ISSN: 2594 - 2905

INTELLIGENT PRODUCTION CONTROL SYSTEM BASED ON POWER BI AND DATA AUTOMATION

INTELLIGENT PRODUCTION CONTROL SYSTEM BASED ON POWER BI AND DATA AUTOMATION

Sosa Pintle Ana María[1] , Porras Aguirre Josefina[2] , Martínez Ramírez Violeta[3] , Machorro Teresa Luciano[4] , Mezura Galindo Adrián Uriel[5]

[1] National Technological Institute of Mexico/Puebla Technological Institute,ana.sosa@puebla.tecnm.mx , https://orcid.org/0009-0000-6529-9793
[2] National Technological Institute of Mexico/Puebla Technological Institute,josefina.porras@puebla.tecnm.mx , https://orcid.org/0009-0006-3316-7511
[3] National Technological Institute of Mexico/Puebla Technological Institute,violeta.martinez@puebla.tecnm.mx , https://orcid.org/0000-0003-1518-786X
[4] National Technological Institute of Mexico/Puebla Technological Institute,teresa.luciano@puebla.tecnm.mx , https://orcid.org/0000-0003-3979-9369
[5] National Technological Institute of Mexico/Puebla Technological Institute, i20222174.19@puebla.tecnm.mx, https://orcid.org/0009-0003-4078-5658

https://doi.org/10.61117/ipsumtec.v8i2.424

Abstract – The following paper outlines the phases involved in creating software automation that controls production flows recorded within the industrial area. The project was developed using a practical and structured approach based on the waterfall model methodology. This approach allowed the system to be built in stages, with its functionality continuously validated by key users at the plant. Throughout the process, techniques such as requirements analysis, database design, non-code application development in Tulip, data modeling in Power BI, and key performance indicator (KPI) visualization were combined.

Keywords: dashboard, Power BI, TULIP, silos.

Abstract -- The following work outlines the stages of creating software automation that controls production flows within the industrial area. The project was developed using a practical and structured approach, based on the waterfall model methodology. This approach allowed the system to be built in stages, continuously validating its functionality with key users at the plant. Throughout the process, techniques such as requirements analysis, database design, no-code application development in Tulip, data modeling in Power BI, and key performance indicators (KPI) visualization were combined.

Key words – dashboard, Power BI, TULIP, silos.

INTRODUCTION

The Ministry of Agriculture reports that five states lead in agricultural production (1). Mexico has a large number of production plants that generate a constantly changing economy. Within Agricultural plants range from vegetable crops such as corn, potatoes, tomatoes, sugarcane, and alfalfa (states with the highest production: Jalisco, Sinaloa, Veracruz, Oaxaca, Chihuahua) to ornamental plants such as cempasúchil, orchids, and dahlias (states with the highest production: Mexico City, Puebla, and Morelos: Ministry of Agriculture and Rural Development (2).

In terms of important industrial plants, these are found in the automotive, electronics, beverages, mining, energy, and other sectors. The automotive industry stands out for generating 3.8% of GDP, which represents 20% of Mexico's total exports. In second place is the electronics industry, which accounts for 6% of the country's annual exports. The aerospace industry has been sustaining significant growth, reaching more than $9 billion in annual exports. This is followed by food and beverage production, which contributes 4% of GDP. In addition, the textile, tourism, energy, construction, ICT, and pharmaceutical industries are among the top ten sectors that significantly support economic development in Mexico, as published in Tijuana EDC (3).

The purpose of the latter is to modernize and simplify production processes in plants so that they comply with international standards. There are various software applications, such as TULIP, that facilitate this and many other tasks that contribute to the achievement of industrial performance indicators.

The TULIP website (4) shows the specific objectives to be achieved with the software in the area of "discrete manufacturing." This is mainly aimed at eliminating silos in accordance with the RAE.

(5): bulk storage containers, synonymous with warehousing, obtaining valuable information, and optimizing workflows. The latter is the subject of the objective of the development in question and relates to downtime in the production area.

The TULIP application is defined as an open ecosystem, where it is possible to easily integrate other software, hardware, and AI systems, thus enhancing its benefits tailored to customer needs, among which ORACLE, Snowflake, LandingAI, HigthByte, etc. stand out.

The University of Bordeaux, France (6) defines TULIP as C++-based software that visualizes information dedicated to data analysis, which includes a library of components for relational data for reuse.

In addition, TULIP was created as a no-code digital manufacturing platform that underpins MES (Manufacturing Execution System) technology, whose purpose is to monitor and control production for real-time analysis, as indicated on its Nine Aptitudes portal (7).

