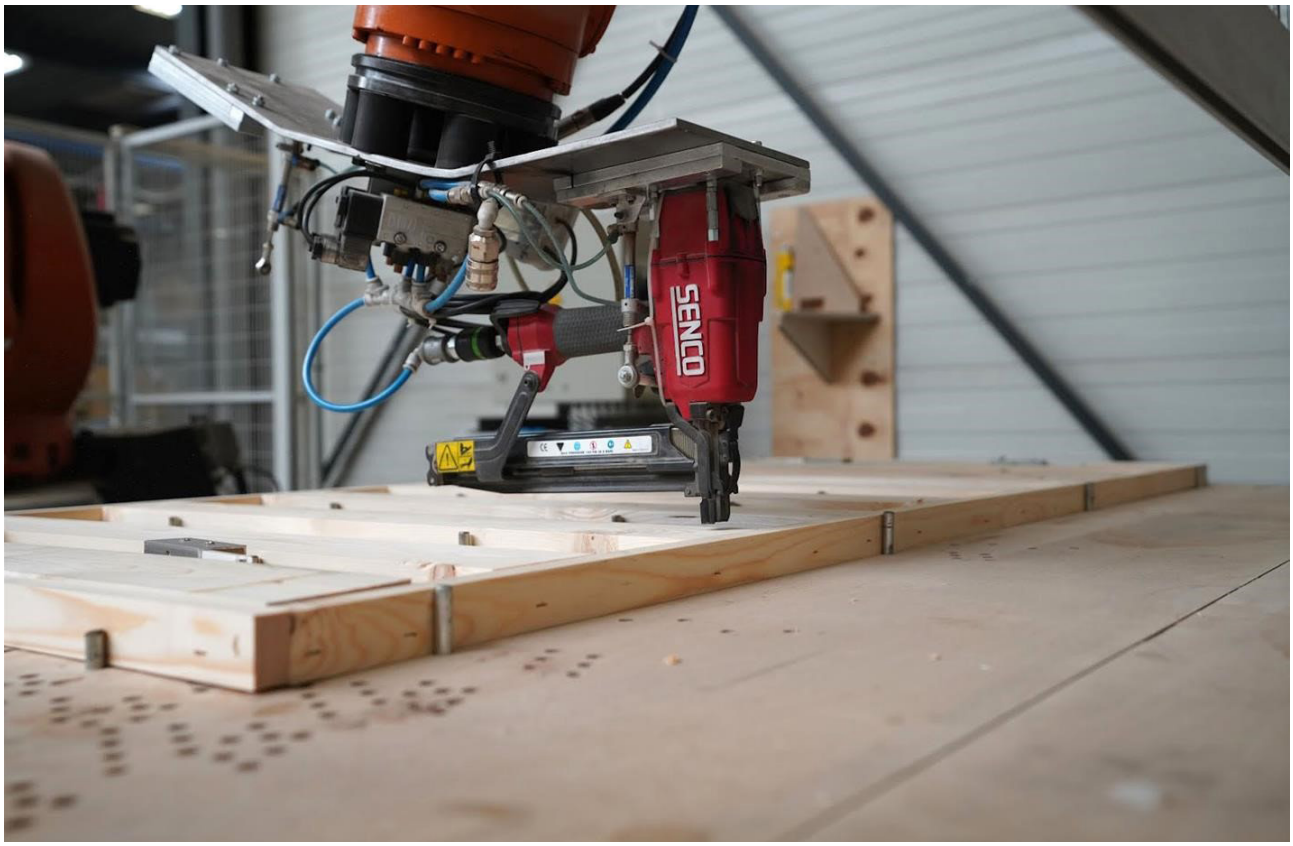
Interreg North-West Europe
COTEMACO
European Regional Development Fund

Success Story

Modular Digital Work Instructions from Bill Of Materials

Noord-Limburgs Open Atelier VZW, BEL



Modular Digital Work Instructions from Bill Of Materials

Company description

Noord-Limburgs Open Atelier is an SME in Flanders that performs several supplying tasks for other companies, including packaging, assembly, confection and metal- and woodworking. Their mission is to prepare low qualified people for jobs in the regular industry by teaching them the relevant technical and social skills (e.g. language, attitude, self-dependence) through personalised coaching on-the-job.

