# Cultural Influences on the Adoption of Digital Technologies in SMEs:

## A Comparative Analysis of India and the Netherlands

Master Thesis Report

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# Cultural Influences on the Adoption of Digital Technologies in SMEs:

## A Comparative Analysis of India and the Netherlands

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# Preface

Two years ago, I made one of the most significant and challenging decisions of my life, leaving the familiarity of home in India to pursue an MSc in Management of Technology in the Netherlands. With a background in engineering, this transition into the world of management was driven by a desire to gain significant knowledge about the larger effect of technology on organizations and society. It was not just a shift in academic discipline but a leap into a completely new culture, environment and way of life.

My journey at TU Delft has been nothing short of transformative. These two years have shaped me in ways I never imagined. The university has offered not only academic rigor but also an environment that is open, dynamic and deeply engaging. I've found joy in the flexibility of learning, the vibrant campus life and the diversity of ideas that circulate in every classroom and coffee corner. I've had the privilege to travel across Europe, experience a multitude of cultures, make lifelong friendships and collect memories I will treasure forever. Professionally, the opportunity to intern here in the Netherlands exposed me to a completely different work culture, one that values autonomy, trust and directness. Observing and experiencing these contrasts made me curious about how national and organizational cultures influence behavior, especially in the realm of digital transformation. That curiosity laid the foundation for this thesis.

I am deeply grateful to Dr. Zenlin Roosenboom-Kwee, my Chair, for always encouraging me to think deeper and ask the questions that matter. Your insightful feedback and the way you challenged my assumptions were nothing short of influential to shape the discourse of this work. My heartfelt thanks go to Dr. Johannes Gartner, my first supervisor, whose steady support carried me through every stage of this thesis. From helping me navigate ambiguity to patiently hearing out my frustrations and complaints, your calm demeanor and thoughtful guidance made a world of difference.

This journey wouldn't be possible if not for the unwavering support of my parents. Everything I am and everything I strive for, is because of them. I owe them my life and this achievement is as much theirs as it is mine. To my brother and my friends, thank you for being my sounding boards, cheerleaders and pillars of strength throughout. Your faith in me, even when I doubted myself, has meant everything.

*"It's a dangerous business, Frodo, going out your door. You step onto the road and if you don't keep your feet, there's no knowing where you might be swept off to." - Ian Holm, The Lord of the Rings.*

And what a beautiful road it has been!

- Komal Kaur Sasan
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# Executive Summary

Imagine two manufacturing companies, one in bustling Mumbai, the other in sleek industrial Amsterdam. Both are small to medium-sized enterprises trying to navigate the growing pressure to adopt digital technologies. While they face some similar hurdles, tight budgets, limited digital skills and a complex tech landscape, the way they approach digitalisation couldn't be more different. What drives these differences isn't just economic context or market maturity, it's culture.

This research dives into the cultural undercurrents shaping how SMEs in India and the Netherlands adopt digital tools like ERP systems, CRM platforms and even emerging technologies like AI. It investigates three critical questions to help understand the main themes: what technologies these firms are actually using, what cultural values influence their decisions and what helps or hinders their digital journey. To get to the heart of these questions, ten interviews were conducted with SME leaders in-depth, five in each country. The interviews were then analyzed thematically, with findings interpreted through two powerful lenses: Hofstede's cultural dimensions and the UTAUT model of technology acceptance.

Patterns quickly emerged. In India, companies tend to follow a top-down approach. Leadership approval is not just important, it's essential. Employees wait for directives, training is structured and new tools are rolled out cautiously, often due to changing industry landscape or customers needs. Open-source software is approached hesitantly due to concerns about security and compatibility. Digitalisation, here, is more of a careful march than a sprint. In contrast, Dutch SMEs encourage their employees to explore, experiment and even lead adoption efforts. Hierarchies are comparatively flatter and resistance to change is lower. People learn by doing. A single engineer automating a task can convince the entire team to follow suit. And tools are often chosen for their practical benefits, how much time or cost they save, rather than waiting for external approval.

What makes these insights especially compelling is how clearly culture interacts with key adoption factors. In high power-distance cultures like India, social influence flows from the top, while in more individualistic, moderate power-distance cultures like the Netherlands, it spreads through peer credibility and practical demonstration. Where uncertainty avoidance is high, as in India, effort expectancy becomes central. People want formal onboarding and step-by-step clarity. In the Netherlands, lower uncertainty avoidance allows for quicker, more agile rollouts. Even the motivation to adopt reflects cultural preferences. Indian firms often seek collective benefit and long-term gains; Dutch firms look for quick wins and personal efficiency.

These findings aren't just theoretical, they form the basis of a practical framework that links cultural traits to digital adoption behaviors. It's a tool that leaders and policymakers can use to tailor digital transformation strategies that actually work in context, rather

than applying one-size-fits-all solutions. Whether it's crafting group-based training programs in India or empowering tech-savvy champions in the Netherlands, the message is clear: successful digitalisation depends as much on cultural fluency as it does on technical and financial competence. From an academic perspective, it extends the UTAUT framework by integrating Hofstede's cultural dimensions, offering a more nuanced view of how adoption factors, such as facilitating conditions, is experienced differently across cultures. Empirically, the study introduces three culture–adoption pathways that illustrate how power distance, uncertainty avoidance, and individualism/collectivism influence adoption behaviours in India and the Netherlands. These pathways are grounded in qualitative insights from SME practitioners. From a managerial standpoint, the findings offer culturally specific guidance, for example, Indian SMEs benefit from structured, top-down onboarding processes, while Dutch SMEs respond more positively to individual autonomy and pilot-based experimentation. Finally, the study draws attention to the relevance of open-source software (OSS) as a flexible and context-sensitive digital solution, with implications for policy support mechanisms that reflect cultural preferences, such as collective grants in hierarchical settings and personalised incentives in individualistic ones.

In the end, what this document offers is a map, one that shows how national culture subtly but effectively shapes the digital journeys of manufacturing SMEs and how understanding this can unlock smarter, more human-centered pathways to transformation.

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# Nomenclature

**Table 1:** Nomenclature

| Term | Definition |
|---|---|
| AI | Artificial Intelligence |
| CNC | Computer Numerical Control |
| CRM | Customer Relationship Management |
| ERP | Enterprise Resource Planning |
| FC | Facilitating Conditions (UTAUT construct) |
| IDV | Individualism (Hofstede's cultural dimension) |
| IoT | Internet of Things |
| LTO | Long-Term Orientation (Hofstede's cultural dimension) |
| MAS | Masculinity (Hofstede's cultural dimension) |
| PDI | Power Distance Index (Hofstede's cultural dimension) |
| PE | Performance Expectancy (UTAUT construct) |
| Q&A | Question and Answer (session) |
| RQ | Research Question |
| SI | Social Influence (UTAUT construct) |
| SME | Small and Medium-sized Enterprise |
| STO | Short-Term Orientation |
| TAM | Technology Acceptance Model |
| UTAUT | Unified Theory of Acceptance and Use of Technology |
| UAI | Uncertainty Avoidance Index (Hofstede's cultural dimension) |
| OSS | Open Source Software |
| CMM | Capability Maturity Model |
| MES | Manufacturing Execution System |
| CAD | Computer-Aided Design |
| CAM | Computer-Aided Manufacturing |
| ATLAS.ti | Qualitative Data Analysis Software |
| SSI | Semi-Structured Interview |
| GDPR | General Data Protection Regulation |
| EU | European Union |
| MSMEs | Micro, Small and Medium Enterprises |
| P&L | Profit and Loss (responsibility) |

# 1

# Introduction

Digitalisation has become a critical factor for businesses aiming to stay competitive, drive innovation and boost operational efficiency in today's fast-evolving global market. Emerging technologies such as artificial intelligence (AI), Internet of Things (IoT), cloud computing, big data, augmented reality and 3D printing are enabling manufacturing firms to streamline processes, improve customer engagement and optimize the use of resources. However, despite the strategic value of digitalisation, many companies, particularly small and medium-sized enterprises (SMEs) struggle to move beyond the early stages of adoption (Elsa et al., 2025). Following Schönfuß et al., 2021, the following research defines Digital Manufacturing as the transformation of processes related to the value chain, products, services and business operations through digital technologies in manufacturing firms. An organization that runs facilities whose main function is the conversion of raw materials, elements, or components into novel, value-added products for sale or additional industrial use is known as a manufacturing company as per UN statistics (Division, n.d.).

SMEs are vital to national economies, representing over 99% of all businesses within the European Union and India ("SME Performance Review", 2024-25; Müller et al., 2018; Briefing, 2025) and playing a key role in job creation, innovation and acts as the foundation of the economies. The European Commission (Patrick, 2020) states that SMEs are firms which have less than 250 employees, have yearly revenues below €50 million or total assets under €43 million. The manufacturing industry holds a critical position in the economic structures of both the European Union and India. In the EU, it is the second-largest contributor to business economy revenues, accounting for €9.8 billion and employing 18.7% of the workforce, approximately 30 million people, while generating over 24% of the region's value added (Eurostat, 2024; "SME Performance Review", 2024-25). In India, manufacturing comprises around 17.3% of GDP and is significantly supported by micro, small and medium-sized enterprises (MSMEs), which contribute over 36% of manufacturing output, 45% of exports, and employ more than 60% of the national workforce (Ministry of Micro, Small & Medium Enterprises, Government of India, 2024; The World Bank, 2025). Given that SMEs comprise over 99% of businesses in both regions and are important for innovation, employment and export generation, their ability to adopt and integrate digital technologies is of national eco-

nomic interest. With the advent of Industry 4.0, these firms have the potential to overcome scale-related constraints, enhance productivity and remain globally competitive (Pozzi, 2023). Understanding how SMEs in manufacturing engage with digitalisation, especially across culturally distinct contexts like India and the Netherlands, is thus both timely and essential. High upfront costs, a shortage of skilled digital professionals, lack of clear strategic guidance and internal resistance to change are frequently cited barriers (Ghobakhloo and Iranmanesh, 2021; Horváth and Szabó, 2019). In this context, Open Source Software (OSS) has emerged as a key enabler of digitalisation for SMEs, particularly in resource-constrained environments. OSS is part of the broader category of open technologies, defined by transparent, collaborative development models and publicly accessible source code (Von Krogh and Von Hippel, 2006). These characteristics offer SMEs greater flexibility, lower cost of entry and reduced dependency on proprietary vendors, features especially valuable for firms with limited IT infrastructure or financial capacity. However, the adoption of OSS is not purely a technical or economic decision; it is also shaped by underlying cultural attitudes toward risk, authority and collaboration. Although numerous readiness and maturity models have been proposed (Wagire et al., 2020), very few address the specific needs of manufacturing SMEs operating within distinct cultural environments.

Beyond structural constraints, both organizational and national cultural elements influence the success of digital transformation initiatives (Cacas et al., 2022; K. M. S. Faqih, 2019). Cultural norms shape attitudes toward innovation, risk-management techniques and the distribution of power and decision-making in SMEs, whether they follow flat or hierarchical organizational models (H. Li et al., 2019). While some scholars have investigated how cultural dimensions affect technology adoption (Nistor et al., 2012; K. M. Faqih, 2016), integration of cultural theory into digital transformation frameworks remains uneven. Studies utilizing models such as the Unified Theory of Acceptance and Use of Technology (UTAUT) have yielded conflicting results on the moderating influence of cultural qualities such as Uncertainty Avoidance and Individualism/Collectivism (Kudjo and Chiweshe, 2024; Chirumalla et al., 2025; S. K. Sharma and Govindaluri, 2014). This inconsistency underscores the need for additional in-depth, context-sensitive comparative research to better understand these processes.

Recent work has encouraged scholars to explore how organizational structure and firm size influence digital transformation, with a focus on identifying which factors carry different levels of importance across various SME contexts (Schuh et al., 2014). Although frameworks like UTAUT, the Technology Acceptance Model (TAM) and the Job Demands–Resources model have been applied to study digital innovation (Rahmani, 2024; H. Li et al., 2019), they often overlook industry-specific and cultural nuances that are particularly relevant to manufacturing SMEs. While academic interest in digital innovation is growing across industries (Chatterjee et al., 2021), much existing research provides broad, generalized findings with little emphasis on the manufacturing sector's unique requirements (Vogelsang and et al., 2018).

Studies on Industry 4.0 have identified key enabling technologies (Pozzi, 2023), but frequently lack validated frameworks that reflect the real-world challenges faced by small manufacturing enterprises. Although digitalisation offers substantial benefits, successful adoption is heavily dependent on readiness from organizational elements, tendency

to culturally adapt and external frameworks that support the transformation (Darbanhosseiniamirkhiz and Ismail, 2013). The pace of digital adoption in SMEs remains uneven, particularly across different cultural and economic contexts. There is a strong impact of culture on how SMEs perceive and implement digital solutions, and here we consider SMEs from the Netherlands and India as illustrative examples of divergent cultural orientations towards risk resilience of SMEs, hierarchial structure and innovative output. These differences in culture complicates efforts to gain more knowledge about the mechanisms through which organizational culture influences digital adoption (Bouhouili, 2023).

This thesis addresses that gap by investigating the overarching research question: *How do digital adoption factors interact with cultural influences in Indian and Dutch manufacturing SMEs with a focus on open technologies?*

To guide this inquiry, the following sub-research questions (SRQs) were formulated:

1. Which digital technologies are primarily adopted by manufacturing SMEs in India and the Netherlands?
2. What are the relevant cultural dimensions that influence digital adoption in manufacturing SMEs in India and the Netherlands?
3. What are the different barriers and drivers of digital adoption in SMEs in the two countries?

These SRQs look at the research objective and address the barriers to technology adoption in terms of culture and context (Leso et al., 2022). By focusing on culturally and economically distinct environments, India, an emerging market experiencing rapid digitalisation and the Netherlands, a technologically advanced European nation, this study seeks to identify which adoption factors are most affected by which cultural influences. It thus contributes to both scholarly and practical knowledge by situating technology adoption within a broader framework of cultural, organizational and industry-specific dynamics.

The research design adopted for the study is qualitative. Specifically to capture rich, context-specific insights. Researcher conducted ten semi-structured interviews with decision-makers and users across five Indian and five Dutch manufacturing SMEs. Transcripts were analyzed using thematic coding to identify emergent code groups, which were then clustered into higher order themes that capture how culture shapes adoption. These themes were subsequently mapped onto UTAUT and relevant Hofstede's Cultural Dimensions frameworks, yielding an integrated framework of digital adoption in each national context.

The organization of the thesis can be drafted as. Chapter 2 reviews the literature on digitalisation in SMEs, cultural frameworks (e.g., Hofstede's model) and technology acceptance theories (e.g., UTAUT). Chapter 3 outlines the research methodology, including the qualitative design, interview protocols and thematic analysis approach. Chapter 4 looks at the results of the study, followed by Chapter 5, which provides a discussion in light of existing theories, cross-country comparisons, theoretical contributions, practical implications, policy-making suggestions limitations and recommendations for future

research.. Finally, Chapter 6 concludes with a summary of the thesis.

By integrating in, depth qualitative evidence with established theoretical perspectives, this thesis sheds light on the often, underappreciated cultural currents that underlie digital-adoption decisions in manufacturing SMEs. The resulting framework not only advances academic understanding but also provides concrete, culturally informed strategies to help SMEs in India and the Netherlands and beyond, navigate an increasingly digitalised industrial landscape.

# 2

# Theoretical Background

Digitalisation has become a strategic priority for businesses globally in the manufacturing sector, where it plays a key role in enhancing efficiency, fostering innovation, and maintaining competitiveness (Bogner et al., 2016; Santos and Martinho, 2020). Despite its growing importance, the pace and nature of digital transformation differ widely among firms. These differences are influenced not only by structural and financial factors but also by deeper cultural dynamics (Erumban and de Jong, 2006; Taras et al., 2010. This disparity is especially pronounced among small and medium-sized enterprises (SMEs), which, while vital to national economies, often face challenges in progressing beyond initial stages of digital adoption due to limited resources and unclear strategic direction (Ghobakhloo and Ching, 2019; Buer et al., 2018).

This chapter outlines the key theoretical concepts and frameworks that inform the study of digital technology adoption in SMEs, with a particular focus on manufacturing firms in India and the Netherlands. It begins by defining digitalisation, identifying the core technologies involved, and examining common barriers faced by SMEs. It also introduces structured frameworks that classify digital solutions relevant to the manufacturing context (Schönfuß et al., 2021; Doyle and Cosgrove, 2019).

The discussion then shifts to the role of culture in shaping organisational behaviour and innovation. It highlights key cultural definitions and places special emphasis on Hofstede's cultural dimensions, a widely used framework for cross-national comparisons (Hofstede, 2001; Jacobs-Basadien and Pather, 2022).

Following this, the chapter introduces two influential models from information systems research: the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). These models help explain how individuals and organisations adopt digital tools (V. Venkatesh et al., 2003; Williams et al., 2015). The chapter also explores how these models have been adapted in the literature to account for cultural influences, particularly in the context of SMEs and international comparisons (Nistor et al., 2012; Tarhini et al., 2017).

Together, these theoretical perspectives provide a comprehensive foundation for this study's cross-cultural analysis of digitalisation in Indian and Dutch manufacturing SMEs.

By integrating insights from digital transformation research, cultural theory, and technology adoption models, the chapter establishes a well-rounded mechanism for comprehending how technology and culture interact to shape digital adoption in SMEs.

## 2.1. Digitalisation

Digitalisation represents a pivotal shift in how manufacturing companies create and deliver value throughout their complete process, from initial design and production to logistics and customer support (Bogner et al., 2016). It facilitates real-time data gathering, flexible planning, intelligent product personalization, smooth integration with external digital platforms (Buer et al., 2020; Santos and Martinho, 2020). It refers to a wide spectrum of technology adoption levels. This can range from basic steps like using computers and internet access to more advanced applications such as adopting digital-first business models or integrating Industry 4.0 technologies like automation, cloud computing, big data (Doyle & Cosgrove, 2019). According to a study done by Eller et al., 2020, the novel use of digital technologies does not see great traction among small firms even for technologies that seem particularly relevant for SMEs. The rate of digitalization among SMEs is divided unevenly based on a study done by L. Li et al., 2017 and the ”ubiquity of non-proprietary technologies and open-access platforms” (Morgan-Thomas, 2015) gives SMEs numerous opportunities to develop their technology infrastructure. For SMEs, however, the road to digitalisation remains uneven. Firms that adopt digital tools without simultaneously transforming their leadership, organizational culture, internal capabilities often struggle to achieve substantial results (Matt et al., 2015; Vogelsang and et al., 2018).

Digital tools are at the core of manufacturing SMEs' transformation efforts, spanning areas such as enterprise resource planning (ERP), customer relationship management (CRM), production monitoring, predictive maintenance, supply chain visibility, data analytics. However, SMEs often lack the structured guidance needed to navigate the vast and complex landscape of available digital technologies. As Schönfuß et al., 2021 argued, effective digitalisation requires more than awareness, it demands targeted prioritisation based on a firm's maturity, needs and constraints. To support SMEs in identifying relevant and achievable digitalisation opportunities, Schönfuß et al., 2021 proposed a structured catalogue of digital solution areas as seen in Appendix A.1, grouped into functional categories aligned with core manufacturing operations. Data collection and sensing technologies, such as IoT devices and machine-monitoring tools, gather real-time or batch data from physical systems. Data processing and analytics tools transform this data into actionable insights through dashboards, statistical models or machine learning. Workflow support technologies (e.g. ERP, MES) streamline administrative and production processes, while automation and control systems enable robotics and machine-level integration. Decision support tools aid managerial planning via simulation and optimisation and collaboration platforms (e.g. CRM, cloud-based systems) enhance coordination and customer engagement. This classification helps SMEs assess their digital maturity and prioritise technologies according to Schönfuß et al., 2021.

Digital manufacturing in SMEs is shaped by a combination of structural limitations, strategic gaps, cultural dynamics. Academic literature consistently highlights several

key barriers. Chief among these are the absence of a clear strategic vision and limited financial resources, which restrict long-term planning and investment in digital infrastructure (Hermann et al., 2023). Low digital maturity and technical skill shortages further hinder implementation, particularly in firms lacking dedicated IT personnel or access to external expertise (Buer et al., 2018). Additionally, cultural resistance, often rooted in informal routines, legacy systems, skepticism toward change, remains a persistent obstacle.

Conversely, several enablers have been identified as critical to successful digital adoption. These include organizational values, strong leadership and clear communication of digital goals (Del Giudice et al., 2021; Ghobakhloo and Iranmanesh, 2022). External support mechanisms, such as government incentives, vendor partnerships, peer benchmarking, also play a vital role in reduction of uncertainty and building confidence in new technologies (Raj, 2019; Ancillai et al., 2023).

Despite these constraints, literature suggests that a phased or incremental approach to digitalisation can help SMEs build internal readiness over time. Firms often begin with foundational tools like ERP or CRM systems and later scale toward more advanced solutions such as predictive maintenance or AI-driven analytics. This incremental strategy helps manage risk, align with internal learning capacities, build organizational readiness over time (Lamperti et al., 2023; Ancillai et al., 2023). Within this broader landscape, themes such as change management and digital champions, play an important role, though often under emphasized. Change management facilitates the behavioral and cultural shifts required for digitalization, helping employees adapt to new tools and workflows (H. Li et al., 2019). Digital champions, meanwhile, act as internal advocates who bridge the gap between strategic intent and operational execution, often gaining influence through trust and credibility rather than formal authority (Paavola et al., 2017).

These findings underscore the need to understand the specific factors that influence digital transformation, especially in SMEs. Unlike larger corporations, SMEs typically have leaner structures, less formalized processes, more centralized decision-making. This can make them both more vulnerable to disruption and more agile in response to factors such as leadership style, organizational values, national culture (Ghobakhloo and Iranmanesh, 2022; Hermann et al., 2023). In such settings, both internal (organizational) and external (national) cultural elements significantly impact how digital technologies are viewed, adopted, integrated.

### 2.1.1. Open source Software

Open-Source Software (OSS), is defined as a digital solution in which the source code is freely accessible for modification and redistribution, has emerged as a strategic enabler of digitalisation, especially for small and medium-sized enterprises (SMEs) with limited resources Nadagoud, 2024. OSS offers significant advantages over proprietary alternatives, including lower total cost of ownership, high customisability, scalability, and independence from vendor lock-in (Stefanou, 2014 Bitzer and Schröder, 2006). Tools like Odoo and ERPNext allow SMEs to implement enterprise-grade digital solutions without the high upfront investments typically required by proprietary systems such as SAP or Oracle. These benefits are especially critical in volatile or developing markets,

where budget constraints often limit digital adoption (Bitzer & Schröder, 2006).

Given the potential financial disparity between SMEs in India and the Netherlands, OSS serves an important levelling function in this study. By focusing on open-source digital tools, which are accessible to firms regardless of financial capacity, this research isolates cultural factors more effectively. It allows for a more meaningful comparison of how organisational and national culture, not economic limitations, influence digital adoption decisions.

However, OSS adoption also presents challenges. These include a lack of in-house technical expertise, security concerns, uncertainties around long-term support, and the complexity of understanding legal obligations under various OSS licenses (Okoli and Carillo, 2006; Devos et al., 2014; Nadagoud, 2024). These issues tend to be amplified in SMEs, particularly those with risk-averse leadership or hierarchical decision-making cultures.

Ultimately, OSS offers SMEs a low-barrier, scalable pathway to digital transformation. Yet, its success depends on the alignment of technological capability, cultural readiness, and external institutional support (Nadagoud, 2024). In the context of this tudy, OSS provides a unique lens to examine how culture, rather than financial capability, shapes the trajectory of digital adoption in manufacturing SMEs across two distinct national settings.

## 2.2. Culture

Culture has been researched as a social concept for many years (Jacobs-Basadien & Pather, 2022). It is a dynamic concept, with different interpretations in different geographical regions. Culture is seen as a social concept and has been studied for decades, but it has faced challenges when it comes to conceptualizing it, leading to a dispute in academia (Jacobs-Basadien and Pather, 2022; Kudjo and Chiweshe, 2024). According to literature, culture is a significant factor in influencing the adoption of new technologies among people and organizations (Cacas et al., 2022).