The performance indicators that need to be identified during production reveal information of utmost importance to the company in the supervision and management stage. KPIs, or key performance indicators, are measurable and specific. Benefits: they help achieve strategic objectives, provide information about good resource planning, enable monitoring for control and positive impact, and permeate the integrated vision of employees and the company, as stated on the ASANA portal (8).

Importance of a Dashboard in a computer system. As a digital dashboard, it allows you to view different graphic components at the same time and monitor statistical information in real time. Its strategic significance is relative as a document whose graphic representation reflects the KPIs involved in the company's strategic objectives, as pointed out by KYOCERA (9).

The EAE Business School Barcelona portal (10), given its importance in monitoring KIPs, data management, and business administration, should consider which dynamic information graphics to display in a single location, as this will subsequently be used to generate executive reports for informed decision-making.

Another extremely important tool in the creation of this project is Power Bi. It has become a powerful weapon for obtaining reports in real time.

During the development of the project, one of the company's main challenges was addressed: improving the collection, centralization, and analysis of information generated in the production and quality area, specifically in the three plants in the Puebla region. Prior to the start of the project, data capture was done manually, with weekly records that made it difficult to accurately track key indicators such as downtime, actual versus expected production, efficiency, scrap, and other relevant KPIs. This situation limited the the ability of area managers to react and led to inefficiencies in decision-making.

In response to this problem, a comprehensive system based on digital technologies was designed and implemented from scratch, consisting of databases developed in Tulip Tables, interactive applications built in TULIP for production operators and quality personnel, as well as automated visualizations in Power BI.

A robust and functional database was designed and structured to serve as the backbone of the system, allowing all applications to integrate and dynamically feed the Power BI dashboards. These interactive dashboards, organized by VSM, line, cell, and shift, provide a clear and up-to-date view of operational performance, facilitating detailed analysis of production, goal achievement, and real-time detection of deviations.

This report details each stage of the project, from analysis and requirements gathering to system implementation and validation, highlighting the benefits obtained and the importance of digitization in today's industrial environment. It demonstrates how the integration of tools such as TULIP and Power BI can completely transform the way production and quality processes are managed. *Problem statement*

Many organizations still face significant limitations in how they collect, organize, and use operational information. This was the case at Stanley Black & Decker Tools in its Puebla plants, where production data capture processes were mostly manual, fragmented, and sporadic.

Critical production-related information such as parts manufactured, downtime, scrap, and rework was recorded weekly, which prevented a clear, real-time view of the status of the production lines. This situation made it difficult to detect problems, continuously monitor key performance indicators (KPIs), and make immediate corrective decisions.

The lack of up-to-date information caused several operational problems, including:

- Delays in the generation of reports and visualizations.
- Increased risk of errors due to manual data entry or duplication.
- Lack of tools that would enable quick decisions based on up-to-date data.

Given this context, it became clear that there was a need to develop a system that would automate hourly data capture, centralize information in a structured way, integrate it from different areas, and facilitate its analysis through dynamic dashboards that could be updated in real time. Solving this problem was essential to improving operational efficiency, reducing the margin of error, and strengthening the culture of continuous improvement within the company.

Overall objective

ISSN: 2594 - 2905

Create an intelligent production control system based on Power BI and data automation.

Specific objectives

• Design and structure a functional database in Tulip.
• Develop an application in Tulip for recording production data.
• Implement a second application focused on quality control.
• Design and build interactive dashboards in Power BI.
• Automate the flow of information between Tulip and Power BI.
• Document each phase of development.

Specific objectives

• Design and structure a functional database in Tulip.
• Develop an application in Tulip for recording production data.
• Implement a second application focused on quality control.
• Design and build interactive dashboards in Power BI.
• Automate the flow of information between Tulip and Power BI.
• Document each phase of development.

Limitations

• Staff training and adoption: Knowledge of the implemented system rests solely with the project developer, which limits future updates without adequate technical transfer.
• Implementation in the city of Puebla.

State of the art

The work entitled "Proposed methodology for dashboard design" discusses the use of dashboards to track key indicators and gain a clear perspective on the current situation of the organization through efficient data analysis in the panels created. (11).

In Spain, a computational study was carried out entitled "Implementation of Data Mart, in Power BI, for the analysis of sales to customers, in the Gransol eco-businesses," where the Dashboard tool was successfully implemented using Power BI. This study was published in Dialnet by Moyano & Molina (12).

