

AGILE PROJECT CONTROL SYSTEM DEVELOPMENT: MODULAR AND ADAPTABLE SOLUTIONS WITH EXCEL AND VBA

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Abstract -- It is proposed to carry out the project "Data Integrity Preservation: Export from SAP BI to Excel with missing file detection, corresponding to Work Package Milestone 1 to 7". This project is essential to ensure compliance with the KPIs of the SAP JPA System, related to Benteler projects in Mexico. Its objective is to ensure the integrity and accuracy of the data, critical aspects for the documentation required in the annual audits.

The lack of a system to validate the veracity of the information has resulted in incomplete documentation, which has negatively impacted the certification of the Projects department, which has not exceeded 60% of the minimum requirements to maintain its Bronze certification in COMPASS. This has highlighted the urgent need for an effective solution.

The execution of this project will bring multiple operational benefits. These include the identification of mandatory documents in SAP JPA for each Work Package, the creation of a responsibilities matrix, the confirmation of corresponding formats and the updating of mandatory documents. In addition, a document progress evaluation system will be established, ensuring a compliance of over 95% on the Gate Review dates.

Data integrity is crucial for information quality. An ERP, such as SAP, allows the automation of processes and centralizes information, facilitating the generation of reports. At Benteler, the correct use of SAP is vital for the development of

projects, ensuring that documentation is always available and up to date.

Therefore, the development of the "Data Integrity Preservation" project is essential to improve the management and control of Sistema BI Mexico. With its implementation, Benteler will be able to have an updated database, respond quickly to management, identify critical points, and facilitate real-time reviews, which will enable compliance with audit requirements and improve operational effectiveness.

Keywords: Integrity, ERP, Excel, system.

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INTRODUCTION

Data integrity essentially refers to the quality and accuracy of the data stored within any computer system. Data integrity implies that the data is correct and consistent and free of inconsistencies considering from accuracy, consistency, maintainability, to completeness. There should be no missing parts that are essential for understanding [1]. Missing data can lead to an erroneous or distorted view of what it really is which can produce unexpected calculations due to poor quality data managed in a database [2].

An ERP (Enterprise Resource Planning System) monitors various internal operations of a business unit, e.g. production, distribution, human resources, etc. [3]. [3]. It automates business processes, making information available in one place, as well as integrating different databases in one place [4]. Also, ERP software generates reports [5] on the state of the company, with the help of BI solutions, allowing to have a more detailed knowledge of the company.

Within Benteler, the use of the SAP system is essential on a basis. All areas work with this ERP. In the project area it is of utmost importance since it contains all the information that serves as documentation used as feedback in the realization of some kind of process within the project that is underway. The company has multiple projects, which documentation must go in hand, therefore, all the time is feeding its information system.

The company is committed to quality in everything they , for this reason they carry out weekly reviews of each project in execution and it is necessary that the

documentation is correctly stored in the place where it is supposed to be; but due to oversight or human error, the ERP is not occupied in the best way, causing a distortion of the data.

In order for Benteler to be able to approve your audits, it is necessary that each phase of each project has the essential information in the place that corresponds to them within SAP JPA.

Currently they have to comply in each evaluation in the administration and control of Sistema BI Mexico Sistema BI Mexico with a percentage higher than 95% on the Gate Review date. But due to incorrect use or non-compliance in general, they are not managing to arrive on time with the review of the information for the audits.

SAP JPA has a function that allows employees to indicate that, in each phase, the Work Package Milestone is covered (documentation of each phase of the project correctly stored), but this is done manually and there is no validation within the system [6] that really allows to verify that the documentation is actually in its respective container, thus, the integrity of the data during the execution of the audits experiences a significant impact.

