

Visual Management Design in Business Processes for Power Transformer Factories Using Virtual *Obeya*

Dony Kurniawan*, Ratna Sari Dewi
Institut Teknologi Sepuluh Nopember, Indonesia
Email: 6010231018@student.its.ac.id*, ratna.sari.dewi@its.ac.id

Abstract

Power transformer factories are an Engineering to Order (ETO) industry where the products produced have small volume characteristics but many variants. This is due to the need for a power transformer that adjusts to the needs of the customer's electrical system so that each transformer is designed custom. This business process requires a very massive and rapid exchange of information. It is necessary to have a platform to make the distribution of information structured. Currently, Physical *Obeya* is implemented using a large space and a board containing important data that can be viewed by all cross-functional teams. However, this board still has some drawbacks to accessibility that require a physical presence and a complicated update process. So, virtualization on Physical *Obeya* was carried out. Virtualization is done by gathering several inputs from cross-functional teams and mapping them into a Value Proposition Canvas to identify the goals and advantages and disadvantages of Physical Obedience that has been carried out so far. Then, the design of virtualization in Physical *Obeya* is carried out by understanding the business processes in the company to identify what are the process checkpoints in a project into a database, and visualized in a way that takes into account human factors and cognitive ergonomics. Thus, virtual platforms can focus on users. Based on the results of these tests, the platform can be put to good use according to the previously identified objectives.

Keywords:

Engineering to Order;
Physical *Obeya*;
System Usability Scale;
Value Proposition Canvas;
Virtualization

INTRODUCTION

The ETO (*Engineering to Order*) industry is an industrial system that produces products with a small volume but many variations. This ETO industry will generally design and produce products according to customer demands. ETO has many challenges, including: long *lead times*, high costs, and information exchange (Strandhagen, 2018). In the ETO industry, all product manufacturing requests will be considered as a project. This is because the ETO industry has quite long stages in producing a product so that the product can be received by customers according to the specifications and delivery times that have been agreed upon in advance (Pokorná, 2015). These stages include order acceptance, product design, approval of a design, manufacturing/manufacturing of products, testing of products, and delivery of products in accordance with contracts or agreements already made between manufacturers and consumers. At each stage in the manufacture of the product, there is a fairly massive information exchange process in a very fast time which requires each *stakeholder* to be able to receive and process information so that communication runs smoothly and products can be produced properly.

Because in the ETO industry, a lot of information is exchanged at a very fast time, so the industry is starting to look for ways to make information exchange more effective and

efficient. One way to facilitate the massive exchange of information can be done by creating a platform that contains information that everyone needs to know so that other parts can receive the information easily and accurately.

One example in the ETO industry is the power transformer manufacturing industry. In terms of products, power transformers have a huge variety between one product and another. Each power transformer product has its own function in the electrical system that makes the production of power transformers cannot be made massively. This is what makes power transformers specially designed according to their function in the electrical system. In terms of manufacturing, because the products have many variations and different designs, each customer's request can be interpreted in a project. So from an operational perspective, the production of power transformers can be interpreted as *project-based*.

At present, in the process of project management of power transformer production, the project progress board facility is still in use (Marchi, 2022; Nguyen, 2019). Where, each team provides an update on the status written on the board for other teams to know. Updates include progress status, planning, material allocation, workers, and issues that may hinder the ongoing production process. All the information is collected and visualized into a status card with the labeling and the team responsible for the points on the board. However, this medium has a weakness where not all teams are in one location. So, there are some teams that experience information gaps and cause the production process to be hampered. All teams should come and see this board every day so as not to miss information that has an impact on the amount of time allocated to see the progress and progress of ongoing projects.

To improve this, research on virtual platforms was carried out. This aims to provide quickly up-to-date information to all teams related to the project so that it can be viewed on each team member's computer. Each team can also have access to update the information obtained according to their respective roles so that the latest status can always be seen anytime and anywhere. This can make it easier for management in the decision-making process and planning process so that the production process can run more planned and measurable (Mapokgole & Mbohwa, 2013; Tezel, 2016). The creation of this platform considers the concept of LEAP by integrating the engineering team in designing, the planning team in determining material purchase and production planning, and the production team in the process of product execution and manufacturing.

