

Redesign of the monthly report of key performance indicators of a Mexican brewery plant

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Abstract

The purpose of this paper is to show the importance of developing strategic dashboards to communicate key performance indicators clearly and concisely. Several authors mention that every company should develop a reporting system to monitor trends and changes of its performance to meet their goals.

In recent years, many companies are maintaining all decision-relevant information in a strategic dashboard because they are simple to use and a quick way to draw significant conclusions from data. Using a data visualization tool is a powerful way to collect and analyze this information.

This paper describes the steps followed by a Mexican brewery plant to improve the effectiveness and efficiency of the monthly report of key performance indicators by considering best practices in business intelligence reports. The application of First Click Testing was used to compare and analyze statistically the current report and the redesigned report. This allows proving if end users have a better experience in decision-making using the redesigned report. Several articles mention that the design of reports directly influences learning, efficiency, decision-making and analysis of data by users.

Keywords

Performance measurement, key performance indicators, dashboard, business intelligence, Power BI

1. Introduction

The problem of concern in this paper is to develop a strategic report to communicate key performance indicators clearly and concisely in a Mexican brewery plant. Therefore, the general objective is to redesign the monthly report "Business Review" to improve the way to communicate the results at all levels of the organization through the consideration of best practices in business intelligence. The specific objectives that support the accomplishment of the aforementioned general objective are: 1) Reduce the time of interpretation of the data through the redesign of the report; 2) Reduce 30% the time used to make the business report by automating the collection of data.

Several research articles and journals mention that it is important that organizations define a performance measurement system so that management can make decisions about the practices to be implemented in the company to achieve results. Hayward (1998) argues: *"If you can not measure it, how can you improve it?"* so this paper demonstrates the importance of designing a report of key performance indicators that is easy to use, and that users can establish effective and efficient conclusions about the data shown.

This report consists of 4 sections. The next section deals with a brief literature review of performance measurement systems, business intelligence, best practices for designing boards and reports, and how to evaluate the effectiveness and design of reports. Then a description of the methodology used to improve the design of the existing monthly report and the application of these steps are undertaken in section 3. A summary of conclusions is presented in section 4.

2. Previous research

A performance measurement system is defined by the Procurement Executives' Association (1998) as a way that enables organizations to "establish agreed performance targets, allocate and prioritize resources, informing managers to either confirm or change current policy or program instructions to meet the goals, and share the results of performance in achieving those objectives."

According to Amaratunga, Baldry and Sarshar (2000), having a performance measurement system allows organizations to: 1) identify potential problems related to cost optimization of the organization; 2) define a disciplined framework where the relationships between decisions and final customer satisfaction can be established; and 3) increase efficiency and sustainability of space management and other assets related to people and processes. All this contributes to increasing efficiency, sustainability, productivity, profitability of organizations, and the possibility of anticipating decision-making. (Cable & Davis, 2004; Amaratunga et al., 2000; Oseland and Wills, 1999)

However, in order for decision makers to perform an analysis, it is necessary that organizations remain active in performing measurements of the same indicators by period to determine the current state of performance that has the organization holistically and determine the practices to be implemented to achieve the desired performance. (Dawson, 2010; Lavy, Garcia & Dixit, 2010; Cable & Davis, 2004; Amaratunga et al., 2000) These indicators should be related to the core business of the organization, and should reflect the power of stakeholders and balance the goals pursued by senior management. (Tranfield & Akhlaghi, 1995)

When selecting performance indicators, Lebas (1995) mentions that it is necessary to consider the type of users, as they can be managers, managers, supervisors or even customers. It is also important to ensure that the selected indicators meet the three criteria proposed by Dawson (2010): 1) represent the success or failure of an effort; 2) be measurable; and 3) be controllable.

