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Automated Report Mailer for Industrial Production Monitoring Using Genesis Workbench and Microsoft SQL Server

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Abstract: *Data in discrete manufacturing environments are constantly generated and stored in centralised database servers, but the reports derived from this data are typically created manually. The manual process of extracting, formatting and sending production reports via e-mails is time-consuming, error-prone and makes data available to supervisors later than necessary. In this paper, we present an automated report mailing application that integrates a Microsoft SQL Server production database, Genesis Workbench reporting engine and SMTP services to deliver asset status reports automatically without manual work required. The two stored procedures Storedprocedure A and Stored procedure B encapsulate the query and filtering functionality for the related assets, plants and lines; Genesis Workbench converts the results into a pre-designed report and sends it as an e-mail attachment to designated recipients. The system has been tested using actual plant data at an automotive manufacturing facility and successfully demonstrated connectivity and accuracy of data extraction as well as reliability of delivery of e-mails. It allowed to decrease the report processing cycle time from about 28 minutes to less than 3 minutes and completely eliminate manual entry errors.*

Keywords: Automated reporting; Manufacturing execution; Genesis Workbench; SQL Server; Stored procedures; SMTP; Industry 4.0

1. INTRODUCTION

Manufacturing facilities create huge amounts of data relating to their activities and assets, which are recorded into relational databases in real-time. Transforming raw data into reports is important in order to monitor the state of machines and the productivity of their use. In most factories, this task is still performed manually – the operator queries the database, extracts its results to the document, formats it, and sends the document via email to the recipient list. When reports are needed per every shift or even for different people, the manual process is time consuming and error-prone, and therefore the information arrives late.

The aim of this research is to automate this procedure and implement a report mailer system which can fetch data from the live Microsoft SQL Server Database, create a structured report using the Genesis Workbench platform and automatically send out the report via email. As the report will be generated on-demand from the live database, it will always contain the up-to-date information on the current production status. The three contributions of this study are: (i) the layered approach for modeling the system involving database, report engine and mail services; (ii) the two stored procedures which are used to retrieve and filter connection status of the asset records; and (iii) the empirical evaluation on the live plant data of an automobile manufacturing company.

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II. REVIEW OF LITERATURE

Automated industrial reporting sits at the intersection of manufacturing information systems (MIS), real-time data acquisition (DAQ) and process automation (PA). The following review groups fifty-two recent studies, predominantly from Elsevier journals, around the themes most relevant to this work.

Manufacturing execution systems (MES) form the software layer that records production history and feeds management reporting. Reviews of next-generation and intelligent MES trace their evolution toward Industry 4.0-ready, interoperable architectures (Shojaeinasab et al.; Mantravadi and Møller) and highlight the challenge of vertically integrating shop-floor data to higher levels of management (Jaskó et al.; Tabim et al.; Eichelberger et al.). Below MES level, the supervisory control and data acquisition (SCADA) systems and programmable controllers obtain the real-time signals that feed the database; contemporary reviews discuss SCADA architecture and condition monitoring applications (Yadav and Paul; Gnana Swathika et al.; S. Wang et al.; Chavhan et al.). In view of the fact that the reporting pipeline establishes an open access to live plant data, the corresponding security literature is highly pertinent: the studies on industrial control system cybersecurity and intrusion detection focus on access authentication and least privilege approach to data (Bhamare et al.; Rubio et al.; Nazir et al.; Knowles et al.; Khadidos et al.; d'Aambrosio et al.; Mubarak et al.).

IIoT extends this data layer, linking sensors and assets to produce live streams for monitoring and decision support purposes, where enabling technology literature indicates high efficiency gains along with integration, interoperability and data quality issues (Ahmed et al.; Khan et al.; Afrin et al.; Ullah et al.; Javaid et al.; Qi et al.; "Internet of Production"). Digital twin research takes the same live data to represent assets in a virtual world to monitor, predict and optimize (Ding et al.; Li et al.; Soori et al.; Leng et al.) by various use cases such as energy management, predictive maintenance, and asset optimization (Billey and Wuest; Feng et al.; Liu et al.). Big data analysis and machine learning-driven predictive maintenance turn the historical and live data into predictive failure models and maintenance scheduling (J. Wang et al.; Shukla et al.; Cui et al.) through systematic reviews that point out that data acquisition and preparation are foundational phases (Zonta et al.; Hassan et al.; Mallioris et al.; Sajid et al.).