The Linked Engineering and Manufacturing Platform (LEAP) is a communication platform between *engineering* as the owner of the design and *Manufacturing* as the one who implements the design so that the products produced are in accordance with the design made. LEAP focuses more on improving manufacturing design collaboration in the context of *Product Lifecycle Management (PLM)* (Gualtieri, 2023). LEAP targets the challenges of modern manufacturing through collaboration, enhanced connectivity, and the comprehensive integration of the product life cycle while in manufacturing (Emmanouilidis, 2018).

In addition, LEAP fosters collaboration among various stakeholders including design engineers, manufacturing teams, and supply chain managers, improving communication and ensuring alignment on project objectives. LEAP supports agile manufacturing practices, allowing companies to quickly adapt to changing market demands or customer preferences, a flexibility that is critical in today's fast-paced business environment. In addition, many LEAP initiatives emphasize sustainable practices, aiming to minimize waste and energy consumption throughout engineering and manufacturing processes, thus aligning with the global trend towards more environmentally responsible production methods (Kiritsis, 2016).

LEAP is particularly useful in ETO-based industries where complex products require close coordination between design and manufacturing teams (Bakas, 2023). By implementing LEAP, organizations can achieve faster time to market, improved product performance, and better customer satisfaction (Brito, 2018). Overall, the Linked Engineering and Manufacturing platform represents a comprehensive approach to integrating engineering and manufacturing processes, driving collaboration, and driving innovation.

Based on *the Manufacturing Industry Outlook 2024* published by Deloitte states that 83% of manufacturers believe digital transformation is one of the crucial steps for future competition. In terms of supply chain management, manufacturers that have not yet undergone digital transformation are likely to experience oversupply or undersupply, resulting in an increase in inventory costs by 20%.

Information migration and the use of digital platforms also have their own challenges, one example is usability, especially for the elderly. Based on data from the *American Association of Retired Persons (AARP)*, 67% of adults over the age of 50 are very cautious and lack confidence in adopting new technology. So that adjustments to *the Human Factor* must be considered so that they can be used properly by digital platform users (Kolko, 2011).

Human factor is an aspect that involves understanding human capacity, human limitations, and human behavior in order to make the design and use of a system, tool, or environment. This also includes optimizing the experience and interface appearance where users can interact with the system effectively and efficiently. The goal is to create a system that is in line with the needs and characteristics of humans (Hugo, 2017).

Understanding the communication process as the basis for how a dashboard is designed, how to design it, where it will be used, and how the design can affect communication between system users. Making the message conveyed make sense also requires an understanding of the system itself, the context and the domain of work where the information is used, and what are the consequences if the information/message is answered or not. It also requires increasing the sensitivity of the characteristics of communication media and the communicative way of shaping perceptions and definitions of certain situations (Hugo, 2017). Currently, this power transformer manufacturing company still uses paper-based monitoring to monitor the life cycle of products that are in the manufacturing process. This results in some parts missing information because they have difficulty accessing, especially if they are on duty out of town. Therefore, it is necessary to transfer information to a virtual platform to facilitate access to information that can be accessed without having to come to the office and this information is well received.

To start the migration, it is necessary to compile a *framework* from the manual process business that has been undertaken so far to find out how the process has been carried out and how the process should be carried out, transforming document control from what previously used paper/notes to a visual platform where all information can be displayed properly digitally so that it can be accessed from anywhere and anytime without having to gather in a room and evaluate how effective digital platforms are in supporting business processes that are already running.

Obeya, which can be interpreted as "big space", is a platform in project management to collect information, process data, and make decisions from the data obtained (Javadi, 2013). The essence of *Obeya* is to bring together key actors in the project to collaborate in one large room by displaying data from each part so that everyone can have the same information. With this, it is hoped that efficient communication and collaboration can be created (Aasland, 2012).