Therefore, it is essential to develop the **Data Integrity Preservation** project: **Export from SAP BI to Excel with missing file detection, with respect to Work Package Milestone 1 to the**

7 (Project Levels), because, with its correct implementation, Benteler will have the following benefits:

- You will be able to count on an updated database in order to confirm the progress of each project.
- You will have a quick response for Mexico Management and Business Units.
- It will have a system in place to identify the critical points in each project.
- It will allow to indicate the documentation progress of each Gate on time.
- It will provide a real-time review with each responsible person of the missing mandatory documents to integrate into SAP JPA system.
- You will achieve the efficient administration and control of Sistema BI [7] Mexico (Product Development Process / Product Lifecycle Management System).

Overall objective

Detect the inconsistencies that exist in the information collected and stored within the ERP SAP JPA system, with the help of exporting the information in the Microsoft Excel software tool, which will allow organizing and managing the data extracted from the ERP, automating the process.

of detecting inconsistencies in the integrity of the data.

Specific objectives

- Identify key information for concise extraction within the ERP.
- Import the information into the Excel software designated by the company.
- Execute the systematic structuring of the data.
- Prepare the necessary information for the generation of reports and graphs.
- Develop automation processes in the identification of incomplete information.

State of the Art

In sense of preserving the integrity of information in companies, there is the publication in Peru of the project "Implementation of a Business Intelligence model for the exploitation of financial data of the ERP Starsoft system of the company Procesadora Perú S.A.C." which achieved the successful control of data and ensuring the integrity of the information within the company for better analysis and centralization of the same using computational tools such as DataWarehouse with Power Bi. [8]

In the sense of connecting a data source to an ERP system, its synchronization with other tools without losing data consistency, was achieved with excellent results in Spain. The work was published under the title "Proyecto eCommerce con sincronización con ERP", showing that technology offers opportunities to protect company information in different environments. [9] The project called "Risks and controls in ERP implementation projects", confirms that it is relevant to foresee the loss of control over the information that the ERP does not offer 100%, implying the avoidance of operational and financial risks [10].

DEVELOPMENT

The development of this system follows the structure described in the waterfall methodology (Figure 1), widely used to develop software projects, due to its structured and linear approach. This model allows each phase of the project to be completed sequentially, starting with the analysis phase, followed by design, implementation, testing and finally maintenance. The clarity offered by this model facilitates the control of each stage of the project and ensures that the initial requirements are met as requested.



Figure 1. Cascade model process

Throughout this process, technical and functional requirements of the system were implemented based on the needs of the area; from the extraction of data from the ERP system, used in the company to manage projects, to the creation of dynamic reports in Excel, without the need for an integrated development environment (IDE).

Analysis

In the analysis phase, system needs were evaluated, such as the ability to extract data from SAP ERP, identify missing files in large-scale projects, and generate automated reports that would improve response times to management regarding the current status of project documentation.

A detailed requirements gathering was performed covering both technical and functional specifications, ensuring that the system could be easily integrated into existing processes without disrupting the current operation, making use of the tools available to both system developer and the collaborators.

The system design was carried out with a modular approach, which allowed segmenting the solution into functional parts. In this way, each module (Figure 2) works independently to perform specific tasks, from data reading to validation and report creation. This approach allows for easy scalability and maintenance, as each module (Figure 2) can be adjusted or upgraded without negatively impacting the overall system.

Design

The system design was planned to follow a modular approach, where each component has well-defined and delimited responsibilities that complement each other in the use focused on analysis and report generation, which facilitates its maintenance and scalability. A clear structure was defined in which all modules operate independently but interconnected, ensuring efficient and coherent interaction between the different parts of the system.

One of the most notable aspects of the design was the use of Visual Basic for Applications (VBA) for

automate repetitive tasks, thus reducing the manual work previously involved in report generation and data validation. VBA was used to build macros that would allow data to be read, processed, and filtered quickly and efficiently.[11]

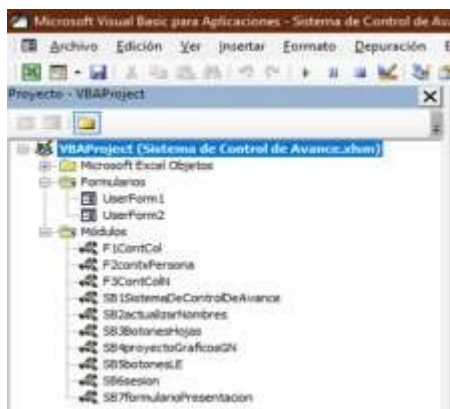


Figure 2. Modules and forms.