In a broader sense of terms, culture can be defined as a framework of shared norms, values and social interactions (Lee et al., 2012). Alternate sources see it as patterns of feeling, thinking, potential acting that are picked up during the course of a lifetime, is common within a social setting like a country, profession, or ethnicity (Nistor et al., 2012). Among different definitions of culture by (Triandis, 1972) by (Leidner & Kayworth, 2006), the one by (Hofstede, 2001) is widely used in academia. By Geert Hofstede's definition, culture is "the collective programming of the mind which distinguishes the members of one human group from another" (Hofstede, 2001). The country-level factor analysis results by Hofstede, 2001, enabled him to categorize the represented nations into four categories, later six. This research has a direct significant impact on our comprehension of culture today. Hofstede's cultural dimensions have been included into several subsequent cultural model studies and his approach has been conformed (Hofstede, 2001, Nistor et al., 2012, Taras and Steel, 2009). Cultural beliefs, attitudes and values are thus key factors affecting the uptake and utilization of technology (Erumban and de Jong, 2006, Jacobs-Basadien and Pather, 2022). Utilization of specific digital tools by individuals and organizations is affected by socio-cultural values and attitudes

(Erumban and de Jong, 2006, Merhi, 2021). To study the relationship with technology adoption and culture, one of the most widely accepted frameworks, especially at the national level, is Hofstede's cultural dimensions theory (Lee et al., 2012; Jan et al., 2022; Jacobs-Basadien and Pather, 2022; Erumban and de Jong, 2006).

### 2.2.1. Hofstede's Cultural Dimensions

Geert Hofstede has been a pioneer in the research around cultural differences and diversification, with Hofstede's cultural dimensions is a widely used framework among various frameworks to study differences in culture (K. A. Alshare et al., 2011; Sunny et al., 2018). Hofstede's framework suggests a group of cultural factors in order to understand and compare national cultures to see how they respond to technological advancements (Hofstede, 2011). These dimensions are considered to reflect issues of universal psychosocial relevance, expressing fundamental dilemmas of humankind. These dimensions originated in the area of industrial and organizational psychology, while also concluding their relevance for understanding cultural and national differences (Hofstede, 2011; Arrindell, 2003). The data for this framework was gathered when Geert Hofstede was working at IBM, between 1967 and 1973, involved 100,000 people from 50 nations and three regions (Hofstede, 2011; Taras et al., 2010; Pfaff et al., 2023). The analysis of this data allowed him to initially identify four, later six key dimensions of national culture (Pfaff et al., 2023; Tarhini et al., 2017). These dimensions are mentioned below:

- **Uncertainty Avoidance:** The aforementioned tells us about the degree with which individuals handles risks and uncertainties. It shows the degree of patience one has while taking care of insecurities and irregularities. This tells us if the person is a risk avoider or risk taker (Jan et al., 2022).
- **Power distance:** This dimension shows us the uneven distribution of status and authority. Hierarchies are largely prevalent in high-power-distance cultures, egalitarian relationships and flat organization structure is favored by low-power-distance countries (Taras et al., 2010;Jan et al., 2022).
- **Individualism-Collectivism:** This helps us study whether an individual is focused on their personal objective or prefers togetherness. Individualistic culture emphasizes on personal goals and independence while collectivist culture places more value on loyalty, cohesiveness and closely knit groups (Jan et al., 2022; Nistor et al., 2012).
- **Masculinity-Femininity:** This dimensions differentiates the role of gender in society. Femininity focuses on quality of life, care and relationships while Masculinity focuses on power, money and authority. More masculine cultures prioritize achievements in career whereas, feminine cultures are focused on overall well-being (Jan et al., 2022; Jacobs-Basadien and Pather, 2022)
- **Long-term Orientation:** This dimensions tells us about the driver of a decision taken by the organization, whether they prioritize long term goals or are focused on short-term results (Jan et al., 2022).
- **Indulgence-restraint:** Restraint is when there are regulation of strict social norms and suppression of fulfillment of needs. On the other hand, Indulgence allows

people to satisfy their inherent needs of enjoyment (Jacobs-Basadien & Pather, 2022).

Based on extensive research, Hofstede's framework is widely recognized across various fields, particularly in technology adoption studies (Jan et al., 2022; Jacobs-Basadien and Pather, 2022). It remains an essential multi-dimensional factor affecting attitudes, behaviors, preferences (Özbilen, 2017). Its methodology and the age of its original data, has been a reason for its criticism but it still continues to be widely accepted in social science literature, allowing for comparisons with past research and serving as a significant tool to knowledge-sharing and research design (Merhi, 2021). Researchers often incorporate Hofstede's dimensions into established models of technology adoption, such as TAM and UTAUT, to explore their direct, moderating, or mediating effects (Xue et al., 2024). A meta-analysis suggests that certain organizational and employee results can be predicted by Hofstede's cultural dimensions sometimes having a greater impact than individual divergences such as personality traits (Jan et al., 2022; Pfaff et al., 2023).

This framework is utilized in international comparisons. For instance, Indian SMEs often have more hierarchical organizations, are highly cost-conscious, tend to be more risk-averse, (Nistor et al., 2012) while Dutch SMEs generally operate with flatter structures, favor consensus-based decision-making, show greater digital readiness (Ancillai et al., 2023), based on the scores calculated by Hofstede's cultural dimensions 2.1. As a result, the same digital solutions may be adopted and used in very different ways depending on the cultural context (Jan et al., 2022).

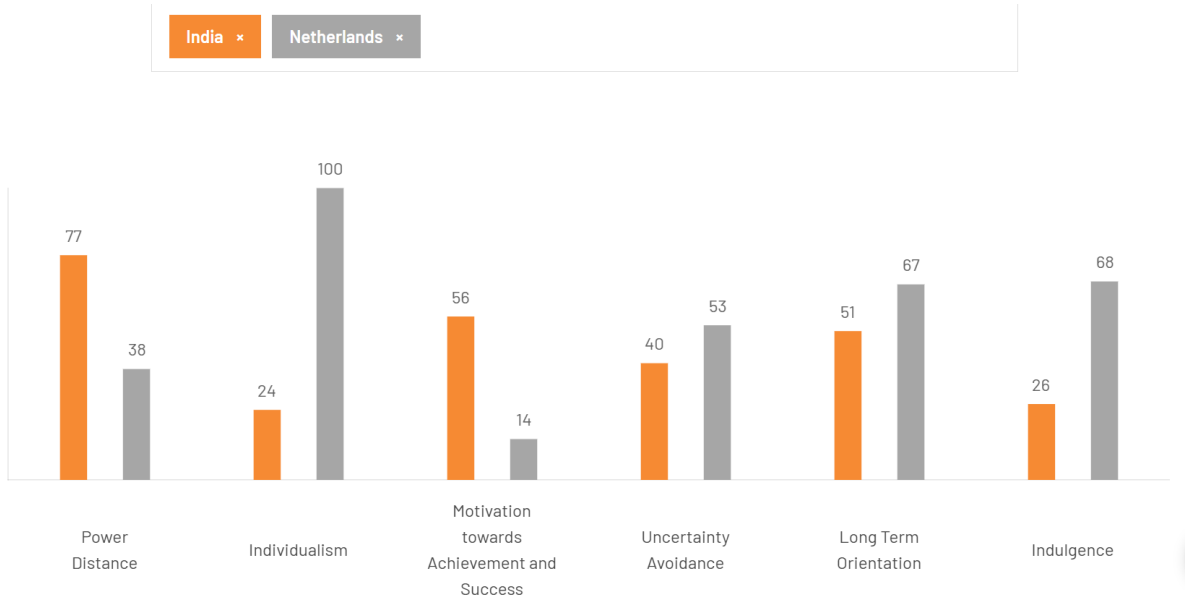


**Figure 2.1:** Cultural score according to Hofstede Insights, n.d.

Although according to Jang et al., 2017, the literature lacked consensus on the use of Hofstede's cultural dimensions as facilitators in technology acceptance models. This research acknowledges the limited amount of available studies and knowledge on this topic.

## 2.3. The Significance of Technology Acceptance Models

Understanding how individuals and organizations adopt and engage with technology has long been a central concern in information systems (IS) research. The proliferation of digital platforms, from enterprise resource planning (ERP) systems to cloud-based customer relationship management (CRM) tools, has significantly reshaped business operations, particularly in manufacturing, where digital tools influence both strategic planning and day-to-day workflows (Mittal et al., 2018; Ancillai et al., 2023). In response to these shifts, scholars have increasingly relied on technology acceptance models to explain and anticipate user behavior in the face of digital change (Williams et al., 2015; Oliveira and Martins, 2011).

A recurring insight across the literature is that digital transformation efforts often falter not due to technological shortcomings, but because of human and organizational resistance. Factors such as user skepticism, perceived irrelevance, or misalignment with existing practices frequently derail implementation (Ghobakhloo and Ching, 2019; Tarhini et al., 2017). This is especially pronounced in manufacturing SMEs, where digital maturity is typically lower, resources are constrained, adoption decisions are driven more by operational necessity than by innovation agendas (Caldeira and Ward, 2003; Ramdani et al., 2009; Mittal et al., 2018). In such settings, understanding the psychological, motivational, contextual drivers of technology use becomes essential (Alshamaila et al., 2013; Awa et al., 2015).

To address these complexities, IS researchers have developed a range of theoretical models. The Technology Acceptance Model (TAM), introduced by Davis, 1989 and predicated on the Theory of Reasoned Action (Fishbein and Ajzen, 1975), states that its key dimensions, the useful nature and ease of use, shape an individual's intention to adopt a technology. Its appeal lies in its simplicity and empirical robustness, making it a foundational framework in studies of digital adoption across various SME contexts, including ERP systems (Dezdar and Ainin, 2011), cloud computing (Alshamaila et al., 2013) and e-commerce (Awa et al., 2015). Empirical applications of TAM have consistently shown that perceived benefits and usability are central to adoption decisions. For example, Oliveira and Martins, 2011 found that in Portuguese SMEs, internal perceptions of value and ease of implementation outweighed external pressures. Similarly, AlBar and Hoque, 2017 emphasized the importance of usability in shaping digital decisions among SME managers in Saudi Arabia. In manufacturing, Dezdar and Ainin, 2011 confirmed that TAM's core constructs effectively explained ERP adoption in Iranian SMEs, reinforcing its relevance in operationally focused environments.

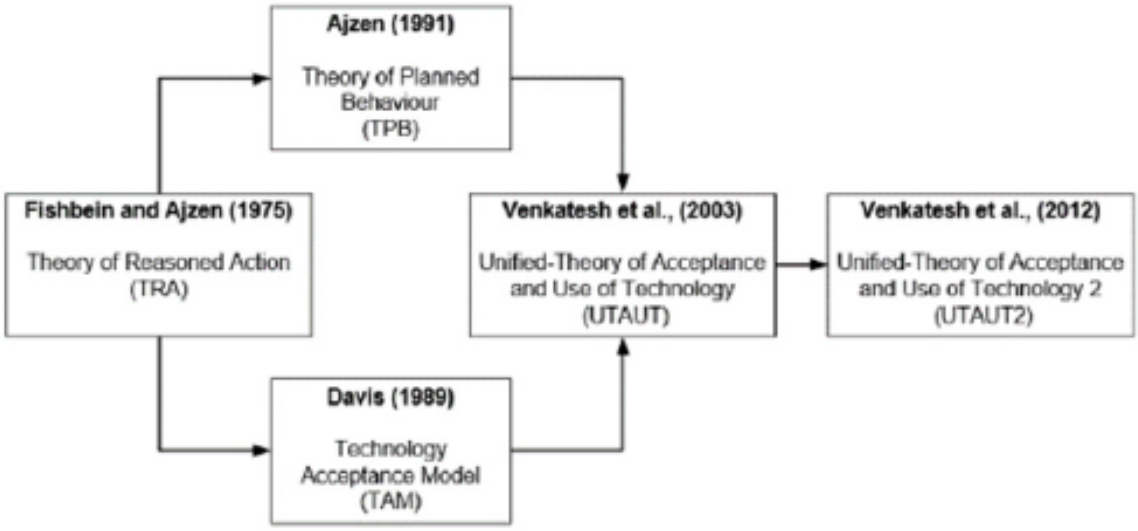


**Figure 2.2:** Technology Acceptance Models over the years; Jacobs-Basadien and Pather, 2022, p. 38.

However, TAM has also faced criticism for its narrow scope. It largely overlooks broader organizational and social factors, such as peer influence, leadership support and infrastructure readiness, that are particularly salient in SME contexts (Ramdani et al., 2009; Ifinedo, 2012;Pishdad and Haider, 2013). These limitations have prompted the development of more comprehensive models, most notably the Unified Theory of Acceptance and Use of Technology (UTAUT) by V. Venkatesh et al., 2003, which combines social influence, facilitating conditions and performance expectations into a more holistic framework.

Despite its enduring impact, TAM is constrained by its individual-level focus and limited scope in explaining adoption behaviors within organisational and cross-cultural contexts (Tarhini et al., 2017). As digitalisation becomes increasingly influenced by external social and structural factors the need for a more integrative model becomes evident. This justifies the shift to UTAUT in the current study, which expands on TAM by including constructs such as social influence and facilitating conditions (Williams et al., 2015, and allows for a better exploration of cultural variability in digital adoption.

### 2.3.1. The Unified Theory of Acceptance and Use of Technology

The Unified Theory of Acceptance and Use of Technology (UTAUT), formulated by V. Venkatesh et al., 2003, offers a consolidated framework for getting familiar with user intentions and actual technology usage. Drawing from eight foundational models, including the Technology Acceptance Model (TAM), the Theory of Planned Behavior (TPB), the Diffusion of Innovations theory, UTAUT combines key constructs to bring forward a well-rounded explanation of the behavior related to technology adoption:

- Performance Expectancy (PE): The degree to which an affiliated individual believes in the potential of a technology to enhance job performance (K. Alshare et al., 2024).
- Effort Expectancy (EE): The believed utilization ease associated with the technol-

ogy (Williams et al., 2015).

- Social Influence (SI): The extent to which individuals perceive the importance of using the technology (Williams et al., 2015).
- Facilitating Conditions (FC): The belief that necessary organizational and technical infrastructure exists for technology use.

Individual attributes including age, gender, experience, and voluntariness of use enable these basic elements, which improve the model's predictive accuracy in various scenarios.

UTAUT has gained significant traction in organizational research, particularly within the SME sector, where it is frequently employed to explore the behavioral dimensions of digital transformation. Its ability to account for both individual and contextual variables makes it especially relevant for understanding adoption dynamics in resource-constrained and culturally diverse environments (Kwarteng et al., 2023).

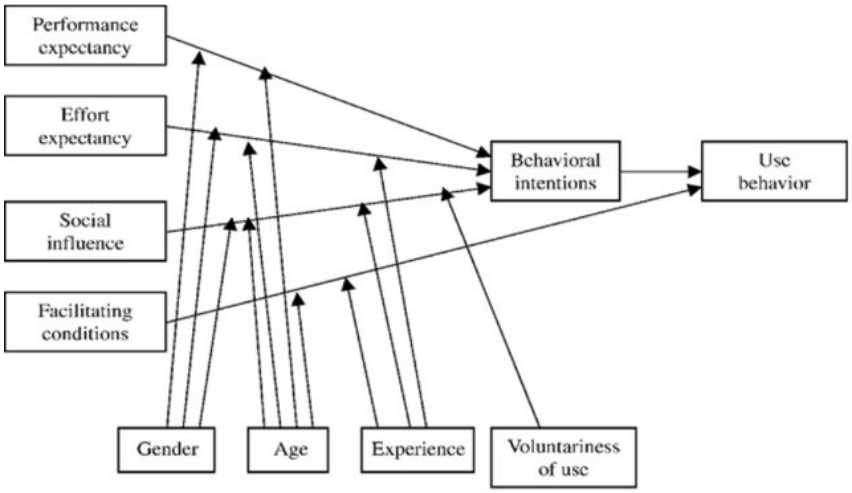


**Figure 2.3:** UTAUT framework from V. Venkatesh et al., 2003, p. 447.

### Applications of UTAUT

Within the domain of manufacturing SMEs, the Unified Theory of Acceptance and Use of Technology (UTAUT) has proven to be a valuable framework for understanding how cognitive, social, infrastructural factors influence the adoption of digital tools. For example, Kwarteng et al., 2023 further provided some additions to the UTAUT model by the introduction of the construct of an "anxiety-digitalized environment," which reflects the unique pressures faced by small firms navigating digital change. Their findings revealed that while performance expectancy remained a strong motivator for adoption, effort expectancy and facilitating conditions, typically seen as enablers, could, in some cases, hinder adoption. This aligns with broader SME literature that points to perceived complexity, digital anxiety, inadequate support systems as significant barriers in resource-constrained environments.

The social dimension of UTAUT has also emerged as particularly salient in SME settings. Schönfuß et al., 2021, in their investigation of digital solution areas for manu-

facturing SMEs, emphasized the importance of peer validation, vendor credibility, inter-firm collaboration in shaping adoption decisions. Their work reinforces the relevance of social influence (SI) in contexts where SMEs often rely on trusted networks and experiential knowledge rather than formalized evaluation processes. This supports the broader UTAUT proposition that use of digital tools is not an individual or managerial decision but is also shaped by collective norms and external expectations.

Beyond manufacturing, UTAUT has been widely applied across various SME sectors undergoing digital transformation. Zheng and Khalid, 2022, for instance, examined cloud ERP adoption in Malaysian SMEs and confirmed the centrality of performance expectancy and the conditions that facilitate such adoption, while also highlighting the critical role of top management support, often intertwined with infrastructural readiness. Furthermore, Ramdani et al., 2009 emphasized that in resource-constrained SME environments, organizational readiness and support infrastructure are crucial for digital transformation success. In a different context, Nepal and Nepal, 2023 applied UTAUT2 in the digital banking sector in South Asia, identifying social influence, facilitating conditions and habit, an extension from UTAUT2, as key drivers in regions where digital familiarity is still developing.

Additionally, Alshamaila et al., 2013, looks at cloud computing adoption among UK-based SMEs and identified performance expectancy and the conditions that facilitate adoption as key determinants of adoption. Moreover, cross-cultural studies have further validated UTAUT's applicability. Tarhini et al., 2017, for example, in their study got results that cultural differences significantly shaped the effect of social and organizational factors on technology acceptance among students in Lebanon and the UK, findings that resonate with this study's emphasis on the cultural dimensions of digital adoption.

While UTAUT2 brings in further constructs such as hedonic motivation, price value, habit to better capture consumer-oriented technology adoption, its relevance to manufacturing SMEs remains limited (N. Venkatesh et al., 2012). The operational focus of manufacturing firms is largely utilitarian and goal-driven, placing minimal emphasis on enjoyment or personal gratification as motivators for adoption. Moreover, technology decisions in such settings are typically strategic, organizational, often mandated, rather than voluntary or individually driven Williams et al., 2015. Hence, this research adopts the original UTAUT model, which is better aligned with the structured, performance-oriented nature of digital adoption in manufacturing SMEs in India and the Netherlands.

## 2.4. Bridging Cultural Dimensions and Technology Acceptance

An expanding area of study has sought to enrich the explanatory capacity of technology acceptance models by combining a Hofstede's cultural dimensions with the UTAUT. This synthesis proves especially insightful for examining digital adoption across culturally diverse contexts, where national cultural values significantly shape organizational behavior and technology uptake (Nistor et al., 2012; Tarhini et al., 2017).

In a cross-national study on e-learning adoption in Germany, Romania and Turkey, Nistor et al., 2012 received results that highlighted cultural traits such as individualism-collectivism and uncertainty avoidance as moderators role in UTAUT relationships. Notably, collectivist cultures exhibited stronger social influence effects on behavioral intention. Similarly, Tarhini et al., 2017 compared university students in Lebanon and the UK, revealing that social influence and facilitating conditions were more pronounced in the collectivist Lebanese context than in the individualistic UK, highlighting the cultural underpinnings of adoption drivers.

Building on this Merhi, 2021 explored e-commerce adoption in Pacific Asian nations, Malaysia, Indonesia and Singapore, identified power distance and uncertainty avoidance as key cultural moderators of UTAUT constructs. In particular, higher power distance was linked to greater social influence on adoption decisions, underscoring the role of hierarchical cultural norms. H. Li et al., 2019 further substantiated these findings through a meta-analysis spanning Asia, Europe, North America, confirming that individualism-collectivism and uncertainty avoidance consistently moderate core acceptance variables such as effort expectancy and social influence.

Considering small and medium-sized enterprises (SMEs), Oliveira and Martins, 2011 examined cloud computing adoption in Portugal and Brazil, demonstrating that masculinity and uncertainty avoidance influenced perceptions of facilitating conditions and effort expectancy. These findings underscore the importance of culturally attuned strategies in SME digital transformation. Complementing this, Xue et al., 2024 conducted a systematic review focused on East Asia, reaffirming that cultural dimensions like power distance and collectivism significantly shape technology acceptance, particularly in high-context cultures.

In summary, the literature review shows that cultural factors, especially individualism, power distance, and uncertainty avoidance, are crucial in determining how digital technologies are embraced in various national contexts. Cultural factors have been successfully added to frameworks like UTAUT and TAM to explain these adoption behaviors. A number of studies (e.g., N. Srite and Karahanna, 2006; Nistor et al., 2012; Merhi, 2021 ) have shown how national culture moderates important constructs like social influence and performance expectancy. The table 2.1's comparative insights highlight that, although UTAUT is still a strong model for analyzing the elements that influence digital adoption, its explanatory value greatly rises when supplemented with Hofstede's cultural dimensions, especially in cross-national studies. In spite of this, the majority of research has concentrated on either big businesses or certain industries like healthcare and education. Qualitative, comparative research that examines the interplay between these cultural and technical adoption variables in manufacturing SMEs, particularly with regard to open technologies like OSS, is conspicuously lacking. This study fills that gap by concentrating on Dutch and Indian SMEs and combining UTAUT with Hofstede's paradigm. It also offers a culturally aware viewpoint on digital adoption in various organizational contexts. The study contributes meaningfully to academic discourse and policy development, offering valuable guidance for enhancing digital transformation efforts in culturally diverse SME environments such as those in India and the Netherlands.