With all the methods and techniques that *Obeya* has, the goal of *Obeya* is to have efficiency in the development and monitoring process and ensure that during the process, the resulting product is in accordance with the design. *Obeya* is divided into 3 types: Visual, Physical, and Virtual. Visual *Obeya* focuses on providing a visual perception of data, which includes the use of images, graphs, colors, objects, and other things that make it possible to capture a complex set of information that relates quickly. Although reading is also based on visual perception, only a few people can read in just a moment (Aasland, 2012). Physical *Obeya* is a *Obeya* where each member of the team meets physically and has direct discussions and exchanges of information. Physical *Obeya* also has a medium in exchange for information such as visual boards and dedicated spaces to discuss specific discussion topics. However, Physical *Obeya* often faces difficulties where every team member cannot gather at one time to exchange information and determine the next step. Virtual *Obeya* can be described as an *adaptive room* or a collaborative and dynamic virtual environment where users can do anything together in a virtual space in real-time. In principle, Virtual *Obeya* is a form of virtualization of Physical *Obeya*. Virtual *Obeya* allows teams with remote locations to access the same information as teams elsewhere. Many devices support Virtual *Obeya* to make it easier for users. One of them is an online meeting platform where users from various parts of the world can hold meetings simultaneously and print the results of the meetings to be updated on the *Obeya* board. Although the Virtual *Obeya* approach is almost equal to Physical *Obeya* in implementation, there is no substitute for physical meeting between fellow team members (Aasland, 2012)

Several other tools are also used in companies such as *Microsoft Project* is one of them. However, in operation, *Microsoft Project* focuses more on being a tool for preparing a master *plan* and knowing production capacity as well as labor slots and tools. It is needed in the production planning process, but it is less effectively used in monitoring the manufacturing process. So, monitoring the manufacturing process is still carried out manually by summarizing all the status of requests or orders into a large board.

The *Obeya* concept was originally used in the product development team. Where each part of a product development project gathers and discusses developments in each process. In the ETO industry, where every request for product manufacturing is considered a project because it has long stages and massive information exchange, *Obeya* can be applied as a platform to control and monitor with the aim of ensuring that the products made are in accordance with customer demands and pre-designed designs. In this study, the *Obeya* Platform is tailored to the needs of users in the execution of product manufacturing in the power transformer industry. It is hoped that the production process control process can be organized effectively and efficiently.

Based on the results of the literature review and the existing background, the formulation of the problem in this study is whether the virtualization of the *Obeya* platform can be used effectively and efficiently to replace the Physical *Obeya* board that is already in use. The purpose of this study is to design the virtualization design of the *Obeya* platform as well as to evaluate the effectiveness and usability of the proposed *Obeya* platform.

METHOD

This research began in the preliminary stage with the identification of problems in a power transformer manufacturing company in Indonesia that has an *Industrial Engineering-to-Order* (ETO) system where all orders for making transformers are carried out from the design stage to the manufacturing and delivery stage. This leads to many complex processes and

involves intense communication between departments and the exchange of information is carried out in an intensive and massive manner. So far, the company is still implementing a paper-based system where each department makes a note to be submitted to other related departments related to the status of the order or order that is being made. It has a disadvantage that everyone has to be present in the office and hold daily meetings for information updates. So this research intends to carry out a digital transformation from a paper-based system to a dashboard where all information is collected.

Furthermore, in this study, a literature study related to the ETO industry was carried out and what are the requirements for procedures in designing a good dashboard so that it can make it easier for users to receive and process information. This includes aspects of *human factors*, *user interface*, cognitive ergonomics, and the principle of usability. From the results of this literature study, what became requirements in a virtual dashboard to have a low cognitive load and be able to use it well by its users (Diehl, 2022).

The next stage is to develop a framework for existing business processes. This is done in research so that the dashboard created remains in the business process flow that exists in the power transformer manufacturing industry. In the process of preparing this business process framework, some secondary data from company documents will be used, and compared with literature in the form of journal articles that discuss ETO to be used as a reference whether the power transformer manufacturing process is in accordance with other ETO manufacturing process business in general.

After the framework has been prepared, the validation of the framework that has been prepared is part of this research. This aims to ensure that the framework created is in accordance with what is being done in the company. This validation process is carried out by a qualitative method through in-depth interviews with mid-level management and representatives from top-level management with the aim that the results obtained are appropriate and adjustments can be made when there are several processes that are felt to be not in accordance with what is carried out in the company.

After the framework of the existing business process has been validated, the next stage is the process of creating and designing a virtual dashboard that can be used online by users and can be monitored at any time as long as it is connected to the internet network. This dashboard will be created based on the concept of the *Obeya* platform and using the software or application that is most accessible to users. With the results of the literature study that has been carried out in the previous stage, the virtual dashboard design process is carried out by following the company's validated business processes.

Once the virtual dashboard has been created, it will be implemented in the company by making the middle level management and the top-level management representative as users and monitoring for three months to see if the dashboard is effective for users or if adjustments are still needed or ineffective for users. Three months is the time to build a power transformer so it is expected that there will be a pilot order in the virtual trial process of this dashboard.

