

# Automated Invoice Processing using Low-Code Technologies

## A Case-Study and App Development

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### Abstract

This master thesis describes a collaborative project with a medical insurance organization aimed at improving its outdated invoice management process. Traditionally, customers had to submit their invoices in person or by mail, resulting in long delays of 3 to 4 months before reimbursements were processed. The early sections of the thesis provide a clear introduction and explore the organizational context, highlighting the inefficiencies of the existing processes.

The focus then shifts to explaining the Power Platform technology and the tools used to develop the new solution. This solution includes two Power Apps applications: a mobile app for customers to submit invoices digitally, and a desktop app to help employees process invoices more efficiently. A Power Automate flow, enhanced with AI Builder, automates the extraction of data from the invoices, changing the role of employees from entering data manually to simply checking that the data extracted by the system is correct.

The thesis demonstrates the improvements brought by the new system using a sample invoice and evaluates the new process in comparison to the old one. The mobile app makes it easier for customers to submit invoices, contributing to a better experience and a quicker start to the reimbursement process. The automated data extraction and validation processes save time, reduce errors, and allow employees to focus on more important tasks. In conclusion, the project significantly reduces processing times and improves the experience for customers, setting a new standard for efficiency in the insurance organization.

**Keywords:** Invoice Management, Process Automation, Power Platform, Digital Transformation

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### 1. Introduction

The increasing complexity of the medical insurance sector has necessitated a transition towards more efficient management of medical invoices, which is critical for maintaining high levels of customer satisfaction. The manual process of circulating physical invoices for data validation within the medical insurance organization presented a significant opportunity for innovation and process optimization. This master thesis delves into this challenge, aiming to enhance the

organizations' operational efficiency through a comprehensive analysis of the existing medical invoice management process. By documenting current workflows, identifying bottlenecks, and pinpointing areas for automation, the thesis lays the groundwork for a transition from traditional, manual processes to streamlined, automated workflows. The development of two low-code app prototypes to automate key aspects of invoice submission and validation further demonstrates the potential benefits of this modernization, acting as a tangible proof of concept into how the

organization can integrate automation in the near future.

## **2. Organizational Context**

### **2.1. The Organization**

A medical insurance provider with around 100,000 customers is at the center of discussion. The entity operates by providing cost reductions on medical procedures to its clients, a common practice in the medical insurance sector. The benefits, predominantly in the form of cost reductions, are accessible through two main avenues:

**Preferred Providers:** Customers choosing from a network of affiliated medical providers experience instant benefit processing due to pre-existing agreements between the provider and the insurer.

**Non-Preferred Providers:** Customers opting for medical services outside of the affiliated network need to pay upfront and later submit invoices for reimbursement, subject to the company's policy conditions.

The main purpose of this master thesis is to tackle the problem of the invoice management related with Non-Preferred Providers, which amount, on average, to 200,000 invoices per year.

### **2.2. Current Invoice Process**

The invoice processing system involves several steps:

**Invoice Arrival:** Customers submit their invoices either in person at company locations or via mail, with no digital submission option available.

**Invoice Data Extraction:** Employees manually input various data points from the invoices into an old desktop application, a process that is time-consuming and prone to errors.

**Invoice Verification:** A second employee checks the data entry to correct any potential errors, introducing a possible delay.

**Invoice Reimbursement Calculation:** The company calculates the reimbursement amount for each invoice, a process that varies in complexity.

**Invoice Payout:** Finally, the reimbursement amount is transferred to the customer's bank account.

### **2.3. Challenges**

The system has several inefficiencies and challenges:

**Outdated Physical Processes:** The reliance on physical submissions and outdated systems hampers efficiency.

**Manual Data Entry:** The labor-intensive and error-prone data extraction process is a significant bottleneck.

**Variability in Invoices:** The diversity in invoice formats from different providers complicates data extraction and verification.

**Verification Bottlenecks:** The necessary secondary verification can cause delays, especially during busy times.

**Complex Reimbursement Calculations:** Calculating reimbursements can be intricate, particularly for complex invoices or when tracking customer-specific limits.

**Customer Experience:** The lengthy processing times and need for physical submissions can lead to customer dissatisfaction.

Addressing these challenges is vital, paving the way for the transformative solution detailed in the following chapters.