The project from Ecuador entitled "Power BI as a decision-making support tool" highlights Power BI as its most widely used technological tool in business intelligence (BI), which increased the productivity of the business where it was implemented (13).

DEVELOPMENT

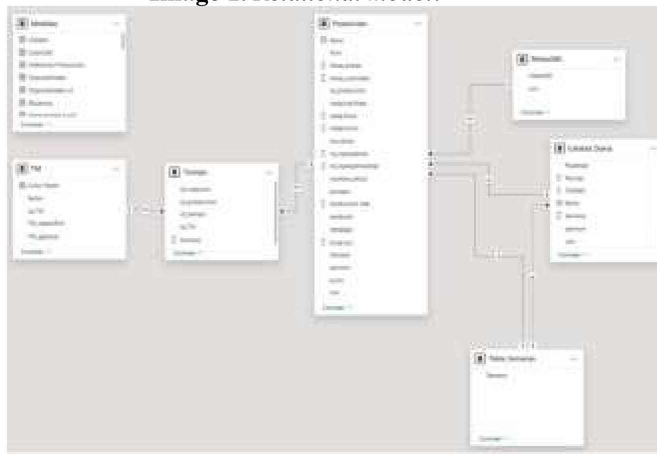
The development of the system was organized into six phases: Analysis and Planning, Data Preparation, Interface Design in Tulip, Visualization Development in Power BI, Testing and Adjustments, and Maintenance.

Database design

The design stage focused on defining the architecture of the digital system that would integrate production, quality, and downtime records into a unified database, allowing for subsequent analysis in Power BI.

The first step was to structure the database from scratch in Tulip Tables, organizing the fields needed for detailed recording. See image 1.

Image 1. *Relational model.*



Source: *Own work* (2025).

Hourly Application Design. See image 2.

Image 2. *Production App Design.*

Source: *Own creation* (2025).

This application is controlled only by the operator who is the line manager, who records the necessary data hour by hour to calculate Efficiency, ***Availability, and OEE.*** The most important data stored by the application are as follows (see Table 1):

Table 1. *Main fields of the Hourly App.*

FIELD	DESCRIPTION
Production ID Date	The ID is automatically generated when saving, to establish relationships.
and time Hours	They are automatically recorded when you press the "Save" button in the production section.
worked VSM	Normal Hours and Overtime Hours are needed to calculate Expected Production.
Cell (Cell number and cell name are saved)	VSM is important for the filters in our Power BI visualizations.
Line or Work Machine Shift Product Process	They are necessary for the upcoming filters to be used and to show how they work hour by hour, displaying the KPIs for each one.
	Used for future filters.
	Used to filter information.
	It can be useful when filtering.
	T h i s can be useful when filtering.

ISSN: 2594 - 2905

FIELD	DESCRIPTION
ID for Production	The ID is automatically generated when saved, to establish relationships.
Date and time	They are automatically recorded when you press the "Save" button in the production section.
Hours Worked	Normal Hours and Overtime Hours are needed to calculate Expected Production.
VSM	VSM is important for filters in our Power BI visualizations.
Cell (Cell number and cell name are saved)	They are necessary for the next filters to be used and to show how they work hour by hour, displaying the KPIs for
Line or Work Machine Shift	each one.
Product	It is used for future filters.
Process	It is used to filter information.
	May be useful when filtering.
	This can be useful when filtering.

Source: *Own elaboration* (2025).

Quality Application Design.

A second application was created for quality department staff. The following are recorded in this interface: Date, VSM, and scrap percentage.

With this data internally, calculations are made and the quality percentage is displayed in the table.

To complement the operational analysis and connect efficiency with product quality aspects, an application was designed in Tulip specifically for the quality department. See image 3.

Image 3. *Quality App interface*.

Source: *Own creation* (2025).

This logic was subsequently applied within Power BI, once the quality data had been integrated with the production records. The relationship between the two data sets was established through fields such as date and VSM, which allowed for a consolidated analysis by week, cell, or line.

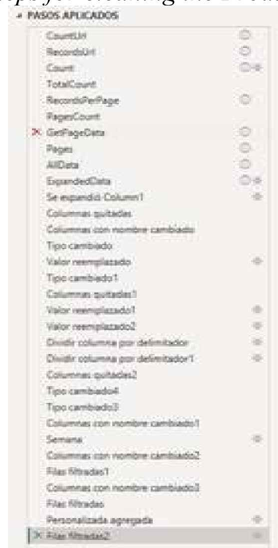
Data cleaning in Power Query.