After implementation, the evaluation of the dashboard was carried out by a qualitative method by conducting in-depth interviews and dashboard users as respondents in this interview. This interview includes topical questions around display, and the effectiveness of dashboards in the decision-making process. The answers of each respondent will be compiled and used as a basis to draw conclusions and suggestions for further research. From this, it is also hoped to get feedback and input related to the virtual dashboard that has been created and used so that it can be improved even better based on input from users.

In this study, the preliminary stage is the stage where the research background is explained and the identification of problems is carried out. In this preliminary stage, it explains the background, problem formulation, objectives, limitations, scope, assumptions, and benefits of the research to be carried out.

In this research stage, a literature study was also carried out which will be used as a reference in designing a virtual dashboard. This literature study is related to cognitive ergonomics, *user interface design*, *human factors*, and the principle of usability.

The framework used in this study is based on the company's guidance documents and procedures as documented and agreed upon by the company's management. The framework in this company document will be used as the basis for the platform virtualization process in the request control process with the *Obeya* concept.

The process of developing the *Obeya* platform design is carried out by compiling a *Value Proposition Canvas* for the overall process to find out what are the Customer Jobs, Pains, Gains, from the process. Identification of customer jobs, pains, gains, is carried out by conducting an *in-depth interview* process with the parts involved in the planning and manufacturing process.

After the key points in the value proposition canvas have been obtained, the design development process is carried out by making a virtualization of the board/*Obeya* board already in the company as an existing tool that has been used so far. Virtualization is done by collecting all the points or *milestones* of an order/project. The features in the *Obeya* platform are created to meet the points in customer jobs, and answer the pains of existing tools, and identify what new gains are obtained after using these tools.

After the platform is successfully created, the platform is tested to test whether the features, usage flow, and appearance are in accordance with what has been planned before conducting the trial stage with users, and conducting an effectiveness evaluation.

Based on ISO 9241-11 on usability, there are three aspects in determining the usability of an application or platform, namely effectiveness, efficiency, and user satisfaction in using the platform.

The effectiveness evaluation will be carried out by providing a platform that has been created to the relevant departments as users, and providing three simple tasks that must be completed by the user. The observed outcome is whether the user can complete all tasks well or not. The level of effectiveness will be assessed based on the level of success of the user in performing the tasks that have been given.

Efficiency evaluation is carried out by measuring how long the user spends in completing his task. Respondents will be given access and each respondent will be given three simple tasks to perform on the platform. The response time in doing this simple task will be recorded and used as an assessment material for how long it takes for the task to be completed. This can be used as a basis for how easy or complicated this platform is for users. Simple tasks are defined into three tasks:

1. Adding a new Order/Project
2. View schedules in 1 month
3. Update the production or material status on the platform.

Each response time for each task will be measured.

Based on (Sauro & Lewis, 2010), the way to present task time with a small sample ($n < 25$), geometric mean is the best approach in determining the median of the population. In this case, the way to determine the *baseline* or limit of whether a task time can be categorized

as efficient or not is to calculate the geometric mean. This time will be used as a reference in determining the baseline of the task time taken by each participant.

User satisfaction evaluation will be carried out by measuring user satisfaction using the System Usability Scale (SUS) method. The System Usability Scale is a method for evaluating how useful a platform is by providing ten simple questions that are summarized into a scale to provide a general view regarding the subjective evaluation of the platform. The SUS method can also be used to analyze the effectiveness of a platform. Using the SUS method, 10 simple questions will be given to the respondents and answers using a scale of 1-5, of which 1 means "strongly disagree" and 5 means "strongly agree". The questions to be asked of respondents are:

Table 1. SUS Questions in Indonesian Language (Sharfina & Santoso, 2016)

No	Item
1	I think I will use this system again.
2	I find this system complicated to use.
3	I find this system easy to use
4	I need help from other people or technicians in using this system.
5	I feel that the features of this system work properly
6	I feel like there are a lot of inconsistencies in this system
7	I feel like others will understand how to use this system quickly
8	I find this system confusing
9	I feel that there are no obstacles in using this system
10	I need to get used to it first before using this system.

Respondents who are asked questions are respondents who have had the opportunity to use this platform, but without prior introduction and discussion. Respondents should be asked to give a quick response without having to think long beforehand.