### **2.4. Organizational Impact**

Resolving these issues offers substantial organizational benefits:

**Operational Efficiency:** Moving to digital submissions and automated data extraction will streamline the process, enhancing efficiency.

**Cost Reduction:** Less need for manual data entry and verification will lead to significant cost savings.

**Data Accuracy and Compliance:** Improved data accuracy and adherence to compliance standards will reduce the risk of errors and potential legal issues.

**Enhanced Customer Experience:** Quicker processing times and the convenience of

digital submissions will improve customer satisfaction and loyalty.

**Adaptability and Scalability:** The system will become more flexible and scalable, better accommodating the variety in invoice formats from different providers.

Updating the outdated invoice processing system is thus crucial for achieving operational efficiency, cost-effectiveness, and enhanced customer satisfaction, underscoring the need for the technological advancements discussed in the next section.

### **3. Process Automation**

#### **3.1. Introduction**

Today's fast-paced business world highlights process automation as a key factor in transforming organizations, particularly noticeable in the realm of medical insurance where processing customer medical invoices is a daily, essential task (Jämsä-Jounela, 2007). Process automation applies technology strategically to streamline and enhance the efficiency of repetitive tasks. This transition from manual, labor-intensive methods to a more flexible and responsive operational structure is crucial for managing the large and complex nature of medical invoices. Automating the invoice process ensures accuracy, quicker processing times, and reduced operational costs, benefiting the medical insurance sector (Lima et al., 2021).

Key technologies in this field include Robotic Process Automation (RPA), workflow automation platforms, API integrations, artificial intelligence (AI), and machine learning (Desai et al., 2021). RPA, for example, is used for data entry and initial validation in invoice processing. Workflow automation platforms and APIs are crucial for tasks requiring cloud-based services and intricate data flows. This adoption not only improves operations but also brings numerous advantages such as eliminating errors, increasing scalability and agility, and keeping insurance organizations competitive. Essentially, incorporating process automation is a strategic necessity, ensuring long-term success and innovation in the competitive business landscape, especially for a medical insurance organization dealing with numerous customer invoices (Sobczak, 2021).

#### **3.2. Robotic Process Automation (RPA)**

RPA is a transformative technology, particularly impactful in the insurance sector, enhancing efficiency and accuracy in customer invoice processing (Tarquini, 2018). It employs software robots to perform repetitive tasks, interacting with digital systems in a human-like manner to perform data entry, extraction, and process execution. RPA operates on predefined rules and workflows, making it adaptable and suitable for various sectors that deal with repetitive and high-volume tasks. In insurance, it changes how customer invoices are processed, speeding up the process and reducing errors (Zhang & Wen, 2021). However, it has limitations, particularly in environments requiring human judgment, which is where AI and machine learning integration becomes beneficial.

#### **3.3. Other Variants of Process Automation**

While RPA focuses on mimicking human interactions with desktop applications, other automation forms like workflow automation platforms and API integrations are becoming more prevalent, extending automation capabilities to include cloud services. These tools, such as Zapier or Microsoft Power Automate, offer automation solutions not solely reliant on UI-based interactions. They facilitate direct data exchanges between different systems, which is useful in insurance where customer data and invoice details might be spread across various systems. Combining these automation forms results in optimal outcomes (Chakraborti et al., 2020).

#### **3.4. Artificial Intelligence (AI) in Process Automation**

Integrating AI into process automation significantly expands traditional solutions like RPA, introducing context understanding, decision-making, and learning capabilities for handling more complex tasks (Chakraborti et al., 2020). In insurance, AI in process automation transforms how customer medical invoices are processed, streamlining the process and reducing reliance on manual data entry. This adaptation not only improves operational effectiveness but also enhances

the customer experience, making processes faster and more reliable.

### **3.5. Benefits and Challenges**

Combining RPA, workflow automation, API integrations, and AI presents immense opportunities for enhancing organizational operations, with each technology bringing unique advantages. However, this integration also comes with its set of challenges (Gotthardt et al., 2020). Benefits include improved data analysis, predictive capabilities, adaptability, enhanced customer experience, and interoperability. Challenges involve implementation complexities, data privacy concerns, high upfront costs, potential algorithmic biases, technical debt, dependence on data quality, and standardization issues.

In summary, the integration of RPA and AI in process automation is a significant step forward, providing numerous benefits but also presenting challenges that organizations need to carefully navigate.