This language, integrated directly into Excel, allowed the execution of automated scripts for the integration of the system directly into the Microsoft Office software package. This ensures that the integrity of the information coming from the SAP ERP remains consistent.

The missing file verification modules were designed to automatically run through information matrices, comparing the exported data with the files present in the system, generating alerts when discrepancies were identified.

The design approach focused on maintaining simplicity without compromising functionality. The interfaces were designed so that any user could operate the system without advanced technical training. The integration of VBA and Excel allows this system to be used on any machine running Office, eliminating the need for additional software, dependencies, libraries or licenses.

System Structure

The system is used by users with read permissions as well as those with write permissions, and is supervised by a developer who maintains the integrity of the system (Figure 3).

Main System Modules

1. Generate reports: This module is in charge of generating reports from the data extracted from SAP BI and entered in the system's information matrix.
2. Detect Responsible and Detect Elements: Through these modules, the system automatically identifies the responsible parties and the elements (system documentation) associated with each project. This facilitates the management of tasks according to the progress of the project.

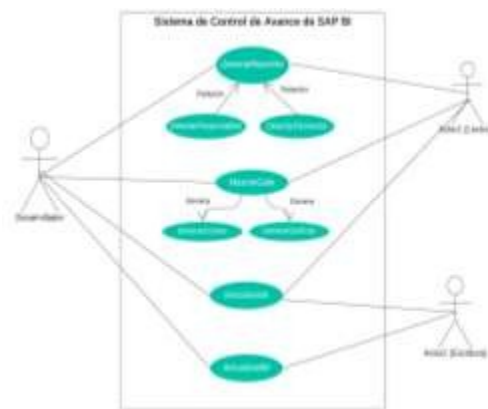


Figure 3. Diagram of use cases.

3. Show Gate: This module is crucial for visualizing the progress of projects, generating graphs that allow users to clearly see the current status of the documentation and its progress.
4. Login: To ensure security and access control, the login module allows users to authenticate themselves, ensuring that only those with the appropriate permissions can access certain system functions.
5. Update DB: This module allows users with write permissions to update the database with new information. Through this process, ensures that the latest and most accurate information is available for reporting and analysis.

Tools

In this system (Figure 4), conventional tools such as Microsoft Excel were selected because of their wide acceptance and familiarity among users, and their ability to handle large volumes of information in an accessible manner. [12]

Excel not only served as a platform for generating reports, but also played a fundamental role as a temporary data repository, facilitating the manipulation and processing of large volumes of information. This choice was key to ensure that the system could be used without requiring intensive technical training or the acquisition of different external add-ons to the resources offered by the company itself, which improved the reception of the software by the end users.



Figure 4. System startup screen.

One of the most important aspects was the integration of macros programmed in VBA (Visual Basic for Applications). These macros were the engine of the system, taking care of automating tasks (Figure 5) such as data processing and consolidation. This not only allowed efficient management of the information exported from SAP BI, but also optimized the time required to process the data. required for reports and reduced the margin of human error. The macros were also designed with a modular architecture, meaning that they could be easily adjusted or modified to suit operational needs without the need for major technical interventions.

The system's ability to automate complex and repetitive processes in seconds not only team performance, but also increases user productivity. By employing tools such as Excel and VBA, a balance was struck between accessibility and efficiency, so that those without advanced technical skills can interact with the system seamlessly.

A key point is that, despite being a solution built on a conventional platform, Excel and VBA offer enough flexibility to adapt to different operating contexts without requiring drastic changes in the technological infrastructure. This flexibility ensures that the system can evolve over time, remaining up to date, without incurring additional licensing or development costs, which reinforces its long-term sustainability.