To calculate the results of the SUS motto, for each answer to a question with an odd number, subtracted by 1 and for each answer to an even number 5 subtracted the scale number. For example:

- a. If question number 3 has an answer of 4, then the calculated value becomes $4 - 1 = 3$.
- b. If question number 2 has an answer of 3 then the calculated value becomes $5 - 3 = 2$.

Then, the results of all assessments of each number are summed and multiplied by a factor of 2.5 to get a value in the range of 0-100.

With the adaptation of the SUS method for evaluating the effectiveness of the *Obeya* platform, ten respondents will be selected based on the departments that are active in monitoring and updating the existing *Obeya* board. The results of the answers from these ten respondents will be recorded and used as an assessment of the effectiveness of the *Obeya* platform.

In determining the results of the SUS, segmentation is based on the Sauro-Lewis CGS table. Where the correlation of the value of SUS with the usability of the product can be divided into several segments according to the table. This is done by determining the value of 68 as a normal distribution and making it into the form of percentiles. (Lewis, 2018)

Table 2. Sauro-Lewis CGS

Your Score Range	Grade	Percentile Range
84.1–100	A+	96–100
80.8–84.0	A	90–95
78.9–80.7	A–	85–89

Your Score Range	Grade	Percentile Range
77.2–78.8	B+	80–84
74.1–77.1	B	70–79
72.6–74.0	B–	65–69
71.1–72.5	C+	60–64
65.0–71.0	C	41–59
62.7–64.9	C–	35–40
51.7–62.6	D	15–34
0.0–51.6	F	0–14

Using the Sauro-Lewis CGS table, the SUS results of each respondent are calculated and the mean value of the SUS results will be correlated into the assessment. The usability value in this table is 68 (C) according to the normal distribution value on the SUS scale system. So that SUS values above 68 can be categorized as *usable* or easy to use, while SUS values below 68 can be categorized as marginal and need improvement (Lewis, 2018).

In addition to the subjective approach using the SUS model, an objective approach is also carried out on respondents. After evaluating the platform that has been created, the next stage is the analysis and discussion stage. This stage will analyze the results of the evaluation and what notes can be improved. At this stage, it can also be concluded whether the platform can help in the manufacturing process or there are still adjustments from the user side to be able to be used according to the needs of the company.

In this section, the conclusion of this study is presented. Then what can be used as a reference or points that can be done in the next research.

RESULT AND DISCUSSION

In preparing a framework for business processes, it is done by using the company's guidance document as a reference. The following is the framework of business processes according to the company's documents:

Based on the flow chart above, the business process in a power transformer manufacturing company is divided into six major parts based on the process. This includes the request acceptance process, the design making process, the material procurement process, the manufacturing process, the testing process, and the delivery process. Each section is divided into several activities and explains how a transformer is produced from the request received until the transformer is delivered. This activity involves many departments and is related to one another. Currently, the process is carried out using a large whiteboard that is hung in the room containing the latest information about all the orders that are running on the production floor. This becomes a board that everyone can see in the room so that everyone can see the current status of all orders that are being worked on the production floor. Currently, the process that is done manually has several challenges, one of which is that it is not accessible to teams that are not in the room and has a pause in the update process so that the information listed on the board is not completely up to date.

Value Proposition Canvas

One way to identify difficulties can be mapped by using a value proposition canvas. A value proposition is an aggregation or package of benefits offered by a producer to answer consumer challenges. Thus, the value proposition canvas is a form of visualization of segmentation between what consumers need and what products are produced by manufacturers

that answer those consumer needs (Osterwalder & Pigneur, 2010). Value propositions answer segmentation of questions such as "What value are we providing to customers?" "Which customers are we helping to solve the problem?", and "What packages/products can

Which consumer segment do we offer?" so that with a value proposition, manufacturers can identify customer needs and can target customers with certain segments with the products offered.

The Value Proposition canvas can be visualized with a diagram like the image below.

