01-012 – Alternatives in the use of water in industrial processes: application in the cleaning of equipment in panel factories – Alternativas en la utilización de agua en procesos industriales: aplicación en limpieza de equipos de fábricas de tableros

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English Spanish

The PM² methodology is the project management methodology developed and endorsed by the European Commission for application to multiple projects in the European Union (EU) and beyond. The improvement of the competitiveness of EU Industry based on strict respect for the environment has been highlighted among others in the Draghi report for a more competitive EU. Water consumption is common to a large part of the industrial production processes and good practices in water management have become a necessity and at the same time an opportunity for cost savings.This paper shows how the implementation of the PM² methodology can be used to analyze the best alternative, implement its development and manage its application in industrial projects of different types. In this case, a wood panel factory is used as a validation project and more specifically one of the phases with the highest water consumption and emission of liquid effluents to the exterior. The result of the work allows to understand the keys for further applications to other industries in this or other sectors.

Keywords: *PM²; Industry; Water recycling*

La metodología PM² es la metodología de gestión de proyectos desarrollada y respaldada por la Comisión Europea para su aplicación a múltiples proyectos que se lleven a cabo en la Unión Europea (UE) o fuera de ella. La mejora de la competitividad de la Industria de la UE fundamentada en un respecto estricto al medio ambiente ha sido resaltada entre otros en el informe Draghi para una UE más competitiva. El consumo de agua es común a gran parte de los procesos productivos industriales y las buenas prácticas en la gestión del agua se han convertido en una necesidad y al mismo tiempo en una oportunidad de ahorro de costes. En el presente trabajo se muestra como mediante la implementación de la metodología PM² se puede analizar la mejor alternativa, implementar su desarrollo y gestionar la aplicación en proyectos industriales de diferente índole. En este caso se utiliza como proyecto de validación una fábrica de tableros de madera y más concretamente una de las fases de mayor consumo de agua y emisión de efluentes líquidos al exterior. El resultado del trabajo permite entender las claves para posteriores aplicaciones a otras industrias de este u otros sectores.

Palabras claves: *PM²; Industria; Reciclaje de agua.*

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1. Introduction

The timber industry has progressed in wood-based products such as plywood, particleboard, fiberboard, and others (Norhazaedawati et al., 2022). Wood-based panels are products made from fibers, particles, veneer, chips, strands, or any other wood derivate through a binding process with adhesive. These products are also known as engineered wood products as they have a great scope of engineering properties with the specification of the design (Youngquist, J. A., 1999, Pandey et al., 2011). The manufacturing of wood-based products leverages the utilization of the whole wood parts including low-grade logs such as thin, bowed, and twisted logs. It also uses wood by-products and recycled materials as well as wood residues such as chips, sawdust, and slabs to be manufactured into many kinds of particleboards and fiberboards. These panel products are commonly the choice for building materials because of the advantages of wood such as its density, strength, and durability (Dukarska, D. & Mirski, R., 2023).

The availability of clean water is essential to human health and well-being (Naiman & Dudgeon, 2011). Industrial wastes into water bodies causes water pollution (Lakshmi et al., 2020; Varjani & Upasani, 2017). Industries release non-treated and/or incompletely treated wastewater in the environment which leads water and soil pollution (Shindhal et al., 2020). Wood-based industries currently, one can observe a certain tendency in the modernization materials that allows for large scale production of intermediate products involving complex processing and finishing while still at the manufacturing stage (Papadopoulos and Taghiyari 2019; Mydlarz et al., 2021)

PM2 methodology is well known as the methodology developed by the European Commission for his projects in the union or abroad (Martínez-Montes et al., 2021). Also, PM2 method can be applied in industries in order to improve their project management, drive their own projects to a successful end with good performance in all fields that PM2 methodology covers during the time the project lasts.

Lucus PB is a particleboard company which foundation takes place in 1970 decade. This company has been working for decades until 2008 crisis. In 2012, Lucus PB closes its activity until 2014 when a big south American company acquires Lucus PB and normal activity of the company can be recovered by 2015. Since 2015 the company has grown in business volume, workers and local impact.

For last 2 or 3 year the company wants to make the gap with other companies in its market making a big effort in order to decrease negative impacts on environment and trying to make its best for making a sustainable development of company business.