Goal

Investigate the potential of modular work instructions for the assembly of product families based on the Bill of Materials

Motivation/Starting Point

Open Atelier has a large need for proper coaching of their employees. The situation today is that they have one full-time coach available for every four employees to support them in their work. The coaches explain the tasks step by step, indicating the points of attention and quality requirements. They closely follow-up execution times and operator mistakes, in order to track the progress of every individual. These coaches experience a high work load due to the increasing complexity of the tasks and the ever increasing quality requirements. Language difficulties in the interaction between coach and operator make it even more difficult to teach this.

The introduction of digital work instructions is expected to reduce the workload of the coaches in different ways. One the one hand, coaches could use these digital work instructions to explain the tasks step-by-step supported with pictures and videos which reduced the language difficulties. On the other hand, the coach can refer the operator afterwards to these instructions as a first point of information. This has the additional benefit that it makes the employees more self-dependent which is an important skill to have in the regular industry.

One of the issues with digital work instructions is that it takes quite some effort to create them. Especially in an environment where the product portfolio is continuously changing, which is the case for Open Atelier, this rapidly becomes a bottleneck in the adoption of digital work instructions. To exploit the full benefit of digital work instructions, their creation should be as simple and fast as possible. For the woodworking department within Open Atelier, the product portfolio can be organised into different product families with a number of variants. If modularity of work instructions for similar product families can be exploited in the creation phase, it would have a major impact on the creation time and therefore increase the adoption of work instructions on the shop floor.