**Table 2.1:** Summary of Studies on Cultural Dimensions and Technology Adoption

| Study Name | Theoretical/ Conceptual Frameworks Used | Context of the Study (Place) | Key Findings | Limitations | Citations |
|---|---|---|---|---|---|
| The Unified Theory of Acceptance and Use of Technology in Education | UTAUT | Global (education sector) | Performance expectancy, effort expectancy, and social influence strongly affect technology acceptance in higher education. | Limited to higher education. | Xue et al., 2024 |
| Extending UTAUT with Competitive Pressure for SMEs' Digitalization Adoption | UTAUT, Competitive Pressure | Czech Republic, Slovakia | Performance expectancy, facilitating conditions, and competitive pressure affect SMEs' digitalization adoption. | Limited to two countries. | Kwarteng et al., 2023 |
| The Role of Culture in User Adoption of Mobile Applications for Health Self-management | UTAUT2, Hofstede's Cultural Dimensions | Global (conceptual framework) | Cultural dimensions such as individualism and power distance affect the adoption of mobile health apps. | Conceptual framework lacks empirical validation. | Jacobs-Basadien and Pather, 2022 |
| Multi-Country Analysis of E-commerce Adoption: The Impact of National Culture and Economic Development | Hofstede's Cultural Dimensions, UTAUT | 60 countries globally | Individualism is the most significant cultural dimension influencing e-commerce adoption; power distance also affects adoption, moderated by economic development. | Economic development moderating factor may not be universally applicable. | Merhi, 2021 |

| Study Name | Theoretical/ Conceptual Frameworks Used | Context of the Study (Place) | Key Findings | Limitations | Citations |
|---|---|---|---|---|---|
| The Unified Theory Acceptance and Use of Technology in the Industrial Internet of Things Era: A Conceptual Framework | UTAUT, Hofstede's Cultural Dimensions | Indonesia | Modifies UTAUT with Hofstede's cultural dimensions, highlighting significant impacts of performance expectancy, effort expectancy, and social influence on behavioral intention and use. | Conceptual framework not tested with empirical data. | Ridhwan and Purwanto, 2020 |
| The Adoption of Industry 4.0 Technologies in SMEs: Results of an International Study | UTAUT, Social Capital Theory | Central Europe (Czech Republic, Slovakia) | Stronger internal and external social capital enhances the adoption of Industry 4.0 technologies in SMEs. | Limited focus on only certain European regions. | Agostini and Nosella, 2019 |
| Examining the Moderating Effect of Individual-Level Cultural Values on Users' Acceptance of E-learning in Developing Countries | Extended Technology Acceptance Model, Hofstede's Cultural Dimensions | Lebanon (students) | Individual cultural values (masculinity, individualism) moderate the relationship between technology acceptance factors like usefulness and ease of use. | Focused only on one country (Lebanon). | Tarhini et al., 2017 |
| The Impact of Natural Culture on New Technology | Hofstede's Cultural Dimensions, Diffusion of Innovation Theory | Global | Power distance, uncertainty avoidance, individualism, and long-term orientation impact the adoption of new technology, but masculinity does not. | Masculinity's impact on technology adoption not significant. | Özbilen, 2017 |

| Study Name | Theoretical/ Conceptual Frameworks Used | Context of the Study (Place) | Key Findings | Limitations | Citations |
|---|---|---|---|---|---|
| The Influence of Organisation Culture on E-commerce Adoption | Organizational Culture Theory, UTAUT | Sri Lanka (SMEs) | Adhocracy culture positively correlates with e-commerce adoption; hierarchy culture negatively correlates. | Limited to Sri Lanka. | Senarathna et al., 2014 |
| The Influence of Cultural Dimension on ICT Acceptance in Indonesia Higher Learning Institution | UTAUT, Hofstede's Cultural Dimensions | Indonesia | PDI and IDV significantly affect constructs like perceived ease of use and usefulness, while UAI had no effect. | Focused only on higher education in Indonesia. | Sriwindono and Yahya, 2014 |
| The Impact of Cultural Differences on Technology Adoption | Hofstede's Cultural Dimensions, Diffusion Models | U.S., South Korea | Innovation is stronger in individualistic cultures (U.S.), while imitation is more pronounced in collectivistic cultures (South Korea). | Focused only on mobile phone adoption. | Lee et al., 2012 |
| Towards the Integration of Culture into the Unified Theory of Acceptance and Use of Technology | UTAUT, Hofstede's Cultural Dimensions | Germany, Romania | Cultural dimensions like individualism, masculinity, and uncertainty avoidance significantly influence educational technology acceptance behaviors. | Small sample size from two countries. | Nistor et al., 2012 |

| Study Name | Theoretical/ Conceptual Frameworks Used | Context of the Study (Place) | Key Findings | Limitations | Citations |
|---|---|---|---|---|---|
| Determinants of E-commerce Adoption by Small Firms in Portugal | TOE Framework (Technology-Organization-Environment) | Portugal (small firms) | Technology readiness, integration, and security applications (Technological); IT training, access to IT systems (Organizational); competitive pressure (Environmental). All significantly influence e-commerce adoption. | Focused on a single country and specific firm size; generalizability may be limited. | Oliveira and Martins, 2009 |
| Examining the Impact of Culture's Consequences: A Three-Decade Meta-Analysis of Hofstede's Cultural Value Dimensions | Hofstede's Cultural Dimensions | Global | Meta-analysis shows cultural values predict organizational outcomes, with individualism/collectivism and uncertainty avoidance being significant predictors. | Lack of country-specific data. | Taras et al., 2010 |
| The Role of Espoused National Cultural Values in Technology Acceptance | Extended TAM, Hofstede's Cultural Dimensions | China, U.S. | Cultural values such as masculinity/femininity and uncertainty avoidance influence technology acceptance and use. | Limited to two countries. | N. Srite and Karahanna, 2006 |
| Culture as an Explanation of Technology Acceptance Differences | Extended TAM, Hofstede's Cultural Dimensions | China, U.S. | Cultural values, especially uncertainty avoidance and masculinity, explain differences in technology acceptance behaviors. | Small sample and two-country comparison. | M. Srite, 2006 |

| Study Name | Theoretical/ Conceptual Frameworks Used | Context of the Study (Place) | Key Findings | Limitations | Citations |
|---|---|---|---|---|---|
| Testing the Technology Acceptance Model Across Cultures: A Three-Country Study | TAM, Hofstede's Cultural Dimensions | Japan, Switzerland, U.S. | TAM holds for the U.S. and Switzerland but not for Japan, highlighting the role of culture in technology acceptance. | Limited sample and focus on only three countries. | Straub et al., 1997 |

# 3

# Methodology

In this section, we shall discuss the methodology of the study. The section aims to elucidate the reader on the research design, sample characteristics, process of data collection and the subsequent data analysis. To address the complex nature of exploring digitalization in manufacturing SMEs across culturally diverse contexts, a qualitative approach is taken to conduct an in-depth study and get a nuanced understanding of the phenomenon, partly following Leso et al., 2022's method. Rather than focusing on statistical generalizability across a large population, the primary objective was to delve deeply into the "how" and "why" of digital adoption, especially within the cultural contexts of manufacturing SMEs in India and the Netherlands. To gain a better understanding of relatively unfamiliar themes, exploratory research was used. This approach opened possibilities of rich contextual insights and allowed for the identification of barriers, drivers and culturally contingent adoption patterns that may not be fully captured by existing theoretical frameworks. Unlike explanatory research, which seeks to validate ideas, exploratory research focuses on asking questions and discovering new insights. In this study, the thoughts of the participants regarding digital adoption in their respective SMEs were collected along with their cultural perspectives and experiences.

## 3.1. Research Design

Following a careful examination of the pertinent I began the first independent phase of the study by familiarizing themselves with the background information of the pertinent subjects. A targeted strategy and the establishment of a specific research demand were made possible by the procedure that was carried out, which revealed a number of research gaps. Furthermore, a conceptual model was developed to support the research's empirical focus. Following one of the strategies used by (Wu, 2012), this study used an inductive, adaptable, and practical research design, combining pre-existing theories with patterns found in the interview data while maintaining an exploratory core.

A qualitative research design was used to investigate the connection between cultural factors and adoption of technology in various nations. This method will offer a thorough investigation of intricate and situation-specific phenomena. Additionally, it improves comprehension of how cultural elements, such as power distance or uncertainty avoid-

ance, affect the processes of digital adoption Erumban and de Jong, 2006. Hence the selected approach matches the research objective of studying the dynammics between cultural differences and digital adoption in manufacturing SME's. Qualitative research allows for a flexible approach to extract richer and detailed insights from the participants of the study. This provides a crucial advantage for the study as the participants not only provide their perspectives but also provide additional, potentially overlooked data points that provide a complete idea about their experiences in their affiliated organizations.

Semi-structured interviews are utilized for conducting the study. In a semi-structured interview, researcher asks both open-ended and closed questions to the participant, frequently accompanied by related follow-up questions focusing on ”why” and ”how” of the topic in discussion. In this situation, it is typical to do individual interviews. The SSI is unusual in the sense that questions may be asked during the interview based on the progression of the discussion, giving the researcher the freedom to investigate other dimensions to the topic that may arise. As a result, it is critical to remain focused on the topic and ensure that the material gathered is applicable to the research. Individual opinions and ideas on a particular topic can be recorded from a properly chosen sample using SSIs (Adeoye-Olatunde & Olenik, 2021). Because it made it possible to design questions and follow-ups to elicit particular perspectives from participants, the method was especially relevant. It gave them the freedom to express their thoughts freely and without being restricted by preset answers. A deeper discussion based on the general atmosphere of the encounter was made possible by the flexibility of SSIs, which allowed participants and researchers to go into areas beyond the pre-established questions.

interview for the study lasted 45 to 60 minutes. To find out how people felt about digital adoption in their company, interviews were conducted. Questions concerning cultural attitudes were also asked of the participants. The MS Teams virtual meeting environment was used to conduct the interviews, and data was gathered for additional research. In order to comply with data privacy laws, participants were asked to sign a consent form prior to the interview. Interview questions were designed to explore culture and digital adoption leveraging the study's theoretical framework. Aligning questions with known theoretical frameworks and insights ensures appropriate and complete data collection. This methodological decision ensured a consistent link between the study's knowledge basis and the main data obtained. Appendix B.4 provides an interview guide, inspired by Hofstede's cultural dimension and UTAUT theoretical frameworks.

## 3.2. Sample Strategy and Data Collection

The sampling strategy employed in this study is based on non-probability, purposive sampling, aimed at selecting participants with significant expertise and firsthand experience in digitalisation. The companies chosen adhered to the EU SME definition mentioned in Chapter 1. The participants were affiliated to organizations operating as manufacturing SMEs in both India and the Netherlands, facilitating a cross-cultural comparative analysis. In order to ensure relevant expertise in SME digitalization, participants were chosen using a variety of professional networks, including direct outreach via LinkedIn and personal contacts within the industry.

| Interviewee | Role | Company size | Annual turnover | Gender [Male(M)\ Female (F)] | Age (yrs) | Industry |
|---|---|---|---|---|---|---|
| II1 | Business Manager | 25 | 1,5M | M | 25-30 | Industrial Machinery Manufacturing |
| II2 | Director | 160 | 4M | M | 25-30 | Industrial Machinery Manufacturing |
| II3 | Operational transformation | 200 | 6M | M | 30-35 | Industrial Machinery Manufacturing |
| II4 | Executive Director | 100 | 1,8M | F | 25-30 | Industrial Machinery Manufacturing |
| II5 | Technical sales engineer | 200 | 10M | M | 30-35 | Industrial Machinery Manufacturing |
| NL1 | Mechatronic Engineer | 25 | 15M | M | 25-30 | Automation Machinery Manufacturing |
| NL2 | Business Development | 85 | 2M | F | 40-45 | Industrial Machinery Manufacturing |
| NL3 | Operations Director | 13 | 1M | M | 30-35 | Renewable Energy Machinery Manufacturing |
| NL4 | Program Coordinator | 100 | 10M | M | 25-30 | Industrial Machinery Manufacturing |
| NL5 | Co-Founder/Product Developmer | 50 | 1.5M | M | 30-35 | Renewable Energy Machinery Manufacturing |

**Figure 3.1:** List of Interviewees

The final sample comprised approximately ten participants, five from each country, representing a range of managerial roles and organizational contexts as mentioned in 3.1. The sample size of ten interviews (five per country) is consistent with Guest et al., 2005, who found that thematic saturation can be reached within the first six to twelve interviews in homogenous groups. This study aimed for depth over breadth and thematic saturation was observed after nine interviews as no substantially new themes emerged Berger, 2013. Selection criteria prioritized individuals directly involved in digital technology implementation and decision-making processes. This focused approach was used to elicit context-specific insights directly aligned with the research objectives.

## 3.3. Data Analysis

Thematic analysis, which provides a methodical way to find patterns and arrange insights in the interview transcripts, was chosen as the main technique for analyzing the qualitative data. Widely recognized in qualitative research, thematic analysis facilitates the identification, interpretation and definition of recurring ideas, thereby enabling a concise yet meaningful organization of data for in-depth exploration. The foundational steps of this analytical method are informed by Braun and Clarke, 2006 widely cited framework present in figure 3.2.

To analyse the data, a hybrid coding strategy was employed, combining deductive and inductive techniques. First, inductive coding was used for the identification of new, unexpected themes immediately coming from the data themselves, later deductive coding was carried out utilising existing framework obtained from literature (Braun and Clarke, 2006; Pfaff et al., 2023). This multi-phase process began with a thorough review of the transcripts to identify salient ideas relating to digital adoption and cultural influences. Codes were then clustered into code groups and later, broader thematic categories.

*Steps of thematic analysis*

| Phase | Description of the process |
|---|---|
| 1. Familiarizing yourself with your data: | Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas. |
| 2. Generating initial codes: | Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code. |
| 3. Searching for themes: | Collating codes into potential themes, gathering all data relevant to each potential theme. |
| 4. Reviewing themes: | Checking if the themes work in relation to the coded extracts (Level 1) and the entire data set (Level 2), generating a thematic 'map' of the analysis. |
| 5. Defining and naming themes: | Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme. |
| 6. Producing the report: | The final opportunity for analysis. Selection of vivid, compelling extract examples, final analysis of selected extracts, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis. |

**Figure 3.2:** Thematic Analysis steps by Braun and Clarke, 2006, p. 87.

Thematic comparison across Indian and Dutch cases allowed for the identification of both shared and distinct patterns, enriching the cross-cultural dimension of the research. This comparative analysis was instrumental in revealing how cultural values may mediate digital adoption processes. Insights from the interview data were compared with findings from the literature review to reinforce the analytical depth and enhance the credibility of the conclusions. This synthesis offered additional layers of interpretation and helped contextualize the primary data within existing theoretical and empirical frameworks.

To support and streamline the analysis, the software ATLAS.ti (version 25) was used. This qualitative data analysis tool enabled effective management of large textual datasets by offering features such as code creation, segment linking and theme visualization. It also facilitated the organization of interview data, coding of specific text sections and the examination of interconnections between codes and themes. The platform's analytical tools allowed for efficient navigation, comparison and integration of findings throughout the coding stages. During the initial phase, the data was reviewed systematically and relevatn segments were assigned to code groups then themes were made based on a preliminary conceptual framework, Figure 3.4. At the same time, the inductive approach made it possible to incorporate previously unanticipated insights, enriching the final thematic structure and ensuring that the analysis remained open to new findings while grounded in existing research.

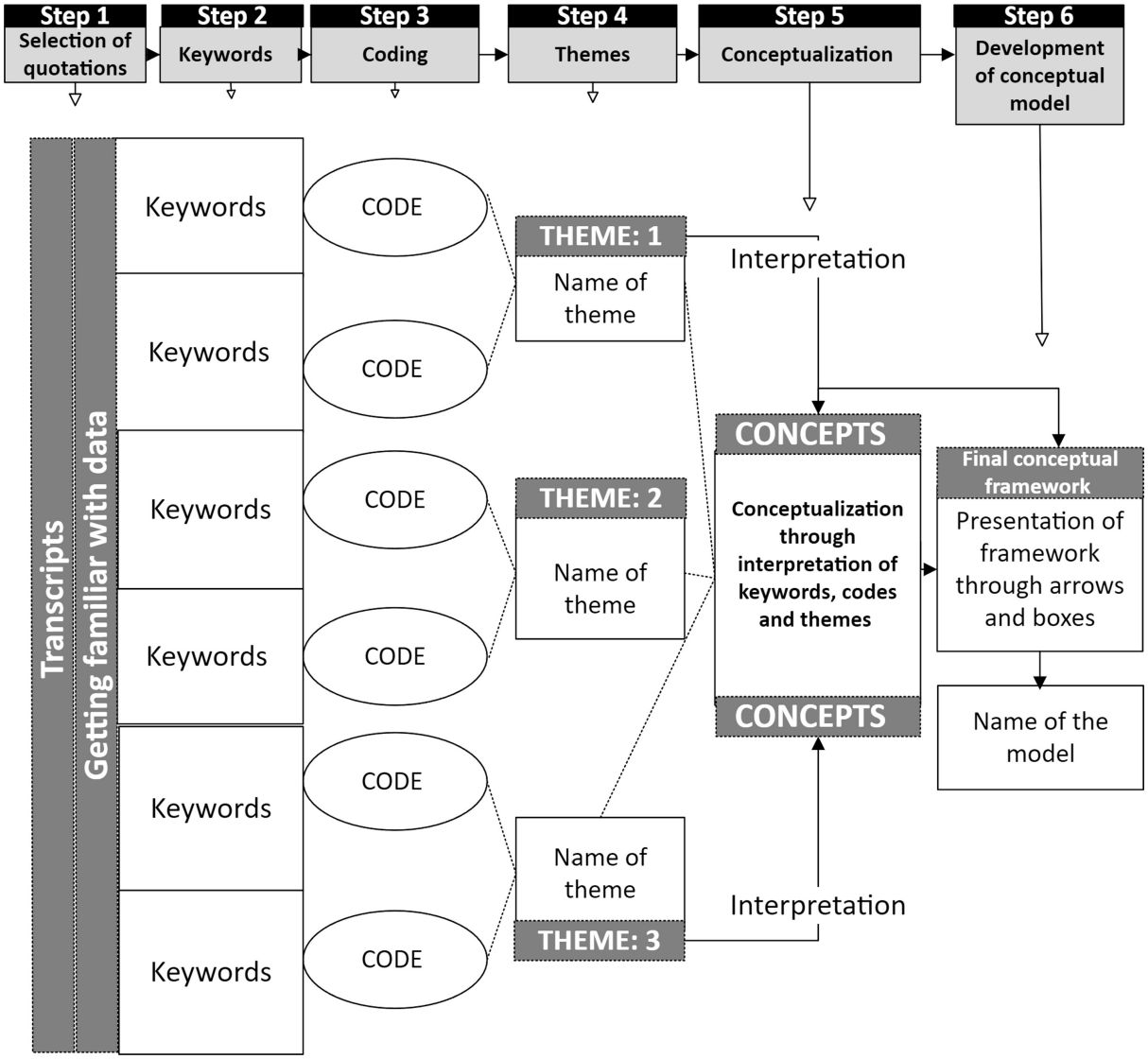


**Figure 3.3:** A systematic thematic analysis process; Naeem et al., 2023, p. 4.

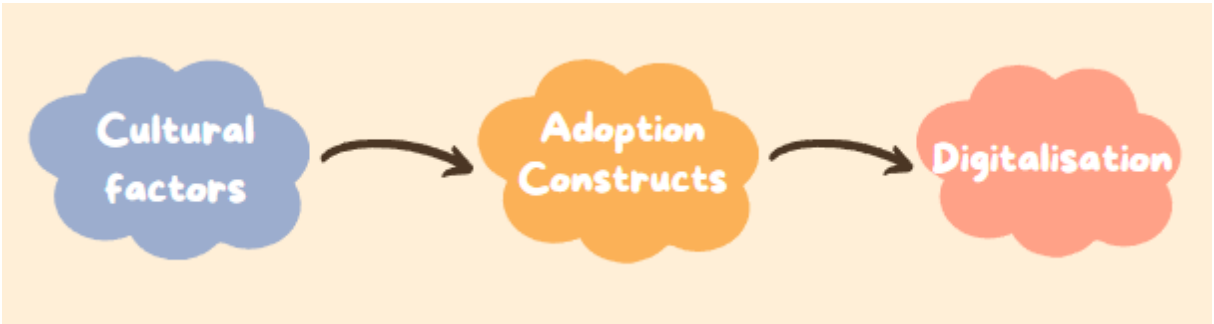


**Figure 3.4:** Preliminary framework

## 3.4. Ethical Considerations

ethical guidelines anticipated for qualitative, cross-cultural research with participants were followed in this work. Every interview was carried out in compliance with the moral standards set forth by the Human Research Ethics Committee (HREC) at TU Delft. All respondents received a thorough explanation of the study's objectives, the voluntary nature of their participation, and the intended use of their data prior to their participation. A formal informed consent form, B.1 was issued and signed by each participant prior to the interview. This document outlined the scope of the research, assured confidentiality, and specified that participants could withdraw at any point without consequence. Participants were also asked for explicit permission to audio-record the interviews and to use the transcribed data for analysis.

To comply with General Data Protection Regulation (GDPR) principles, all identifying information was anonymised during transcription. Company names, employee titles, and any sensitive operational details were removed or coded to prevent indirect identificationOnly the researcher and supervising team had access to the password-protected, encrypted drives where the data was safely kept.

This study made sure that the participants' privacy, autonomy, and dignity were respected throughout the research process (Orb et al., 2001). Reflexive sensitivity refers to the awareness and reflection on how a researcher's background, experiences, and perspectives may influence the research process and findings (Finlay, 2002). Reflexive sensitivity was maintained, especially given the cross-cultural nature of the study. In qualitative research, it is essential to acknowledge and mitigate potential biases that may arise from the researcher's positionality. To address this, I engaged in regular self-reflection throughout the data collection and analysis phases, ensuring that my interpretations remained grounded in the participants' experiences rather than my own preconceptions (Berger, 2013). Care was taken to avoid leading questions, cultural stereotyping or power imbalances during interviews. As recommended by Tracy, 2010, the research design emphasized transparency, ethical credibility and care in the treatment of both data and participants.

The nature of the topic, digital adoption in SMEs, was not considered high-risk, but still required ethical diligence given the potential sensitivities around organisational strategy and internal decision-making. For this reason, participants were assured that no direct quotations would be attributed without anonymisation and that all data would be used strictly for academic purposes.

# 4

# Findings

In this section we present the findings from 10 semi-structured interviews conducted The transcripts were Inductively coded and then deductively analysed. Initially there were 112 codes and merged to 66 codes to remove repetitiveness or overlapping. These codes were then grouped into 13 code group that broadly meant the same, 7 for each country, with one overlap. The codes were also used to understand the digital tools used, driver and barriers in each country and the culture within the companies of each country. Each section below tackles a research question this thesis set to answer.

## 4.1. Digital Manufacturing Landscape

To explore which digital technologies manufacturing SMEs in the Netherlands and India are adopting as part of their Industry 4.0 transformation, we conducted 10 semi-structured interviews with key decision-makers from both countries. During these interviews, we asked about the hardware and software tools they use within their organisation for various purposes such as customer engagement, manufacturing, business process management and more. After carefully analyzing and deductively coding the interview transcripts to capture every technology mentioned, we grouped the findings into five main functional categories: ERP, specialized design tools, CRM, AI, Automated machinery and Data Analysis & Simulation.

### 4.1.1. Technologies used in the India

Before branching out into shop-floor automation and design, small and medium-sized manufacturers in India usually start their digital journey by focusing on basic back-office functions like inventory, billing, accounting and customer administration. ERP systems, automated machinery, specialized design and CRM technologies are the main technology clusters identified by our respondents. These are not very supportive of Open source softwares due to data security, compatibility and authority related issue

*II3: "Data security when you are using open source, there is nobody here in terms of.There is no company in front of you to take the responsibility of the security of the data that you probably be putting in"*

*II4: "I realised the the benefits of building custom software far outweigh me relying on a 3rd party software."*

### Enterprise, Resource Planning (ERP)

Majority of small Indian manufacturers don't immediately adopt expensive software solutions rather, they choose low-cost, entry-level ERP programs. They consider them to be the company's basic digital "backbone." With that foundation in place, the same tool is used by everyone, from the finance desk to the shop floor, to: Keep track of stock, billing and order recording and to manage accounts to reduce inefficiencies at the end of the month by seeing all of the money coming in and going out in one location.

*II2: "And if I am using ERP software or any kind of set software so that would be that is beneficial for me to track my inventory to track my data, to track my losses"*

*II3: ".....Obviously transitions into a data line for the ERP, so leads and then the details are put in the order goes through from the customer"*

Tally is a famous choice of most Indian SMEs from our sample as their finance-focused system.

*II2:"Tally is basically for financing." II4: "..... that has been prevalent since for several years is tally.*"

In addition to accounting, interviewees have integrated modular resource-management tools onto these systems to automate invoicing, track stock movements and record sales orders. One workshop manager made the following observation:

*II1:"We have some process-management tools…to manage inventory, stocks and everything. That helped us streamline the inventory management and then billing process as well."*

By replacing manual Excel-based records with a single source of truth, these lean ERP deployments help businesses improve data accuracy and make decisions faster.
P. Sharma, 2014

### Specialised Design technologies

Indian manufacturers use specialized programs for design and engineering in addition to ERP and shop floor automation. For quick prototyping and 3D modeling they often use FreeCAD and AutoCAD, Hypermil, and Fusion 360.