In addition, the system was designed to be easily scalable. As data volumes grow or business needs change, macros and workflow can be adjusted without the need to reconfigure the system from scratch.

This reinforces the robustness of the solution, demonstrating that, even without an integrated development environment dedicated to software development, it is possible to build a system that offers performance, scalability and adaptability.

The computational contribution of this project goes beyond simple task automation. It stands out for the way in which it combines accessibility and efficiency, offering a system that can be used and

maintained by the users themselves, without the constant intervention of a specialized IT team. This technical independence, coupled with the ease of creating computer systems without the use of an integrated development environment dedicated to software, ensures that the system can continuously evolve to meet the needs of the business without requiring costly or maintenance-intensive solutions.

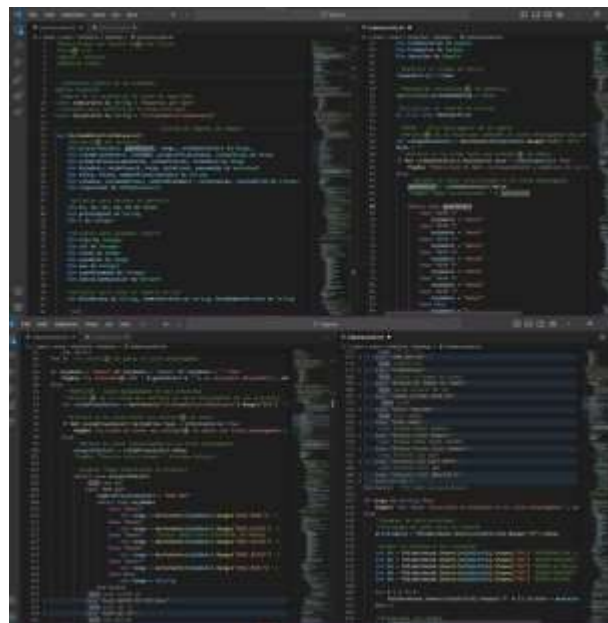


Figure 5. Code fragment of the "Start Advance Control" button.

One of the most outstanding aspects is the fact that the dependence on expensive tools or more complex development solutions was minimized, and instead, a system was implemented that, using a commonly used tool such as Excel, can generate results with a tangible computational impact. This demonstrates that it is not always necessary to resort to an integrated development environment or an advanced programming language to solve complex problems that a company faces with day-to-day project management.

Implementation

During the implementation phase, we worked hand in hand with SAP BI, using the JPA sub-module for the

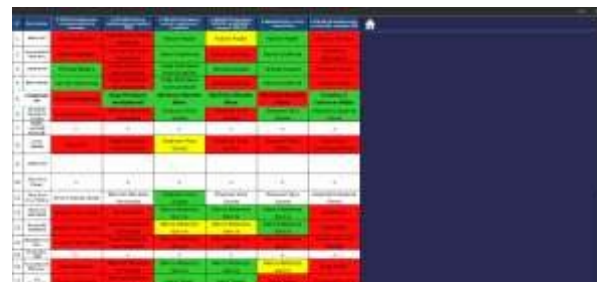


Figure 6. Data matrix

extraction of the data needed to feed the information matrices (Figure 6) in Excel. This step ensures that the data can be easily manipulated by VBA macros. The system's subroutines automate the identification of personnel who have missed deadlines, allowing the generation of graphs that show progress and pending files. Thanks to the modularity of the code, the system is quickly adaptable to different contexts and needs.



Figure 7. Example of the graphical analysis of Gate4.

The system includes specific forms (Figure 8) to manage users, where the privilege level of each user is identified. This ensures that only authorized users access critical functions such as generating reports or updating the database. In addition, there is another form for viewing development credits, facilitating the maintenance and understanding of the system for future developers.



Figure 8. Login form.

Overall, the forms and the rest of the system offer an intuitive interface, optimizing the user experience and reducing the risk of operational errors. In addition to programming subroutines, macros and generating reports, the system has native functions of the software in which it is developed.