Process automation, especially robotic process automation (RPA), solves the same problem of manual effort through a workflow approach in which software agents are employed to perform repetitive and rule-based activities such as order processing and reporting, achieving improved accuracy and speed with little cost for integration (Krzywy et al.; Shamsuzzoha and Pelkonen; Moreira et al.).Enterprise reporting also depends on data integration; studies on ERP modernisation, cloud and edge deployment, and big-data/cloud integration in manufacturing examine how transactional data is consolidated and surfaced for decision-making (Saraswat and Choudhari; Mossa et al.; "Cloud- and Edge-Based ERP Systems"; "Exploring ERP Systems Adoption"). For the report content itself, overall equipment effectiveness (OEE) and standardised key performance indicators are widely used to quantify availability, performance and quality; recent work develops data-driven and energy-aware OEE models and stresses the need for accurate, real-time performance data ("Advanced Energy Data Analytics"; "Green Overall Equipment Effectiveness"; "Development and Validation of an Overall Equipment Efficiency"; "Overall Equipment Effectiveness: Consistency of ISO"). Finally, business-intelligence and dashboard research shows that data only creates value when delivered in a form decision-makers can absorb ("Business Intelligence and Cognitive Loads"), while the emerging Industry 5.0 and human-centric literature reframes automation as augmenting rather than replacing human operators ("Towards New-Generation Human-Centric Smart Manufacturing"; "AI-Driven Optimization Techniques"; "Human-Centric Artificial Intelligence towards Industry 5.0").

Across these themes the recurring message is that the value of industrial data depends on its timely, accurate delivery to the right people. Much of the reviewed work targets advanced analytics or twin models; comparatively little addresses the practical "last mile" of automatically generating and distributing routine production reports from a live database. This is the gap the present paper addresses with a lightweight, deployable solution.

III. SYSTEM MODEL AND ARCHITECTURE

The system is organised as three cooperating layers (Fig. 1). The data layer is a Microsoft SQL Server database that stores asset, plant, line and status records populated from shop-floor PLC/SCADA sources; SQL Server Management Studio (SSMS) is used for administration and validation. The processing and reporting layer comprises the SQL stored procedures and the Genesis Workbench report engine, which opens a secure connection to the database, executes the procedures, and maps the returned rows to a formatted report template. The distribution layer is an SMTP e-mail service that attaches the generated report and delivers it to a predefined recipient list.

This separation keeps the database, report logic and delivery concerns loosely coupled, so recipients, templates or queries can be changed independently. Data flows in a single direction from database to stored procedures to Genesis Workbench to SMTP to recipients, which simplifies reasoning about correctness and makes the pipeline straightforward to schedule and audit.