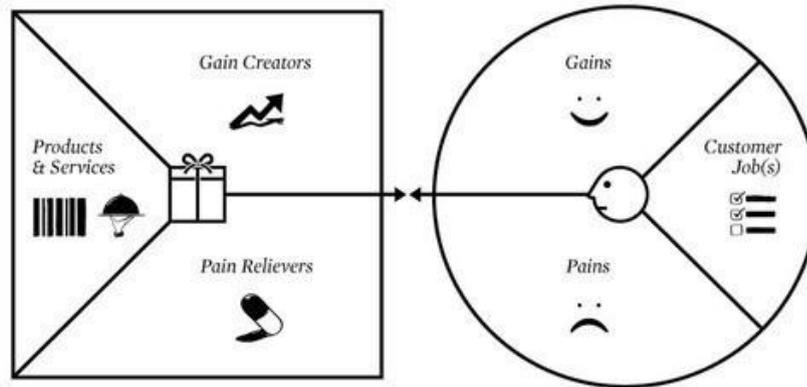


Figure 1. Value Proposition Canvas (Pokorna, 2015)

The Value Proposition Canvas can be divided into 2 sections: Producer and Consumer. On the consumer side, the identification of *customer jobs* is carried out to determine what goals or things want to be achieved from consumers, then the *pains* part can be identified with what challenges consumers face in achieving these goals. The *share of gains* is identified by what profits are obtained or profits that arise when consumers achieve their goals (Pokorna, 2015). Using things that have been identified on the consumer side, the product begins to be developed. What products or services can answer consumer goals, generate *gains* and answer *pains*.

In the topic of developing the *Obeya* platform, we identified using visualizations from the Value Proposition Canvas. This process begins with identifying the consumer side and examining whether *Obeya* platform can answer the pains of consumers and increase gains for the consumer's work.

From the identification using the value proposition canvas method, it can be seen that with the existence of *Obeya*, the platform can answer the pain points that exist and have been felt by consumers, namely in the material control section, access that can be reached anywhere and easy and fast updates.

Based on the Value Proposition Canvas that has been created, we can identify customer jobs points to design the *Obeya* Platform so that the features on the platform can answer the customer jobs that have been identified.

The main view of the *Obeya* platform is a dashboard of manufacturing progress and material availability for all existing requests/orders. The points in this dashboard are created/complemented by transferring points on a large board in existing tools and adding several points according to the existing business process.

PROJECT	RFQ	PO	OC	ELECTROMAGNETIC	CONDUCTIVE	INSULATION (SOLID & FLUID)	CLAMPINGS	TAP CHANGER	BUSHINGS	COOLINGS
519195-IN_APEX Kennedy	Done	Done	Done	Done	Done	Done	Done	Done	Done	Done
519196-IN_APEX Kennedy	Done	Done	Done	Done	Done	Done	Done	Done	Done	Done
519197-IN_APEX Kennedy	Done	Done	Done	Done	Done	Done	Done	Done	Done	Done
519198-IN_APEX Kennedy	Done	Done	Done	Done	Done	Done	Done	Done	Done	Done
MVV - 519529-53 MVA	Done	Done	Done	Done	Done	Done	Done	Done	Done	Done
GHO - 519530-63 MVA	Done	Done	Done	Done	Done	Done	Done	Done	Done	Done

Figure 2. Main view on the Obeya platform

On the main view of the Obeya platform shown in the image above, a dashboard is designed that contains all requests or orders in the company and their progress status in manufacturing. This progress is a form of virtualization of existing business processes and tools that have been used before. In this view, milestones can be seen and information is also provided regarding the current status of the process and materials. With this display and feature, we can already meet the needs of customer jobs related to manufacturing progress and procurement status and material availability.

If one of the request or order lists is clicked, a pop-up will appear informing the status of the project or order in more detail.

Project Status / GHO-519530-63 MVA

GHO -519530-63 MVA [Edit](#)

Remarks

RFQ: Done

PO: Done

OC: Done

Electromagnetic: Done

Conductive: Done

Figure 3. Pop-up view when one of the projects is clicked

When the pop-up view appears, the user can change the manufacturing progress status of the order, adding a note to provide important information that they want to convey to other users related to the project. This can be in the form of a list of risks or issues that have not been resolved. To make an update, it can be done by clicking on one of the points and there is a *drop-down menu* that can be selected according to its status.

RFQ

Done

On time

Attention

Delayed

Done

Done with delay

NA

Done

Figure 4. Drop-down menu to update status

The drop-down menu is created using the option so that the information displayed in the dashboard can be properly classified and not expanded. This makes it easier for users to provide status according to the options below. If there are indeed points that cannot be selected in the drop-down menu, users can provide a description in the "remarks" field so that the same information can be read by all users. These features can solve customer jobs at the point of the risk list and open issues.

