ Sales Outside EU.) VAT code is based on the supplier number where the claim/goods are made.	E.g. If the invoicing party is in the EU country but the complaint is made outside of EU, VAT code need to be 'Sales outside EU'.	
1. Input to System	Finance	All	I'm able to make credit note / cancel the complaint invoice. There are also possibility to make approvals for the credit note.	If the supplier did not accept the complaint but the invoice is already formed, there need to be possibility to make credit note.	
1. Input to System	Finance	Basic User	When making the claim there are text box where basic user can add information. Example references, contact persons, additional text. This information is transferred to the debit/credit invoice.	To avoid questions from the supplier because they do not indentify the invoice to the claim.	