Finally, key performance indicators are placed in a report of indicators, which must show at least: 1) the desired state; 2) the actual value of the indicator; 3) the variation between the actual value and the desired; 4) a comment section; 5) be able to analyze the performance that had each of the indicators in the past. (Dawson, 2010; Lebas, 1995) To show a balanced view of the performance of the organization this report should include performance indicators and costs. (Dawson, 2010; Amaratunga et al., 2000)

2.1. Business intelligence

Business intelligence is a process in which operational and strategic decisions are made based on data analysis, data collection from internal and external sources, and through the creation and preparation of reports through technology. Currently, there are tools that allow visualizing the data of the metrics and key indicators of an organization on dashboards through the use of graphics. (Bhatt, Aggarwal and Sharma, 2017)

A dashboard is a visual sample of the information related to the most relevant performance indicators of an organization to make decisions; consolidated and organized in a single screen by using figures in different panels so that information can be monitored at a glance by employees of different hierarchical levels of the organization. The figures used on the dashboard have the purpose of informing users the current situation of the different areas of the organization. (Firican, 2017; von Eiff, 2012; Few, 2003)

According to Firican (2017) a powerful dashboard is simple to use, and offers a quick and meaningful way to draw conclusions about the displayed data. Therefore, this author also mentions that those who design these boards are required to have a thorough understanding of the data that are showing and the needs of organizations; also they need to know the skills, knowledge and experience of users.

2.2. Best tools to create dashboards and reports

Over time, the amount of information that organizations handle is greater; therefore they should improve the method of gathering and analyzing it. (Duncan, 2017; Mather 2004) It is recommendable to use some of the data visualization tools that are available in the market such as Tableau and Power BI, which allow showing data visually attractive to the users of the dashboard or report. (Bhatt et al., 2017; Duncan, 2017)

Tableau is a tool that allows you to create images from data of different spreadsheets or relational databases, multidimensional or even those that are in the cloud. It also allows creating attractive graphic designs and creating reports or dashboards with the indicators of a company. (Hamersky, 2016)

Power BI is a tool developed by Microsoft that is in the cloud and allows performing analysis and information reports. This tool has a high demand for use because it allows the addition of personalized visual elements. (Bhatt et al., 2017). In addition Jelen (2016) mentions that Power BI offers an application for Android and iOS devices, which allows users to view the report from their smartphones or tablets.

2.3. Best practices for designing dashboards and reports

To design an effective dashboard or report that allows users to interpret the values quickly and correctly, Firican (2017) proposes to follow the following recommendations:

- Determine the frequency of update. In case you want to design a strategic dashboard, it can be updated weekly, monthly, quarterly or even annually.
- Define the medium by which the information is going to be consulted. It could be in a desktop, laptop, smartphone, tablet or even if it is going to be printed on paper.
- Include titles, captions near the graphics and even brief descriptions that provide the user a better understanding of the presented information.
- Arrange the graphics that are most important in the upper left and then organize the rest in a Z pattern in case the native language is written from right to left.
- Avoid the use of tables or dynamic tables and select graphics according to the information that will be displayed. Bar graphs are the simplest way to visualize information, while line graphs are ideal for analyzing trends over a period of time.

In relation to the last recommendation described, 3M Corporation (2001) mentions that our brain interprets images 60,000 times faster than words.

It is also important to consider the three general principles proposed by Losbichler and Michels-Kim (2017) to design a good report: 1) use simple representations; 2) use precise and clear formats; 3) use the same format to display the data.

2.4 Evaluation of the effectiveness and design of indicator reports

Losbichler and Michels-Kim (2017) mention that there is a new trend related to giving a greater focus to the actual design of reports due to the exponential growth of data that must be analyzed for decision making. They also ensure that the interpretations made by users can be influenced by the type of visualization or the message that is being sought to be transmitted.

It is important to guarantee that the data visualization ensures the effectiveness of the reports, as the type of graphics used in the reports can influence interpretations of users. It is important to measure the user experience through usability testing. (Norman and Nielsen, 2013) Useful results can be obtained with a sample of five people. (Nielsen, 2000; Nielsen, 2012) Some attributes related to the usability of the user interface are the capacity for learning, efficiency, memory, errors and satisfaction. (Nielsen, 2009)

Optimal Workshop is a free software that performs Chalkmark tests, to analyze page layouts by first click. (White and Kapakos, 2017) This type of test involves inviting users to complete tasks by clicking where they think they will find the correct information. The results of these tests allow us to know if the users of the report can find the

information they are looking for easily and quickly and even show in clicmaps where they are clicking to find the requested information.

It is necessary to present several alternatives for the design of the report to the users, to later compare and analyze them statistically. Losbichler and Michels-Kim (2017) mention that there are two key criteria to evaluate if a report is objectively good and better than other alternatives, which are:

- **Efficacy:** Corresponds to the number of correct answers that users respond to based on what is observed in the report, the lower the proportion of incorrect answers, the greater the effectiveness.
- **Efficiency:** Corresponds to the response time in seconds that the users of the report use to obtain conclusions; therefore, the more time they need, the lower the efficiency.