This kind of practices, are suitable for environmental management system of the company (Lucus PB is certified on ISO 14.001) and also, impact directly on reducing water treatment costs, reducing risks of contamination on effluent coming from the decanting pool (pool that can be not properly clean or can be working in a poor manner for constructive reasons).

For the case presented in this paper, the project consists of a placement of a cleaning system for water used for dryers, screening machines, and mills for wood in a particleboard company.

Cleaning installation is a very important part of the wood industry, the reason for that is the creation of wood powder during milling, screening, drying, sanding or cutting processes. This powder generates potentially explosive atmospheres, any electrical problem in an area where this dust exists, and a big explosion can be devastating for the company.

In order to reduce this danger, cleaning processes take place every day using mainly water as moisturiser agent. As can be imagined, the amount of water used for this cleaning process is enough to consider other alternatives or think in the way this water could be cleaned and reused.

Team Projects and Managers of Lucus PB have developed this idea in PM2 project format closely joined to other environmental projects as decarbonization of drying system and a cleaning wood station to clean recycled wood and to use this material in the production process.

2. Objectives

The main objective of the project is to save water in cleaning process.

The projected equipment is prepared to save 18,3 m^3 of water per working day, about 5.142,3 m^3 could be saved just recycling the cleaning water. Takin in account a 20% of leak ratio, the expected savings reach 4.000 m^3 per year.

In cleaning process water is guided to a decanting settler where wood particles decant to the bottom of the vessel and clean water is discharged to a effluent discharge point. At this point of the process the objective is not saving water but save effluent quantity that is discharged on its discharging point closing the effluent discharge point and saving all the expenses in water control and cleaning the decanting settler (10.000 €/year).

On the other hand, during the cleaning process, sludge is obtained and this sludge can be used on the biomass boiler of the company saving from buying other kinds of biomass.

3. Case study

The purpose of this project is to launch a water treatment station to reuse water that company uses for cleaning equipment. In the moment results for the effluent of water coming from cleaning process has big amounts of ammonia, BOD5, COD and suspended solids.

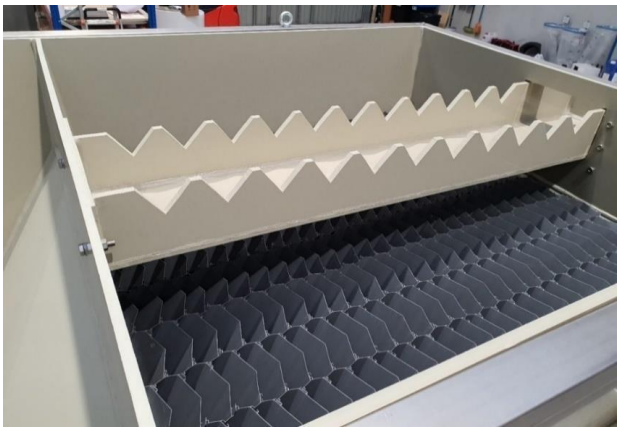
This contaminated water is currently treated in a decanting pool which is a poor system to get the results that the company needs. The recycling water plant is going to process 1m^3/h of contaminated water.

The process begins by collecting the equipment cleaning water through a network of pipelines. This water will be leaded to a tank where coagulants and flocculants are added, also acid to balance the pH.

Water and additives reach the decanter system. In this case the decanter is a lamella clarifier which lamellas are made in PVC, inclined 60 degrees and have a surface-to-volume ratio of 11.

This system is dimensioned to reach a maximum speed of sedimentation of 0.8m/h.

Figure 1: Lamella clarifier with a Thomson-type weir.



Clarified water comes out from the clarifier by the Thomson-type weir to the clarified water camera. From here, water will be pumped to further treatment.

Sludge coming from this first process is purged automatically by a pneumatic bomb that will pump the sludge to a sludge thickening system.

Wastewater is leaded to a settler where remains quiet permitting solids settle. This solids and particles are absorbed by piping systems and leaded to biomass bunker.

This clarified wastewater is collected into a tank that has a volume of 3,000L.

4. Results of PM2 analysis to manage the project

The manual project for the whole idea has been written under PM2 standards. As the company has not experience managing projects under PM2 standards, or others, this methodology has been tailored according company needs.