## **4. Power Platform**

### **4.1. Introduction**

Microsoft Power Platform is an extensive suite including Power BI, Power Apps, Power Automate, and Power Virtual Agents, designed for automation, data analysis, and app development in a low-code environment. The chapter focuses on its capabilities in RPA, AI integration via AI Builder, and app development with Power Apps.

### **4.2. Power Automate**

Power Automate enables workflow automation across Microsoft and third-party services, surpassing traditional RPA with its low-code, user-friendly approach. It includes both desktop-based RPA and cloud-based API workflow automation, allowing for complex task automation. Workflows consist of triggers and actions, streamlining operations and improving efficiency.

### **4.3. AI Builder**

AI Builder enhances the Power Platform with artificial intelligence, offering pre-built and customizable models for various applications, from text analysis to object recognition. It makes AI accessible to users of different

expertise levels, enriching data analysis, decision-making, and user experiences.

### **4.4. Power Apps**

Power Apps provides a low-code development platform for creating versatile applications. It includes Canvas Apps for a user-interface-first approach and Model-Driven Apps focusing on data. Applications can be deployed across devices, integrating seamlessly with automated workflows and AI-enhanced processes.

### **4.5. Project Fit**

Power Platform addresses some of the disadvantages of RPA and AI, such as implementation complexities and data privacy concerns, through its low-code nature, compliance policies, and native security features.

### **4.6. Conclusion**

Microsoft Power Platform is a versatile tool for process automation, offering capabilities in RPA, AI integration, and app development. It enhances business operations by automating tasks, analyzing data, and providing user-friendly interfaces, making it a valuable asset in modern business operations.

## **5. Proposed Solution**

### **5.1. Problem Statement**

The organization has been facing inefficiencies and increased operational costs due to the manual process of extracting and manipulating data from medical invoices. There is a pressing need to automate this process to enhance efficiency.

#### **5.1.1 Objectives**

- Digitize the customer invoice submission process.
- Streamline the internal invoice management, especially the data approval process.
- Utilize AI for intelligent data extraction from invoices to minimize human intervention.

#### **5.1.2 Expected Outcomes**

- Reduction in manual labor and operational costs.

- Improved accuracy in data extraction and manipulation.
- Enhanced customer experience with a faster and simpler invoice submission process.

### 5.2. Solution Architecture

The proposed solution utilizes Microsoft Power Platform, comprising:

- PowerApps Mobile App for customer use.
- PowerApps Desktop App for internal use.
- Power Automate Flow for automation.
- Dataverse Database for data storage.

Figure 1 provides a visual representation of the system components' interactions.

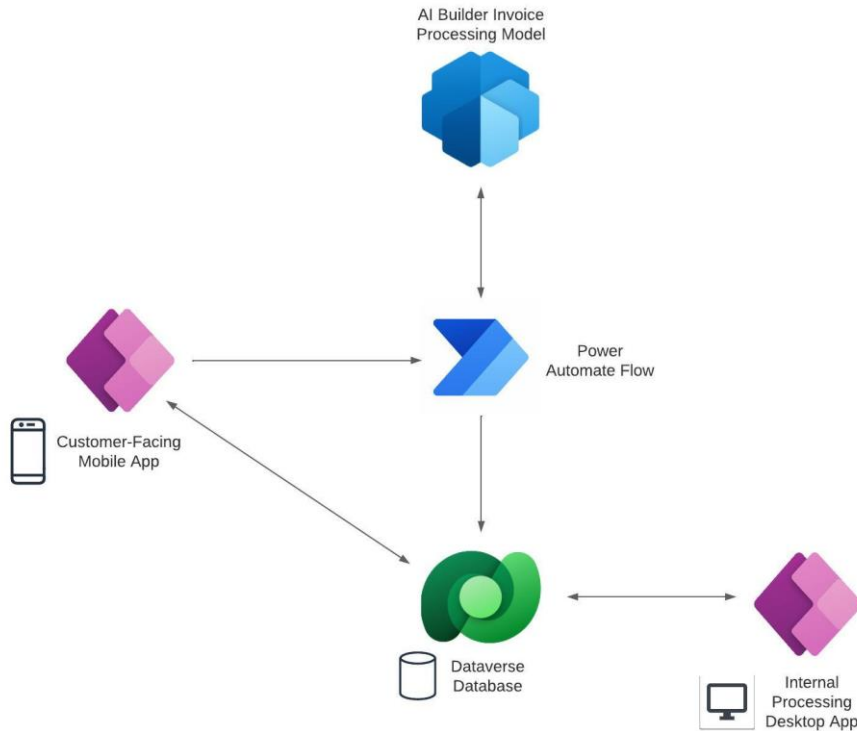


Figure 1 - Solution Architecture, based on Microsoft Infrastructure

### 5.3. Process Design

Invoice Submission:

- Customer submits an invoice via PowerApps Mobile App.
- Power Automate extracts necessary information using AI Builder and creates a new record in Dataverse.