Once you have the evaluation of at least two design alternatives, you proceed to use the matrix proposed by Losbichler and Michels-Kim (2017) to identify which quadrant they belong considering the results obtained about the percentage of incorrect answers and the efficiency of the participants. It should be noted that the winning design is the one with the lowest error rate and the least time for completion of tasks by users.

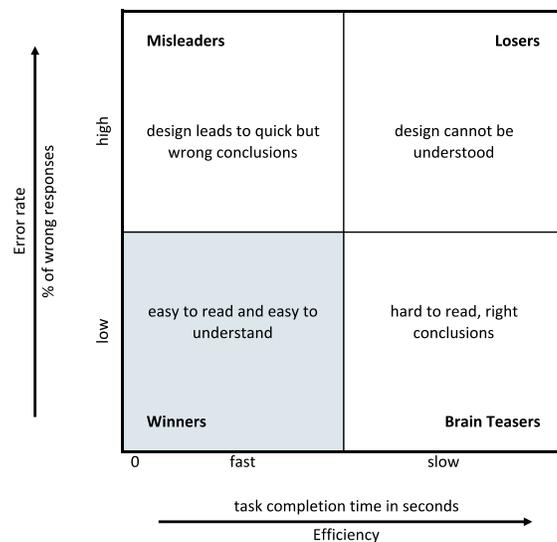


Figure 1. Matrix to evaluate the design of a report (Losbichler and Michels-Kim, 2017)

2.5 Tool to share documents

SharePoint is a Microsoft tool that offers security, ease of use and remote accessibility to an organization to exchange information internally. (Diffin, Chirombo & Nangle, 2010) It has as benefits that it combines the best features of cloud and intranet storage: 1) employees can share information and documents; 2) update in a simple way; and 3) quick access. (Koplowitz & Owens, 2009; Natarajan, 2008; Weiner, 1999)

3. Methods

The methodology used in this study is based on the work of Losbichler and Michels-Kim (2017): “Eye tracking for better reports”, which is a peer reviewed paper that exposes a case study of an Austrian company that improve the design where possible of their existing internal management report. The steps followed in the company’s project were: 1) Analysis of existing reports; 2) Clarification of customer preferences; 3) Design of alternative report formats; 4) Selection from short list of alternatives; 5) Eye-tracking test (existing reports and alternatives); 6) Analysis of eye-tracking tests; 7) Presentation of eye-tracking test results; 8) Facts-based final design; 9) Definition of a company-specific standard (guideline)

Because this study will analyze whether the users of the report can find the information they are looking for easily and quickly; then in step 5 of the methodology proposed by Losbichler and Michels-Kim (2017) the Chalkmark tests described in the previous section will be applied. In the following subsections, these steps will be described.

3.1 Analysis of existing reports

The brewery developed a monthly report of indicators in order to know the current status of it. However, when observing and analyzing Figure 2 of the existing report, it can be observed that:

- Some of the key performance indicators do not have the units of measurement.
- Graphs or data that allow knowing the behavior of key performance indicators by comparing current results with previous months are not included.
- It is not possible to ensure that employees at all levels of the organization know the terminology used because some key performance indicators are expressed in Spanish and others in English.



Figure 2. Partial view of the existing report of the Plant.

3.2. Clarification of customer preferences

An inductive and subjective, holistic and process-oriented approach was used to understand the preferences of the brewery management. Therefore, to collect the information a set of interviews, and individual and group sessions were carried out; in which the director, managers and heads of the plant participated.

Once the answers and feedback were analyzed, the preferences to be taken into account in the design of the report were:

- Respect the color code and symbology of the company.
- Make the report using terms in Spanish so that employees at all levels of the organization can understand the concepts.
- Use a report format that can be sent by email to all employees of the brewery.
- Use a board that allows having an overview of the most relevant indicators of each of the areas to know the current status and performance of the plant.

- Monthly update the information in the report so that management can make decisions about how each of the areas can contribute to compliance with global indicators.
- Maintain a section of comments for each indicator of the report in order to know the details of them.