The company has developed the 2 earlier stages of the project already, which, according to PM2 methodology are start phase (in which the project has been defined, business case has been created and scopes are properly defined), and planning phase (in which one the company is right now). Project team has been created. As the project has an environmental charge, the project manager is the environmental manager of the company reporting directly to the CEO who is the owner of the project. The project team is formed by managers of areas that are directly involved in the project which are: maintenance manager, production manager, plant manager, risk prevention manager and finance manager. All of them have been taken into account in stakeholder's management. Influence and interest has been considered.

As execution phase has not started jet, project cycle will not be overlapped in phases of planning and execution. This is due to economic matters and emergency projects that Lucus PB has been prioritized as an obligation to maintain the production running.

Standards and artefacts from PM2 methodology have been successfully used planning this project and approved by the CEO. In this paper some of them will be showed in further points as these are the core of the project but artefacts as externalization plan, acceptance of deliverables or meeting reports artefacts has been included in company files to manage the project according to PM2 method.

4.1 Benefits of the project

The installation is calculated to save 18,3m^3/day of water coming from wells, which means approximately 5.000 m^3 of water per year. This consumption means savings of 2.000 €/ year in water taxes.

The settler system exiting nowadays will not be used to clean water, will be just a discharging point if the tank for clarified water is full and the use of this system is mandatory. The company expends around 20.000€ per year on cleanings, this 20.000€ will be saved in a 90%.

4.2 High level impacts

Wood warehouse: This project will be developed in wood warehouse area so agreements with the responsible of the area will be needed.

Also, this department is the one which has the responsibility of cleaning dryers, screens and the equipment that generates this wastewater. So, they will use the “recycled water” on their daily work and make sure everything is working OK.

Maintenance department: Operators of maintenance department will receive instructions to make sure the cleaning system has a satisfactory performance, detect problems during operation and solve them properly.

Accounting department: Savings are going to impact directly on the accounts of the company.

Acquisition department: New suppliers and materials must be evaluated and authorized to work with Lucus PB.

Production department: Biomass is going to be generated during the process. It is the responsibility of production department make sure this biomass is mixed in the bunker.

4.3 Success criteria

- Al least 80% less expenses on cleaning water.
- 2 years of good performance of the plant.
- 50% reduction in water consumption coming from wells compared to 2023.
- Discharge water will fulfill all discharge parameters.

4.4 Scope

The project covers:

- Compilation of action options.
- Compilation and technical assessment of equipment budget.
- Design of necessary civil works.
- Compilation and technical assessment for civil works.
- Channeling discharged water to the cleaning equipment.
- Channeling clean water to the settling pond using the existing stormwater system.
- Proper monitoring of water consumption and discharged water 6 months after installation is commissioned.
- Water analysis system at the outlet (pH and chlorine).
- Adaptation to RD 1215/97.
- Search for a suitable location form the control station.

Is NOT covered:

- Sludges transportation to biomass bunkers.

- Wastewater discharging on discharge point should be analyzed 6 months after the commissioning.
- Regular maintenance of equipment.
- Water analysis out from chlorinator process.
- Cleaning equipment.
- Human resources management.
- Acquisition management.
- Costs and payments management.

4.5 Requirements management

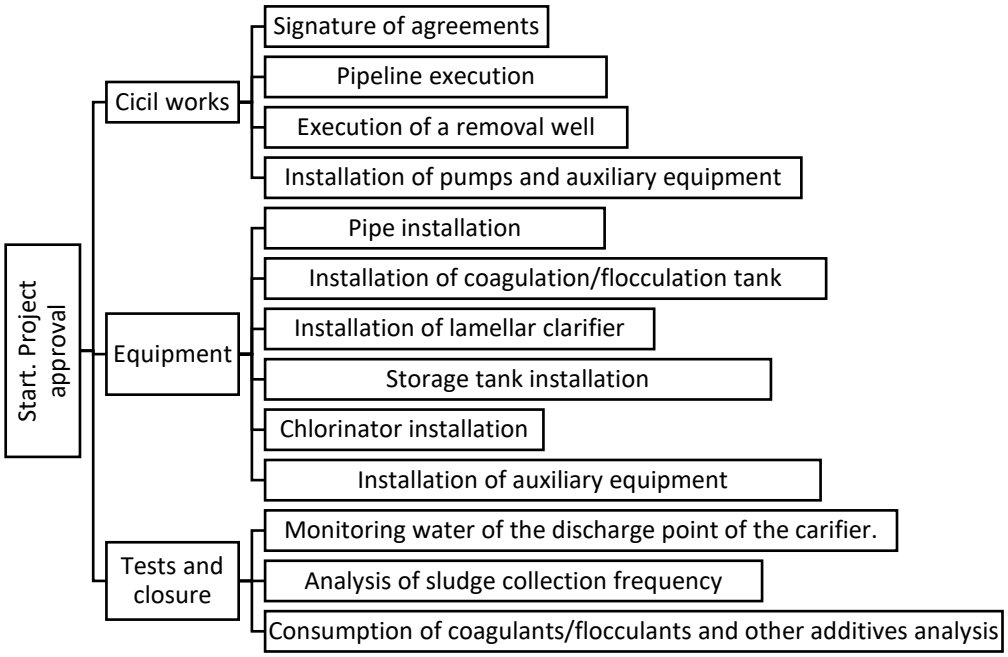
This part of the project has been summarized in the following chart:

