

Mapping IT and Management Challenges in Small and Micro-Businesses: A Path to Digital Maturity in Manufacturing [†]

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[†] Presented at the Sustainable Mobility and Transportation Symposium 2024, Győr, Hungary, 14–16 October 2024.

Abstract: Small and micro-businesses often struggle with poor data accuracy due to a lack of dedicated labor force for non-core business functions. The required efforts and costs associated with improving data accuracy, such as setting up and operating an adequate inventory management system, are unpredictable for these businesses. Despite the data-intensive nature of operating specialized software like MES and WMS, the decision to invest in excessive data manipulation can be challenging for micro-entities, even with the potential benefits. This study aims to empirically determine the challenges, risks, and other non-financial decision factors micro-enterprises face when establishing effective data management and utilization practices. A data model was developed based on interviews with 17 small business manufacturers and service companies to support the essential data entry requirements of micro-businesses. The findings support the concept of a SAAS (Software as a Service) product tailored to the needs of these businesses. Furthermore, this research highlights the under-researched areas of logistics processes and data management in small businesses.

Keywords: micro-businesses; IT system; digital maturity; software startup



Citation: Tápler, C. Mapping IT and Management Challenges in Small and Micro-Businesses: A Path to Digital Maturity in Manufacturing. *Eng. Proc.* **2024**, *79*, 92. <https://doi.org/10.3390/engproc2024079092>

Academic Editors: András Lajos Nagy,
Boglárka Eisinger Balassa, László
Lendvai and Szabolcs Kocsis-Szürke

Published: 19 November 2024



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1. Introduction

This study aims to explore the challenges of micro-enterprises that emerge when improving their management and IT systems. The outcome will also be used to determine the basic strategy of a SAAS enterprise, focusing on the production scheduling and order management of manufacturing companies; hence, this study focuses on the manufacturing sector. Micro-enterprises play a crucial role in local economic growth and in providing employment opportunities [1]. In the case of micro-businesses, the importance of individual core worker's effective working time is outstanding compared to larger corporations. Workflow, daily tasks, operative data, and goals are not precisely set, usually managed by business owners ad hoc. Prioritizing strategic tasks has a direct effect on current core activities; hence, these strategic steps are often overtaken by everyday business activities. Micro-enterprises have a very strong motivation to improve their digital presence, especially regarding their revenue-generating activities [2]. Improvements offering less-direct results, like raw material inventory management or adequate production planning at micro-sized manufacturing companies, are generally prolonged. Inadequate estimations cause indirect results, and losses emerge due to overstocking/stockouts, delays in replenishment, and inappropriate order fulfillment estimations [3]. On the other hand, excessive detail in regards to the processes and data management will distract focus and operative time from core activities. In the following sections, we will locate an essential minimum system improvement state for certain types of micro-businesses, which will also serve as hypothetical model for future research.

Financial record keeping compliance, along with minimal business management requirements, force micro-enterprises to use simple IT tools for financial management; furthermore, these businesses realize the additional benefits of cloud-based accounting

systems i.e., data storage and accessibility, scalability, automation, integration capabilities, data security and backup, flexible costing without upfront costs, and strong customer support [4]. Studies show that cloud infrastructure capabilities enhance operational agility, partnering agility, and customer agility [5]. According to regional surveys, only a small portion of micro-enterprises are content with their current IT systems or reject any changes; the majority are open to changes or are not decided yet [6]. A possible improvement is to integrate the accounting system with the tools of other functional areas like warehousing (WMS), task management and production scheduling, and e-commerce platforms. Another path is when the company shifts from a cloud accounting system to a cloud-based ERP system, achieving goals such as operational cost reduction, enhancing work efficiency, and better accessibility [7,8]. There are even micro-enterprises offering ERP systems to companies, and [9] deal with the motives of these enterprises. The desired state is to construct a complex manufacturing ecosystem [10]. The introduction of an ERP system is a major challenge to micro-enterprises due to, e.g., financial uncertainties, shared responsibilities, fear of data leaks, and high up-front costs [11]. Several studies deal with assessments of digital maturity [12], digital adoption [13,14], and evaluation [15], which are important for realizing which phase a company is in.

2. Materials and Methods

A qualitative research approach was applied, involving 17 micro-companies that were examined and interviewed. The interviews with the companies provided valuable insights into their operations and processes. By constructing a general process flow model, the researchers were able to visually represent how these companies operated and identify areas for improvement. The highlighted challenges offered a deeper understanding of the obstacles that the companies face, potentially paving the way for future research and recommendations to address these issues effectively.