3.3 Design of alternative report formats and selection from short list of alternatives

Once the preferences of the brewery have been identified, different wireframe designs were presented to the users before working on the final design, since several authors mention that design experts recommend paper prototyping because of its simplicity, fast turnaround, and ease of use for the team and the user (Snyder, 1996; Scalon, 1998; Klee, 2000; Spool, 2005). In addition Norman (1983) mentions that wireframes "helped us clarify our design requirements and understand the 'mental models' that different groups of users brought to mapping interfaces, which then informed the process of designing prototype screens".

Subsequently, a sequence of meetings was held with the users and personnel that generate the information to evaluate qualitatively the distribution of the information to be displayed in each screen of the report. Once the managers and director of the plant approved the 12 prototype screens, the final design of each of them was worked on PowerBI using the results obtained during the previous year for each of the indicators to be included in the report. Figure 3 shows an example of the process previously mentioned for one section of the monthly report.

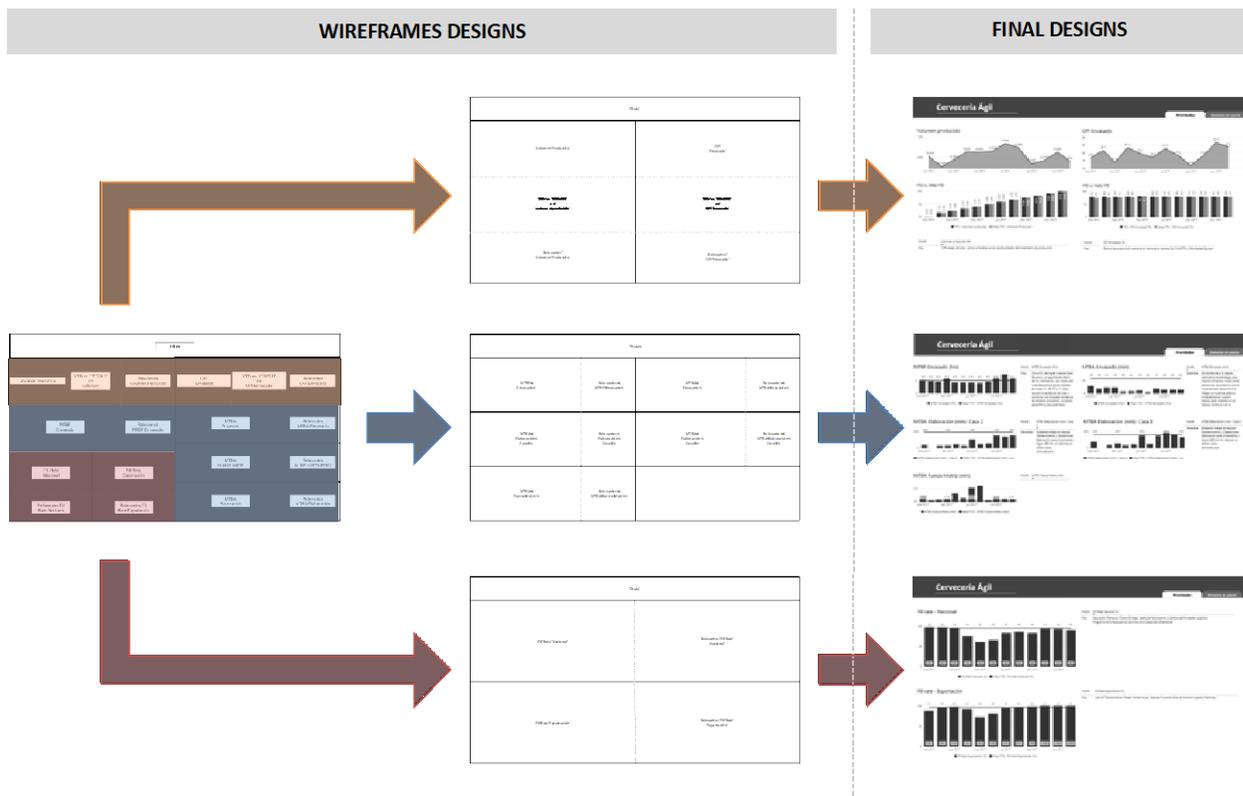


Figure 3. Example process for designing alternative report formats from wireframes.