*II3: "Digital platforms with respect to the design content because we are very much engineering heavy company"*

*II4: "So we use a CAD/CAM software. AutoCAD Fusion 360 Hypermil."*

*II4: "Just say for example in AutoCAD. So if we if we have a premium one"*

*II1: other than that we have design automation processes as well where major of our designs are.*

These technologies help companies design 2D/3D drawings that can be further used for manufacturing or feeding into teh automated machinery Subramanian et al., 2019

### CRM

Indian manufacturers use specialized programs for customer relationship management, to track leads and improve customer interactions. It is mostly used by sales and marketing department.

*II5: "If you talk about the manufacturing units and an organization, so basically they are using CRM, SAP"*

*II3: "We we use CRM for capturing the lead and....*

*II5: "Month in a month 20 to 25 days we we got the sales we we we getting get lots of inquiries from that area"*

CRM systems as implied by the interviewees, help improve customer loyalty, satisfaction and retention, by managing data and automating processes to personalise communications.

### Automated Machinery

A rising number of Indian SMEs have started integrating CNC machines and other automated manufacturing equipment to increase throughput and quality consistency, even though comprehensive Industry 4.0 deployments are still in their early stages. In the words of one interviewee:

*II1: "For Manufacturing we have Automated machinery like CNC which we have prepared from outside"*

*II5: "They are also playing a vital role because if you do a doing a mass production then you just need to adopt the automated lines ...."*

Companies claim to have decreased lead time by combining programmable machine tools with simple process-management software. Even a partial adoption of CNC technology is seen as a crucial step toward increased operational efficiency, even though investment in automation is still limited.

### Conclusion

Major technologies show up when we map the digital technologies as seen in the Figure 4.1, mentioned by Indian manufacturing SMEs based on the frequency of their appearance in transcripts, Appendix**??**. Using Schönfuß et al., 2021's catalogue Appendix A.1, the ERP-based order-entry and stock-tracking modules of inexpensive systems like Tally or entry-level Odoo are the main means of recording each sale, inventory movement and invoicing in a single ledger. This is the first example of Data

Acquisition & Collection. Second, no companies have yet to implement specialized predictive-maintenance or simulation software. Data Analysis is only present in the form of rudimentary, built-in reporting and dashboard functionalities within these ERPs and process-management tools, allowing month-end sales comparisons or stock-turn measures.Last but not least, support systems include the entire range of core ERP platforms, modular extensions for inventory, billing and work-order processes, shop-floor automation through CNC machines and programmable tools and specialized add-ons like cloud-based CRM (Zoho CRM) and CAD packages (FreeCAD/AutoCAD). Support Systems are by far the most common of these three. Before pursuing stand-alone data collection or advanced analytics solutions, Indian SMEs overwhelmingly place a higher priority on developing a transactional and operational backbone, replacing manual Excel registers with automated operations.

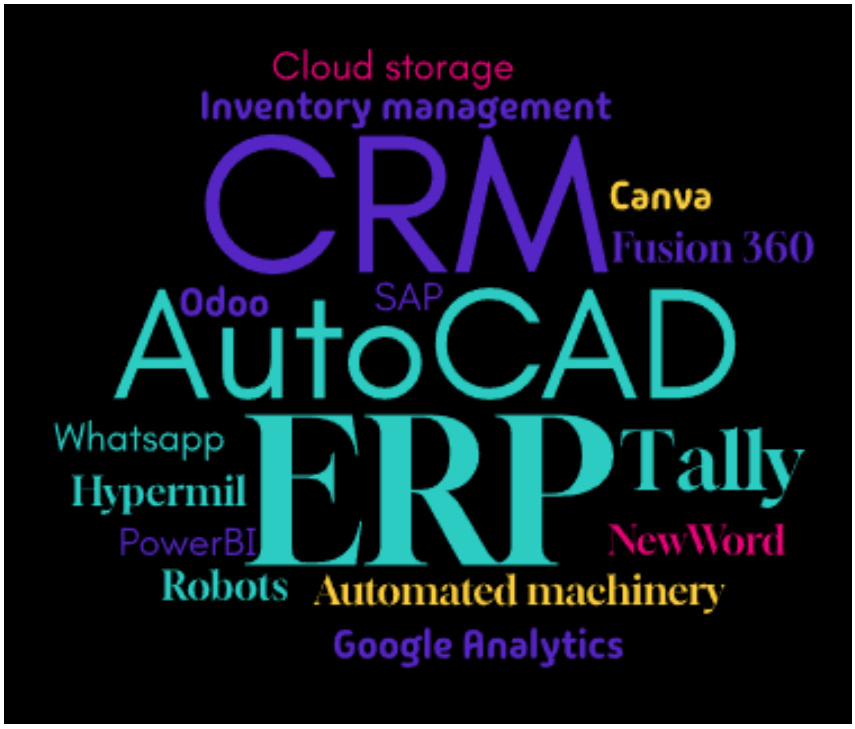


**Figure 4.1:** Digital tools used in Indian manufacturing SMEs

### 4.1.2. Techonlogies used in the netherlands

Based on our interviews, Dutch manufacturing SMEs deploy digital tools across four functional clusters: ERP, CRM, Data Analysis & Simulation and AI. Interviews suggested openness to open source softwares in order to make them as the base of their company softwares as discussed at the start of section 4.1.

#### Enterprise Resource Planning(ERP)

Commercial or open-source ERP solutions are frequently used by Dutch SMEs as the foundation of their operations. Ordering, billing, purchasing and inventory are all centralized via these systems.

*NL3:"We implemented Exact Online at first… last year I switched to Odoo…"*

*NL4:"So we use a local ERP… once open source… called OpenBravo. We've invested in this since 2011."*

*NL2: "We use business central. Which is from from Microsoft and we do all our orders..invoice in it."*

As businesses grow, paid licenses replace early experiments with free or entry-level tiers (Exact Online, Odoo Community), demonstrating a practical balance between cost-control and capabilities.

### Customer Relation Management (CRM)

Dutch businesses choose cloud-based CRM solutions that link seamlessly with their ERP for front-office and sales pipeline operations.

*NL1:"For the commercial side… we use HubSpot which is… commercially quite robust."*

*NL4:"When we started to invest our energy and attention to… Pipedrive, which is our CRM."*

These solutions provide smooth data flow from marketing to fulfillment by ingesting leads, managing contacts and sending qualifying orders to the ERP.

### Data Analysis and Simulation:

Many Dutch SMEs use specialized analytical and simulation tools in addition to transactional reporting to anticipate performance, optimize designs and model processes.

*NL1:"Our main design tool is SolidWorks… then we also use a software called Abaqus, which is done to simulate SIM."*

*NL5:"I'm talking for developing products… at the core we have SolidWorks and… OrcaFlex."*

In addition to integrated ERP dashboards, simulators (Abacus, OrcaFlex) allow these companies for virtual testing of production layouts and stress evaluations prior to shop floor implementation.

### Artificial Intelligence

SMEs are experimenting with AI in both back-office and customer-facing settings, although its use has not been very extensive in terms of transforming business processes.

*NL3:"I think the AI tools that are available… as an external help desk… work wonderfully."*

*NL5:"I think the biggest thing at the moment is the use of AI."*

Use scenarios include generative design assistants in CAD systems, help with basic coding, automated document classification in SharePoint and chat-based help for ERP inquiries.

### 4.1.3. Conclusion

The digital tools used by Dutch SMEs as seen in 4.2, based on the frequency of their appearance in transcripts, AppendixC.4. Using Schönfuß et al., 2021's catalogue Appendix A.1, Support Systems, which include the extensive ERP/MES backbone, CAD/-CAM suites (SolidWorks, HyperMill), shop-floor CNC interfaces and collaboration platforms (OneDrive, Teams, SharePoint); Data Acquisition & Collection, through ERP order-entry modules (OpenBravo, Exact Online, Business Central); and CRM lead forms (HubSpot, Pipedrive); and Data Analysis, through embedded ERP dashboards and standalone simulation packages (Abaqus, OrcaFlex); and emerging AI-driven analytics assistants.

*NL1: "We communication like Outlook, OneDrive, teams, those are the main communication tools."*

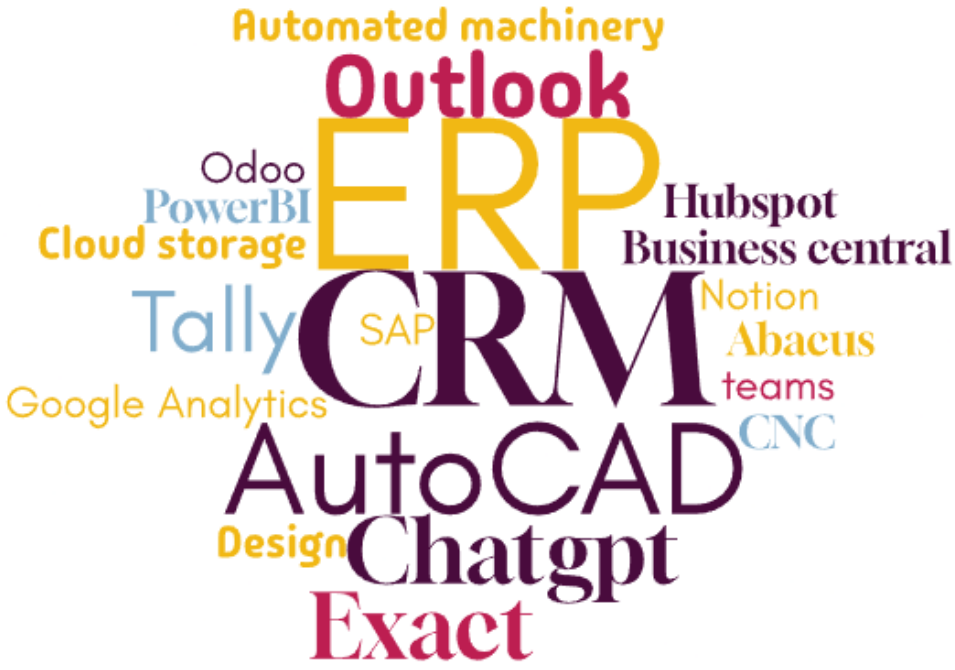


**Figure 4.2:** Digital tools used in Dutch manufacturing SMEs

### 4.1.4. Open-Source Software Adoption in India vs. the Netherlands

The function and resilience of open-source software (OSS) represent a significant difference between the two domains. OSS products are moderately tested by SMEs in India as a low-risk entry point.

*II1:"We initially start with open source… so that the employees get comfortable with using the new technology and then we move on to the fully paid version."*

*II2: "with Odoo but yeah they are also good company but that was not suitable for what we are doing or what we wanted that's why we didn't pass to those but."*

In this case, open source software (OSS) mostly acts as a training medium; businesses

employ community-supported modules to gain experience before purchasing commercial licenses for the same platform. As a result, when funds permit, proprietary updates frequently replace pure OSS implementations (Stefanou, 2014). Indian SMEs have security issues and it not being comprehensive with other technologies.

*II1: "So what we do is we take those open source software for training purpose so that the employees get comfortable with using the new technology and get then we move on to the fully paid version or something that is really helpful."*

Dutch SMEs, on the other hand, have a longer-lasting, engineering-driven fondness for OSS. A number of answers highlighted how they have been modifying and expanding open-source cores for many years.

*NL1:"The own tools we make, we usually base them off another open-source tool… we're very open to it and we're doing it."*

*NL4:"We use a local ERP… once open source… called OpenBravo. We've invested in this since 2011."*

Instead of being just a prelude to commercial software, open source software (OSS) is still a viable strategic option in the Netherlands since it promotes interoperability, reduces total cost of ownership and permits more extensive in-house modifications. Dutch SMEs are often open to OSS as compared to India. Furthermore, higher level of OSS and technology adoption is seen in Dutch manufacturing SMEs. Indian SMEs rather focus on building softwares and hardware customized to their needs.

**Table 4.1:** Solution Areas Mapped to Schönfuß et al., 2021's Categories

| **Category** | **Solution Area(s)** |
|---|---|
| Data Acquisition & Collection | Customer and demand data gathering and analysis |
| Data Analysis | Predictive equipment maintenance |
| | Simulation of tools & processes for virtual process planning |
| Support Systems | Integrated information system between design & production operations |
| | Digital management architecture (ERP & MES / cloud-based ERP) |
| | Digital manufacturing project-management system |
| | Digital purchase-order management system |
| | Digital sales-order management system |
| | Digital methods for employee training (webinars, VR, AR) |
| | Digital works-order management system |
| | Digitised work instructions, photos & assembly procedures |

### 4.1.5. Conclusion

Table 4.1 summarizes the different areas digital tool are used in in manufacturing SMEs in both the countries. Majority of the tools used are related to support system, example the ERP and CRM systems. Machinery automation is seen in a few companies but it is still not very prevelant among manufacturing SMEs due to cost benefit analysis not favouring its uptake.

*NL4: "I think at the moment it's just incremental changes..... where your volume is like on a certain level. Then you can say OK, let's start off... Let's see if we can automate it."*

## 4.2. Relevant Cultural Factors across Netherlands and India

To address Sub-Research Question 2, *What are the relevant cultural factors that influence digital adoption in manufacturing SMEs in India and the Netherlands?*, we draw on insights from ten semi-structured interviews, comprising five participants from each country. This section begins by outlining our coding methodology, which was used to systematically categorize code into code groups representing cultural themes emerging from the interviews. The code group are then explained for better understanding their use in the following subsection. We then present country-specific tables that summarize the key cultural code-groups, each supported by illustrative quotations from the interviewees. Finally, we offer a side-by-side comparative analysis and an interpretive narrative that highlights both shared and divergent cultural dynamics that are the most relevant while comprehending the influence of digital technology adoption in the two national contexts.

### 4.2.1. From initial codes to cultural code groups

To understand the cultural factors influencing digital technology adoption in manufacturing SMEs, we conducted a mixture of deductive and inductive coding, of ten semi-structured interviews, five from India and five from the Netherlands. This approach allowed us to iteratively move between empirical data and theoretical concepts, refining our understanding of how culture differs between countries in relation to digilatisation.

Our analysis followed these steps:

1. Open Coding: Each transcript was open-coded to capture all instances of culture-related discourse. Codes included references to themes such as "authority," "training," and "competition."
2. Code Grouping: Synonymous or closely related codes were merged into higher-order code groups. For example, "Age-related resistance" and "General hesitation" were consolidated under the broader category of Risk & Resistance.
3. Validation: Each code group was validated against multiple excerpts. To ensure analytical robustness, we retained only those groups supported by at least two distinct quotations.

4. Naming and Thematization: Each validated group was named to reflect a core cultural dimension that conditions digital-technology adoption.

Through this process, we identified seven broad shared cultural code-groups across both national contexts: Hierarchy, Communication Style, Learning & Experimentation, Motivation & Strategic Orientation, Risk & Resistance, External Influence and Autonomy vs. Collective Cohesion. Definitions for each are provided in 4.2, which are used further in the paper.

**Table 4.2:** Definitions of Cultural Code-Groups

| Culture-groups | Definition |
|---|---|
| Hierarchy | The degree to which power is centralized in formal authority figures (CEOs, Operations Manager) and how top-down mandates shape decision-making and resource allocation. |
| Communication Style | The prevailing norms around information flow and dialogue, how transparently ideas travel across levels and how inclusively stakeholders (from executives to shop-floor workers) are engaged. |
| Autonomy vs. Collective Cohesion | The tension between self-reliant initiative, where individuals champion and self-direct tool uptake and group-oriented collaboration, where patience, shared troubleshooting and bottom-up involvement ensure collective progress. |
| Learning & Experimentation | The collective appetite for hands-on trials, pilot projects, formal training and iterative problem-solving as a way to reduce ambiguity and build collective competency. |
| Motivation & Strategic Orientation | The orientation toward performance outcomes, whether driven by short-term return-on-investment (ROI) goals, competitive positioning or long-term vision and strategic continuity. |
| Risk & Resistance | The cultural tolerance (or intolerance) for uncertainty and change, reflected in staff anxieties, generational divides and the willingness (or reluctance) to embrace novel practices. |
| External Influence | The extent to which organizations look outward, to customers, competitors, government bodies or vendors, for signals, pressure or support in their innovation journey. |

Using these cultural themes, we will provide an analysis of the interviews.

### 4.2.2. Culture: Indian manufacturing SMEs

In Indian manufacturing SMEs, digitalisation initiatives is often supported by cultural values that emphasize collaboration, such as patience and cooperative problem-solving. These efforts are further reinforced by a hierarchical organizational structure, where both senior leaders and frontline workers play active roles in decision-making while following the multi-leveled structure of authority. Strategic changes, particularly the shift from service-oriented to product-focused business models, are largely influenced by external factors, including increased market competition and evolving customer demands. The emphasis on delivering fast, structured training sessions and clear question-and-answer formats reflects a cultural preference for less ambiguity and ensuring clarity. At the same time, the drive to build new capabilities is motivated by a strong focus on performance and continuous improvement reaching a long-term goal. These findings are presenting in the table 4.3 along with quotations from the transcripts that support our results.

**Table 4.3:** India: Cultural Dimensions & Illustrative Quotations

| Dimension | Illustrative Quotations |
|---|---|
| **Hierarchy** | "*II2: We keep it a leadership base decision making her because as a top management we take a decision for the whole company, right*"<br>"*II1: So majorly the upper management is involved in this decision so. We have the directors of the company, who generally are more involved towards these kind of decisions. Majorly on the financial side.*" |
| **Communication Style** | "*II4: .....there was a lot of transparency, any manager can access our financial data. There's no hiding of any of it.*"<br>"*II5: But in case if you have some good ideas or some initiative or if you want to speak so we are open to speak.....*" |
| **Collective Cohesion** | *II1: "From that we have some knowledge transfers, so some of our employees are really skillful in their, in their particular area."*<br>*II4: "So for me my learning has been I have to be more patient because I am essentially changing their 20 years of operating."* |
| **Learning & Experimentation** | *II2: "We tried to first, as I said, we tried to create awareness. Then second, we keep small training sessions"*<br>*II3:"prepare for the migration on the training program. They run parallelly so we completed the training program."* |
| **Motivation & Long term Orientation** | *II4: "Competition definitely plays a big role… we're now thinking how to move from a service shop to a product-first model like our peers."*<br>*II1:"So they are quite a significant role and it saves us a lot of Money."* |
| **Risk & Resistance** | *II1: "So the education level there is very low and people are not very familiar with using these kind of softwares."*<br>*II3:"there was some mental blocks that a person had to overcome and it comes to your team members because nobody likes change in their day to day work."* |
| **External Influence** | II4:"One its customer driven you know customer says I am not going to give you this big ticket project if you cannot begin using an ERP then they are forced to make that transition"<br>*II4:"the introduction of automated machinery was happened due to some of the neighboring companies"* |

### 4.2.3. Culture: Dutch manufacturing SMEs

In Dutch manufacturing SMEs, digital adoption is shaped by a blend of moderate hierarchical structures and a strong individualistic culture. Rather than relying heavily on top-down control or formal training programs, these firms place trust in skilled employees to manage their own learning and implementation processes. This self-directed approach reflects a broader cultural emphasis on autonomy and personal responsibility.

A common mindset among these firms is “practice until proficient,” where employees are expected to learn by doing. This hands-on learning style helps reduce the risks typically associated with onboarding new technologies, as it encourages gradual, experience-based mastery. Strategic decisions about which digital tools to adopt are often driven bya mix of short and long-term performance goals, ensuring that new technologies deliver immediate, measurable value.

External support mechanisms, such as service provider-led training or government subsidies, play a relatively minor role in the Dutch context. This limited reliance on outside assistance reflects both a high degree of organizational independence and a pragmatic approach to resource use, where firms prefer to invest in tools and processes that align closely with their internal capabilities and strategic priorities. This is further supported with exceprts from the interview transcripts and presented in 4.4

**Table 4.4:** Netherlands: Cultural Dimensions & Illustrative Quotations

| Dimension | Illustrative Quotations |
|---|---|
| **Hierarchy** | *NL1:"We're a very flat company....founders and board make the big decisions, then it's flat among engineers."* *NL4:"In production we have quality manuals and safety regulations....there's a required hierarchy, but as a culture we really try to operate as flat as possible."* |
| **Communication Style** | *NL2:".... But even the highest even Bob the CEO is very accessible.... All the bosses were there...You know you can say everything you it's really it's so much."* *NL3:"let's just keep the feedback, get the feedback and keep on improving. And we we've also built in a couple of feedback loops to make sure that we get all the feedback we need."* |
| **Autonomy** | *NL1:"Engineers choose their own tools....if I want an open-source package, no one higher up can say no."* NL5:"So you need these tools. So I was able to hire people for the tool and with experience in that tool..." |
| **Learning & Experimentation** | *NL1:"If there is good documentation ....We would value that higher than, say, a cheaper product that's that's harder to integrate."* *NL4:"What they do is...trainings are being taken....transcript it into paperwork..... of shortcuts in the steps you need to take to enter an order, enter a quote, and it's all placed on SharePoint."* |
| **Motivation & Short-term Orientation** | *NL1:"We need to be focusing on what we're doing and what we what we want to achieve"* *NL3:"I think short term pain .... but so if you have a tool which is gonna be short term pain but long term gain that will be very hard to accept by the people who are going to use it."* |
| **Risk & Resistance** | *NL1:"very open towards new tools and the more tools the better as long as there is a choice to to implement them or not"* *NL2:"..... because he is 57 or whatever. He doesn't know how it works and he's also not open to it,"* |
| **External Influencer** | *NL5". I'm not sure.....Overtly influenced by, for example, competitors or customers. I think this is just you're you're we're working, we see inefficiency and we improve....."* *NL2:"It has so for digital tool selection I have not come across anywhere where government support has been in factor."* |

### 4.2.4. Comparative Overview of culture among manufacturing SMEs: India vs the Netherlands

Both Indian and Dutch manufacturing SMEs demonstrate the presence of seven key cultural dimensions that influence digital technology adoption: Hierarchy, Communication Style, Autonomy vs. Collective Cohesion, Learning & Experimentation, Motivation & Strategic Orientation, Risk & Resistance and External Influencer. However, the way these dimensions are expressed and combined, differs significantly between the two national contexts.

In Indian SMEs, a strong top-down hierarchy is paired with a collectivist mindset. Decision-making typically flows from senior factory managers and successful adoption of new technologies depends heavily on group-based cooperation, patience and shared problem-solving. These efforts are supported by structured training sessions and rapid-response Q&A formats, which help reduce uncertainty and build confidence. External pressures, particularly from competitors and customers, play a major role in shaping digital strategies. Overall, Indian firms tend to adopt new tools cautiously and incrementally, reflecting a cultural preference for minimizing risk and ensuring stability.

In contrast, Dutch SMEs operate with a more balanced hierarchical structure and a strong emphasis on individual autonomy. Employees, particularly engineers and technical staff, are trusted to independently select and master new tools, often with minimal formal training. Learning is largely experiential, supported by a “learn-by-doing” approach. Motivation is closely tied to short-term performance outcomes and personal initiative and younger staff are often encouraged to take calculated risks but instances of long-term orientation makes it difficult to choose one. External influences such as service provider support, government subsidies, or market signals are present but play a relatively minor role, reflecting a culture of self-reliance and pragmatic resource use.

Taken together, these findings suggest that while Indian and Dutch SMEs share the same cultural building blocks, they configure them in distinct ways. Indian firms emphasize collective, structured approaches under strong hierarchical and competitive pressures, whereas Dutch firms favor individual, experiential methods supported by moderate control and high levels of autonomy. 4.5 presents a side-by-side comparision.

### 4.2.5. Conclusion

Our analysis of ten semi-structured interviews with Indian and Dutch manufacturing SMEs has revealed seven key cultural dimensions that consistently shape how digital technologies are adopted: Hierarchy, Communication Style, Autonomy vs. Collective Cohesion, Learning & Experimentation, Motivation & Strategic Orientation, Risk & Resistance and External Influencer. While these dimensions are present in both national contexts, they are configured in distinct ways that reflect broader cultural norms and organizational practices.