According to the self-assessment of participating companies, they were classified into maturity categories, their development aspirations were determined, and their challenges to overcome in their development were identified, primarily to progress to the next level from a lower one. Table 1 shows the categorization of examined companies. Additionally, the datasets handled by the companies were mapped.

Table 1. Interviewed companies by company size and industry.

Core Features	Sole Traders/Solo Companies	Micro-Enterprises Excl. Solo Companies	Small Enterprise
Construction services	3	2	1
Machinery		4	2
Electric industry			2
Freight transport	2		1

3. Results and Discussions

This qualitative research shows that the micro-enterprises involved are dedicated to IT and management improvements based on their current level of development. The initial interviews showed that the IT systems of companies can be categorized into four distinct levels of maturity (see Table 2). This study does not address non-digitalized companies, i.e., companies that do not use any specialized management software beyond an invoicing app (Level 0).

Table 2. Different levels of IT system development.

Core Features	Level 1 ERP Invoicing Module/Accounting System	Level 2 Accounting System with Isolated Solutions	Level 3 Accounting System Integrated Solutions (MES, WMS, CRM, etc.)	Level 4 ERP with Relevant Modules Used
Basic financial compliance	x	x	x	x
Task management		x	x	x
CRM—contact management		x	x	x
CRM—automated customer workflow management		x	x	x
Inventorying			x	x
Production planning			x	x
Production planning with purchase management and inventory forecasting			x	x
Production monitoring			x	x
Centralized fine reporting and controlling				x

3.1. Level 1—Accounting Software

At this stage, the companies' management system is only capable of handling compliance, financial management, and credit control. The motivation for moving from Level 0 is the need for constant access to accurate financial data. Commonly used accounting systems are Xero, Quickbooks, Zoho, etc. Many micro-enterprises start using the financial module of an ERP (e.g., SAP, Microsoft Dynamics) to meet basic compliance and financial management requirements.

3.2. Level 2—Accounting System/ERP Financial Module and Isolated Functional Solutions

At this level, companies recognize the need for enhanced data management and start to use specialized functional software, typically cloud-based SaaS (Software as a Service) solutions such as Salesforce for CRM or Trello for task management. This upgrade is driven by the need for a system that can manage and control key activities more effectively.

3.3. Level 3—Accounting System Integrated Solutions (MES, WMS, CRM, etc.)

This study observed that a solid integration between the accounting system and a SaaS product is typically achieved only if the organization is committed to conscious and continuous development, has the expertise in-house, or invests in the development. The motivation for upgrading is to obtain precise enterprise-wide data on all regulated activities. However, the benefits of integrating MES and WMS systems come with the cost of complex data input and extra logistic tasks. An example of a costly investment is improving inventorying by introducing identification tasks. For solo entrepreneurs, these investments may be challenging due to prioritization, lack of time, and expertise. However, even for solo entrepreneurs, it may be a necessary task, e.g., for an e-commerce business.

3.4. Level 4—ERP with Relevant Modules Used

A slightly higher level of maturity is achieved when ERP modules cover all business processes. In one case, additional MES software was integrated with the ERP system. Centralized reporting becomes easier with ERP systems, as built-in reports eliminate the need for system coordination and manual report merging.

Figure A1 shows the detailed data and functionality map of the interviewed companies. This study identified several challenges encountered when upgrading from a lower level to a more advanced one.

Obviously, the primary challenge, or as companies perceive it, the main cost of implementation, was related to inventory tracking. At many of the companies examined, the inventory replenishment heavily relies on manufacturing worker's intuitive, self-created, convention-based systems. Transitioning from this reliance on the expertise of a warehouse operator to a more transparent inventory system introduces new costs such as identification labeling of purchased items, registering purchase items more accurately in the IT system, registering inventory usage accurately, reconciling errors, and making stock adjustments.

Other highly ranked challenges include the pre-calculation and post-calculation of production orders, indicating that the companies are eager to improve their project evaluation capabilities. There is also a strong demand for integrated fine reporting that provides quick, detailed, and centrally accessible reports based on datasets from various departments.

4. Conclusions

This study highlights the challenges micro-enterprises face in improving their management and IT systems, particularly within the manufacturing sector. The findings emphasize the unique difficulties these businesses encounter in managing their operations efficiently. This research highlights the importance of digital maturity and the potential benefits of integrating specialized software solutions, such as MES and WMS, into the existing IT infrastructure of micro-enterprises.

This study categorizes micro-enterprises into different maturity levels based on their IT systems and management practices, ranging from basic accounting software to integrated ERP solutions.