Significantly different alternatives to design report, were considered the best proposals for Firican (2017) practices; where the most relevant recommendations are: include titles and captions, select graphics according to the information to be displayed, and include brief descriptions of the information presented so that users have a better interpretation of it.

3.4 Chalkmark test (existing reports and alternatives)

After designing the final report screens, it is necessary to evaluate the visual design of the existing report and proposed in the previous step by applying Chalkmark tests, which were created in Optimal Workshop. To make a valid comparison of the results obtained in the tests, it is necessary that the users answer the same task using both reports; as a result a task to be answered was defined for each of the screens of the proposed report.

In order to apply the Chalkmark tests, the test links and brief instructions of how to solve the tests were sent to the employees of the different hierarchical levels of the brewery by email, ie operating staff, administrative and managers.

3.5 Analysis of Chalkmark tests & presentation of test results

In this study 16 people participated for the solution of both tests through Optimal Workshop. This software generates a report indicating the number of participants who correctly answered each of the tasks, as well as the time used to solve each of the tasks requested with the screens of both reports. It also has the possibility of generating clicmaps with the areas where the participants clicked to answer the question, which allows knowing where the participants would observe to answer the requested task.

Subsequently, the results obtained in both tests were compared for each of the tasks. An example of the results obtained for the tasks requested in the tests is shown in Figure 4. In this case, the task that the users answered was: “Suppose that at the end of the year you wish to consult the trend of the monthly water of the plant, where would you observe this information?”. Figure 4 shows that the report proposed in section 3.3 allows users to respond to the task faster and with less error than with the existing report.



Figure 4. Chalkmark test results of a task requested to the users.

3.6 Facts-based final design

To compare effectiveness and efficiency of the design of the previous report against the set of screens of the proposed report, the total time the participants invested to solve the 12 tasks requested in each of the tests was taken into account; as well as the total percentage of incorrect answers.

To evaluate the existing and the proposed report, the matrix proposed by Losbichler and Michels-Kim (2017) was used since it allows to identify the quadrant to which those reports belong. In Figure 5 it can be seen that the proposed report is better than the existing one, since it belongs to the quadrant of the winners; this is because it has a lower error rate and shorter time of completion of the tasks by the users.

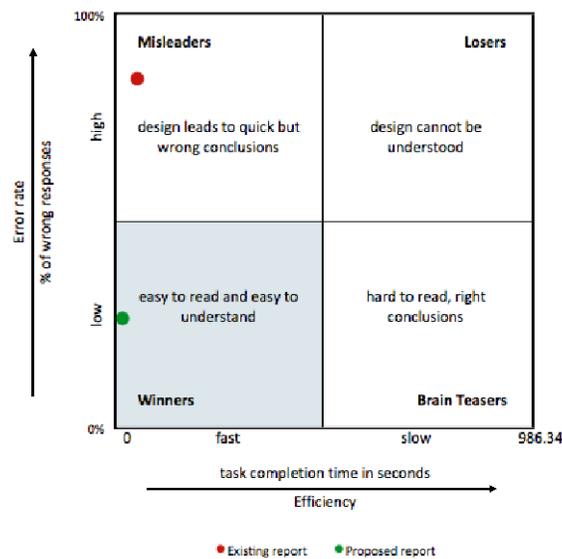


Figure 5. Comparison of the test results of the existing report against the proposed

3.7 Definition of a company-specific standard (guideline)

Currently the brewery does not have a standard guide for the monthly report of the plant; therefore the data of the monthly report is requested in person or via email. This information is manually entered into the existing report, so in Figure 6 it is possible to observe that the time it takes to update the document is 27 calendar days after the end of the month.