On the main view of the dashboard, at the top there are 2 tabs between the manufacturing progress status and the production schedule. On the production schedule tab, there is a complete calendar display with a description of the production schedule of each project displayed in one month.

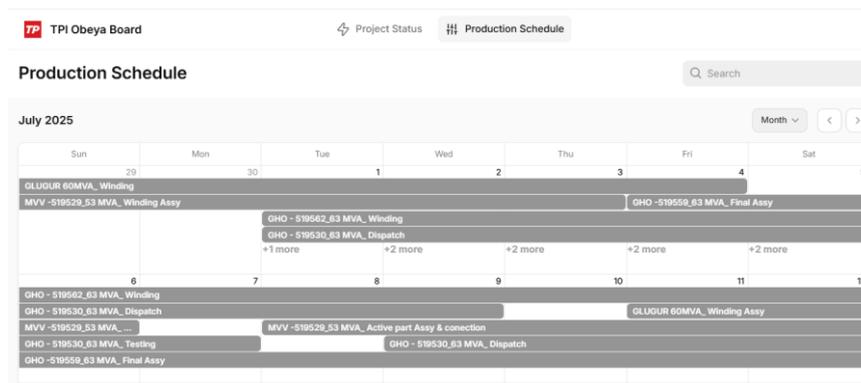


Figure 5. Production Schedule Display

The production schedule displayed is all orders that have started the manufacturing process. So that it can be identified when the process is completed and the important dates to communicate with customers. Communication with customers is crucial because there are several activities where customers have to witness the production process. The production schedule can only be changed by the PPIC department so as to reduce the occurrence of inadvertences in determining the date. In addition to being featured on this platform, other tools in the form of *Microsoft projects* are also used in determining annual production slots and how many targets must be achieved.

Usability Evaluation

Ten respondents from the company as users have been selected and carried out the data collection process in the form of filling out the SUS questionnaire and recording the success rate and response time.

System Usability Scale

Respondents have answered the SUS questionnaire and obtained the results of the following scores:

Table 3. Results of SUS value calculation

Name	SUS Score
Participant 1	72,5
Participant 2	85
Participant 3	97,5
Participant 4	80
Participant 5	72,5
Participant 6	70
Participant 7	62,5

Name	SUS Score
Participant 8	72,5
Participant 9	72,5
Participant 10	62,5
Average score	74,75

Based on the results above, the mean value of the 10th participant's SUS score was obtained at 74.75, and if matched with the value in the Sauro-Lewis CGS table, the results of the SUS score can be categorized as grade B. So, from a subjective approach, the *Obeya* platform is usable to be implemented in company operations.

Response Time Measurement

With the same respondents, the process of recording response time was carried out.

Respondents have the same tasks, namely:

1. Adding a new Order/Project
2. View schedules in 1 month
3. Update the production or material status on the platform.

In this measurement, each respondent performs their respective tasks and the time will be recorded since each of the respondents is given a link. The respondents were not explained in advance regarding how to use this *Obeya* platform. So, the time obtained is the time when the link is first given until the task is completed, the duration from the first task to the second task, and the duration of the second and third tasks. The results of the time measurements are recorded in a table and presented in the form of a table.

In the data collection process, the success rate in doing the task is 100%, this indicates that each respondent or participant can complete the task well with a different duration for each task.

From the results of the time measurement, we can determine the *baseline* by calculating the geometric mean plus a margin of error of 10% (usability testing in general). So, the baseline of the task time of each task is:

1. Task 1: 45.3 seconds
2. Task 2: 7.9 seconds
3. Task 3: 21.9 seconds

When comparing the results of time measurement to the baseline, the results were obtained:

1. 70% of participants were able to complete task 1 in less than 45.3 seconds.
2. 40% of participants were able to complete task 2 in less than 7.9 seconds
3. 50% of participants were able to complete task 3 in less than 21.9 seconds.

So based on the results above, the efficiency level of the *Obeya* platform is declared efficient for the first task and needs to improve the appearance of the second and third tasks.

In the future, to increase efficiency in task 2, it can be done by simplifying the display on the calendar or production schedule and using color indicators to illuminate every process that is running. To increase efficiency in task 3, steps can be adjusted in the process of updating the production status.