The non-representative survey indicated that many of the 17 companies involved identified the three main obstacles of data management improvement as inventory tracking, production order calculations, and integrated reporting. This survey serves as a framework for future quantitative research, supporting further investigation into inventory management adaption. It also provides initial validation for integrating features in a SAAS product currently under development.

It is also important to note that several other circumstances, like knowledge-sharing and access to community-based networks, play crucial roles in improvements at micro-enterprises [16]. During the interviews, the potential for a more extensive survey was discussed. The author's goal is to expand the number of companies involved in order to achieve more representative results.

Funding: This research received no external funding.

Institutional Review Board Statement: Ethical review and approval were waived for this study due to the anonymous nature of the survey and the absence of sensitive personal data.

Informed Consent Statement: Not applicable.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors on request.

Acknowledgments: The author would like to express his gratitude to the company representatives who generously contributed their time and insights through interviews for this research.

Conflicts of Interest: The author declares no conflicts of interest.

Appendix A

During the interview process, the data and function map were prepared for all of the companies, as shown in the table below (✓: data/ functionality is present, ✗: data/functionality is missing, -: data/functionality is not necessary).

Company type	Digital maturity	Customer data	Detailed CRM data	CRM automation	Supplier data	Procurement management and forecasts	E-commerce integration	Inventory data	Financial data	Production orders	BOM data	Routing data	Resource allocation and availability data	Human resources data	Inventory forecast and future availability	Production order/project pre-calculation	Production order/project post-calculation	Warehousing data	Freight transport data	Task management data excl production tasks	Document management	Integrated fine reporting	Major challenge
Solo-constr	Level 2	✓	-	-	-	-	-	×	✓	-	-	-	-	-	-	×	✓	-	-	×	-	-	Data collection and budgeting for routes
Solo-constr	Level 1	✓	-	-	-	-	-	-	✓	-	-	-	-	-	-	✓	-	-	-	×	-	-	Poor task management
Solo-constr	Level 1	✓	-	-	-	-	-	×	✓	-	-	-	-	-	-	×	×	-	-	-	-	-	Accurate inventory of constr materials
Solo-fr tr	Level 1	✓	-	-	-	-	-	-	✓	-	-	-	-	-	-	×	×	-	×	✓	-	-	Pricing issue due to poor pre-calculation
Solo-fr tr	Level 2	✓	✓	-	-	-	-	-	✓	-	-	-	-	-	-	×	✓	-	×	✓	-	-	Pricing issue due to poor pre-calculation
Micro-constr	Level 3	✓	✓	-	-	-	-	×	✓	✓	-	-	-	-	-	✓	✓	×	-	✓	-	✓	Track inventory on multiple sites
Micro-constr	Level 2	✓	-	-	-	-	-	×	✓	✓	-	-	-	-	-	✓	✓	✓	-	×	✓	×	Track inventory on multiple sites
Micro-mach	Level 4	✓	✓	-	✓	✓	-	✓	✓	✓	✓	×	×	✓	×	✓	×	✓	-	✓	✓	×	Resource allocation is not transparent, ad-hoc
Micro-mach	Level 3	✓	✓	-	-	×	-	×	✓	✓	✓	✓	×	✓	-	✓	✓	×	-	-	✓	✓	Track inventory in warehouse
Micro-mach	Level 4	✓	✓	-	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	-	✓	✓	✓	Improvement of e-commerce sales channel
Micro-mach	Level 3	✓	✓	-	✓	✓	-	×	✓	✓	✓	✓	✓	✓	×	✓	✓	✓	-	✓	✓	✓	Track inventory in warehouse, lead time forecast based on procurement
Small-const	Level 3	✓	✓	-	✓	-	-	✓	✓	✓	✓	-	✓	✓	✓	✓	×	✓	-	×	-	✓	Poor task management
Small-mach	Level 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	×	✓	✓	-	✓	✓	×	Reporting and post calculation
Small-mach	Level 4	✓	✓	-	✓	×	-	×	✓	×	×	-	✓	✓	✓	✓	×	✓	-	✓	✓	×	Inventory managed by operators manually
Small-elec	Level 4	✓	✓	-	✓	✓	-	✓	✓	✓	✓	✓	-	-	×	✓	✓	✓	-	✓	✓	✓	Future inventory availability not transparent
Small-elec	Level 4	✓	✓	-	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	No major issues/ challenges revealed
Small-fr tr	Level 2	✓	✓	✓	✓	-	-	-	✓	-	-	-	×	×	-	✓	×	-	✓	✓	✓	×	Resource allocation not managed

Figure A1. Data and function map.

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