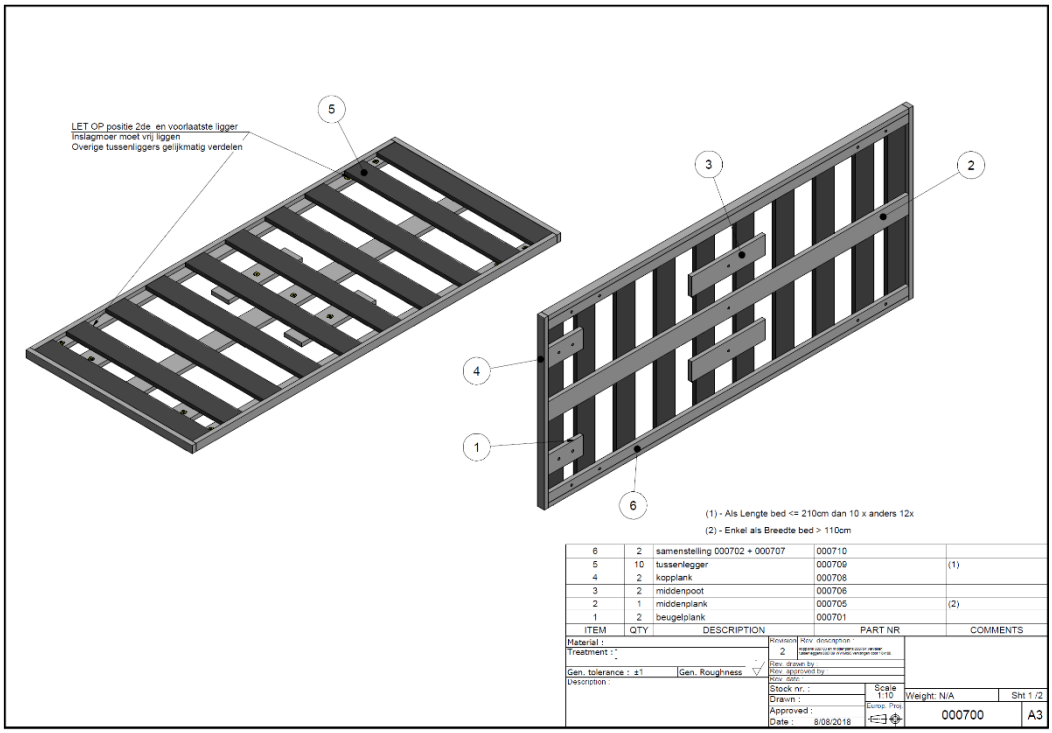


Figure 1: Original situation: technical drawing used as work instruction

Analysis

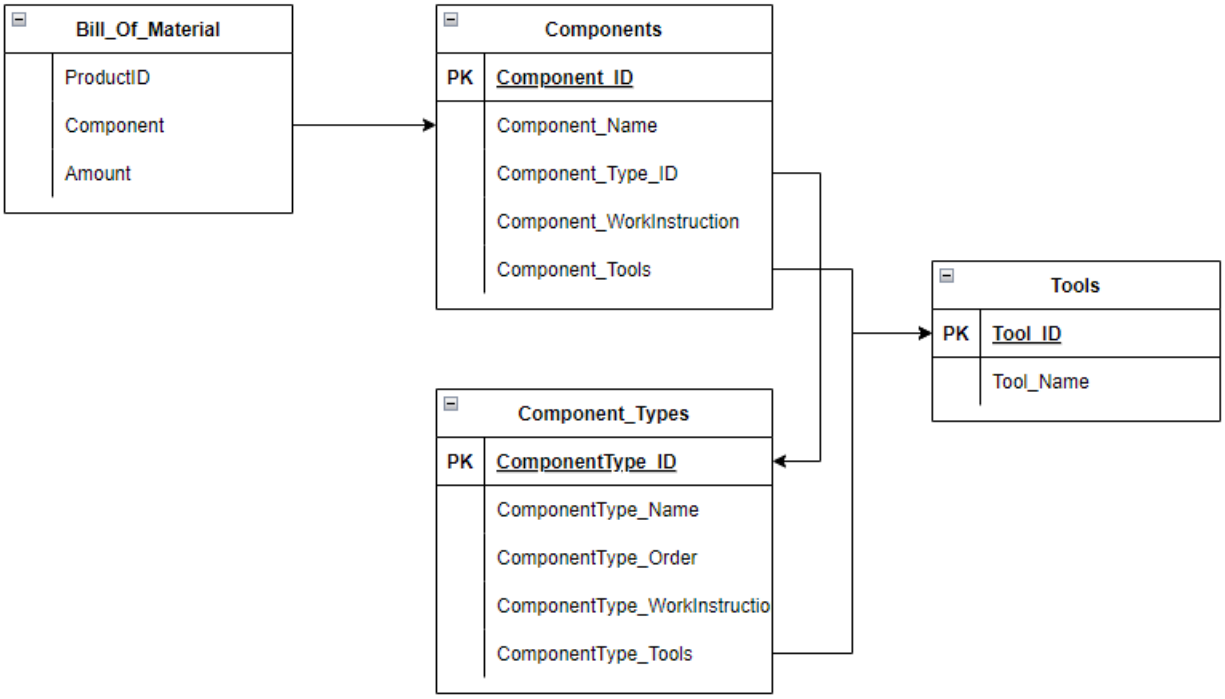
The feasibility study will focus on a methodology to create modular digital work instructions by starting from a Bill of Materials. This will be applied to the assembly process of a series of bed frames within the woodworking department of Open Atelier. As Open Atelier already introduced digital work instructions on the shop floor in their other departments using Microsoft Powerpoint, this is the preferred output format of work instructions in this feasibility study to ensure consistency in the way of working within the company. The final work instructions should be again provided according to the templates used by Open Atelier. These instructions include text, pictures, annotations and potentially videos.

The product portfolio of bed frames can be grouped into different product families. Variance withing one family includes altering dimensions and amount of parts, while variance across families might also influence the order of the assembly process and additional steps. The main focus of this feasibility study should be on this second type of variance that influences the assembly order and thus also the order of the work instructions itself.