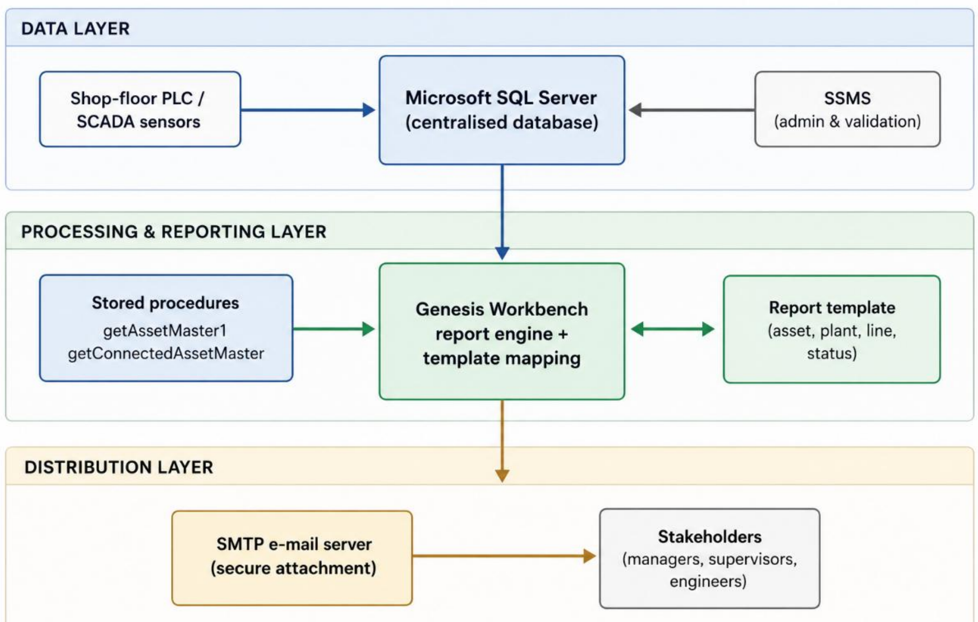

Fig. 1. Three-layer model of the automated report mailer, from the SQL Server data layer through the Genesis Workbench reporting layer to the SMTP distribution layer.

IV. METHODOLOGY

The development process involved a total of seven steps in sequence (Fig. 2). First step comprised analysing the requirements to determine the report scope i.e. what attributes, assets and recipients are required. In the second step, the database design and relationship between the asset, plant and line table were determined. Thirdly, the logic behind retrieval was implemented through stored procedures and tested in SSMS based on existing records. The fourth step entailed setting up a secure connection from Genesis Workbench to SQL Server. In the fifth step, the output of the procedure was mapped into a report template with proper headings and columns. In the sixth step, the SMTP mailer was set up with server configurations, subject, message body and recipient addresses. Finally, the entire process was tested and validated with real data, where the discrepancies were resolved in the query and templates steps until the output was right.

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Having the logic contained in stored procedures rather than embedded in SQL in the application will help in improving performance, security, and maintainability and will allow for testing of the database logic independent of the reporting tool.

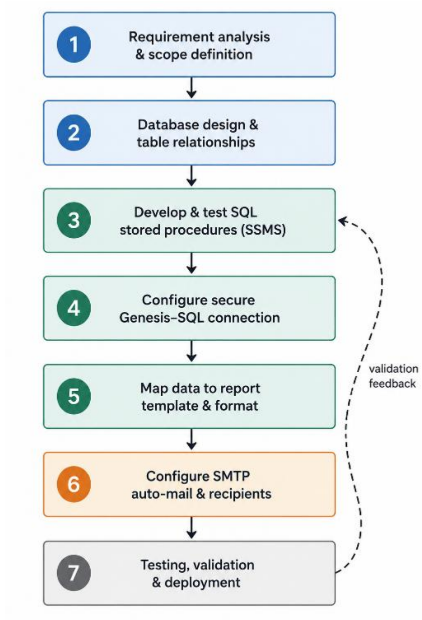

Fig. 2. Seven-stage development methodology with a validation feedback loop from testing back to the query and template stages.

V. SYSTEM IMPLEMENTATION

5.1 Technology stack

Software components with their descriptions are given in Table 1 below. Each has been chosen because of its natural suitability: SQL Server for data storage and performance query, SSMS for development and testing, stored procedures for logic implementation, Genesis Workbench for connectivity and report creation, and SMTP for sending messages.

Table 1. Technology stack and the role of each component.

Component	Role
MS SQL Server	Centralised store of asset, plant, line and status data
SSMS	Develop, test and validate database objects/queries
Stored procedures	Encapsulate retrieval and status filtering
Genesis Workbench	Connect, run procedures, format report, trigger mail
SMTP server	Deliver the report as an attachment to recipients

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5.2 Database design

Production data is normalized between all associated tables (see Fig. 3). The table MPAS_ASSET_MASTER contains the asset number, asset name, plant ID, line ID and its connection status; USER_CONFIG_PLANT and USER_CONFIG_LINE contain plant and line descriptions respectively. There are foreign and primary keys which connect assets to their respective plant and line, so that one query could give the readable plant and line description for all assets without duplication. The schema is extendable since new fields or even tables may be added later on..