In Indian SMEs, a high-authority driven and collectivist culture results in a top-down decision-making structure, where senior managers lead adoption efforts and frontline teams rely on structured training, shared problem-solving and clear communication.

**Table 4.5:** Comparative Cultural Dimensions in Indian and Dutch SMEs

| Code-Group | India (Collectivist Context) | Netherlands (Individualist Context) |
|---|---|---|
| Hierarchy | Top-down decision authority with production managers leading mandates | Moderate hierarchy balanced by managerial self-reflection |
| Communication Style | Data-driven transparency across levels | Positive framing to gain buy-in |
| Autonomy vs. Collective Cohesion | Emphasis on group patience and shared resilience | Focus on personal skill and autonomy |
| Learning & Experimentation | Structured training + quick Q&A cycles | On-the-job practice over formal instruction |
| Motivation & Strategic Orientation | Competition-led shift to product strategies | Short-term results and long-term investments |
| Risk & Resistance | Hesitation without preparation; high resistance | Generational divide but overall open to new technology |
| External Influence | Customers & competitors are external drivers; reliance on market research | Minimal external drivers; low dependency on government aid |

Competitive market pressures and customer demands act as strong external motivators, while a preference for minimizing uncertainty leads to a cautious, step-by-step approach to implementing new technologies by depending on pilot testing and various internal and external training programs.

In contrast, Dutch SMEs operate within a moderate-authority driven, individualistic culture. Employees are granted autonomy to explore and adopt tools independently, often learning through hands-on experimentation rather than entirely depending on formal training. Uptake is driven by short-term performance goals and personal initiative, with younger staff encouraged to take calculated risks. External supports such as vendor input or government subsidies play a more limited role, reflecting a culture of self-reliance and pragmatic resource use.

These findings directly address Sub Research Question 2 by identifying the cultural dimensions that influence digital adoption in each national setting. They provide a nuanced understanding of how cultural context shapes organizational behavior and decision-making around technology.

These insights also lay the foundation for the next section, where we turn to Sub-Research Question 3, which explores the barriers and drivers of digital adoption in SMEs across the two countries. Building on the cultural configurations identified here, we will examine what are the enablers or obstacles to the journey of digitalization in manufacturing SMEs and how these dynamics differ between the Indian and Dutch

contexts.

## 4.3. Enablers and Hinderer's of Digital Adoption

This section addresses Sub-Research Question 3: What are the different barriers and drivers of digital adoption in SMEs in India and the Netherlands? Building on analysis of the transcripts and coding, we systematically reviewed all interview data to identify factors that either enabled and hindered digital adoption. Each relevant excerpt was tagged as a Driver (enabler) or Barrier (obstacle), allowing us to trace patterns across both national contexts.

To structure the analysis, we clustered these coded insights into six overarching categories that emerged consistently across the dataset:

- Leadership & Governance – the role of top management, decision-making structures and leadership commitment.
- Training & Skill Development – access to digital skills, learning opportunities and workforce readiness.
- Financial & Resource Constraints – budget limitations, cost-benefit considerations and access to funding.
- Market & Competitive Pressure – external forces such as customer expectations, industry benchmarks and peer competition.
- Technical & Infrastructure – availability and reliability of digital tools, systems integration and IT support.
- Cultural Resistance & Uncertainty – attitudes toward change, generational divides and risk tolerance.

These categories provide a lens through which we compared the Indian and Dutch SME experiences. By examining how each factor operates as a barrier or driver in the two contexts, we gain a deeper understanding of the structural and cultural conditions that shape digital transformation. The following analysis highlights key contrasts and commonalities, offering insight into the practical and contextual challenges that SMEs face as they navigate their digital journeys.

### 4.3.1. Enablers and obstacles for indian manufacturing SMEs during digitalisation

According to Table 4.6 in Indian manufacturing SMEs, digital adoption is influenced by a mix of supportive and challenging factors. Strong leadership often plays a key role in setting the direction for digital change and many firms invest in structured training programs to help employees adapt (Gibreel et al., 2024). The use of affordable, open-source tools also makes it easier for smaller firms to begin their digital journey. (Stefanou, 2014) In addition, pressure from customers and competitors encourages companies to modernize their operations.

However, several barriers remain. Financial decisions are often tightly controlled, which can slow down or limit investment in new technologies. Many firms also struggle with technical issues, especially when trying to connect older systems with newer digital tools. Finally, some senior staff are hesitant to change long-standing practices, which can create resistance to adopting new technologies (Horváth & Szabó, 2019).

**Table 4.6:** Drivers and Barriers of Digital Adoption: IN vs NL

| Category | Type | India | Netherlands |
|---|---|---|---|
| Leadership & Governance | Driver | Open governance-Driven Adoption<br>II4: *"Being a data first company .....And also having empowering our not just top management but also our middle management practically."* | Executive Sponsorship<br>NL3: *"Large decisions like switching to Odoo… I pitched that to our CEO and he gave the final approval on that."* |
| Leadership & Governance | Barrier | Decision-Making Bottleneck<br>*II3: "There is a somebody who is a boss or for somebody, right? So you you eventually end up having yes..... it doesn't work out because at the end of the day they are not adopted....."* | Lack of Balance in Authority<br>*NL3: ".....So somewhere in in between, It's a mix. Well, I think this company has struggled with it....."*<br>*NL4: "...transitioning people away from old technologies onto new ones because we do try to be flat we don't really make a forced effort sometimes, right..."* |
| Training & Skill Development | Driver | Structured Training<br>*II1: "We tried to first.....we tried to create awareness. Then second, we keep small training sessions"*<br>*II4: "we definitely bring in consultants to physically training classroom training workshops...."* | Hands-on Training<br>*NL3: ".....get the feedback and keep on improving. And we we've also built in a couple of feedback loops ....."*<br>*NL2: "If you if you take one or 2 employees who really know how automation works and have to work with it and let them play with it and then testing, testing, testing...."* |

*Continued on next page…*

*Table 4.6 continued from previous page…*

| Category | Type | India | Netherlands |
|---|---|---|---|
| Training & Skill Development | Barrier | Skill Resistance<br>*II3: "we have some knowledge transfers, ..... we dedicate some time from those employees to train the incoming new/old employees."* | Personal priorities<br>*NL2: "He is 57 or whatever… he doesn't know how it works and he's also not open to it."*<br>*NL4: "So if they have a issue on the production or on the workforce, then that's going to take priority over training...."* |
| Financial & Resource Constraints | Driver | Subsidy & Freemium Adoption<br>*II1: "Yes, we initially start with open-source softwares as training… then move to paid versions that really help."*<br>*II3: "Government grants are available if you follow the procedures...money is there if you know how to use it."* | OSS Utilization<br>*NL1: "The own tools we make, we usually base them off, another open source tool or something like that. ...."* |
| Financial & Resource Constraints | Barrier | Budget Constraints<br>*II3: "SMEs focus highly on cost… some hesitate to spend until ROI is clear."*<br>*II5: "If the investment doesn't pay off quickly, managers will push back on further roll-out."* | Tied-Up Budgets<br>*NL3: "So money is basically always tied."*<br>*NL1: "I think licensing is quite a a a big part..... like you only have so much capital you can spend on licensing."* |
| Market & Competitive Pressure | Driver | Customer & Competitor Pressure<br>*II1: "the introduction of automated machinery was happened due to some of the neighboring companies"*<br>*II2: "As of now, digitalization, use of AI or software is the next is the upcoming thing. So the sooner we imply those kind of things in our companies, the faster we will grow."* | Customer-Driven Adoption<br>*NL4: "..... but it's we're not in a bubble. We are have competitors, right. And we have demands from customers and so on...."* |
| Market & Competitive Pressure | Barrier | Lack of Knowledge sharing<br>*II3: "our industry does not allow us to look at the competitor to see what kind of technology they are using in House...."* | Lack of External Pressure<br>*NL1: "So I I don't think we're that influenced by by outside."* |

*Continued on next page…*

*Table 4.6 continued from previous page…*

| Category | Type | India | Netherlands |
|---|---|---|---|
| Technical & Infrastructure | Driver | System Integration<br>*II2:"Data we can generate the more future planning we can do."*<br>*II1:"That helped us streamlining the inventory management and. Then billing process as well."* | Core System Reliance<br>*NL1: "Time is a is very valuable resource and having someone develop these tools instead of just using open source ones is is quite labor intensive"* |
| Technical & Infrastructure | Barrier | Infrastructure Limitations<br>*II3: "Realities of running a business in in in a country like India, right? We don't have the best WiFi and you know and so you have to work with the constraints that you presented with."* | Technology Overflow Concerns<br>*NL1: "Otherwise it will be like a an overflow of tools and then they they could take more time than than they give..."* |
| Cultural Resistance & Uncertainty | Driver | Participatory Onboarding<br>*II3: "And a lot of the times they they provide an input and say this would work. This wouldn't work for us...."*<br>*II3: "If you keep room for questions and Plan B, uncertainty becomes manageable."* | Enthusiastic Advocacy<br>*NL2: "If the person you speak with is enthusiastic, it refers also to you....and that's how it works."*<br>*NL5: "everybody is important. If you work in the warehouse or if you whatever its everybody is important."* |
| Cultural Resistance & Uncertainty | Barrier | Resistance to Change<br>*II2: ".....Early in the project is important to keep that momentum going if there's a lot of roadblocks and a lot of setbacks in the beginning, then its harder for people to believe in adopting technology."*<br>*II3:"I see that there are few senior members in the team right? So, there is some kind of a slowness in terms of adopting."* | Change Aversion<br>*NL3: "Issue is change and resistance to change....people have their ways of working and then we come to try to implement a new way of working."*<br>*NL2: "People are too impatient in the beginning…it doesn't work how you want."* |

### 4.3.2. Enablers and obstacles for Dutch manufacturing SMEs during digitalisation

According to Table 4.6, in Dutch manufacturing SMEs, digital adoption is often supported by a combination of leadership and peer involvement. Senior leaders, especially CEOs, play an important role in sponsoring new initiatives, while employees on the ground often lead small-scale pilot projects to test new tools. This bottom-up experimentation is encouraged and sometimes supported by investor backing rather than government subsidies, which help reduce the financial risk of trying new technologies.

However, several challenges can slow down progress. Budgets are often tight and companies tend to invest cautiously. Formal training is limited, which means employees are expected to learn new systems on their own. In some cases, there is a strong preference for fully developed or “perfect” solutions, which can delay adoption, especially among more experienced staff who may be less comfortable with trial-and-error approaches. While customer expectations can motivate firms to adopt digital tools, in the absence of clear external pressure or incentives, some initiatives may lose momentum or stall altogether.

### 4.3.3. Conclusion

In both Indian and Dutch manufacturing SMEs, digital adoption is shaped by a shared set of factors, such as leadership, training, funding, market pressure, technical infrastructure and cultural attitudes, but these factors operate differently depending on the national context. In India, adoption is typically initiated through strong top-down leadership, with executives playing a central role in approving projects. Training is formal and structured, often involving workshops and Q&A sessions, which reflects a cultural preference for clarity and risk minimization. Financially, Indian SMEs initially rely on open-source tools and government grants to get started, but investment decisions are cautious and closely tied to clear returns. Market pressure, especially through peer comparisons and client feedback, acts as a strong motivator.

In contrast, Dutch SMEs combine initial leadership approval with a more decentralized, team-driven approach. Employees are encouraged to experiment with tools through informal pilots and learning tends to happen on the job rather than through formal training. Dutch firms often delay adoption until the business case is well justified. Customer demands can trigger rapid uptake, but in the absence of visible peer activity or external urgency, innovation may slow. Adoption of technologies rise from internal inefficiencies. Technically, Dutch firms face challenges with the rigidity of large ERP systems ex: EXACT, requiring creative workarounds, while Indian firms struggle more with integration and connectivity issues.

These findings provide a detailed answer to Sub-Research Question 3, highlighting the different barriers and drivers of digital adoption in each country. More importantly, they set the stage for the next phase of analysis, where we explore how these adoption factors interact with deeper cultural influences. This will allow us to move towards understanding of how digital adoption unfolds within culturally distinct SME environments

## 4.4. Interaction between Culture and Digital Adoption constructs

Building on our in depth answers to Sub RQ2 (identifying the key cultural dimensions in Indian and Dutch SMEs) and Sub RQ3 (cataloging the principal drivers and barriers of digital adoption), this section turns to the overarching research question:

*RQ: How do digital adoption factors interact with cultural influences in Indian and Dutch manufacturing SMEs with a focus on open technologies?* Here, we look at four overarching themes that are derived from our thematic analysis within each national setting, Figures 4.3 and 4.4. By articulating these themes in our own terms, we lay the groundwork for their subsequent alignment with the UTAUT framework and Hofstede's cultural dimensions. Each theme reflects a unique perspective on how organizational culture influences the adoption of digital technologies in manufacturing SMEs in India and the Netherlands. This will help in the later sections thereby creating a theoretical lens through which we interpret our qualitative findings.

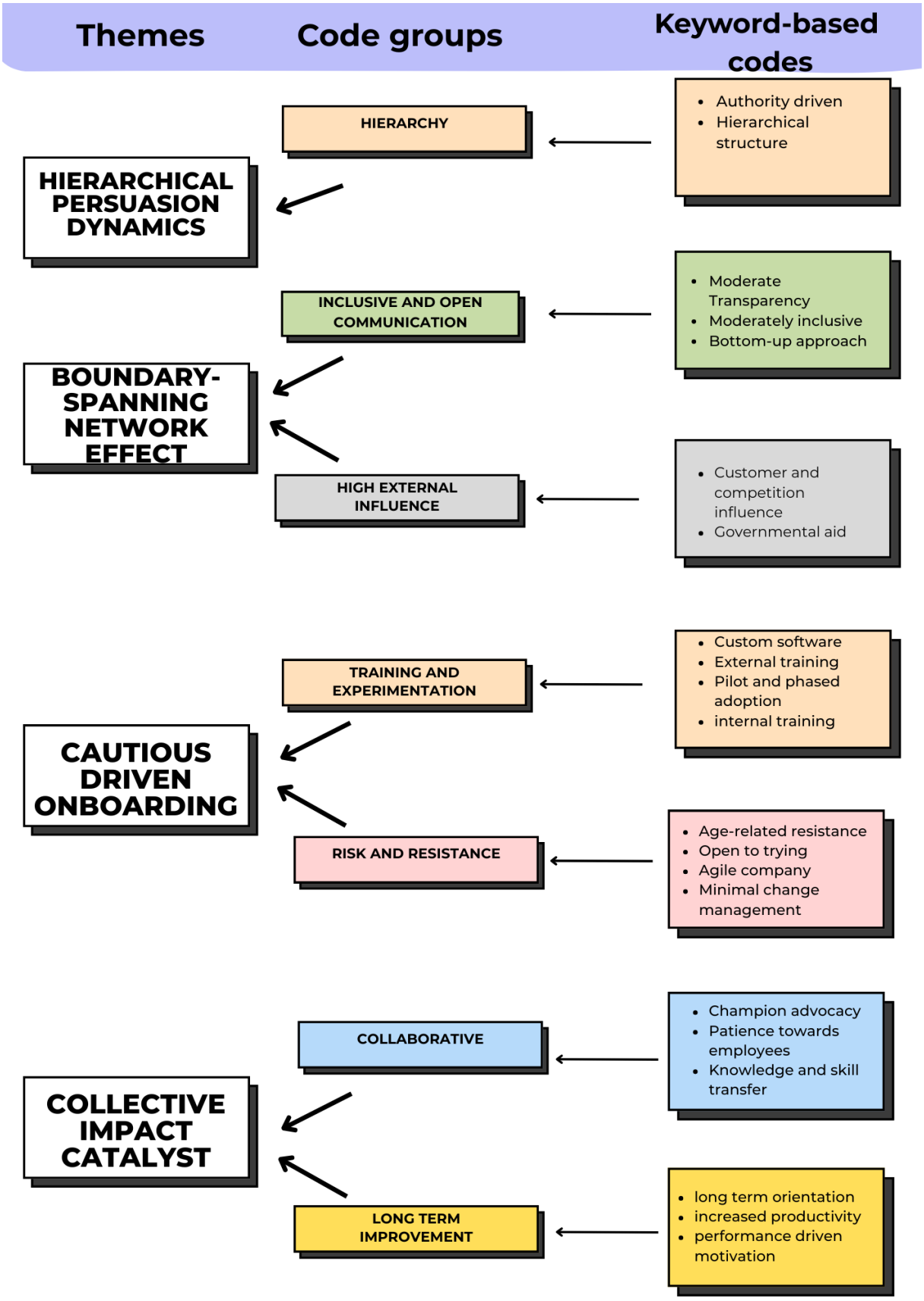


**Figure 4.3:** Thematic analysis for IN

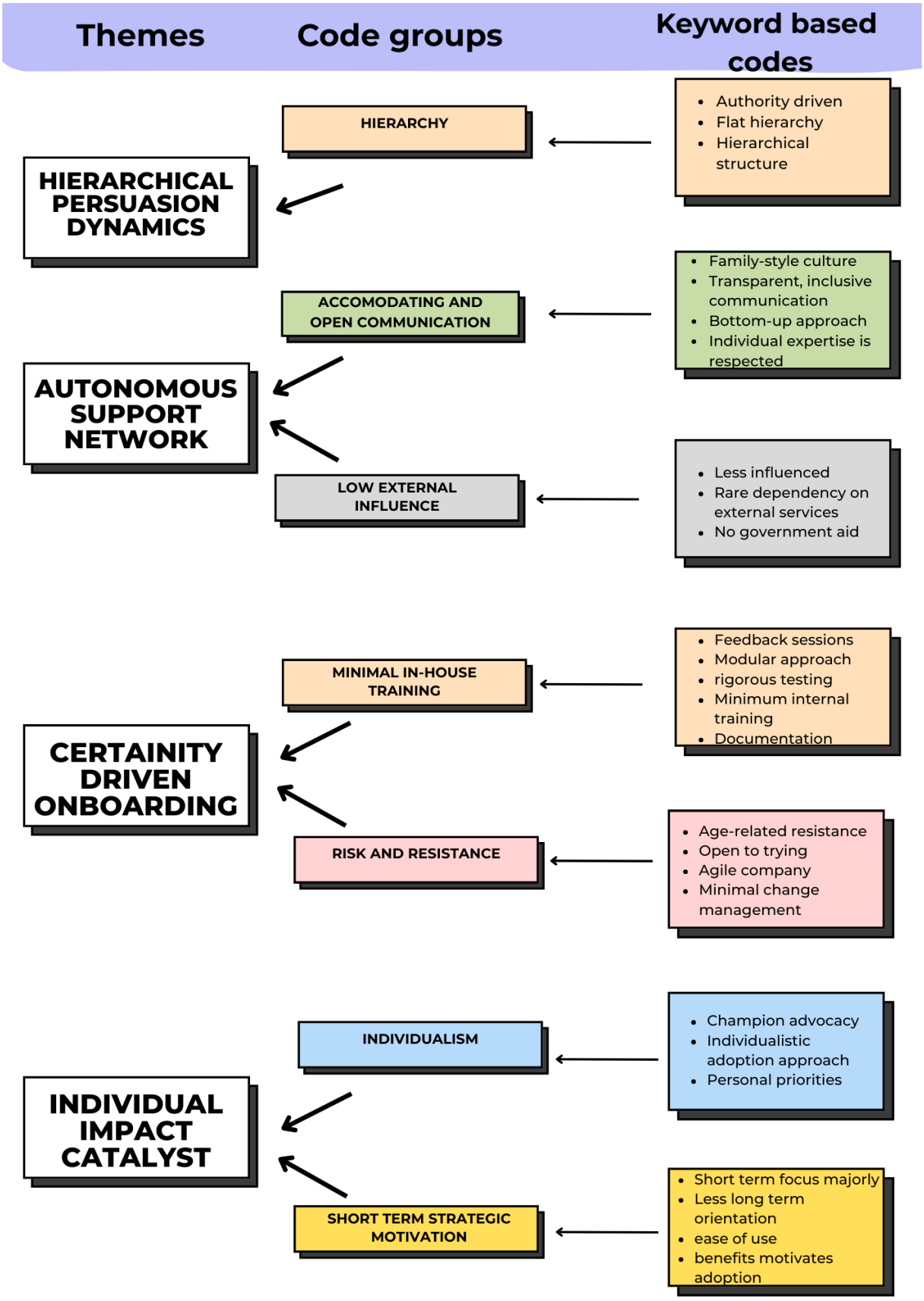


**Figure 4.4:** Thematic analysis for NL

Finally, we will synthesize these insights into a conceptual model, overlaying directional arrows on our thematic diagrams to show the flow from cultural dimension → adoption factor → outcome previously mentioned in Chapter 3. In the subsequent Discussion chapter, we will situate this model within the broader literature on national culture and technology acceptance, demonstrating both its empirical grounding and its theoretical contribution.

**Table 4.7:** Themes and General Definitions

| Theme | General Definition |
|---|---|
| Hierarchical Persuasion Dynamics | Decision-making driven by leadership endorsement, where senior approval confers legitimacy and directs organizational action. Irrespective of the dialogue between employees and management during the decision-making process, the entire adoption decision majorly is in the hands of the executives. |
| Boundary-Spanning Network Effect | Reliance on external stakeholders, such as colleagues, competitors, customers or government agencies, to provide both social cues and practical resources that facilitate adoption. |
| Cautious-Driven Onboarding | Structured, risk-mitigating onboarding processes (e.g., formal training, Q&A loops, phased roll-outs) designed to reduce uncertainty and build confidence before full implementation. |
| Collective Impact Catalyst | Group-oriented championing, knowledge-sharing and long-term oriented investment, where collective patience and peer collaboration drive sustained adoption. |
| Autonomous Support Network | Empowerment of individual employees to experiment and learn independently, often via small pilot projects or self research before presenting ideas, while relying minimally on formal external assistance. |
| Certainty-Driven Onboarding | Light-touch onboarding that balances minimal formal instruction with hands-on demos and iterative practice, providing just enough structure to ensure comfort. |
| Individual Impact Catalyst | Emphasis on personal benefits and quick wins, where individual champions advocate adoption based on immediate, tangible improvements to their own workflow. |

### 4.4.1. Excerpts supporting the themes

**Table 4.8:** India – Themes & Representative Quotations

| Theme | Quotations (Transcript ID) |
|---|---|
| Hierarchical Persuasion Dynamics | *II2: "We keep it a leadership base decision making her because as a top management we take a decision for the whole company, right,"*<br>*II3:"So basically its its the operations or the CEO or somebody who got the P&L in his focus..."* |
| Boundary-Spanning Network Effect | II4: *" So for me, after having evaluated a few softwares in the market, I realised I ended up consulting with a few other family owned businesses who are., Who offer complimentary services and then some are in direct competition to us"*<br>"<br>*II3: "I mean government is pushing it, government is giving grants for different transformation."* |
| Cautious-Driven Onboarding | II2: "First week is all about classroom sessions: 'Here's how the software works, here's a worksheet.' Then on Day 8, we sit down for Q&A. Without that step, employees get stuck."<br>*II5: "We do a pilot on one production line for three days, then measure error rates. If it's below two percent, we add more lines. But if not, we revert."* |
| Collective Impact Catalyst | *II1: ".....migrate slowly. We take a small part to the new platform .....to help majorly to help employees, we breakdown everything in steps like in targets like in first week we have to achieve this much and then move on after feedback we move on to the next stage.."*<br>*II2: "Plus, at the end we bimonthly or by 6 month we keep one more kind of session, to check whether they are comfortable using it or they have adapted it or not."* |

**Table 4.9:** Netherlands – Themes & Representative Quotations

| Theme | Quotations (Transcript ID) |
|---|---|
| Hierarchical Persuasion Dynamics | NL3: "Ultimately made by the CEO ....But who pitched it? Was the designer.....It will increase my speed. ." NL4: "Yes, it's the owner who decides which ERP we'll buy-but after that, every Friday we have a shop-floor meeting where anyone can say, 'Hey, this feature doesn't match our workflow." (NL4) |
| Autonomous Support Network | NL1:"Then they will themselves test it as well, and if they like it, then they announce it to other engineers and they usually write a a short manual of how to use it, how to implement it." NL1: "we always try to work as modular as possible. So we don't like having to be dependent on something, and that alone helps with the with uncertainties...." |
| Certainty-Driven Onboarding | NL1: "If there is good documentation and good support from from technologies that would make things easier to implement....." NL3: "I think at the moment it's just incremental changes." |
| Individual Impact Catalyst | NL3: ".....I have to sell it a little bit. You know, I have to understand what are you doing? And then I have to sell, how is this going to make your life easier? And then after that I have to deliver....." NL5: "....if you are the one who is introducing stay positive. Because if you have bought a new program." |

### 4.4.2. Comparing Themes in both the countries

**Hierarchical Persuasion Dynamics**

- India: Across most Indian interviews, decision-making authority was heavily centralized. Whenever the executives signaled support for a new digital tool, shop-floor teams moved quickly to try to implement without further major opposing. Conversely, if senior leaders remained unconvinced, even well-prepared proposals stalled and mid-level managers would hold off until explicit permission was granted.
- Netherlands: Dutch SMEs also acknowledged the top management view, but hierarchy was more consultative. After top management approved a project, employees at all levels immediately convened for open discussions to iron out details. In most transcripts, the initial management-driven decision was followed by cross-functional sessions where anyone could raise concerns. This two-step process-endorsement, then dialogue, was a hallmark of Dutch hierarchical dynamics.

