Design and Implementation of a Manufacturing Information System
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Abstract. The purpose of this project was to design an information system for Linamar CAMTAC that would record information from an industrial machine. The information is generated by Programmable Logic Controllers (PLC), extracted by a utility called RSSQL and stored into a Structured Query Language (SQL) Database Server. Reports would then be generated using the database. A simple three table design for the database was proposed and implemented. The database design was implemented successfully and was tested thoroughly using simulated data. The end result is a successful partial implementation of the overall information system.

Key words: PLC, SQL Database Server, RS Bizware, RSSQL, CAMTAC

1 Introduction and Background
CAMTAC is a manufacturing plant owned by the Linamar Corporation, a large manufacturer of metallic components for the automotive industry. The purpose of this project was to design and deploy an Information System capable of tracking events within a manufacturing process at the CAMTAC plant [1].

The system is designed to extract PLC event information from the process using software called RSSQL, which is designed to store all fault bits generated by the machine. The events are stored in an SQL database. Reports can be exported from the SQL database to Microsoft Excel and the database has also been designed for functionality with RSBizWare. The purpose of RSBizware is to assist manufacturers in increasing production, reducing costs and increasing quality through the generation of reports based on analysis of data gathered by RSSQL [3]. A conceptual model of this system is shown in Figure 1.

The system which was designed, developed and implemented met all of the criteria and constraints of the project. It is an efficient solution with the ability to be expanded to encompass other machines when desired.

2 Method
Design of the CAMTAC information system began with a thorough analysis of the presented specifications for the project in order to create a generalized model of the system. This was then expanded into a list of criteria and constraints which are listed in Table 1.

![Conceptual Model of the System](image-url)

Table 1. Criteria and Constraints

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Constraints</th>
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<tbody>
<tr>
<td>Make all aspects of the system as user friendly as possible</td>
<td>Develop a system that uses existing hardware and software</td>
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<tr>
<td>Focus on scalability to allow for future expansion</td>
<td>Implement the system using the hardware and software supplied by CAMTAC</td>
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<tr>
<td>Ensure the system and its results maintain a high level of reliability</td>
<td>Minimize downtime by making the project development as unobtrusive as possible</td>
</tr>
<tr>
<td>Minimize maintenance so that CAMTAC employees will not need to modify the system</td>
<td>The project must be completed by April 4th 2008</td>
</tr>
</tbody>
</table>

After compiling the criteria and constraints it was possible to expand on them in order to create a measurable list of functional requirements.

2.1 Functional Requirements
- The database must be capable of storing all desired events from the RSSQL software
- Events are stored with their beginning and ending date and time
- The system must display the duration and quantity of each event over a specified time span
- The system must be capable of differentiating error bits between machines based on serial number
- The database must be able to assign a managers name to each machine in the system
- Data must be exportable to Excel for analysis and report generation
3 System Modelling

Through iterations of the preliminary design a final database schema was created. A model of the schema can be seen in Figure 2.

Fig. 2. Conceptual model of the implemented database.

These are the conceptual tables of data within the database. The titles inside these tables are represented by the columns inside the physical tables, which are also known as attributes. The attributes within each table are the descriptors and column headings of the data [2].

As can be seen from Figure 2 the concepts of primary keys, foreign keys and unique indexes were used to design the database. The model shows that the tables in the database are connected through the SNumber attribute and the AddressBit attribute. More on these concepts can be read in other database literature [2].

4 Results

Once the schema had been implemented in SQL the tables could be filled with information. For this project sample data was used to fill the tables for testing the implementation. This data was then passed through a query that formatted the data to present the number of times each event occurs, the total downtime caused by each event and the average downtime when each event occurs.

Once a query has generated the desired information the tables can be exported into a familiar format for analysis, such as Microsoft Excel. Figure 3 displays an analysis performed by Excel highlighting the event bits, by machine, which produce the longest average downtime as well as their contribution to the total percentage of downtime experienced by the line.

5 Discussion

At the moment, Linamar is interested in tracking only one automated machine. However as mentioned earlier the system designed is very scalable. The possibility of expanding this system beyond machines is also available. The system can rapidly be configured to allow for other information to be stored and reported via RSBizWare or some other utility.

6 Conclusion

The information system deployed satisfies the requirements of the customer and is viable solution to the problem presented by CAMTAC and Blue Sky Consulting. The design process ensured that the clients requirements were carefully examined and that the objectives of the design were met.

References