Among the native tools available in Excel, which were highly useful for the development of the project, we find the functions predefined by the spreadsheet to perform mathematical and logical operations; the use of native elements helps to focus on the development of the logic for programming subroutines and macros using the results previously calculated with these tools.

In addition, with the functionalities offered by Excel, it was possible to create a system highly adaptable to users who are familiar with this software, implementing the use of sheet manipulation and management functions, such as hiding or showing sheets, protecting cells, linking images, inserting graphics, adding buttons, formatting cells, changing the layout or customizing the user interface, to make the system (Figure 9) flow like any other developed in more robust development environments.

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Figure 9. Main screen of the system as administrator user.

Verification

The testing process was of great importance to ensure that the system responded appropriately as proposed in the analysis and design phases. Both internal and external tests were carried out with non-specialized users (Figure 10), which made it possible to identify minor errors and make adjustments to the code to improve its performance and eliminate minor compilation errors. Each module was subjected to specific tests to verify its correct operation, ensuring that the macros and subroutines operated as expected.

The system's ability to be tested and adjusted quickly allowed testing to be carried out directly in Excel in real time, on any computer within the company.

Thanks to the modular design of the code, changes made to one module did not affect the overall functionality, allowing for agile evolution of the system according to user needs, without requiring significant rewrites or migrations to new development environments.

Maintenance

One of the most important aspects of the system is the design, which is intended to work within a variety of computers that have only Excel spreadsheet software pre-installed; this approach allows maintenance and modifications to be performed by any team member with basic knowledge of Excel and VBA, a widely used and understood technology, ensuring that the project can evolve even if the lead developer leaves the company.

The weekly use of the system in management meetings project monitoring enables the quick identification of areas of opportunity, feeding in new features or requested improvements.

The use of the management system, by providing weekly maintenance, allows identifying errors to be corrected in a way that does not impact the management of the system. At the end of each iteration of maintenance and implementation, it is highly recommended to document all modifications made, thus maintaining a detailed control of the development and ensuring the long-term integrity of the system.

DISCUSSION AND ANALYSIS OF RESULTS

The development of the project showed that the use of conventional tools such as Microsoft Excel and VBA did not represent an impediment to achieve the objectives set. In spite of the limitation of using spreadsheets as the main tool, the developed system complied with import, processing,

analysis and presentation of data stored in SAP BI, preserving the integrity of the information in an effective manner, the system provided a solid solution that optimized the control and monitoring of progress in the different projects. The automation of the detection of missing files and notification of missed deadlines improved operational efficiency, obtaining positive results within the company's semi-annual audits. In addition, the system's modular design allowed it to be quickly adapted to different contexts without compromising its functionality or accuracy. The reports generated and presented graphically facilitated a clear and accessible understanding of key information, minimizing errors and accelerating the decision-making process.

The impact of this system can be seen in its ability to optimize time, reduce inefficiencies and ensure that resources are used more effectively. The tool simplified the visualization and analysis of data, improving the responsiveness of the areas involved and allowing managers to focus on the critical aspects of each project.

Throughout the development, it was proven that it is not necessary to rely on specialized development environments or complex tools to create a computer system that is efficient, flexible and accessible. The combination of macros, subroutines and native Excel functions allowed meeting operational needs while maintaining simplicity and accessibility for end users, as demonstrated in post-deployment surveys.

This system is a clear example of how an efficient IT system can be developed without relying on expensive tools or specialized development environments. The use of Excel and VBA made it possible to implement a flexible and maintainable solution that is relevant, while facilitating the rapid generation of reports and ensuring the integrity of the data extracted from SAP BI.

The key to success lies in the simplicity and modularity of the tools used, which allowed rapid implementation and real-time adjustments without the need for a complex environment. This demonstrates that it is possible to create technological solutions with the intelligent combination of conventional tools, optimizing resources and adapting to the changing needs and delimitations of an operation without compromising the efficiency of the system.