**Boundary-Spanning Network Effect / Autonomous Support Network**

- India: Indian firms consistently described turning outward for both pressure and resources. When a major customer insisted on a particular software standard, companies would rally to meet that requirement. Likewise, interviewees explained coordinating to apply for government subsidies, though the application process was a hurdle. In almost every case, external stakeholders (industry peers, government programs, or large clients) were the catalysts for adoption. With changes industry space, companies were encouraged to take part in the race of digitalisation.
- Netherlands: Dutch SMEs frequently encouraged self-sufficiency. Managers deliberately set up a dedicated “demo station” where engineers could log in and experiment on live data, without waiting for formal training sessions. Several transcripts described junior technicians who discovered new features on their own, then shared those insights with the larger team. This emphasis on individual trial-and-error (external influence) exemplified a orientation to resource access. They also depended on documentation for learning and occassionaly champions within the company who promoted uptake of a particular technology.

**Cautious-Driven Onboarding / Certainty-Driven Onboarding**

- India: Indian interviews emphasized meticulous, multi-stage onboarding. Initial classroom-style training sessions were almost universal, followed by structured QA loops. Managers walked through step-by-step demonstrations on one production line, then waited several days to measure defect rates before expanding. This phased, highly scripted approach minimized risk and gave employees a clear “Plan B” if issues arose. Resistance was common among veteran workers, so consultants or trainers remained on-site throughout the first two weeks to ensure smooth uptake.
- Netherlands: Dutch transcripts revealed a leaner, more hands-on process. Instead of full-day workshops, companies scheduled a few short, targeted demos, often lasting no more than an hour or two. Engineers and operators were encouraged to experiment immediately, with a manager occasionally stepping in to clarify a button or setting. When older staff proved reluctant, the team formed small pilot groups rather than convening large seminars. In this way, Dutch firms balanced minimal formal instruction with enough experiential practice to build confidence quickly.

**Collective Impact Catalyst / Individual Impact Catalyst**

- India: Many Indian SMEs formed cross-functional committees or task forces, operators, supervisors, finance and IT, when assessing a new tool’s potential. These groups remained intact for weeks or months, watching early adopters and pooling feedback. The shared sense of purpose and “we’re in this together” attitude helped overcome skepticism. Companies were willing to tolerate knowledge gap, accepting short-term productivity dips because everyone believed the group would eventually benefit. Patience and collaborative problem-solving were per-

vasive across transcripts. One of the interviewee was understanding enough to keep and teach the old employee isntead of laying them off.

- Netherlands: In Dutch interviews, adoption often hinged on a single enthusiastic individual. Once one engineer or young hire demonstrated a tangible time savings or efficiency gain, colleagues would quickly follow suit. Rather than lengthy committee deliberations, the focus was on personal ROI, when one person could show a workflow improvement, managers felt comfortable scaling up. This champion-driven dynamic meant that full buy in sometimes progressed unevenly, early adopters led the way and skeptical staff eventually joined once they saw a colleague's success in real time.

### 4.4.3. Theme Salience by Country

In this subsection, we try to relate code-group occurrence from figure C.5 and C.6. In order to understand which cultural patterns were most prominent in each national context, we aggregated individual code-group frequencies into four overarching themes. The resulting percentages indicate how often each theme emerged across all interviews in that country.

In India, digital-adoption conversations were overwhelmingly shaped by collective collaboration, figure 4.10. The Collective Impact Catalyst theme accounted for 40.57 percent of all coded instances, reflecting managers' consistent reliance on cross-functional committees, shared knowledge and a willingness to accept timelines for return on investment. Nearly one-third (33.96 percent) of references fell under Cautious-Driven Onboarding, highlighting the importance of formal classroom sessions, patience during implementation phase and fallback plans to minimize disruption and build confidence gradually. Reliance on external support also featured prominently. The Boundary-Spanning Network Effect appeared in 16.98 percent of codes, illustrating how Indian SMEs frequently gathered resources from government grants, reacted to changing industry practices or responded customer mandates in order to stand out. Finally, although it was the least cited theme at 8.49 percent, Hierarchical Persuasion Dynamics remained significant, as many interviewees described waiting for clear approval from top level management before initiating any technology rollout, underscoring that, even amid collaborative, risk-averse practices, formal top-down endorsement could not be overlooked.

**Table 4.10:** India: Theme-Level Percentages, sample size (n)=5

| Theme | Theme % (India) |
|---|---|
| Collective Impact Catalyst | 40.57% |
| Cautious-Driven On-boarding | 33.96% |
| Boundary-Spanning Network Effect | 16.98% |
| Hierarchical Persuasion Dynamics | 8.49% |

In the Netherlands, digital-adoption patterns were marked by a blend of pragmatic onboarding and strong individual initiative, figure 4.11. The Certainty-Driven Onboarding

theme, at 33.84 percent of all coded instances, highlighted the preference for brief, focused demos followed immediately by hands-on practice, allowing employees to learn quickly without lengthy formal instruction. Next, the Autonomous Support Network accounted for 23.08 percent, reflecting a prevalent do-it-yourself ethos. Engineers and operators were empowered to set up demo stations and experiment independently, then share successful approaches with colleagues. An equally weighted 28.15 percent fell under Individual Impact Catalyst, underscoring how single champions—often a tech-savvy engineer or new hire—could spark broader uptake by demonstrating clear, personal efficiency gains. Hierarchical Persuasion Dynamics appeared in 12.31 percent of references, capturing a hybrid model in which CEO or owner approval initiated/finalised adoption but was always involved inclusive, all-hands discussions that leveraged horizontal feedback.

**Table 4.11:** Netherlands: Theme-Level Percentages, sample size (n)=5

| Theme | Theme % (NL) |
|---|---|
| Certainty-Driven Onboarding | 33.84% |
| Individual Impact Catalyst | 28.15% |
| Autonomous Support Network | 23.08% |
| Hierarchical Persuasion Dynamics | 12.31% |

Overall, these theme-level percentages make it clear that India's cultural landscape is dominated by collective collaboration and careful, staged onboarding, with external support and hierarchical approval playing secondary roles. In contrast, the Netherlands features a more balanced distribution, practical, short-form onboarding and individual autonomy lead the way, supported by both a moderated hierarchy and targeted external cues. In the Discussion chapter, we shall see how these findings relate to the existing literature especially using the Hofstede's cultural dimensions and Venkatesh's UTAUT lens'.

# 5

# Discussion

This study focuses on the interaction between the culture of a nation on the adoption of digital technologies within manufacturing SMEs, using India and the Netherlands as comparative case studies. The research was guided by three core questions: which digital tools are being adopted, what are the prevalent cultural themes and what country-specific enablers and barriers shape digitalisation trajectories. All these question helped set a foundation to answer our main research question; ”how do digital adoption factors interact with cultural dimensions in Indian and Dutch manufacturing SMEs with a focus on open technologies?”.

The results in Chapter 4 reveal distinct patterns in the digitalisation journeys of SMEs in the two countries. Indian SMEs tend to adopt basic, rarely open-source digital tools, implementing them incrementally. This cautious approach aligns with cultural characteristics such as high power distance and strong uncertainty avoidance. Conversely, Dutch SMEs are more inclined towards implementing advanced, integrated digital systems, and are supported by moderately flat organizational hierarchies and a cultural orientation toward experimentation. These are traits consistent with low power distance and uncertainty avoidance (Hofstede, 2001).

Social influence also plays out differently across the two contexts. In India, it is amplified by hierarchical decision-making structures, whereas in the Netherlands, it is more peer-driven, emerging through internal inefficiencies. While both countries face common challenges such as limited budgets and digital skills gaps, these issues are shaped by their respective cultural and organizational environments.

These findings highlight the value of integrating UTAUT with Hofstede’s cultural dimensions to better understand technology adoption in manufacturing SMEs. The interaction between cultural values, specifically Power distance, Uncertainity avoidance and Individualism and collectivism and UTAUT constructs, performance expectancy, effort expectancy, social influence and facilitating conditions, offers a more nuanced explanation of the divergent adoption behaviors observed across national contexts.

## 5.1. Digital technologies

When it comes to adopting digital technology, small and medium-sized manufacturing companies in both India and the Netherlands tend to follow a similar path. They start by putting in place basic systems that help them manage their operations, things like ERP software and tools for automating shop-floor tasks. These are known as Support Systems Schönfuß et al., 2021 and they form the foundation for any further digital upgrades.

Indian SMEs typically adopt foundational digital tools that are both cost-effective and adaptable to limited technical capabilities. This aligns with the findings of Doyle and Cosgrove, 2019 and Ghobakhloo and Ching, 2019 that due to financial limitations, skill gaps and a lack of digital maturity, SMEs in developing economies frequently start their digital transformation with back-office automation. Commonly used systems include basic enterprise resource planning (ERP) platforms such as Tally and Odoo Community Edition, along with entry-level customer relationship management (CRM) tools and standalone applications for computer-aided design (CAD) and computer numerical control (CNC). The strategic deployment of open-source software (OSS) in Indian SMEs often serves as a transitional mechanism, enabling incremental digitalization with minimal financial risk, an approach echoed in Alshamaila et al., 2013 study on cloud adoption in resource-constrained environments.management as their budgets and skills grow.

In contrast, Dutch manufacturing SMEs demonstrate a more sophisticated and integrated digital landscape. They frequently implement advanced ERP systems such as Microsoft Business Central and Exact, alongside cloud-based CRM platforms like HubSpot and Pipedrive. These firms also utilize high-end CAD and simulation tools, including SolidWorks and Abaqus and are early adopters of artificial intelligence (AI) technologies. This reflects a higher level of digital readiness and a culture of OSS customization that supports tailored, innovative solutions, characteristics consistent with the Industry 4.0 maturity framework described by Mittal et al., 2018. As noted by Schönfuß et al., 2021, such digital infrastructures enable Dutch SMEs to maintain competitive advantages through agile and innovative manufacturing practices.

Despite these regional differences, both Indian and Dutch companies show that you need to get your basic systems in place before you can move on to more advanced things like data analysis or AI. The research by Schönfuß et al., 2021 backs this up, showing that most tech investments go into these foundational systems. However, their implementation strategies diverge. Indian SMEs typically adopt a phased and cautious approach, beginning with low-cost tools and placing strong emphasis on training and structured workflows. Dutch SMEs, supported by robust digital infrastructure and a cultural inclination toward experimentation, favor rapid prototyping and iterative integration of systems to achieve end-to-end process optimization as seen in the Chatper 4.

These adoption patterns are consistent with broader cross-national studies on SME digitalization. Oliveira and Martins, 2009 observe that SMEs in developing economies prioritize scalable, cost-effective solutions due to resource limitations. Similarly, Ramdani et al., 2009 highlight the critical role of organizational readiness and technological infrastructure in enabling complex system adoption, factors that distinguish the Dutch experience from that of Indian SMEs.

To summarize, both Indian and Dutch manufacturers take a step-by-step approach to digital transformation. They first focus on stabilizing their operations with core systems, then move on to collecting data and finally explore more advanced tools like simulations and AI. This method helps them get quick wins while slowly building up more sophisticated capabilities. This approach is in line with the existing course of digitalisation studied in literaure (Jamwal et al., 2023).

A particularly revealing insight from this study lies in how Indian and Dutch SMEs approach Open Source Software (OSS). While both groups interact with OSS, the way they adopt and integrate it reflects not just technical needs or financial constraints but deeply embedded cultural values around risk, autonomy and control.

In the Indian context, OSS is often treated as a transitional solution, something used temporarily until the organization can afford or justify investment in proprietary software. While financial limitations may initially drive OSS adoption, the eventual shift toward commercial tools reflects broader cultural tendencies. Indian SMEs operate within a high uncertainty avoidance context, where predictability, structure and risk mitigation are highly valued (Hofstede, 2001; Merhi, 2021). Interviewees explicitly cited concerns about data security, integration risks and the lack of vendor accountability as key reasons for abandoning OSS, perceptions that resonate with findings by GGhobakhloo and Iranmanesh, 2022, who observed that firms in high-UAI environments prioritize formal support infrastructures in digital technology adoption.

Additionally, the centralized nature of decision-making in Indian firms, aligned with a high power distance culture, limits experimentation at the operational level. OSS typically thrives when users have the autonomy to test, adapt and iterate. However, in hierarchical systems, those closest to the tools (e.g., engineers, analysts) often lack the authority to implement or recommend them meaningfully. This top-down control reinforces a preference for ”safer,” manager-approved proprietary options. Nistor et al., 2012and Tarhini et al., 2017 similarly highlight that in high-PDI settings, social influence is driven predominantly by leadership approval, making decentralized technology like OSS less compatible with established organizational norms.

In contrast, Dutch SMEs exhibit a markedly different approach. Here, OSS is not just a low-cost entry point but a long-term, strategic choice. Companies actively modify open-source tools or use them as a base to build customized solutions. This reflects a combination of low to moderate uncertainty avoidance and high individualism, two dimensions that promote experimentation and personal initiative in the adoption of new technologies (Hofstede, 2001; Lee et al., 2012). Interview data showed that Dutch engineers were often empowered to select and deploy digital tools independently, including OSS platforms. This autonomy encourages iterative learning and internal innovation, rather than reliance on external vendors. N. Srite and Karahanna, 2006 further support this perspective, noting that in individualistic cultures, technology adoption is often championed by individual users who prioritize flexibility and performance over institutional endorsement.

Moreover, OSS fits well with Dutch SMEs' practical and modular approach to technology. Several participants described a preference for interoperable, customizable solutions, traits commonly associated with OSS and were comfortable operating without formal

vendor support, as long as internal expertise was sufficient. These findings align with Schönfuß et al., 2021, who noted that SMEs in low-UAI settings often view open-ended tools like OSS as opportunities to innovate rather than risks to be contained.

From my perspective, these contrasting approaches illustrate that OSS adoption is not simply a technical or economic decision, it is culturally embedded. In India, the reluctance to continue using OSS even when it is functional and scalable may stem from a deeper need for certainty and institutional validation. Conversely, in the Netherlands, the appeal of OSS lies in the control and flexibility it offers, particularly in settings that value autonomy and trust individual judgment.

Therefore, I believe that efforts to promote OSS adoption in contexts like India cannot rely solely on cost-based arguments. To succeed, they must address the cultural barriers to open, decentralized innovation. For example, introducing trusted OSS support channels, certification mechanisms or integration frameworks could provide the structure and reliability that high-UAI users seek (Darbanhosseiniamirkhiz and Ismail, 2013). Equally important, empowering mid-level staff to participate in digital decision-making could help mitigate the top-down rigidity that currently constrains OSS experimentation. As Nadagoud, 2024 suggests, the effectiveness of OSS depends not only on its design but also on how well it aligns with the cultural norms of the organizations adopting it.

### 5.1.1. Insights and future direction of adoption of digital tools

While this study gives a clear picture of how manufacturing SMEs in India and the Netherlands are currently using digital tools, it also highlights some important gaps and areas for future research. For example, although OSS is commonly used, often as a temporary solution in India and a long-term one in the Netherlands, we still don't know enough about how companies move beyond these early tools over time. Especially, when it comes to data security and scalability of these solutions as reflected by Nadagoud, 2024 in their research. Future studies could look at whether businesses in emerging markets, where budgets are tight, eventually upgrade to more advanced systems and what motivates them to overcomes issues during this process.

Additionally, this research focused mainly on what kinds of tools are being used and the areas in which they're being implemented. It didn't explore how these choices affect business performance, how well the tools work together or how satisfied employees are with them, especially across different cultural settings. Future research could use surveys or a mix of interviews and data analysis to connect tool choices with outcomes like productivity or innovation.

Finally, looking more closely at different types of manufacturing, like comparing heavy machinery firms with those in precision engineering, could reveal more detailed insights about which tools are most useful in specific sectors. These directions would help deepen our understanding of how digital strategies are shaped by both cultural and practical realities in small and medium-sized businesses.

## 5.2. Different countries, different cultures during Digitalisation

Digital adoption is influenced not only by an organization's technological capabilities or financial resources but also by the underlying cultural values that shape how new technologies are perceived, approached and integrated (Oliveira and Martins, 2011; Tarhini et al., 2017; Merhi, 2021). This section examines the divergent adoption behaviours observed between Indian and Dutch manufacturing SMEs, this section draws on Hofstede's cultural dimensions framework, a robust and widely cited model in cross-cultural research (Taras et al., 2010; Nistor et al., 2012; Hofstede, 2001). The study identified seven cultural dimensions that influence digital adoption: Hierarchy, Communication Style, Autonomy vs. Collective Cohesion, Learning & Experimentation, Motivation & Strategic Orientation, Risk & Resistance and External Influence. These were then mapped onto Hofstede's cultural dimensions to identify similarities or none in Tables 5.2 and 5.1.

**Table 5.1:** India: Code-Groups Mapped to Hofstede Dimensions

| Code-Group | Hofstede Dimension(s) | Rationale |
|---|---|---|
| **Hierarchy** | High Power Distance (PDI) | Indian SMEs exhibit clear top-down decision-making. High-PDI cultures accept unequal power: when a CEO or manager endorses a tool, everyone follows. |
| **Inclusive & Open Communication** | Collectivism (IDV) & Low Femininity | While India is generally collectivist, findings show pockets of transparent, continuous involvement to understand collective needs. This code-group signals movement toward group consensus, patience for colleagues. |
| **Training & Experimentation** | High Uncertainty Avoidance (UAI) | Structured "Q&A + consultant" sessions in India help reduce anxiety around new tools. High-UAI cultures demand formal training to lower perceived risk. |
| **Risk & Resistance** | High Uncertainty Avoidance (UAI) | Widespread age-related inertia and reluctance to change underscore a high UAI orientation-workers seek predictability and fear trial-and-error without formal safeguards. |
| **Collaborative** | Collectivism (IDV) | Emphasis on group problem-solving, knowledge sharing and patience reflects a collectivist orientation where collective progress matters more than individual wins. |
| **Long-Term Improvement** | Moderate Long-Term Orientation (LTO) | A focus on "sustainable productivity gains" and "performance-driven motivation" shows that some firms think beyond short-term ROI, reflecting a moderate-to-high LTO in Indian SMEs. |

**Table 5.2:** Netherlands: Code-Groups Mapped to Hofstede Dimensions

| Code-Group | Hofstede Dimension(s) | Rationale |
|---|---|---|
| **Hierarchy** | Moderate Power Distance (PDI) | Although Dutch SMEs are flatter than Indian firms, management authority still matters. Low-PDI cultures accept more egalitarian structures-but a degree of hierarchy remains, reflecting moderate PDI. |
| **Accommodating & Open Communication** | Moderate Feminity (FEM) | Emphasis on transparent, bottom-up dialogue (family-style, individual respect) is characteristic of feminine cultures where each voice can be heard regardless of rank. |
| **Minimal In-House Training** | Low Uncertainty Avoidance (UAI) | Dutch SMEs' preference for "learn by doing" rather than formal workshops indicates a low to moderate UAI, they tolerate ambiguity and experimentation. |
| **Risk & Resistance** | Low Uncertainty Avoidance (UAI) | Generational divides (older staff resisting, younger staff experimenting) point to a low to moderate UAI. |
| **Individualism (Champion Advocacy)** | Individualism (IDV) | The "individual champion" code-group-where employees pursue tools for personal gain-reflects high individualism. Dutch culture prizes personal autonomy and self-direction. |
| **Short-Term Strategic Motivation** | Masculinity (MAS) & Short-Term Orientation (STO) | A focus on immediate ROI ("ease of use," "benefits motivate adoption") shows a moderately masculine orientation (performance-driven) combined with a relatively short-term horizon. |

Among Hofstede's six cultural dimensions, three emerged as particularly relevant in this study: power distance, uncertainty avoidance and individualism versus collectivism. This is based on the number of times a particular code group occurred reflected in Figures C.5 and C.6 in Appendix B. Masculinity/Femininity did show up but due to not having enough supporting statement, it was left out. Motivation and Strategic orien-

tation was a bit tricky to consider since it included motivation basically driver that aid digital adoption. Both the countries gave mixed signal while choosing either long term or short term. This could be because management looks at scalability or future use while in order for the employees to accept a tool they prefer early wins. Furthermore, the major three dimensions were found to significantly influence organizational behaviors related to decision-making authority, risk management, implementation strategies and the motivations behind adopting digital tools. By comparing India, a culture characterized by high power distance, strong collectivist values and high uncertainty avoidance, with the Netherlands, which exhibits moderate power distance, individualism and low uncertainty avoidance, this section aims to deepen our understanding of how cultural context shapes not just the decision to adopt digital technologies, but the manner in which adoption unfolds (Hofstede, 2001).

### Power Distance and Decision Making Hierarchies

The difference between hierarchies that was observed in how digital adoption is initiated and managed within SMEs in India and the Netherlands, was not very different, reflecting their respective positions on Hofstede's power distance dimension, Indian SMEs, consistent with a high power distance culture, demonstrated centralized and hierarchical decision-making structures. Digital transformation initiatives typically required formal approval from senior leadership and employees were seldom empowered to act autonomously. This top-down approach emphasized structured implementation, formal training and adherence to managerial directives (Hofstede, 2001; Taras et al., 2010).

On the other hand, Dutch SMEs exhibited traits associated with moderately to high power distance, where decision-making authority is still with the higher authorities but adoption process is more inclusive of the employees and their opinions. Employees and mid-level managers were often entrusted with the autonomy to explore and suggest digital tools independently, fostering a more agile and participatory digitalisation process. This semi-decentralized model differ with Hofstede's classification of the Netherlands as a society that values flat hierarchies, but is similar in terms of open communication and shared responsibility in organizational change (Hofstede, 2001; Murcia and Whitley, 2007).

### Uncertainty Avoidance and Implementation Strategies

Indian SMEs exhibited characteristics aligned with moderate to high uncertainty avoidance, favoring structured and predictable implementation processes. These included clearly defined timelines, formal onboarding procedures and targeted training for specific digital tools along with openness in rare situations to try new tools. Merhi, 2021 noted that high uncertainty avoidance cultures prefer structured onboarding and formal training. Their preference for stability and control influenced their technology choices, often leading them to adopt well-established solutions with proven track records rather than riskier, untested innovations (Hofstede, 2001; Merhi, 2021).