Final goal of this feasibility study is to explore the possibility of modular work instructions based on the BOM (parts list) currently available in their ERP system. For this to work, the assembly sequence should be reconstructed based on the type and amount of parts present.

Technical Realization

The proposed methodology combines the information from the Bill Of Materials with an additional database that structures the products and product families and their additional information. Since the individual components of the Bill Of Materials were labelled by several persons over a period of several years, the given labels were not consistent and therefore not sufficient to identify similarities in the assembly process. A dictionary was created that categorizes the different labels into fixed component types that might be expected during the assembly process of a bed frame. These generic categories are then used to describe the general outline of all assembly processes. Each component type is provided with some specific instruction slides for that component type, as well as a list of involved tools and a general order in the assembly process. Information on component level can be used to overrule the information on component type level, in case the generic information is not sufficient or incorrect for the given component.



This information is then fed to a automatic Python-code toolchain consisting of an instruction composer and an instruction editor. In a first step, the instruction composer collects the different modular work instructions from the database based on the components in the BOM. The individual DWIs are then combined and sorted according to the correct assembly sequence. In a next step, the instruction editor applies some changes to the combined slide set to make sure the required tools and parts are correctly filled in and the correct labels for the specific variant are present. After the instruction editing step, the instructions are ready to be used by the employees on the shop floor.

This methodology was developed as a standalone toolchain, but in the future this might be integrated in an automated workflow in their ERP system or connected to a product configurator.

Result

In this feasibility study four variants of bed frames (disregarding dimensions) were explored. It was noticed that these four variants share a common assembly order. In total 8 component types could be identified for which modular work instructions were created. The table below shows the analysis for these variants. On average about 88% of the instructions is shared between variants within this limited explored subset. If this would be applied to the complete portfolio, this ratio would definitely further increase.

Variant	# Different Components	# Component Types	# Shared instructions	# Shared instructions	# Shared instructions
000700	6	6	4	2	66%
000800	7	7	7	0	100%
000900	7	7	7	0	100%
001200	11	7	6	1	86%
				Average	88%

The explored toolchain has the potential to speed up the creation and maintenance of digital work instructions for the assembly process of product families. Open Atelier currently has 59 variants of bed frames in their product portfolio (not taking altering dimensions into account) for which this methodology can be applied. Manual creation of instructions for all these variants would take about 4 hours per instruction. By grouping this into modular instructions for each component type (or component) instead of an instruction for each product, we estimate the total effort can be reduced by 80%. There is still some effort needed for the analysis of commonalities between products and for the creation of these individual instructions per component or component type.