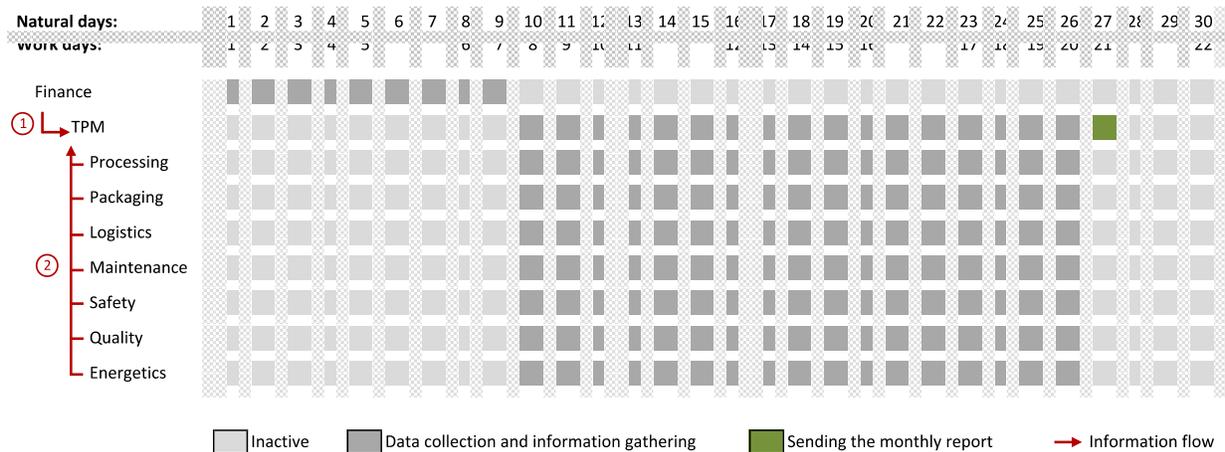


Figure 6. Number of days required to update and send existing report.

In order to reduce the time of preparation of the monthly report, it was designed an automated Excel format that collects information from key performance indicators from different areas of the plant. This format is linked to the file prepared in PowerBI, which generates the graphics automatically according to the final design of the screens of the proposed report. To ensure the correct functioning of the Excel file is important that the databases of the different areas are stored on the company's server. Figure 7 shows a partial view of the automated Excel file for the collection of security indicators.

Mes	Accidentes internos	Cálculo - Accidentes internos	Meta YTD - Accidentes internos	Incidentes internos	Meta YTD - Incidentes internos	Accidentes contratistas	Meta YTD - Accidentes contratistas	Incidentes contratistas	Meta YTD - Incidentes contratistas
ene-18	0.00	0	0	1	7	0	0	1	7
feb-18	0.00	0	0	3	7	0	0	2	7
mar-18		0	0		7		0		7
abr-18		0	0		7		0		7
may-18		0	0		7		0		7
jun-18		0	0		7		0		7
jul-18		0	0		7		0		7
ago-18		0	0		7		0		7
sep-18		0	0		7		0		7
oct-18		0	0		7		0		7
nov-18		0	0		7		0		7
dic-18		0	0		7		0		7

Figure 7. Partial view of the automated Excel file for the collection of security indicators.

To ensure the sustainability of the report preparation process, a manual was delivered to the brewery that contains: 1) a glossary with the meaning of each of the key performance indicators included in the monthly report; 2) the detailed operation of the automated Excel format for the collection of information; 3) the date at which the information of each area is available; 4) list of responsible employees in generating the information of each area; 5) the process to update the information in the proposed report generated in PowerBI.

3.8 Results of implementation

The results of the implementation have been very significant for the company. Figure 8 shows the days taken by the brewery to prepare the proposed report, so a reduction of 37.04% on the average number of days required during 2017 to send the monthly report to all employees. It is expected that in 2019 the time required will be less than 17 calendar days after the end of the month, because during 2018 the management will be working with the IT department to collect the information from the software or platforms that generate it.