CONCLUSION

This study demonstrates that the virtualization of the *Obeya* platform represents an effective and practical solution for monitoring production status and schedules in real-time within a power transformer manufacturing company operating under an Engineering-to-Order (ETO) system. Designed in alignment with the company's validated business process

framework and grounded in the principles of human factors, cognitive ergonomics, and the Value Proposition Canvas, the Virtual Obeya platform successfully addresses the core limitations of the existing paper-based Physical Obeya board, particularly its restricted accessibility for distributed teams. Usability evaluation based on ISO 9241-11 revealed a 100% task completion rate, confirming strong effectiveness, while efficiency results showed that the majority of participants completed primary tasks within the established baseline, though tasks related to the production schedule view and status updates require further interface refinement. User satisfaction, measured through the System Usability Scale (SUS), yielded a mean score of 74.75, corresponding to a Grade B on the Sauro-Lewis CGS table, indicating that the platform is usable and fit for operational deployment. For future research, it is recommended that the platform be further developed by incorporating color-coded indicators and a simplified calendar interface to improve efficiency in schedule-related tasks, as well as streamlining the status update workflow. Additionally, future studies could expand the scope of usability testing by increasing the sample size, involving a more diverse range of user roles across departments, and extending the trial period beyond a single production cycle to capture longitudinal usability data ultimately strengthening the generalizability of findings across other ETO manufacturing contexts.

REFERENCES

- Aasland, K. E. (2012). *An analysis of the uses and properties of the Obeya*.
- Aasland, K. E. (2012). *Virtualizing the Obeya*. In *NordDesign*.
- Bakas, O. (2023). Managing industry transitions in ETO: The case of yards intralogistics. *56th CIRP Conference on Manufacturing Systems (CIRP CMS '23)*, 120, 1369–1374.
- Brito, E. C. D. D. (2018). Practical update on presenting health data in an effective way. *European Journal of Public Health*, 28(Suppl. 4), 306.
- Diehl, C. (2022). Defining recommendations to guide user interface design: Multi-method approach. *JMIR Human Factors*, 9(3), 1–12.
- Emmanouilidis, C. (2018). Taking the LEAP: The methods and tools of the Linked Engineering and Manufacturing Platform (LEAP). *Production Planning & Control: The Management of Operations*.
- Gualtieri, L. (2023). Guidelines for the integration of cognitive ergonomics in the design of human-centered and collaborative robotics application. *56th CIRP Conference on Manufacturing Systems*, 374–379.
- Hugo, J. V. (2017). *Human factors principles in information dashboard design*. NPIC & HMIT.
- Javadi, S. (2013). Supporting production system development through the Obeya concept. *IFIP Advances in Information and Communication Technology*.
- Kolko, J. (2011). *Thoughts on interaction design* (2nd ed.). Morgan Kaufmann.
- Lewis, J. R. (2018). The System Usability Scale: Past, present, and future. *International Journal of Human–Computer Interaction*, 577–590.
- Mapokgole, J., & Mbohwa, C. (2013). The art of managing production disruptions in pump industry through visual management. *6th IFAC Conference on Management and Control of Production and Logistics*, 25–31.
- Marchi, L. de A. (2022). *Project Management in an Electrical Distribution Application Center*.
- Nguyen, H. (2019). *Project Management-Electrical Installation of a 50MW Solar Power Plant*.
- Osterwalder, A., & Pigneur, Y. (2010). *Business model generation* (1st ed.). John Wiley & Sons.

- Pokorná, J. (2015). Value Proposition Canvas: Identification of pains, gains, and customer jobs at farmers' markets. *Agris On-Line Papers in Economics and Informatics*, VII, 123–130.
- Sauro, J., & Lewis, J. R. (2010). Average task times in usability tests: What to report. In *CHI 2010: Usability Methods and New Domains* (pp. 2347–2350).
- Sharfina, Z., & Santoso, H. B. (2016). An Indonesian adaptation of the System Usability Scale. *ICACSYS*, 146–148.
- Strandhagen, J. W. (2018). Operationalizing lean principles for lead time reduction in engineer-to-order (ETO) operations: A case study. *IFAC PapersOnLine*, 51(11), 128–133.
- Tezel, A. (2016). Visual management in production management: A literature synthesis. *Journal of Manufacturing Technology Management*, 27(6), 766–799.