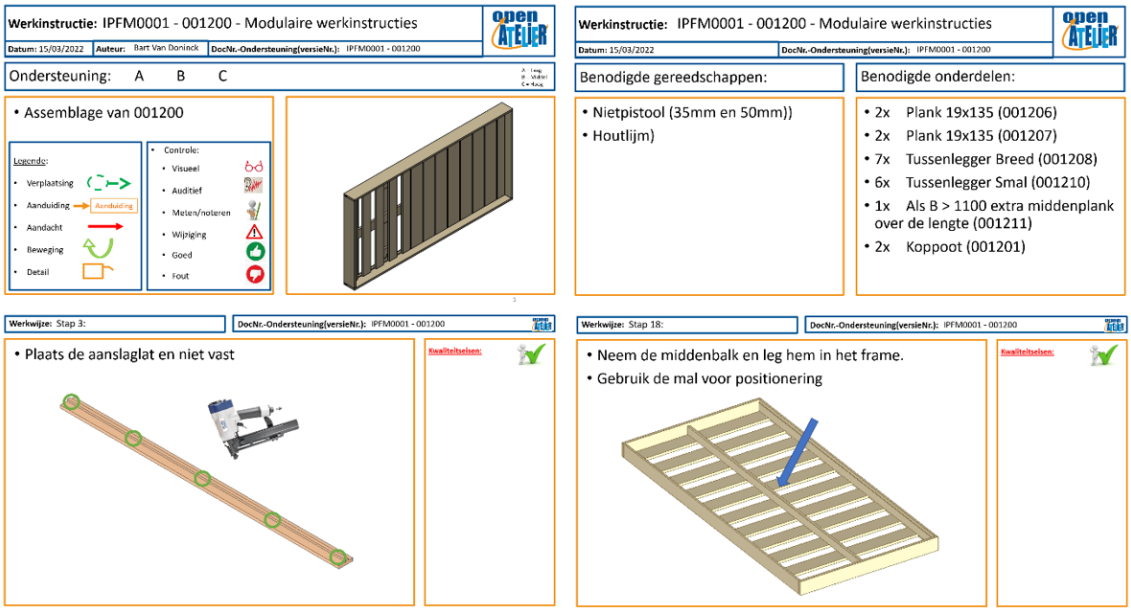


Figure 2: New situation: powerpoint presentations on the shop floor with detailed step by step instructions (image of operator with tablet)

A statement described by Koen Cools, CEO of Noord-Limburgs Open Atelier: “As we notice a continuous increase in variation of products we have to make for our customers, we need to be flexible and efficient in our organisation. Combined with an increasing amount of employees that needs to be trained, we believe digital work instructions can clearly help us with that. But we need smart ways to integrate them in our production.”

View from the employee perspective

The explored methodology has a direct impact on the employees of Open Atelier.

For the coaches, digital work instructions will be available to reduce their workload. When explaining the assembly procedure, they can refer to the step by step work instructions available at the workstations. They can put more focus on the overall growth of the employees instead of spending time on the teaching the details of the assembly process.

The employees can work on their self-dependence skills. Taking initiative is stimulated, without increasing the risk of failures and quality issues. The digital work instruction are available as back-up in case they forget the next steps in the assembly process. By using the modularity, it is expected that they can see the links between the product families and the same type of instructions for the same type of actions, which will increase consistency for them.

For the production responsibles, less time is required to create proper work instructions. Therefore, they can introduce new orders from customers faster and the produced products will be less prone to errors. The employee allocation problem will also become easier as no specific training or previous experience is required to assemble the bed frames anymore.