The data collected from Tulip Tables (using applications designed for production and quality) was exported into tabular files, which were processed in Power BI to give them shape and context. Within Power Query, the data was processed using the following steps:

- Empty or unnecessary columns were removed.
- The appropriate data types (dates, numbers, text) were ensured.
- Cell names, shifts, VSM, and lines were normalized to avoid errors due to spelling variations.
- The production and quality tables were unified using key fields such as semvsm.

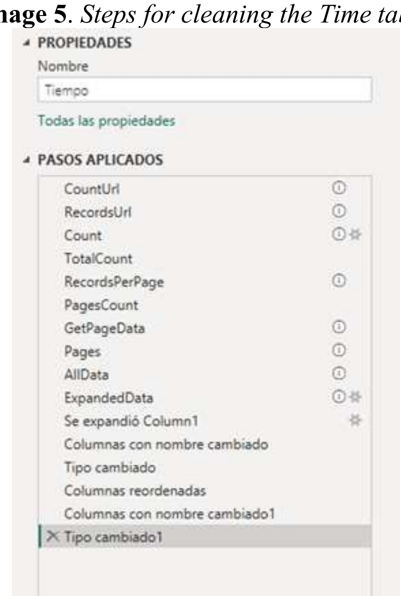
The steps applied to clean up the information extracted for each table are as follows (see images 4 and 5):

Image 4. *Steps for cleaning the Production table*.



Source: *Own work* (2025).

Image 5. *Steps for cleaning the Time table*.



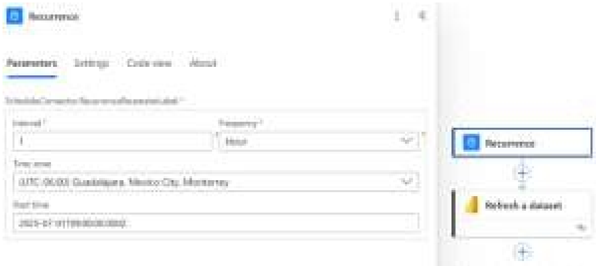
Source: *Own work* (2025).

Automation and Measures.

An essential part of the testing process was to ensure that the Power BI dashboards were kept up to date with the latest data, without relying on manual updates by the user. To do this, an automated flow was implemented using Power Automate, a tool integrated into the Microsoft 365 ecosystem.

The objective of the flow was to force the Power BI dataset to update on a scheduled basis, thus ensuring that data from Tulip Tables was processed periodically in Power BI and reflected in the dashboards without manual intervention. See image 6.

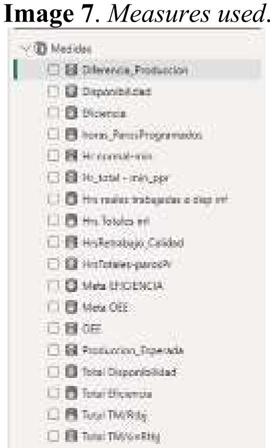
Image 6. *Flow to update Dataset.*



Source: *Own creation* (2025).

The measures used are as follows (see image 7):

Image 7. *Measures used.*



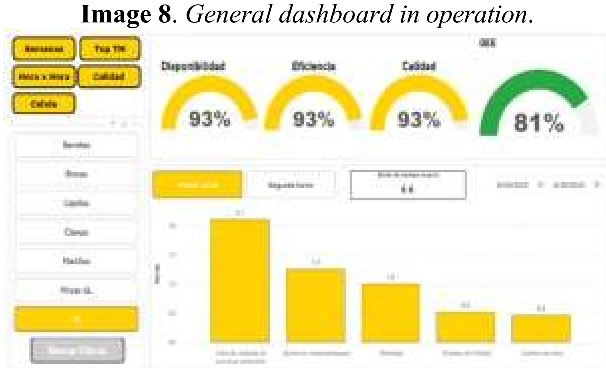
Source: *Own creation* (2025).

Development of dashboards in Power BI.

Six dashboards were created, each with a specific purpose:

General dashboard: Mainly used by the plant manager to compare indicators with different plants globally. See image 7.

Image 8. *General dashboard in operation.*



Source: *Own elaboration* (2025).

Weekly analysis: Used for weekly reports by production, manufacturing, processes, and continuous improvement managers. See image 9.

Image 9. *General dashboard in operation.*

Source: *Own creation* (2025).