Invoice Validation:

- Employee accesses the record via PowerApps Desktop App.
- The extracted data is reviewed and approved.
- Once approved, the record in Dataverse is updated and sent for further processing.

Additional details on each component's contribution to the solution are provided in the subsequent sections.

### 5.4. PowerApps Mobile App

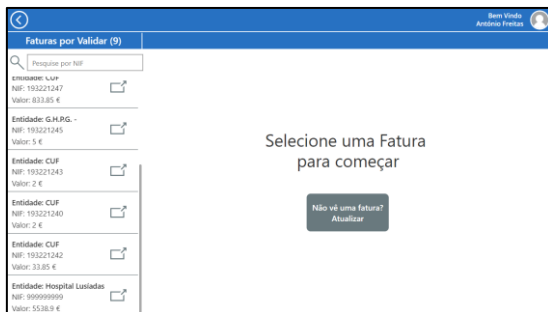
A customer-facing app designed for mobile devices using PowerApps to digitize invoice submissions. The app's functionality and interface are detailed thoroughly on the full version of the thesis. Figure 2 showcases a sample screen from the mobile app.



**Figure 2 - Example Screen from Solution's Mobile App**

### 5.5. PowerApps Desktop App

An internal app for managing invoices, crucial for minimizing manual data extraction as employees only need to validate the AI-extracted information. The app allows viewing, editing, and approving invoices. The app's functionality and interface are also detailed thoroughly on the full version of the thesis. Figure 3 depicts a sample screen.



**Figure 3 - Example Screen from Solution's Desktop App**

### 5.6. Power Automate Flow

The Power Automate flow that was created for the solution acts as a bridge between the two applications and the Dataverse Database. It has three main functions:

- Receiving the submitted invoices from the users of the mobile application;
- Using AI Builder to extract the information from the submitted invoice;
- Placing the extracted information inside the database for further processing inside the desktop app.

A full detailed description of the flow trigger and actions can be found on the full version of the thesis.

### 5.7. Dataverse Database

Dataverse is the native database solution inside Power Platform, with many integrations with other Power Platform services like Power Apps and Power Automate available out-of-the-box. This is a crucial component in the solution architecture, allowing both applications (mobile and desktop) to access and edit information in real time.

The created database consists of two tables, which serve different purposes. Both tables are connected by a column called GUID, which uniquely identifies an invoice with all of its corresponding line items.

#### 5.7.1 Invoices Table

The invoices table is responsible for storing the general information related with each invoice submitted by the customers.

#### 5.7.2 Line Items Table

The Line Items table is responsible for storing the data associated with each item of each invoice. As one invoice can and typically has more than one item being billed, this table will have a greater number of rows when compared with the Invoices Table.

## 6. Evaluation

In this chapter, a comparison will be made between the new system, which was built utilizing Power Platform tools, and the already existing processes at the medical insurance organization. The objective is to highlight the potential transformative impacts, improvements, and the overall efficiency gains anticipated from this change.

### 6.1. Expected Improvements

The implementation of the Power Platform-based system is expected to bring about significant advancements in the way invoices are managed and processed within the organization. Below are summarized the key areas of anticipated improvement:

#### 6.1.1 Invoice Submission

Current State: Customers are required to physically submit their invoices, either by

visiting one of the company's offices or mailing them, a method that is time-consuming and inconvenient.

**Future State:** The introduction of a customer-facing mobile Power App is anticipated to ease the submission process. Customers will be able to submit their invoices digitally at their convenience, saving time and initiating the reimbursement process as soon as possible. This shift is not just better for customer experience but is also expected to contribute to environmental sustainability by reducing physical paperwork.