In contrast, Dutch SMEs, operating in a cultural context of low uncertainty avoidance, were more open to experimenting with emerging technologies such as AI and cloud-based platforms. They frequently employed pilot projects and iterative, trial-and-error

approaches, reflecting a cultural comfort with ambiguity and innovation. These findings align with Tarhini et al., 2017, who noted that low uncertainty avoidance cultures are generally more receptive to innovation and require less formalized support when engaging with digital systems. This difference in uncertainty avoidance is different than that of Hofstede, 2001's findings. Potentially due to Dutch SMEs being more open to adopting and experimenting with new technologies and technically more sound.

### 5.2.1. Individualism vs collectivism and Adoption Motivation

The study also revealed differing motivations for digital adoption rooted in cultural values. Indian SMEs, shaped by collectivist norms, often viewed digital transformation through the lens of group benefit, social cohesion and external validation. Decisions were heavily influenced by peer behavior, customer expectations and prevailing industry standards. This aligns with Merhi, 2021, who found that collectivist organizations tend to prioritize group harmony and shared success over individual gains.

On the other hand, Dutch SMEs, reflecting a highly individualistic culture, emphasized personal and departmental efficiency as key drivers for adoption. Autonomy in decision-making, self-directed learning and measurable improvements in task performance were frequently cited. These findings match with Tarhini et al., 2017, who found that individualistic cultures emphasize autonomy and self-directed learning in digital adoption. Although training session in some companies did exist but most of them relied on the employee to have knowledge of the technology. This could be because they are highly self-reliant. These patterns are consistent with Hofstede's classification of the Netherlands as one of the most individualistic societies, where personal initiative and independence are highly valued (Hofstede, 2001).

Few instances suggesting that India focuses on Long-term benefits while the Dutch are looking more towards short-term benefits goes against the results by Hofstede, 2001. This can be seen in the country comparision graph by Hofstede in Figure 2.1. This could also be use to the SMEs selected per country differed in their size and years in the market.

### 5.2.2. Reflections and Directions for Future Research

This cultural difference between nations underscores the necessity of strategizing digital adoption to national contexts. As Hofstede, 2001 emphasized, cultural values shape organizational behavior and influence how technologies are perceived and implemented. Both countries approach can be effective but require tailored management strategies and support systems (Nistor et al., 2012; Ghobakhloo and Iranmanesh, 2022).

Nonetheless, the study has its limitations. Hofstede's cultural dimensions offer useful insights but represent national averages, potentially overlooking regional or sector-specific variations (Taras et al., 2010). Moreover, the small sample size, limited to ten interviews, might not sufficiently reflect the variety of SME experiences. Future research could delve into how sub-national cultures influence digital adoption or examine how cul-

tural attitudes evolve over time with ongoing digitalisation. Employing mixed-method approaches that combine qualitative insights with quantitative performance metrics could further enrich our understanding of how digital tools reshape organizational practices across different cultural settings.

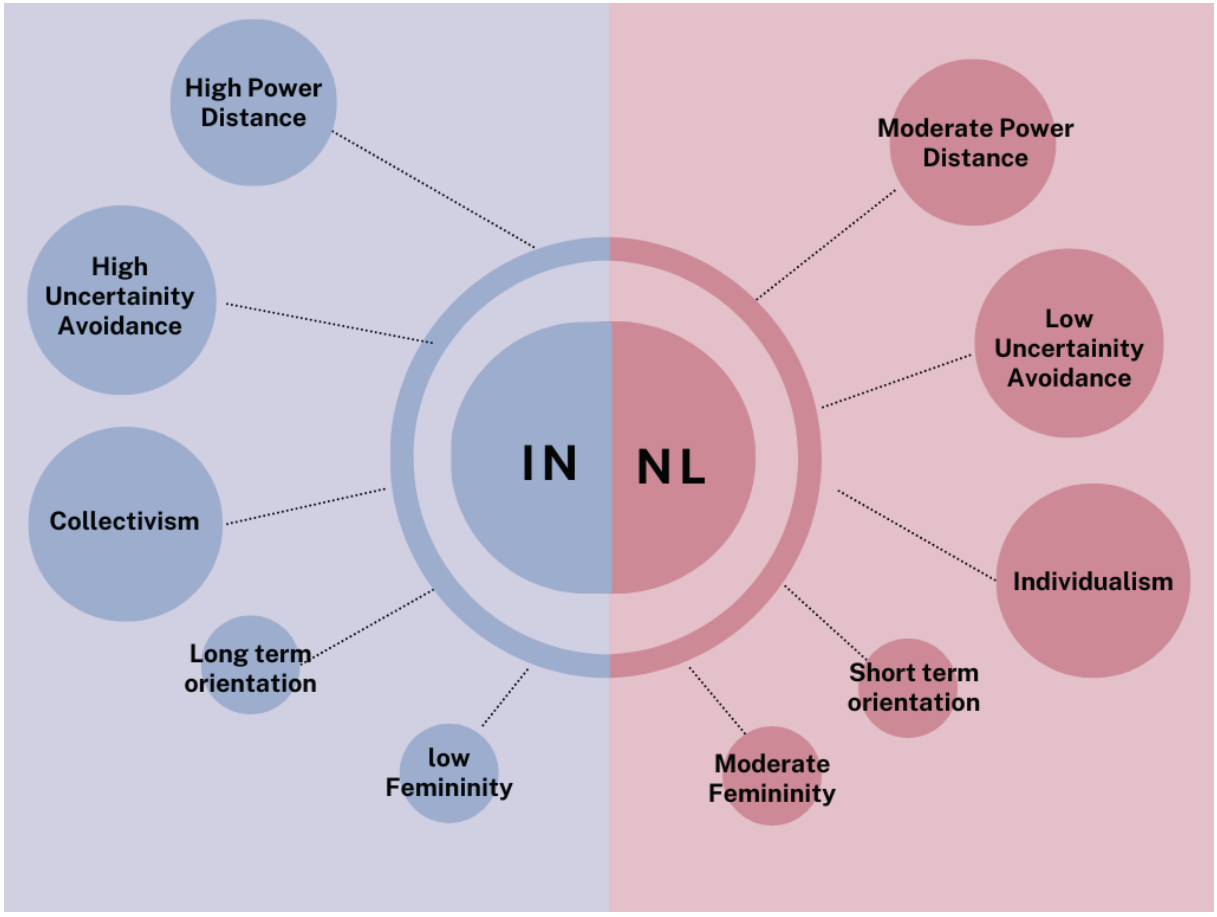


**Figure 5.1:** Cultural Mapping: IN vs NL

## 5.3. Barriers and drivers

The study identified six categories of barriers and drivers: Leadership & Governance, Training& Skill Development, Financial & Resource Constraints, Market & Competitive Pressure, Technical & Infrastructure and Cultural Resistance & Uncertainty.

In India, digital adoption is often initiated through strong top-down leadership. Structured training and government subsidies support adoption, but budget constraints, integration challenges and resistance from senior staff remain significant barriers. These findings echo those of Ghobakhloo and Iranmanesh, 2022, who highlighted the role of leadership and financial constraints in SME digitalization in emerging economies. Although majority of the Indian SMEs did focus on cost constraint, very few of them mentioned cost not being a barrier. This could be due to availability of resources upon proper explanation for the need of a particular technology. Government in India provides trainings, Special Economic Zones that are tax free, if you set up your business

there and subsidies. So provided you justify your idea to the stakeholder, cost constraints can always be overcome.

In the Netherlands, adoption is supported by executive sponsorship and a culture of experimentation. However, limited formal training and a preference for fully developed solutions can delay adoption. These findings are in line with Bueno et al., 2020, who noted that even in digitally mature contexts, organizational inertia and perfectionism can hinder innovation. Although a few SMEs did follow flat hierarchy, they saw potential barrier in that. This could be because this could induce variance while selecting a digital technology. More individual thoughts can lead to more delay in coming to a conclusion.

One of the most prominent barriers to digital adoption, in both the country's SMEs, is the high perceived cost of implementing advanced technologies. This aligns with prior research, which consistently identifies implementation costs as a critical deterrent for SMEs Ghobakhloo and Ching, 2019. When the financial burden of adopting a technology is perceived to outweigh its benefits, especially in resource-constrained environments, firms are likely to delay or forgo adoption altogether. This was evident in the Indian context, where cost-benefit considerations were central to decision-making. In contrast, Dutch SMEs, while also mindful of costs, were more likely to proceed with adoption when internal performance gains were evident, reflecting a more decentralized and performance-driven decision culture. The divergence between Indian and Dutch SMEs highlights how cultural and structural dynamics jointly shape digital transformation pathways. Indian SMEs, embedded in high power distance and collectivist cultures, tend to rely on formalized procedures and external validation, such as customer expectations or peer benchmarking, to legitimize adoption decisions. In contrast, Dutch SMEs, operating within moderate power distance comparatively and individualistic settings, are more inclined towards internally driven innovation, where individual initiative and perceived performance gains play a central role (Hofstede, 2001; Vrontis et al., 2022).

### Potential future studies and gaps

A particularly novel insight from this study is the nuanced role that cultural traits play in either amplifying or mitigating common barriers to digital adoption. For example, the hierarchical communication structures prevalent in Indian SMEs, while often criticized for slowing decision-making (Erumban and de Jong, 2006), may paradoxically enhance accountability and control during digital rollouts. This centralized authority can streamline implementation once leadership is aligned. Conversely, the decentralized and individualistic organizational structures observed in Dutch SMEs foster rapid experimentation and innovation (Vrontis et al., 2022), but may also result in fragmented tool usage and inconsistent adoption practices if coordination mechanisms are weak. These trade-offs underscore the importance of culturally informed implementation strategies that balance agility with coherence.

Nevertheless, it is essential to acknowledge the methodological limitations of how these drivers and barriers were assessed. The qualitative, interview-based design enabled rich, context-sensitive insights, but it inherently limits breadth and generalisability. The identification of cultural linkages to adoption dynamics is interpretive rather than causally

tested, relying on thematic analysis rather than statistical inference. Furthermore, the small sample size and the sectoral focus on manufacturing constrain the application of these findings to other industries or national contexts. Cultural traits may also interact with other organizational variables not explored in this study, such as firm age, digital literacy, or regional policy environments (Ghobakhloo and Iranmanesh, 2022; Elsa et al., 2025). Research in the future should aim to address these gaps through bigger, more varied samples and mixed-methods approaches.

## 5.4. Interpreting the Culture–Adoption Interplay in Indian and Dutch SMEs

This thesis addressed the central research question, how digital adoption factors interact with cultural influences in manufacturing SMEs in India and the Netherlands with a focus on open technologies, through a two-phase qualitative approach. It tries to answer the research gap that has been rarely studied in literature according to Ridhwan and Purwanto, 2020. It also tries to understand the role of culture in developing countries technology acceptance studies Sriwindono and Yahya, 2014. In the first phase, thematic coding of ten semi-structured interviews revealed seven key internal cultural dimensions within each national context. In the second phase, these cultural dimensions were systematically mapped onto the four primary themes and then these themes were mapped onto the UTAUT constructs (Social Influence, Effort Expectancy, Performance Expectancy and Facilitating Conditions), alongside the most relevant Hofstede cultural dimensions (Power Distance, Uncertainty Avoidance and Individualism vs. Collectivism) (Hofstede, 2001; V. Venkatesh et al., 2003). This section interprets the implications of these mappings, demonstrates how they collectively respond to the overarching research question and situates the findings within the broader academic discourse on digital technology adoption and national cultural frameworks.

This chapter synthesizes the empirical findings with existing theoretical perspectives to address the central research question. Based on ten semi-structured interviews and the themes developed in Chapters 4, the analysis revealed three recurring culture–adoption linkages: (1) Power Distance influencing Social Influence, (2) Uncertainty Avoidance shaping Effort Expectancy and (3) Individualism versus Collectivism affecting both Performance Expectancy and Facilitating Conditions, presented in 5.3. In the following sections, each of these pathways is examined in detail to explain the observed adoption behaviors and to contextualize the findings within the broader literature on digital technology acceptance and cross-cultural studies.

**Table 5.3:** Themes mapped to Hofstede–UTAUT Relations

| Theme | Hofstede Dimension | UTAUT Construct |
|---|---|---|
| Hierarchical Persuasion Dynamics | Power Distance (PDI) | Social Influence (SI) |
| Boundary-Spanning Network Effect | Individualism/ Collectivism (IDV/Coll) | Facilitating Conditions (FC) |
| Cautious-Driven Onboarding | Uncertainty Avoidance (UAI) | Effort Expectancy (EE) |
| Collective Impact Catalyst | Individualism/ Collectivism (IDV/Coll) | Social Influence (SI) |
| Autonomous Support Network | Individualism/ Collectivism (IDV/Coll) | Facilitating Conditions (FC) |
| Certainty-Driven Onboarding | Uncertainty Avoidance (UAI) | Effort Expectancy (EE) |
| Individual Impact Catalyst | Individualism/ Collectivism (IDV/Coll) | Social Influence (SI) |

### 5.4.1. Digital adoption factors interaction with cultural dimension

**Power Distance → Social Influence**

Thematic analysis revealed that the cultural dimension of hierarchy plays a central role in shaping Social Influence (as defined in UTAUT) in both Indian and Dutch SMEs. In India, where Power Distance is high, decision-making authority is concentrated at the top. Also, digital adoption is often driven by executive mandates, with limited input from lower-level staff. Even when senior leaders are not directly involved in daily operations, their decisions are rarely questioned. In contrast, Dutch SMEs, despite operating in a moderate Power Distance environment, still rely on leadership endorsement, though in a more consultative manner. However, in the Netherlands, this influence is moderated by open communication practices, such as regular all-hands meetings, where employees at all levels are encouraged to contribute. This participatory approach stands in stark contrast to the more hierarchical and directive style observed in Indian firms.

Previous studies on UTAUT (e.g., V. Venkatesh et al., 2003; Tarhini et al., 2017) have shown that Social Influence is more pronounced in high Power Distance cultures. Tarhini et al., 2017 presented that Power Distance significantly moderates the link between social norms and behavioral intention, particularly in hierarchical settings like India. N. Srite and Karahanna, 2006 similarly argued that in such contexts, the opinions of superiors carry disproportionate weight in shaping technology acceptance. Conversely, in low to moderate Power Distance cultures like the Netherlands, Social Influence tends to emerge from manager-employee dialogue. These studies suggest that in European SMEs, influence is more likely to be horizontal, with peer champions playing a key role in driving adoption, particularly operations manager.

**Uncertainty Avoidance → Effort Expectancy**

The connection between Uncertainty Avoidance and Effort Expectancy was evident through the theme of Cautious driven on-boarding containing code-groups, Learning & Experimentation and Risk & Resistance. In India, where Uncertainty Avoidance is moderate to high, employees prefer structured learning environments that minimize ambiguity and improves the adoption of technologies, making it easier for them to use.

This reflects a cultural preference for formal training and clear guidance before engaging with new technologies. In contrast, Dutch SMEs, characterized by lower Uncertainty Avoidance, favor more flexible, experiential learning approaches. This method reflects a greater comfort with ambiguity and a willingness to learn through experimentation, rather than relying solely on formal instruction. They prefer to put efforts into individual practice to understand how easy is it to use a particular technology.

While Tarhini et al., 2017 found that Uncertainty Avoidance moderates the relation between Perceived Usefulness and Behavioral Intention, they did not find a significant effect on Perceived Ease of Use. However, our findings suggest that in moderate UAI contexts like India, structured training directly reduces perceived effort, indicating a stronger link between UAI and Effort Expectancy. This aligns with earlier work by Straub et al., 1997 but is in contrast with the work of Sriwindono and Yahya, 2014. On the other hand, my finding about the Dutch preference for hands-on learning is in line with Agostini and Nosella, 2019, who observed that European SMEs often adopt a more experimental approach to digital adoption.

**Individualism/Collectivism → Performance Expectancy & Facilitating Conditions**

Our analysis showed that the cultural dimension of Individualism versus Collectivism influences both Performance Expectancy and Facilitating Conditions. In India, where collectivism is prevalent, digital tools are often adopted based on group consensus and peer benchmarking. Additionally, Indian SMEs frequently rely on shared resources such as government subsidies

In contrast, Dutch SMEs, operating in a highly individualistic culture, focus on personal efficiency and customer-driven incentives. Dutch firms prioritize individual performance gains and mobilize resources on a case-by-case basis, rather than relying on collective support.

N. Srite and Karahanna, 2006 and Lee et al., 2012 found that collectivist cultures tend to emphasize shared perceptions of usefulness and rely on community-based resources when adopting technology. Our findings from India support this, showing that group-level benchmarking and access to public funding are key enablers. Our finding is in line with the study by Sriwindono and Yahya, 2014 In contrast, Lee et al., 2012 observed that individualist culture often base adoption decisions on personal preferences and ease of use, patterns mirrored in the Dutch data. Tarhini et al., 2017 also noted that Individualism acts as a moderating variable between Perceived Usefulness and Behavioral Intention, with individualists focusing more on personal benefits. Our study extends this by showing that Facilitating Conditions are also culturally mediated, collec-

tivist firms view them as shared assets, while individualist firms treat them as individually accessed or negotiated supports.

### 5.4.2. Towards a unified Framework

By synthesizing the three key culture–adoption linkages, Power Distance influencing Social Influence, Uncertainty Avoidance shaping Effort Expectancy and Individualism/-Collectivism affecting both Performance Expectancy and Facilitating Conditions, this study proposes an integrated framework for understanding digital adoption in Indian and Dutch SMEs (see Figure 5.2).

In the Indian context, the convergence of high power distance, strong uncertainty avoidance and a collectivist orientation fosters a cautious and socially reinforced approach to digitalization. Here, adoption is typically driven by top-down directives, supported by structured training programs and facilitated through shared resources such as government subsidies.

Dutch SMEs, on the other hand, function in a culture that values individualism, moderate power distance, and moderate uncertainty avoidance. . This combination encourages a more agile adoption process, where individual employees take initiative, learn through hands-on experimentation and respond to direct customer demands as key enablers of digital uptake.

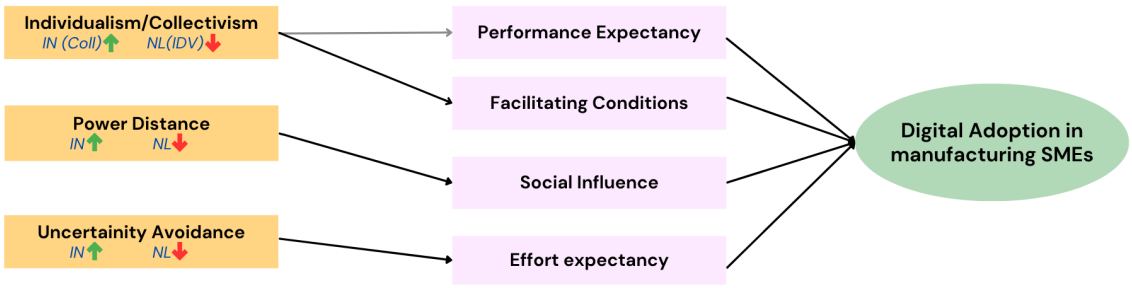


**Figure 5.2:** A Culture-Infused UTAUT Framework for SME Digital Adoption

## 5.5. Reasons for Divergence from Existing Literature

While this study aligns with core principles of UTAUT and Hofstede's cultural dimensions, several contextual factors explain the observed deviations. Sector-specific dynamics in manufacturing SMEs, such as operational efficiency and customer compli-

ance, may amplify the influence of hierarchy and structured training beyond what is typically reported in broader technology adoption literature. The type of company; corporate or family owned, could affect these variances. Additionally, organizational maturity and digital readiness likely shape how cultural traits manifest, firms at earlier stages of digital transformation may exhibit stronger reliance on formal authority and risk-averse behaviors, particularly in high-UAI contexts like India.

Moreover, hybrid cultural practices within globally connected SMEs may blur national cultural boundaries, leading to mixed adoption behaviors. Dutch firms, for example, while culturally individualistic, still value executive endorsement, suggesting a symbolic role of leadership even in low-PDI settings. Methodological differences also contribute: this study's qualitative approach captures nuanced, context-specific interpretations of constructs like Facilitating Conditions, which are often treated as culturally neutral in quantitative models. These insights underscore the need to adapt theoretical frameworks to reflect the lived realities of SMEs operating in diverse cultural and industrial environments.

## 5.6. Theoretical Contributions

This study advances the theoretical framework for digital adoption model in numerous ways. First, it shows that cultural factors actively influence how key concepts like Social Influence, Facilitating Conditions, Effort Expectancy and are perceived and used in businesses, rather than only serving as moderators in technology adoption models.

Second, the study urges a re-conceptualization of Facilitating Conditions in future models by demonstrating that it is understood differently in cultural situations.

Third, the findings suggest that the UTAUT model may benefit from a more dynamic integration with cultural frameworks such as Hofstede's dimensions. Rather than treating culture as an external variable, this study positions it as a foundational lens through which digital adoption behaviors are filtered and understood.

Finally, This thesis offers new insights into how manufacturing SMEs in two culturally distinct countries, India and the Netherlands, adopt digital technologies, including open-source software (OSS). By conducting semi-structured interviews with SME leaders across both regions, I identified three cultural pathways influencing digital adoption as presented in fig 5.2 The study offers a unified interaction model that maps specific cultural traits (PDI, UAI, IDV/Coll) to corresponding UTAUT constructs (SI, EE, PE, FC), providing a more detailed understanding of how digital adoption unfolds in culturally distinct SME environments.

## 5.7. Practical Implications for SMEs

This research provides actionable insights for manufacturing SMEs and their managers navigating digital transformation challenges across culturally distinct environments like India and the Netherlands. For SME managers and digital transformation leaders, the findings highlight the importance of context-sensitive digital strategies tailored to cultural

dimensions. In high power distance (PDI) and high uncertainty avoidance (UAI) settings such as India, digital adoption efforts should prioritize formal leadership endorsement, structured training programs and collective validation mechanisms. Employees in such environments tend to embrace new technologies more readily when introduced through top-down directives, supported by clear, risk-mitigating procedures. Additionally, identifying and supporting hidden champions within organizations, those individuals who actively promote and sustain digital initiatives, can significantly enhance adoption success.

Conversely, in moderate PDI and low UAI contexts like the Netherlands, a more agile, decentralized approach proves effective. Empowering individual employees to experiment with digital tools, providing hands-on learning opportunities and aligning digital initiatives with personal productivity goals can substantially boost technology uptake.

Understanding how employees perceive support, as either a shared organizational resource or an individual empowerment tool, enables managers to better tailor onboarding and training programs to fit cultural expectations, thereby improving engagement and reducing resistance.

Beyond individual strategies, this research offers a nuanced framework integrating Hofstede's cultural dimensions with UTAUT constructs, providing managers a sophisticated lens to tailor technology adoption plans. This cultural-technology lens enables the design of change management initiatives that align with prevailing cultural norms, fostering communication and training approaches that resonate more deeply with employees.

Furthermore, this study underscores the role of Open Source Software (OSS) as a cost-effective enabler of digital transformation, particularly for resource-constrained SMEs. The practical guidance on integrating OSS with existing ERP and CRM infrastructures, customized to each country's cultural context, equips managers with sustainable pathways to digitalisation.

Finally, for multinational SMEs or those pursuing cross-border partnerships between India and the Netherlands, these findings shed light on cultural barriers and facilitators influencing technology acceptance, thus fostering smoother collaboration and effective knowledge transfer.

## 5.8. Policy Implications

The results also have significant implications for legislators who want to hasten SMEs' digital transformation. In collectivist and high-PDI contexts, policy interventions should focus on strengthening institutional support mechanisms such as government subsidies, public training programs and industry, wide digital literacy campaigns. These collective resources are more likely to be utilized and valued in such environments. In individualist and moderate-PDI settings, policies that incentivize innovation at the firm or individual level, such as tax credits for digital investments or grants tied to performance outcomes, may be more effective. Additionally, fostering peer learning networks and industry consortia can help disseminate best practices and reduce the perceived risk of adoption. Policymakers should also consider the symbolic role of leadership in digital

transformation. Programs that engage SME leaders directly, through executive training, digital leadership forums or public recognition of digital champions, can amplify the impact of policy initiatives.