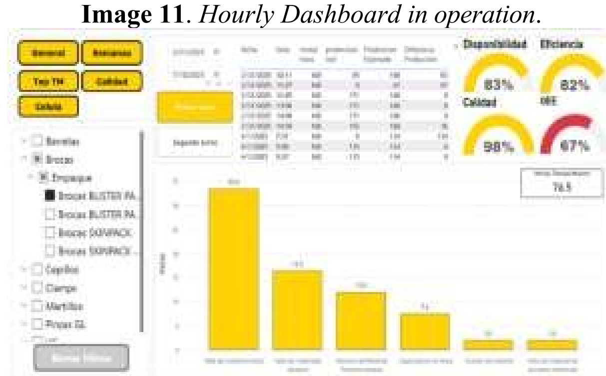
Top downtime: Identifies the downtime where the most time is lost. See image 10.

Image 10. *Top downtime dashboard in operation.*

Source: *Own creation* (2025).

1. Hour by hour: This dashboard is a key tool for detecting deviations in real time. It allows you to identify: Whether expected hourly production is being met, recurring stoppages at certain times, and lines and cells that record the most downtime. See image 11.

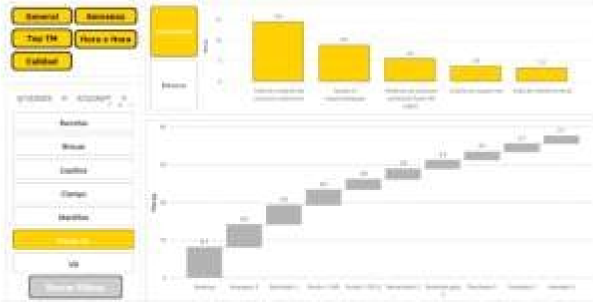
Image 11. *Hourly Dashboard in operation.*



Source: *Own creation* (2025).

2. Cell analysis: This panel is designed to delve deeper into the relationship between total downtime and the cells that generate it, as well as to differentiate whether losses are due to efficiency or availability. See image 12.

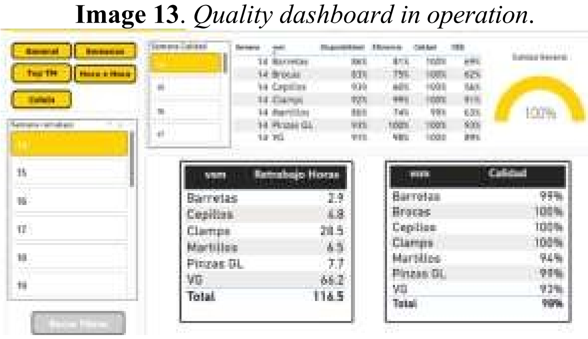
Image 12. *Machine/cell dashboard in operation.*



Source: *Own creation* (2025).

3. Quality dashboard: Its purpose is to provide a clear overview of the impact that quality issues have on the efficiency of the production system. See image 13.

Image 13. *Quality dashboard in operation.*



Source: *Own creation* (2025).

Summary.

The methodology used enabled an orderly transition from the manual system to a comprehensive digital solution. The combination of automatic capture, structured cleaning, and advanced visualization has resulted in a scalable tool that is aligned with Industry 4.0 principles.

The development of this system represented a significant technical and professional challenge that allowed me to apply real knowledge in a global manufacturing environment.

DISCUSSION AND ANALYSIS OF RESULTS

Maintenance

Introduction to system maintenance

The system implemented for the capture, analysis, and visualization of production data is made up of multiple components that require ongoing maintenance to ensure proper functioning: Tulip applications, data structure, input files (CSV), transformations in Power Query, and dashboards in Power BI.

Maintenance involves not only bug fixes, but also adjustments due to changes in plant processes, the addition of new production lines, or requests from management. The types of maintenance applicable to the system are described below, along with recommendations to ensure its long-term sustainability.

Types of maintenance applied

a) Preventive maintenance

Preventive maintenance consists of periodically reviewing data flows, constantly updating the data generated by Tulip Tables, and ensuring the integrity of the relationships between tables in Power BI. This includes:

• Verifying the format and consistency of downloaded Tulip files.
• Validating the correct functioning of DAX formulas and measures.
• Checking for automatic Power BI updates and version compatibility.

b) Corrective maintenance

This type of maintenance is applied when the system experiences unexpected failures, such as data loading errors, incorrect visualizations, or breaks in table relationships. Common actions include:

• Correcting DAX measures that are poorly formulated or do not filter correctly.
• Adjusting relationships between tables in the Power BI model.

c) Evolutionary maintenance

This involves incorporating new features or modifications requested by users as plant processes evolve. This type of maintenance is key to maintaining the usefulness of the system over time. Some actions include:

• Adding new filters (by line, supervisor, etc.).
• Including new metrics, such as cycle time, energy use, or operator performance.
• Integrate other data sources, such as SharePoint lists or Power Automate flows.