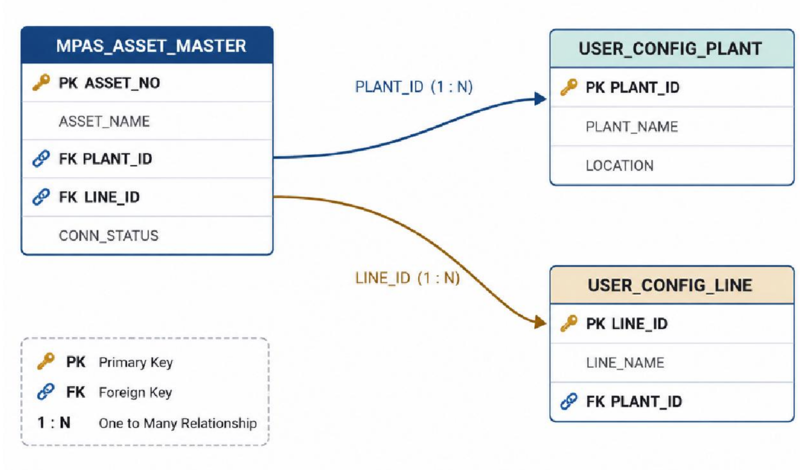

Fig. 3. Entity–relationship schema linking the asset master to the plant and line configuration tables through foreign keys.

5.3 SQL implementation

Two procedures embody the logic (Table 2). The procedure Storedprocedure A combines the asset, plant, and line tables to return the complete asset master with names and properties resolved. The procedure Stored procedure B filters out the connection status to ensure that only connected assets are listed in the report. Both were developed and tested in SSMS before incorporating them into Genesis Workbench..

Table 2. Stored procedures and their functions.

Procedure	Function	Key operation
Storedprocedure A	Full asset master	JOIN asset–plant–line; resolve names
Stored procedure B	Active assets only	Filter on connection status

5.4 Genesis Workbench configuration

Having connected to and tested the database, the two functions were bound to the report layout; the returned column was mapped to the template fields asset, plant, line and status. Then the email function was set up with the SMTP server parameters, fixed subject and body content, and recipients list, so that on completion of report generation the file is attached and sent automatically.

VI. RUNTIME WORKFLOW

During execution, the pipeline operates in a strict sequence (see Fig. 4). The trigger either manually or automatically initiates the process; Genesis Workbench connects to the database securely, and the stored procedures get executed.

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The database then returns the present asset records, with Stored procedure B for removing disconnected assets; the data is structured in accordance with the report template; the report is then attached and sent via the SMTP server; and finally reaches the recipient's mail box. As the process accesses the live database at every execution, every report is an updated one reflecting the production status. The entire process is automated with no human intervention..

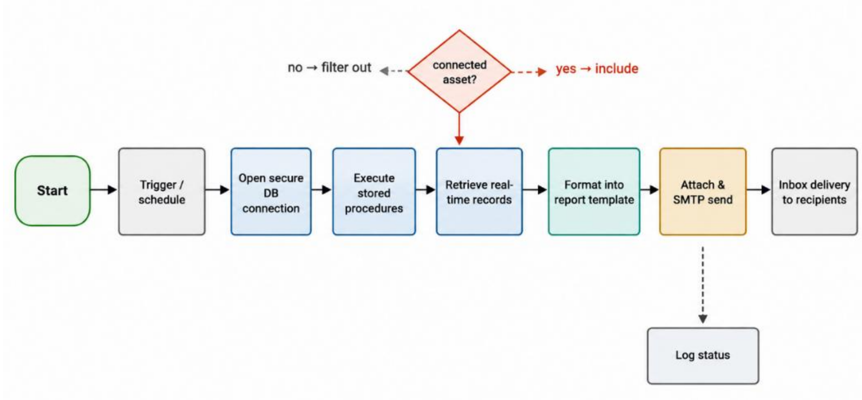

Fig. 4. Runtime data-flow of a single reporting cycle, including the connection-status decision that filters inactive assets.