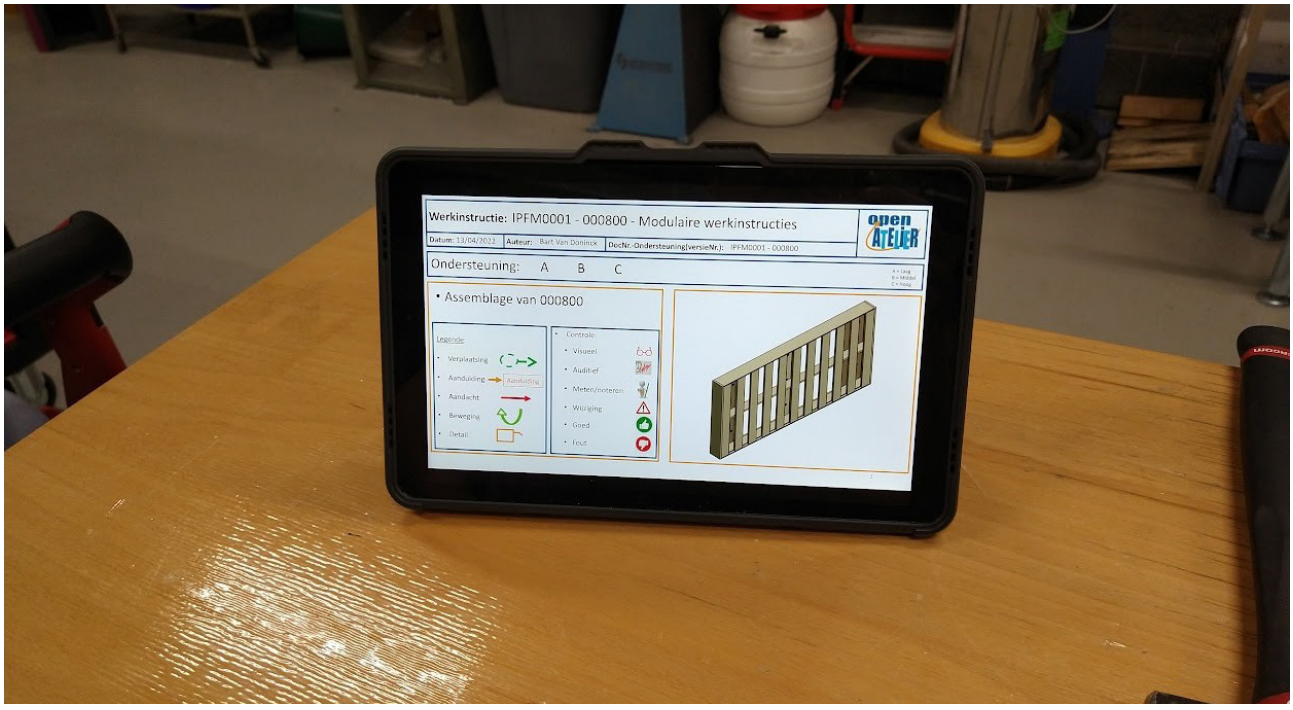


Figure 3: Tablet with instructions near the workstation

Interview

How could COTEMACO support you?

“We could use some advice with regards to the general rollout of digital work instructions within our company. We are aware of the benefits of work instructions, but we are still looking for ways to efficiently create and manage these. Our production responsibles have a technical background when it comes to the assembly and production processes, but they lack the software and programming background to support the digitization process. The COTEMACO experts showed us some possibilities and applied them on a real use case for us.”

What was implemented and what are the benefits?

“A Proof-of-concept software program was tested and proved successful in creating work instructions for the four variants for which we provided the info. The software combines the individual information of the different parts in the Bill of Materials to one large work instruction in the Powerpoint format we are used to work with. At first sight, this solution could allow us to save a lot of time when creating the instructions, but further testing on the shop floor in the future with more variants will have to confirm this.
Additionally, we tested the Powerpoint templates for creating our regular work instructions. This would simplify our current process of creating work instructions and makes it easier to manage our existing instructions if we want to apply changes to the general layout.”

Were your expectations fulfilled – technical implementation?

“Yes, we expected to get a clear view on the possibilities to simplify the process of work instruction creation at Open Atelier. We explained our way of working to the experts and pointed out some of the issues we noticed. Based on this information, they started thinking and came up with several possible improvements. The most interesting ones were further worked out and tested on our actual use case. This way we could clearly see how it works and we got a better idea of what the added value for us would be. Some results are ready to use, but in order to adopt the complete methodology we will need to do some more validation first.”

Were your expectations fulfilled – Support through COTEMACO?

“We had a good interaction with the experts of COTEMACO throughout the project. Our first contact was during the advisory day on digital work instructions where we had the chance to explain our situation. As a follow-up, they’ve brought us in contact with a digital work instruction platform provider that was most suited for our company. Although the solution was very interesting, we didn’t go for it at that time because we noticed there was some preparation work for us to be done first. However, a couple of months later we reached out again to the experts for some more specific advice. The benefits of work instructions were clear, the platform was chosen, but the creation process took quite long. Before spending the effort to create instructions for all our products, we wanted to know whether there might be a better way and that’s when we started this feasibility study. Without COTEMACO, we would not have been aware of all these possibilities.”

What is COTEMACO?

The project, which is an initiative of Interreg North-West Europe, aims to support around 60 SMEs in the automotive and food manufacturing industries with so-called „test environments“ and to encourage them to integrate collaborative robotic systems and digital technologies into their business. Accordingly, in addition to increasing production flexibility, the relocation of production abroad will be curbed and the number of jobs in manufacturing increased, which will generally lead to an improvement in the competitiveness of the companies involved.
In the project new technologies are implemented in application examples - the aim is to move from the prototype in the laboratory environment to the transfer to production, taking into account the legal situation and certifications.

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