Maintenance protocol

Since currently only the project developer has complete knowledge of the system, it is recommended to implement an internal maintenance protocol that includes:

• Technical documentation of the Power BI model (tables, relationships, measures, transformations).
• User manual for the apps in Tulip, with screens and flows explained.
• Weekly and monthly system review schedule.
• Log of changes applied.

Training and knowledge transfer

One of the main challenges in maintaining the system is the dependence on a single person with knowledge of Power BI. Therefore, it is essential to gradually transfer knowledge to the continuous improvement or systems team.

Table 1. Comparative data

Aspect	Before the system	After the system
Data capture	Manual, on paper forms (approximately 800 per day)	Digital, through applications on Tulip, recording hourly
Quality recording	Partial, outside of working hours, with weekly compilation	Immediate, using a specific quality app, with automatic calculations automatic
Consolidation of information	Manual, using Excel, every week	Automatic in Power BI with centralized and updated data and updated
Availability of KPIs	Limited, delivered weekly	Real time, filterable by week, shift, VSM, cell, or line

IPSUMTEC
ISSN: 2594 - 2905

Detection of downtime	General, without detail by cause, line, or cell	Specific, with Top 5 causes, classification by efficiency/availability, etc.
Data visualization	Excel tables without interactivity	Interactive dashboards in Power BI, with comparative graphs and dynamic filters
Decision making	Based on delayed reports and weekly summaries	Immediate, with updated data that allows action to be taken during the same shift
Scalability	System limited to one plant and manual reports	Ready for comparison between plants globally using Power BI
Operational workload for staff	High, with hours spent filling out, reviewing, and digitizing forms	Low, as the entire flow is automated from capture to visualization
Data errors	Frequent, due to manual entry and transcription into Excel	Minimal, thanks to app validations and digital form structure

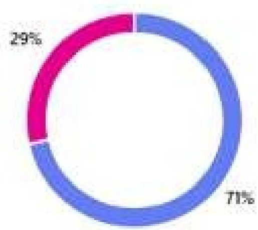
Source: Own elaboration (2025).

Satisfaction survey.
Upon completion of the system, a satisfaction survey was conducted among end users to evaluate their experience using the system, assess its ease of use, evaluate the training they received prior to using the system, assess the support they received during its use, and evaluate its level of usefulness on a daily basis.

A. The following graph shows whether the system meets end-user expectations:

• 5 people said they totally agreed (71%)
• Two people said partially (29%).

Image **14**. *Expectations chart*.

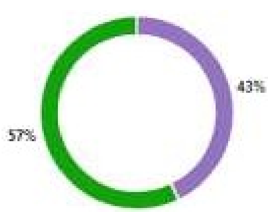


Source: *Own elaboration* (2025).

B. The following graph shows how satisfied you are with the solution implemented, where:

(Scale from 1 to 5, where 1 = Very dissatisfied and 5 = Very satisfied):
• 4 people said very satisfied (57%)
• 3 people said satisfied (29%)

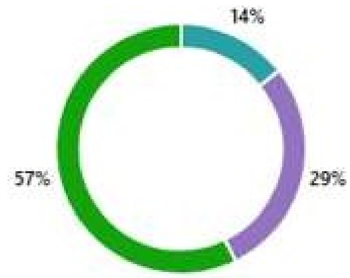
Image **15**. Expectations chart.



Source: *Own elaboration* (2025).

C. The following graph shows how you would rate the system's ease of use:

(Scale from 1 to 5, where 1 = Very difficult to use and 5 = Very easy to use)
• 4 people said very easy to use (57%)
• 2 people said easy to use (29%)
• 1 person said it wasn't that easy to understand

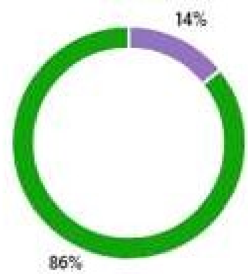


System usability chart

D. The following graph shows whether the user feels supported by the team responsible for questions or problems:

(Scale from 1 to 5, where 1 = I never received support and 5 = I always received support):
• 6 people said they always received support (86%)
• 1 person said they did receive support (14%)

Image 16. *Graph showing the level of support received while using the system*.