VII. RESULTS AND DISCUSSION

Evaluation was performed using actual plant data. Each individual step and the entire process flow was assessed separately (Table 3). There was successful establishment of connection from Genesis Workbench to SQL Server; there was consistency between the results from stored procedures and database; report produced had correct fields and formatting; and the report sent through e-mail had proper attachments to all intended recipients..

Table 3. Summary of test cases and outcomes.

Test	Objective	Result
DB connection	Verify Genesis–SQL connectivity	Pass
Stored procedures	Validate records against SSMS	Pass
Report generation	Check fields and formatting	Pass
Automatic e-mail	Confirm attachment and delivery	Pass

The primary advantage is the enormous savings in time and latency. As shown in Fig. 5 and Table 4, the manual procedure took about 28 minutes per report, mainly due to data extraction and formatting; the automated procedure takes less than 3 minutes and doesn't need any operator intervention at all. Transcription errors disappeared since there is a direct data path from database to report, and reporting became reliable since it was scheduled rather than operator-dependent. Reports also became more up-to-date, as they reflected the current state of the database at the time of report sending.

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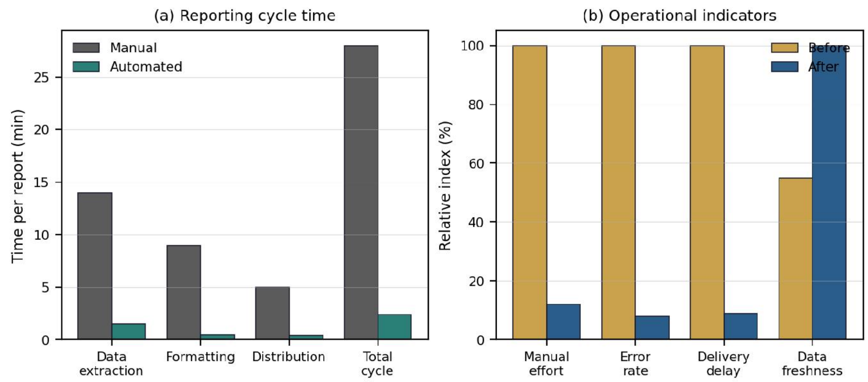

Fig. 5. Impact of automation: (a) reporting cycle time per stage; (b) relative operational indicators before and after deployment.

Table 4. Comparison of the manual and automated reporting processes.

Aspect	Manual	Automated
Cycle time / report	~28 min	< 3 min
Operator effort	High	None (unattended)
Transcription errors	Possible	Eliminated
Data freshness	At compile time	At send time (live)
Delivery consistency	Staff-dependent	Scheduled

Such results coincide with the existing literature on the topic of process automation and MES reporting (Tabim et al.; Shojaeinasab et al.; Krzywy et al.) and provide similar improvements in terms of accuracy and cycle time. The system in question is purposely light-weight and uses existing infrastructure and stored procedure-based logic so that its cost of implementation and maintenance is lower compared to full-fledged analytics or digital twin solutions (Ding et al.; J. Wang et al.). The main drawbacks of the solution are that reports are generated on a template basis and sent via e-mail and evaluation performed at one deployment only.

VIII. CONCLUSION AND FUTURE WORK

This paper proposed a system for automatic mail distribution of reports using a Microsoft SQL Server database, the Genesis Workbench reporting system, and SMTP service to create and send out reports automatically. Data retrieval and filtering were done by two stored procedures. Data validation on live plant data showed correctness of reports and successful delivery with reducing the average time for each report from approximately 28 minutes to below 3 minutes, eliminating manual mistakes in the process. The design of the system is cost-efficient, flexible, and easy to adapt. Further work will consist of scheduled distribution of multiple reports, parameterized and dashboard-like outputs, delivery methods beyond email and multi-plant validation of reports in order to create a reporting service based on Industry 4.0 and Human-centered Industry 5.0 principles..

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