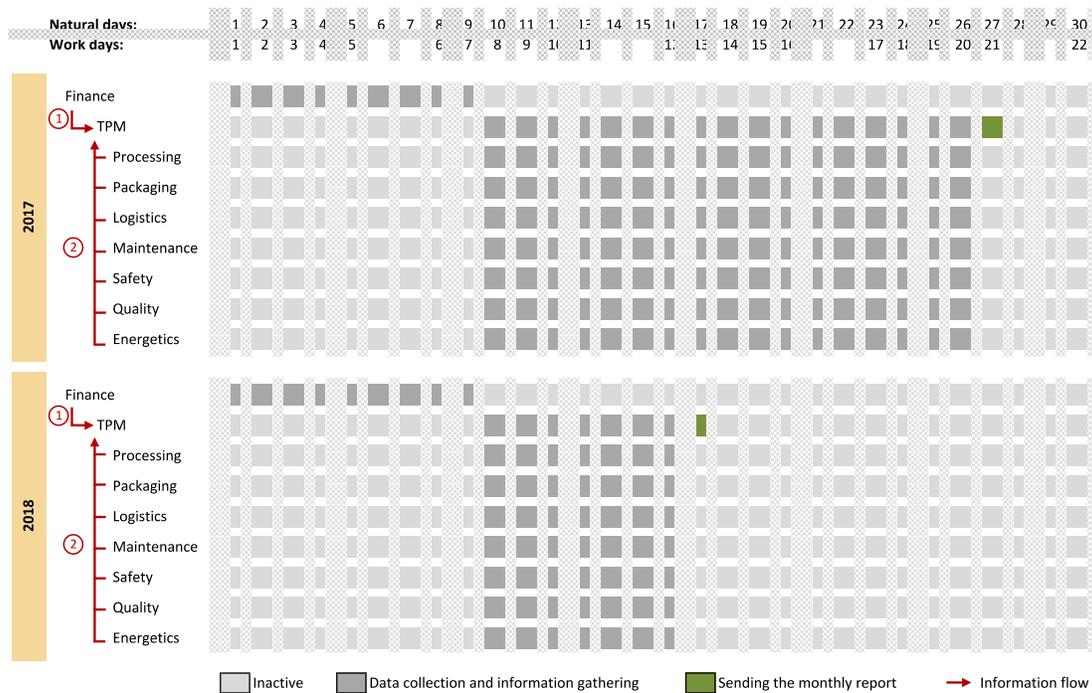


Figure 8. Comparison of the number of days required updating and sending existing report against the proposed report.

It should be noted in Figure 9 that the brewery with implementations mentioned has reduced 82.6% the time taken by managers and heads a year in preparing the monthly report in 2018. Because the proposed report has automated the collection of information, then the heads and managers can take advantage of this time in other responsibilities and it is also no longer necessary to hire a specialized intern to carry out this task. Figure 10 shows this generates a 95.4% savings in the total man-hours paid to these employees to prepare the report during 2017.

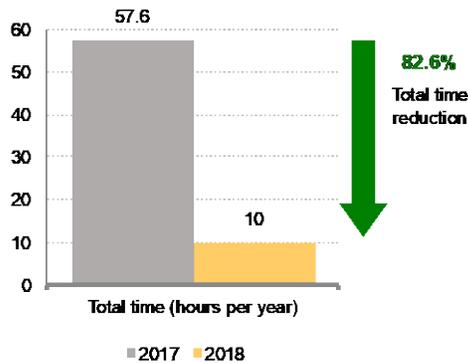


Figure 9. Number of effective hours per year taken by managers and heads preparing the monthly report.

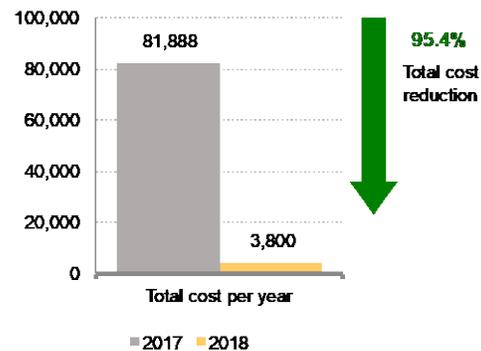


Figure 10. Savings in the total man-hours paid per year to prepare the monthly report.

4. Conclusions and Results

The problem of concern in this paper is the redesign of the monthly report of key performance indicators of a plant. This work provides a brief description of the application of the best practices to design a dashboard or monthly report that allows users to quickly and correctly interpret the values of the key performance indicators in Mexican brewery plant. The company wants end users to have a better experience in decision-making using the redesigned report. Therefore, the management of the company developed a strategy to measure the user's experience through usability tests to ensure the effectiveness and efficiency considering the visualization of the proposed report.

The main implementations in the brewery were: 1) redesign of the monthly report of indicators through the use of best practices; 2) measurement of the user's experience to guarantee the efficiency and effectiveness of the monthly report; 3) automation and standardization of the monthly report preparation process. This allows the company to reduce the number of days required for elaboration, which generates savings in total man-hours paid to such employees to prepare the report.

In addition, this project has a high intangible value that is a function of reducing the opportunity cost, since the administration will have more days to make decisions that allow the plant to achieve agreed performance goals, allocate and prioritize resources according to the results of the last month.

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