Source: Own elaboration (2025).

E. The following graph shows how useful they consider this tool to be for their daily work:

• 5 people said very useful (71%)
• 2 people said it was useful (29%)

Discussion
As a result of the analysis of the successful implementation of the project, the topic for discussion is mainly directed towards the actual evolution of this type of computational solution that incorporates cutting-edge software technology tools.
According to experts in dynamic construction created for mobile applications (Apps), it is possible to mention that they manage operations more dynamically due to the changing needs of companies, according to the TULIP portal (14).
Digital transformation in manufacturing involves the adoption of digital technologies that primarily provide manufacturers with efficiency and cost reduction, thereby optimizing production and eliminating downtime, as stated by the MINGOSMARTFACTORY portal (15).
Similarly, the CAPTERRA publication (16) highlights the benefits of MES included in TULIP for its speed in solving challenges during operations, and its robustness does not detract from its customization.

CONCLUSIONS

Maintaining a data analysis system does not end with its implementation, but rather represents an ongoing process. As processes, equipment, and information needs change in the plant, the system must be adjusted to continue providing value. With the right preventive, corrective, and evolutionary maintenance strategy, the durability, reliability, and scalability of this technological solution at Stanley Black & Decker – Puebla Plant is guaranteed.

Once the system implementation was complete, multiple operational and strategic benefits were observed in the areas of Production, Quality, and Continuous Improvement. The main results achieved are detailed below:

First, the use of physical cards, which were previously filled out manually by operators to record hourly production, was completely eliminated. This procedure involved more than 800 cards per day, which generated high volumes of paper, delays in data consolidation, and a high probability of human error. Thanks to digitization using applications developed in Tulip, data capture became immediate, structured, and standardized.

In addition, centralizing information in Power BI allowed data recorded by operators and the quality department to be viewed automatically, without the need for exports to Excel or manual processing. This integration significantly improved the efficiency of analysis and the availability of information for different hierarchical levels within the plant.

One of the most important benefits was the ability to accurately identify the main causes of downtime. Through dashboards such as "Top Downtime" and "Cell Analysis," it was clearly visualized where and why valuable minutes were being lost, allowing for rapid intervention by the relevant areas, such as maintenance or supervision.

The dashboards also enabled better decision-making by offering analysis by hour, shift, week, or value stream mapping (VSM). Production managers were able to act in real time on deviations, and plant management gained a visual tool to evaluate overall performance and performance by operating unit.

Finally, the implementation fostered a culture of continuous improvement based on data, in which operators, supervisors, and analysts actively participate in both the capture and use of information for decision-making and improvement proposals.

In summary, the system developed not only automates the data capture and analysis process, but also strengthens responsiveness, operational control, and decision-making quality at the plant.

Recommendations include:

• Conduct internal training sessions on the use of Power BI and Power Query.

• Document the steps for updating data and reviewing metrics.

• Create video tutorials or step-by-step PDF guides for using the dashboards.

Future work

The developed system can be installed in the cloud, as the latest generation TULIP provides the necessary tools to achieve this and can be accessed from anywhere, 24 hours a day.

Apply AI to create predictive analytics to optimize informed decision-making and eliminate downtime costs.

BIBLIOGRAPHY

[1] Government of Mexico. Ministry of Agriculture. Five states with five stars in agricultural production [Internet]. May 7, 2021 [cited Aug. 8, 2025]. Available at: [https://www.gob.mx/agricultura/articulos/cinco-estados-con-cinco-estrellas-en-produccion-agricola#:~:text=Ma%C3%ADz%20grano%20(6%2C440%2C205%20t)%20y%20jitomate%20(764%2C435%20t](https://www.gob.mx/agricultura/articulos/cinco-estados-con-cinco-estrellas-en-produccion-agricola#:~:text=Corn%20grain%20(6%2C440%2C205%20t)%20and%20tomato%20(764%2C435%20t).435 tons).)

[2] Government of Mexico. Ministry of Agriculture. List of domestic flower production for Mother's Day celebrations [Internet]. May 7, 2021 [cited Aug. 8, 2025]. Available at: [https://www.gob.mx/agricultura/articulos/cinco-estados-con-cinco-estrellas-en-produccion-agricola#:~:text=Corn%20grain%20(6,440,205%20t)%20and%20tomatoes%20(764,435%20t](https://www.gob.mx/agricultura/articulos/cinco-estados-con-cinco-estrellas-en-produccion-agricola#:~:text=Corn%20grain%20(6%2C440%2C205%20t)%20and%20tomato%20(764%2C435%20t).435 tons).)