Table 1: Requirements.

	Requirement	Type
1	Suppliers' offers contain all the necessary equipment to implement.	Of solution
2	The maintenance department must verify all needs to make its part of the project.	Functional
3	Documents provided by suppliers will reflect the hole cost of the part of the project they refer.	Of business
4	Suppliers will provide a footprint design	Of solution
5	Offers will reflect delivery time	Of business
6	Offers will reflect form and payment method	Of business
7	The project agreement must reflect penalties for non-compliance by external companies.	Of business
8	Lucus PB will provide of electrical connections	Of solution
9	The civil works offer will reflect the slabs and trenches with all their characteristics and measurements.	Of solution

4.6 WBS (Work Breakdown Structure)

Figure 2: WBS scheme.

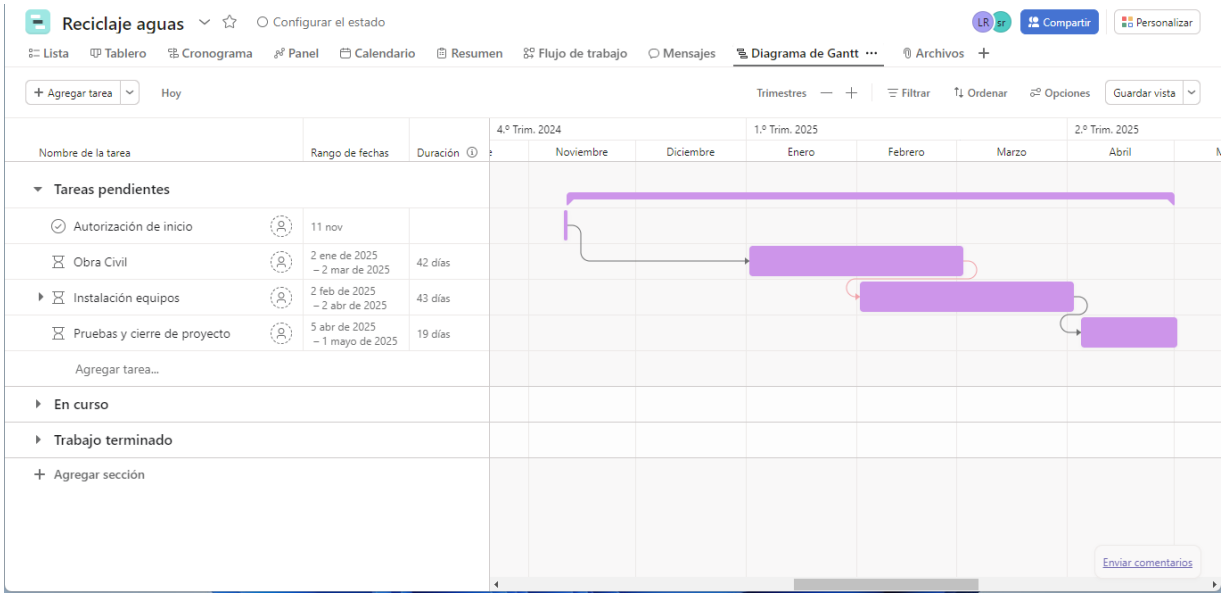


The project will have 3 very different phases.