### **6.1.2 Data Extraction and Entry**

**Current State:** Manual insertion of data by a worker is a tedious and error-prone task, at times taking up to or more than 10 minutes per invoice, depending on its complexity. At 200,000 invoices per year, this amounts to a very substantial time investment that could be used on other higher value-adding tasks.

**Future State:** With the integration of Power Automate and AI Builder, the system is expected to autonomously extract the necessary data from the submitted invoices. The automation is anticipated to significantly cut down the time spent per invoice, mitigate human error, and free up human resources for more critical tasks.

### **6.1.3 Invoice Verification**

**Current State:** A second worker is required to manually verify the data inserted, adding another layer of time consumption and potential for errors.

**Future State:** The automated data extraction process is expected to considerably lower the likelihood of errors. However, to ensure the biggest accuracy possible, an employee will review the extracted data through the Desktop Power App. This review process is quicker as it merely involves verification rather than manual data entry, ensuring a more efficient and reliable verification process. The application will also inform the worker using visual cues of what fields the AI model was confident on extracting, helping the worker to validate the invoice information.

## **6.2. Anticipated Time and Cost Efficiency**

The digitization and automation of the invoice processing system are expected to result in substantial time savings and cost reductions. The promptness in processing is not only expected to enhance customer satisfaction but is also anticipated to expedite reimbursement payouts. Furthermore, the reduction in the need for physical space (owing to less paperwork) and the optimal utilization of human resources are projected to translate into significant cost savings.

## **6.3. Challenges**

Despite the evident anticipated improvements, the transition to a digital system wouldn't be without its challenges. The adoption of this new technology would necessitate adequate training for both clients in using the mobile app and employees in navigating the desktop app, and there may be some level of aversion to change inside the organization when making such a radical change in the process structure.

## **7. Conclusion**

### **7.1. Main Contributions**

This master thesis represents a significant stride toward modernizing the invoice processing system of the organization. The project involved a comprehensive analysis of the existing invoice management process, documenting each step to lay a solid foundation for process improvement.

One of the paramount achievements of this endeavor was the development of two distinct applications using Power Platform's low-code technologies. The first application, a mobile app, facilitates customers in submitting their invoices digitally, eliminating the need for physical submission and thereby substantially enhancing customer experience. This app effectively addresses the previously outdated mechanism that required either in-person submission at a store or via mail, a process that was not only time-consuming but also inconvenient for the customers.

The second application is a desktop app, designed to streamline the internal workflow of the invoices inside the organization. This app

integrates with Power Automate and AI Builder to automate the extraction of invoice data, feeding it into a Dataverse database. Consequently, this innovation significantly reduces the manual labor previously required for data extraction, thereby accelerating the process and mitigating the risk of human error. Internal workers would now be able to validate the extracted data through an intuitive UI, a task that is considerably less burdensome than the manual extraction previously necessitated.

## **7.2. Limitations**

Despite the evident progress made, the project is not without its limitations. The newly developed system is not yet fully integrated with the organization's existing systems, which hampers its efficiency to a certain extent. Its reliance on Microsoft Infrastructure also presents a limitation, as it creates a dependency that may pose challenges in terms of flexibility and adaptability to other platforms or technologies in the future.

Additionally, the system still requires human validation, which, while considerably reduced, indicates that there is room for further automation. The effectiveness of the system is also contingent on the quality of invoices submitted. Poor quality invoices could lead to inaccurate data extraction, necessitating manual intervention and thus diminishing the efficiency gains achieved by the system.

## **7.3. Future Work**

Looking ahead, there are several avenues for future work and improvement to bolster the effectiveness and efficiency of the invoice processing system. A primary objective should be the full integration of the developed system with the organization's existing systems. This integration would ensure a seamless workflow and augment the system's efficiency.

Further enhancement of the UX/UI of both applications would also contribute to a more user-friendly experience, encouraging adoption and facilitating easier navigation for users.

Additionally, future endeavors should aim for the full automation of invoice information extraction, striving to reach a point where human validation becomes obsolete. This would entail improving the AI model's accuracy

and reliability, ensuring it can handle invoices of varying quality and complexity with high precision.

Finally, addressing the more complex stages of the Invoice Reimbursement Calculation and Invoice Payout, which were beyond the scope of this thesis, represents a significant opportunity for future work. These stages demand intricate integrations with a variety of systems and a thorough understanding of the complexities involved, posing a challenging yet rewarding avenue for improvement and innovation.



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