In order to measure the level of performance of this project when implemented within the company with the new computer functionalities, the following graphs show the scope measurements perceived by the users.

In the case of overall experience in its performance, it obtained a 4.2 out of 5 points with respect to the previous system. See image 1.



Image 1. General experience of the system.

About the level of performance measured in units of time and yield, it is located at 4.3 out of a maximum of 5.



Performance level: time and yield.

Regarding future updates, their measurement is not conducive to immediate updates at this time. See image 3.



Image 3. Level of requirement for upgrades.

Discussion

According to the research published in Peru under the name "Cost-benefit analysis of the implementation of an ERP locally versus an ERP in the cloud - case study SAP r3 vs SAP Bydesing in the city of Quito" allows to identify the advantages of implementing ERPs on-site or in the cloud, or a combination of both to obtain a hybrid. The choice of one of them is

will be more inclined to rely on the security, higher quality and real-time access to information provided by the cloud. [13]

Or apply open source (OSS) for an ERP chosen from the beginning ensuring the elimination of the cost of license fees in the company, when it comes to small and medium enterprises that must limit their investments, as was previously analyzed for its implementation in the project in Catalonia Spain called "Selection and implementation of an open source ERP system". Once the study was completed, a version of open source ERP in the Cloud was chosen.[14].

Excel is a powerful tool that manages a very large volume of information, however, there are different better and more compatible solutions not used for the same purpose as those investigated in the project "Implementation of ERP systems, their impact on the management of the company and integration with other ICT" and not all companies exploit all the functions of an ERP to the maximum, there are modules of low level of transactions.[15] The following table shows the results of this research.

CONCLUSIONS

Throughout the development of the project <<Data Integrity Preservation: Export from SAP BI to Excel with missing file detection, with respect to Work Package Milestone 1 to 7 (Project Levels)>>, the delimitation of the use of as the main tool for the resolution of the initially planted problematic, did not turn out to be a significant impediment to create a system that would allow the fulfillment of the outlined goals. In essence, these topics focus on the integral management of information, addressing its extraction, processing and presentation design of data stored in the ERP SAP BI system, thus guaranteeing the integrity of the data. These specifications allowed the creation of an integral system in Microsoft Excel software through programming with the VBA language (Visual Basic by Application). This approach proved to be effective and aligned with the project objectives, providing a solid and efficient solution for the preservation of data integrity in the defined context.

The Progress Control System in SAP BI marks a before and after in the Projects area, particularly in COMPASS internal audits. The development of this system allows a more rigorous control capable of detecting and notifying the parties involved about the current status of each of the projects in each of its phases (Gates). In this way, it seeks to streamline and disseminate this information to employees in order to identify the departments that require greater attention.

The ERP software currently implemented demonstrates a robust system, however, it is compromised by an unintuitive user interface and long loading times. In addition, the use of rudimentary tools and the lack of knowledge for its efficient operation generate inefficiencies that translate into a waste of resources for the company, negatively impacting its overall productivity.

The Progress Control System seeks to automate this entire process in an efficient manner by reducing the time associated with data consultation, collection and analysis.

It also foresees possible scanning errors, presenting such data in a graphical way and easily visible at a glance with reports in PDF files, which are user-friendly and just a click away. Simultaneously, the response time for the general management is optimized by identifying and addressing the most vulnerable points of the company.

The application of such a system will result in significant time savings that can be translated into higher value-added activities.

Future research will involve extending compute activity to move complex data and processes to cloud environments, which are on the rise due to their ability to deliver immediate efficiencies and better data management. "An appropriate data architecture that can support on-premises, cloud and hybrid solutions will help control costs, whether it is licensing, storage, data integration or bandwidth," stated Power Data[16].

In the same sense, another research to be addressed will be the inclusion of the same ERP Clouding version, which reduces all those manuals still present in this system based on spreadsheets up to 70%, through the use of a back office system that includes finance, compliance, inventory and sales. With this, excessive spreadsheets and the space occupied by them can be eliminated. [17]

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