- First phase: First, civil work must be completed. Wells, piping lines, auxiliary pumps and other canalizations should be ready before phase 2.
- Second phase: In this phase equipment will be installed.
- Third phase: This is the phase for commissioning and testing. At its conclusion, project can be closed.

4.7 Time management

Figure 3: Gantts Chart.



As can be appreciated on the chart, the project should last for 5 months. In this chart, the project will be authorized by November 2024th. After this authorization, offers and budget must be carefully checked and approved. In January 2025th civil works will start and will last for two months.

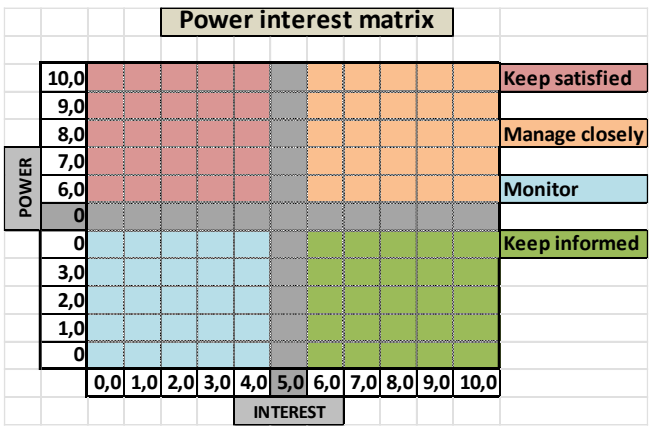
After this work, equipment can be implemented in the plant according to it footprint approved by the manager of the project. Another two months will be needed but some equipment can be placed before the end of civil construction. On phase 3 of the project, commissioning and starting up will last 19 days.

4.8 Stakeholders' management

Stakeholders' management has been planned as is usual in this kind of projects. On a first phase a power-interest matrix. The stakeholder in analysis will be given a score from 1 to 10 according to its power and its interest on the project.

As the matrix accounts with double entry, the stakeholder will be placed in a specific area as follows:

Figure 4: Power Interest Matrix (*self adaptation*).



As an internal project, in the current project of recycling water almost all stakeholders have a quite big power and, also, interest plan for stakeholders is manage them closely and in theory their position should be a promotor position.

Also, a log of the stakeholders is provided with the project plan where designation, department, organization, role and experience and education is specified.

4.9 Quality management

Quality management of the project involves all the activities that will increase the capacity of achieving expected results reflected in scope and success criteria.

The evaluation of quality of project deliverables will be made by KPIs and objectives that must be measurable.

The quality management plan will document criteria agreed between stakeholders at the beginning of the project. To make sure it is complete enough this structure has been followed.

After identifying phases of the project on WBS and adding another phase where authorization of the project is verified, phases are divided into its deliverables.

For each deliverable, exhaustive requirements list has been developed describing requirement itself and objective (why making this is needed). For each requirement a quality indicator has been described (metrics, units, sampling percentages, review frequency, acceptance interval, penalties and responsibilities).

48 quality KPIs have been described for the project.

4.10 Risks management

To make sure risks are properly managed, a risk matrix has been developed. In the matrix description of the risk (cause, uncertainty and consequences) and type categorizes risks in threat and opportunity. Also, the type is described (business, communication, external, people…) and a probability and impact are evaluated.

Risks are written following the maximum impact to the minimum and, if same impact is detected, more probable risk will be first.

In this way the first risk that is seen on the table is the one which has the most impact index (between 1 and 5), the higher probability of happen (in percentage).

16 threats and 3 opportunities have been detected for the project.

5. Conclusions

Development of current project plan for a forestry industry proves that PM2 methodology can be used in many different projects, companies or public administration.

Lucus PB and particleboard industry is a singular field where innovation is very slow due to majority of companies are small and familiar, very traditional and have their own “methodology”.

Project Plan has been developed with relative success as it has been tailored to company reality.

As the company is not long experienced in Project Management methodology, PM2 has been received as an easy methodology to start, easy to tailor to the company technicians and to the company reality. Also, this methodology can be developed by Lucus PB through years from a

simple methodology that helps to document and manage projects to a more complex system integrated in all departments and being part of the usual management of the plant.

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Use of Generative Artificial Intelligence

No AI has been used in this paper.

Communication aligned with the Sustainable Development Goals