[3] Tijuana EDC. What are the 10 most important industries in Mexico? [Internet]. May 3, 2025 [cited 8 Aug 2025]. Available at: https://es.tijuanaedc.org/cuales-son-las-10-industrias-mas-importantes-de-mexico/

[4] TULIP. Composable operations: continuous transformation [Internet]. Spain; 2025 [cited Aug. 8, 2025]. Available at: https://tulip.co/es/

[5] Royal Spanish Academy. Dictionary of the Spanish language: silo [Internet]. 2025 [cited 8 Aug 2025]. Available at: https://dle.rae.es/silo

[6] Université Bordeaux. TULIP [Internet]. France; [cited 8 Aug 2025]. Available from: https://tulip.labri.fr/site/

[7] Nine Altitudes. Tulip, the next generation MES [Internet]. [cited 8 Aug 2025]. Available from: https://9altitudes.com/es/productos/tulip#35696

Receipt: October 16, 2025 | Acceptance: November 21, 2025 | Publication: December 18, 2025

EDUCACIÓN TECNOLÓGICO NACIONAL DE MÉXICO
IPSUMTEC ISSN: 2594 - 2905

[8] Asana. What is a KPI, what is it for, and how to use it in your project [Internet]. Aug. 16, 2024 [cited Aug. 8, 2025]. Available at: https://asana.com/es/resources/key-performance-indicator-kpi

[9] KYOCERA. Dashboards and their strategic significance [Internet]. 2025 [cited Aug. 8, 2025]. Available at: https://www.kyoceradocumentsolutions.es/es/smarter-workspaces/business-challenges/procesos/dashboard-y-su-significado-estrategico.html

[10] Business School Barcelona. The importance of dashboards in business management [Internet]. Barcelona: EAE; Nov. 28, 2024 [cited Aug. 8, 2025]. Available at: https://www.eaebarcelona.com/es/blog/que-es-un-dashboard#:~:text=%C2%BFQu%C3%A9%20es%20un%20dashboard?,comprensi%C3%B3n%20de%20los%20datos%20reunidos

[11] Córdova Viera Y, Martínez Borrego J, Córdova Viera E. Proposed methodology for dashboard design. Rev Cub Transf Dig [Internet]. 2021;2(3):56-7 [cited 8 Aug 2025]. Available from: https://rctd.uic.cu/rctd/article/view/141

[12] Moyano DMB, Molina MAC. Implementation of Data Mart in Power BI for the analysis of sales to customers in the "Gransol" eco-businesses. Polo Conocim Rev Cient Prof [Internet]. 2020;5(1):647-73 [cited Aug. 8, 2025]. Available at: https://dialnet.unirioja.es/servlet/articulo?codigo=7436046

[13] Vásquez RAD, Espinoza JLA, Cabrera MAC. Power BI as a decision-making support tool. Univ Soc [Internet]. 2022;14(S3):195-207 [cited 8 Aug 2025]. Available at: https://rus.ucf.edu.cu/index.php/rus/article/view/2949

[14] TULIP. How it works: a new and smarter way to run your operations [Internet]. 2025 [cited 8 Aug 2025]. Available at: https://tulip.co/es/how-it-works/

[15] Mingo Smart Factory. Mingo Smart Factory vs. Tulip: in-depth comparison [Internet]. Apr. 25, 2023 [cited 8 Aug 2025]. Available at: https://www.mingosmartfactory.com/mingo-smart-factory-vs-tulip-in-depth-comparison/

[16] G2. Tulip: reviews and product details [Internet]. 2025 [cited Aug. 8, 2025]. Available at: https://www.g2.com/es/products/tulip-interfaces-tulip/reviews

Contribution Roles Table

Role	Author(s)
Conceptualization	Adrián Uriel Mezura Galindo
Data curation	Adrián Uriel Mezura Galindo
Methodology	Teresa Luciano Machorro
Project management	Josefina Porras Aguirre
Resources	Review and editing – Violeta Martínez Ramírez
Software	Adrián Uriel Mezura Galindo
Supervision	Josefina Porras Aguirre
Validation	Adrian Uriel Mezura Galindo
Visualization	Ana María Sosa Pintle
Writing	Original draft – Violeta Martínez Ramírez
Writing	Revision and editing – Violeta Martínez Ramírez