## 5.9. Limitations

This study has limitations given its contributions, of the relatively small sample size, comprising ten interviews across two countries. Although this made it possible to gain deep, contextual insights, it also restricts how broadly the results can be used. Validating these findings with bigger, more varied populations should be the goal of future research. The study also focused exclusively on manufacturing SMEs, which may not reflect the dynamics of digital adoption in other sectors such as services, retail, or agriculture. Sector-specific factors could interact with cultural dimensions in unique ways, warranting further investigation.

Like most qualitative research, this study has limitations in scope and generalisability. With ten participants, the sample size is small and does not aim for statistical representation. Instead, the focus was on achieving thematic saturation, which has been found achievable with even modestly sized, well-targeted samples (Guest et al., 2005).

Potential biases had to be addressed because the study aimed to examine participants' attitudes and beliefs. The social desirability bias is one of them, where respondents give answers based on what they think is the most preferred response (Barriball & While, 1994). A variety of techniques were employed to lessen the effects of this bias. Initially, participants were told that there was no ”correct” or ”wrong” answer and that their replies would remain anonymous. This was meant to encourage real and honest contemplation. Second, the emphasis was on neutral and non-leading question framing, which reduced the likelihood of participants being guided toward an answer that was seen socially acceptable. Third, preserving respondent anonymity can frequently reduce the need to conform to society norms, allowing for more genuine feedback. Previous research has demonstrated that transparency, secrecy and anonymity can greatly diminish the possible effects of social desirability bias on participant replies (Lavrakas, 2008). A fourth limitation is the potential impact of language and communication style, especially in a cross-cultural setting. While all interviews were conducted in English, differences in fluency and cultural expression may have influenced the richness of responses. To reduce this risk, a conversational tone was used and participants were invited to clarify or elaborate as needed (Liddicoat, 2024). Finally, the study included only SMEs that were already engaged to some degree with digital tools. As such, it may not fully represent firms that are digitally resistant or unaware. This limitation was partly addressed by selecting firms at various stages of digital maturity, B.3. This information was gathered during initial talks with the interviewees. While analytical generalisability is prioritised over statistical generalisability, this is a widely accepted norm in qualitative inquiry (Smith, 2017).

Moreover, the use of Hofstede's cultural dimensions as a framework, while widely accepted, comes with known critiques. It treats culture as a relatively static, national-level phenomenon, which overlooks within-country variation and individual differences. Although this study's qualitative approach helps capture more nuance, some cultural

complexity may still be oversimplified or missed. Additionally, cultural traits were inferred from qualitative data rather than measured directly using standardized instruments. While this approach allowed for rich, grounded interpretations, it may introduce subjectivity and interpretive bias. This could lead to the framework not being generalised in different settings. Finally, the study did not account for other potentially influential variables such as organizational age, digital maturity, leadership style, or regional policy environments. These factors could moderate or mediate the observed relationships and ought to be studied in subsequent studies.

## 5.10. Future Research

Several avenues for future research can be recommended after consideration of the insights and limitations of the study. First, quantitative studies using validated scales for cultural dimensions and UTAUT constructs could test the proposed interaction model across bigger and more varied samples. This would improve the generalizability and statistical robustness of the findings.

Second, future research could dive into the role of organizational subcultures and leadership styles in mediating the national culture influence on digital adoption. For example, do flat leadership structures within high-PDI cultures mitigate hierarchical effects?

Third, longitudinal studies could examine how cultural influences on digital adoption evolve over time, particularly as SMEs progress through different stages of digital maturity.

Fourth, comparative studies involving additional countries, particularly from Latin America, Africa or Southeast Asia, could test the global applicability of the proposed framework and uncover new cultural configurations.

Finally, interdisciplinary research that integrates insights from organizational psychology, information systems and cultural studies could offer a holistic comprehension of the intricate relationship betweenculture and technology in the SME context.

# 6

# Conclusion

This thesis set out to explore the central question: ***How do digital-adoption factors interact with cultural influences in Indian and Dutch manufacturing SMEs with a focus on open technologies?*** Grounded in ten semi-structured interviews and rigorous thematic analysis, I identified seven internal code-groups that capture organizational culture (e.g., Hierarchy; Learning & Experimentation; External Influencer) and organized them into four overarching themes for each country. By mapping these themes onto the four UTAUT constructs, which are Effort Expectancy, Social Influence, Facilitating Conditions and Performance Expectancy. Along with those, considering the three core Hofstede dimensions: Individualism/Collectivism, Power Distance and Uncertainty Avoidance, resulting in three dominant culture-adoption pathways:

1. Power Distance → Social Influence: In India's high-PDI environment, CEO or plant-head mandates create nearly automatic compliance, whereas in the Netherlands' lower-PDI context, executive sponsorship is followed by open, all-hands dialogue, diffusing influence across teams.
2. Uncertainty Avoidance → Effort Expectancy: High UAI in Indian SMEs demands formal training sessions and rapid Q&A cycles to reduce anxiety, while Dutch SMEs, comfortable with ambiguity, favor hands-on, pilot-based learning that accelerates experiential buy-in.
3. Individualism/Collectivism → Performance Expectancy & Facilitating Conditions: Collectivist Indian firms build shared belief in long-term performance gains through peer benchmarking and pooled government grants, whereas individualist Dutch firms ground adoption in personal ROI and rely on direct customer mandates for support.

Together, these pathways paint a coherent picture: India's digital roll-outs are risk-mitigated and socially reinforced, while the Netherlands' are rapid and autonomy-driven. These findings confirm and refine existing UTAUT–Hofstede scholarship (Tarhini et al., 2017; N. Srite and Karahanna, 2006) by demonstrating, for example, that high UAI in India indeed conditions Effort Expectancy.

Theoretically, this thesis contributes a parsimonious, empirically grounded interaction

model that aligns three Hofstede dimensions with four UTAUT levers, an approach that can be quantitatively validated in future cross, national SME research. Practically, my results offer clear guidance for managers: Indian leaders should leverage top-down sponsorship, structured Q&A and collective subsidy applications, while Dutch leaders should empower individual champions, facilitate hands-on pilot labs and secure customer-driven mandates. Policy implications include cluster-based subsidy programs and standardized upskilling modules in India, as well as “pilot vouchers” and client-subsidized integration incentives in Europe.

Despite the richness of the qualitative data, limitations-such as sample size, cross-sectional design and omitted Hofstede dimensions-suggest fertile ground for future studies: large-scale quantitative surveys, longitudinal tracking of evolving adoption behaviors and exploration of additional cultural factors (e.g., Indulgence vs. Restraint). Nonetheless, by illuminating exactly how culture and technology acceptance co-construct digital uptake in SME settings, this thesis provides a robust, actionable framework for researchers, practitioners and policymakers aiming to accelerate digital transformation in culturally diverse environments.

## 6.1. Link to Management of Technology

This thesis aligns closely with the MSc Management of Technology curriculum at TU Delft by integrating core principles of technology strategy, innovation management and organizational behavior into a concrete, field-based study. First, the program emphasizes how technological change must be guided by sound management practices; by investigating how digital manufacturing solutions are adopted (or resisted) in SMEs, this research directly informs of practices for managing digital transformation projects. Second, TU Delft’s coursework on “Emerging Breakthrough Technology; Technology Dynamics and Leadership and Technology and Management” underscores the importance of understanding both internal organizational capabilities and external ecosystem dynamics, precisely the dual focus of the comparative analysis of Indian and Dutch SMEs. Finally, the program’s strong orientation toward practical, impact-oriented research is mirrored in this study’s actionable recommendations for policy, training and leadership in manufacturing firms. In sum, by combining rigorous qualitative methodology with frameworks, a method learnt in the Management of Technology syllabus, this thesis both draws upon and contributes back to TU Delft’s mission of preparing graduates to lead technology, driven change in complex, cross, cultural environments (“TPM MOT studyguide”, n.d.).

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# A

# Theoretical Background

Catalogue of Digital Solution Areas for Manufacturing SMEs.

| Category | # | Solution Area |
|---|---|---|
| | 1 | Automated visualisation of financial KPI to all relevant function |
| | 2 | Capacity monitoring of human and machine resources |
| | 3 | Condition monitoring of equipment |
| | 4 | Customer and demand data gathering and analysis |
| | 5 | Digital faults monitoring (tracking of re-works and complaints) |
| | 6 | Digital inventory status and reconciliation |
| | 7 | Digital job cards |
| | 8 | Digital job cost variance tracking |
| | 9 | Digital library of typical errors/faults and rectification instructions |
| | 10 | Digital waste recording system (goods, energy, water, etc.) |
| **1) Data Capture and Visualisation** | 11 | Display of production schedule around the shop floor |
| | 12 | Integrated information system between design and production operations |
| | 13 | Monitoring and reporting on working conditions |
| | 14 | Monitoring of lead time |
| | 15 | Problem and context oriented display of information for operators |
| | 16 | Process monitoring (vibration/energy/temperature, etc.) |
| | 17 | Real time emission monitoring |
| | 18 | Real time tracking of internal jobs (location, status) |
| | 19 | Real time waste and emission monitoring |
| | 20 | Traceability, evidence and data of the cost of meeting CSR requirements |
| | 21 | Traceability, evidence and data on product wear and obsolescence |
| | 22 | Traceability, evidence and data on supplier ethos |
| | 23 | Automated bottleneck identification in operations |
| | 24 | Automated bottleneck identification in supply chain |
| | 25 | Automated finished product scan and integration with logistics provider |
| | 26 | Automated generation of CNC code |
| | 27 | Automated job scheduling to human and machine resources |
| | 28 | Automated minimisation of tooling |
| | 29 | Automated optimisation of process parameters |
| | 30 | Automated quoting system for spot pricing |
| | 31 | Automated sustainability index of products (energy, raw materials, etc.) |
| | 32 | Automated tracking and assignment of tools to operations |
| | 33 | Automated visual inspection of shape/finish of goods |
| | 34 | Automated weight check and packaging |
| **2) Data Analysis** | 35 | Control procedure for equipment maintenance |
| | 36 | Control procedure for equipment operation |
| | 37 | Control process to manage line side feeds/counters |
| | 38 | Digital cost model for jobs |
| | 39 | Digital cost modelling of disruptions and changes |
| | 40 | Digital supply chain visualisation and decision assistance |
| | 41 | Digitally assisted inbound goods quality verification |
| | 42 | Material arrival predictions |
| | 43 | Optimisation of energy consumption |
| | 44 | Optimisation of machine set-up times |
| | 45 | Optimisation of material flow and travel within operation |
| | 46 | Predictive equipment maintenance |
| | 47 | Weather based scheduling |
| | 48 | Automated delivery of workpieces and tools to operators |
| **3) Actuation** | 49 | Automated tool changer / part feeder |
| | 50 | Digital management architecture (ERP and MES) |
| | 51 | Digital manufacturing project management system |
| | 52 | Digital purchase order management system |
| | 53 | Digital sales order management system |
| | 54 | Digital methods for employee training (webinars, VR, AR, etc.) |
| **4) Support Systems** | 55 | Digital worker shift management system |
| | 56 | Digital works order management system |
| | 57 | Digitised work instructions, photos and assembly procedures |
| | 58 | Product life cycle management system |
| | 59 | Simulation of tools and processes for virtual process planning |

**Figure A.1:** Catalogue of digital solution areas by Schönfuß et al., 2021

# B

# Methodology

**TU DELFT INFORMED CONSENT FORM**

**Opening Statement**

You are being invited to participate in a research study titled **'Cultural Influences on the Adoption of Digital Technologies in SMEs: A Comparative Analysis of India and the Netherlands'.** This study is being conducted by **Komal Kaur Sasan**, a Master's student at **TU Delft**, under the supervision of **Dr. Johannes Gartner**, Assistant Professor at the Faculty of Technology, Policy and Management (TPM), TU Delft.

The purpose of this study is to explore how organizational culture influences the adoption of digital tools in small and medium-sized enterprises (SMEs), specifically comparing experiences between India and the Netherlands. The study involves a 45–60 minute interview that aims to gather insights into your company's organizational values, openness to change, and decision-making processes related to digital transformation.

The data collected will be used strictly for academic purposes, including thesis writing, potential academic publications, conference presentations, and teaching. You will be asked about your experiences with digital technology in your organization, challenges faced, cultural factors influencing decisions, and perceptions of digital transformation.

While every effort will be made to ensure the security and confidentiality of your data, as with any online communication, there is a small risk of data breach. To ensure that we minimise any risk when storing and using the data, any data that is collected will be done in a password protected environment using TU Delft's institutional storage. Moreover, unauthorised access to all personal and interview data will be prevented via access control. This data will only be accessible to the TU Delft research team consisting of the responsible researcher and the responsible researcher's graduation committee. As with any online activity there may pose a risk of a potential breach, however to the best of our ability we will ensure your data remains strictly confidential.

To help with the data analysis of this study, we will record the interview via MS Teams to generate a written transcript of the interview. As we will also be collecting your name, associated company and role, these will strictly for administrative purposes. After the interview, a copy of the interview transcript will be shared with you, if you have any modifications/suggestions or issues, you can express your concerns and they will be taken care of. Furthermore, all data included in the final thesis will be anonymised and aggregated to ensure confidentiality. The thesis will be publicly published on the TU Delft repository. All personal data will be deleted at the end of the research project dated 01st Sept, 2025. All the data will be handled according to the GDPR of both the countries, India and the Netherlands.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any questions.

If you have any questions about this study, please feel free to contact Komal Kaur Sasan (Researcher) k.kaur.sasan@student.tudelft.nl and/or Dr. Johannes Gartner (Responsible Supervisor) j.gartner@tudelft.nl

| PLEASE TICK THE APPROPRIATE BOX | Yes | No |
|---|---|---|
| I agree that my responses, views or other input can be quoted anonymously in research outputs | ☐ | ☐ |

**Figure B.1:** Consent form for Interview participants

**Signatures**

I, as a participant, have read and understood this information, and I consent to participate in this study along with the data being processed as described above.

| _____ | _____ | _____ |
|---|---|---|
| Name of participant | Signature | Date |

I, as researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

| Komal Kaur Sasan | KomalKaurSasan | 03-04-2025 |
|---|---|---|
| Researcher name | Signature | Date |

Study contact details for further information:
Komal Kaur Sasan: k.k.sasan@student.tudelft.nl

**Figure B.2:** Consent form for Interview participants

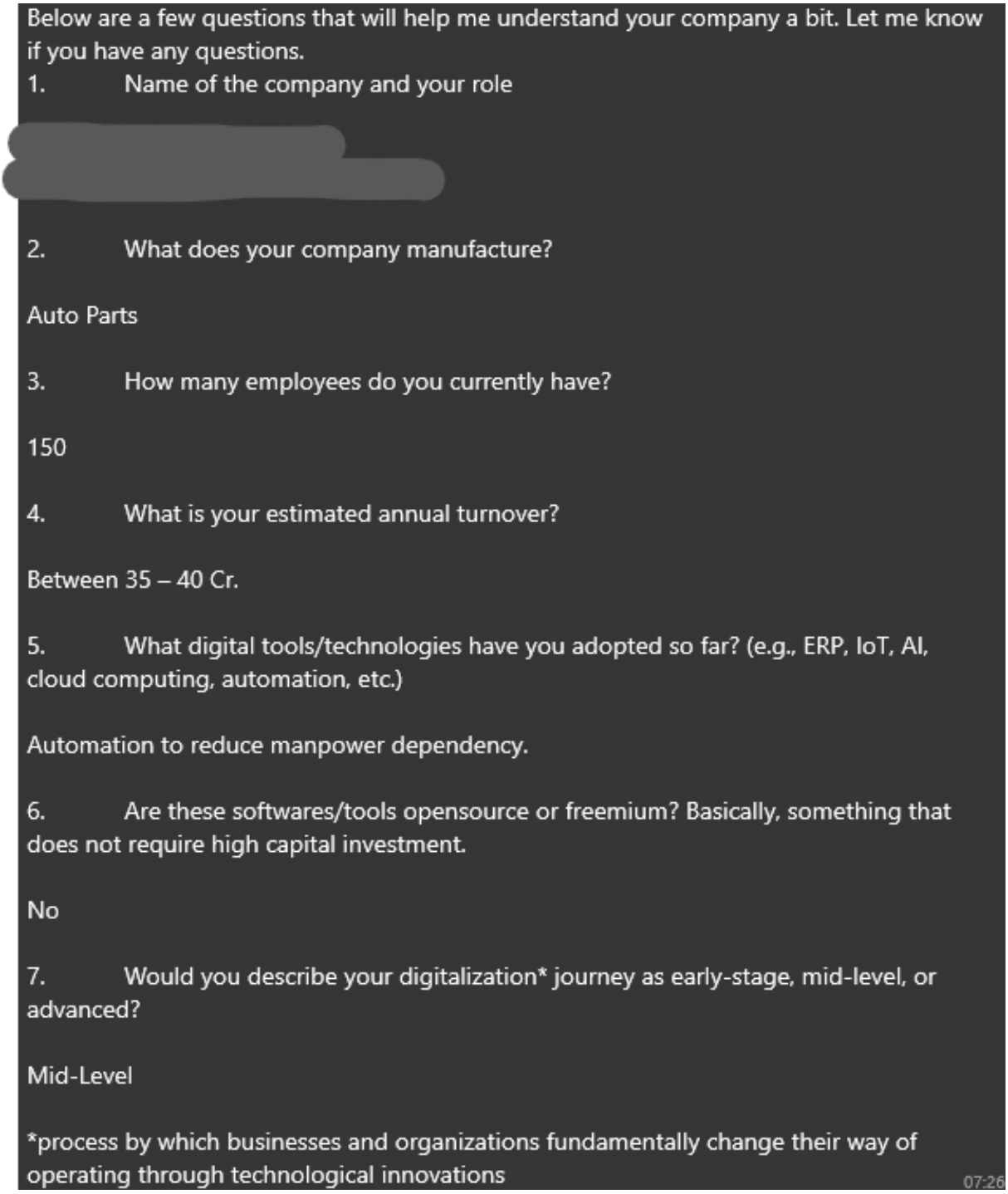


**Figure B.3:** Initial screening Q&A: II2

## Interview Guide – UTAUT × Hofstede (Open Innovation & Digital Adoption)

### A. Opening and Background (Narrative Focus)

- Can you tell me a bit about your background — for example, your education and experience in this sector?
- What brought you into this line of work or this company?
- What is your current role in the company, and how does it relate to technology or operations?
- How large is your company in terms of employees and annual turnover?
- What types of digital technologies (like ERP, IoT, AI) are currently part of your company's manufacturing or operations?
- What role, if any, do open-source, freemium, or low-cost technologies play in your digital setup? Can you give examples of tools you use and how they've helped the company (e.g., saving costs, improving workflows)?
- How would you describe the company structure?

### B. Experiences with Digital Technologies

- Can you describe a time when your company decided to adopt a new digital technology? What was that process like?
- What kinds of challenges, if any, came up during that time — and how were they handled?
- How have digital technologies changed the way your company works — in areas like production, communication, or customer service?
- In your experience, how important is it for manufacturing companies to adopt digital tools to stay competitive?

### C. Learning and Adapting to New Tools

- How do employees typically get familiar with and start using new technologies in your company?
- To what extent does your team rely on support like training, external assistance, or informal help during this process?
- How would you describe the ease or difficulty of using the digital tools your company has adopted?

### D. Decision-Making and Organizational Support

- Can you share an example of how a decision to adopt new technology was made in your company? Who was involved, and what influenced the final decision?
- What kind of support — from within the company or from outside — has helped you implement these digital tools?

**Figure B.4:** Interview Guide

### E. External Influence and Trends

- Can you think of any situations where the opinions of colleagues, leaders, or industry peers affected a decision to use certain technology?
- Are there any digital trends or market pressures that push your company to adopt new technologies?

### F. Cultural Factors in Technology Adoption

- What is the relationship like between management and employees when it comes to suggesting or experimenting with new technologies?
- What factors does the company consider when weighing the benefits of a new technology? How do you balance short-term results with longer-term planning?
- Can you give an example of how company culture influenced a decision around digital adoption?

### G. Barriers, Opportunities, and Recommendations

- What are the biggest challenges/drivers (motivation) to adopt low cost tech your company faces when adopting new technologies?
- What do you think would make it easier for companies like yours to adopt digital tools? Are there changes or resources that would help?
- What advice would you give to other small or medium-sized companies thinking about starting or improving their digital transformation?

### H. Closing

- Is there anything else you'd like to share about your experience with digital adoption, culture, or how your company approaches change?

**Figure B.5:** Interview Guide

# C

# Research Questions

| | Quotation Content | Codes |
|---|---|---|
| 4:1 | Majorly we use the designs | Digital tools: design and engineering |
| 4:2 | automated machinery for manufacturing process. | Digital tools: automated machinery |
| 4:3 | For the management, we have some process management tools we use that we used for managing like different kind of like customer relations or the. Different areas we work in to manage inventory, stocks and everything for. | Digital tools: business process |
| 4:4 | So what we do is we take those open source softwares as a training for training purpose so that the employees get comfortable with using the new technology and get then we move on to the fully paid version or something that is really helpful. So yes, we initially start with open source | Pilot and phased adoption |
| 4:5 | So they are they are quite a significant role and it saves us a lot of. Money. | Performance-driven motivation |
| 4:6 | That helped us streamlining the inventory management and. Then billing process as well. | Digital tools: business process<br>DT helps with resource planning |
| 4:7 | So majorly the upper management is involved in this decision so. We have the directors of the company, who generally are more involved towards these kind of decisions. Majorly on the financial side, | Authority-driven adoption<br>Heirarchical structure |
| 4:8 | So the education level there is very low and people are not very familiar with using these kind of softwares. | knowledge gap |
| 4:9 | So main problem is to get them into training and like. Making making them familiar with the software, educating them and some. Of them like need more time than required. | Knowledge and experience sharing<br>patience towards employees<br>Training and capacity building |
| 4:10 | So luckily near our facility we have one of the education institutes set up by Indian government known as MSME Institution. | External Resources |
| 4:11 | From that we have some knowledge transfers, so some of our employees are really skillful in their, in their particular area. | Knowledge and experience sharing<br>Training and capacity building |
| 4:12 | Yeah. So it is obviously difficult thing for the employees to like adapt to those change because they have been working on things for for their life. And then you suddenly change the | knowledge gap |
| 4:13 | So yeah, so first we I think what we do is we first try to migrate slowly. We take a small part to the new platform and then move like that. So to help majorly to help employees, we breakdown everything in steps like in targets like in first week we have to achieve this much and then move on after feedbacks we move | Long term strategic perspective<br>Pilot and phased adoption |

| | Quotation Content | Codes |
|---|---|---|
| 4:14 | So employees are also very supportive in doing that. | Bottom-up involvement |
| 4:15 | the introduction of automated machinery was happened due to some of the neighboring companies | Customer and Competitor pressure |
| 4:16 | The the other employees are also very much involved because at the end of the day they are the ones who will be interacting with these kind of technologies and they.Will be the ones who are working first hand on these, so they are taken into the loop | Bottom-up involvement |
| 4:17 | So it is always wise to look at the long, long term as aspect of it because.Generally, if it is a very new technology, it will hopefully pay off in the future. | Long term strategic perspective |
| 5:1 | d if I am using ERP software or any kind of set soft | Digital tools: business process |
| 5:2 | so we have top management, then we have head of departments, then the subsidiary under them | Heirarchical structure |
| 5:3 | the people that are working from day one over here like they were not ready to adapt, they were like they might be this problem or this problem | Age-related resistance<br>knowledge gap |
| 5:4 | I was more keen to do it like me. One of my team members we are. We are keen to introduce ERP or send to the company as we know what beneficial it was | Champion advocacy |
| 5:5 | We keep it a leadership base decision making her because as a top management we take a decision for the whole company, right, | Authority-driven adoption |
| 5:6 | these are the advantages that we are going to have and it can help us in the long run | Long term strategic perspective |
| 5:7 | creating awareness and informing the employees about a digital tool and its benefits. | Knowledge and experience sharing |
| 5:8 | It is not more of a competitive compare comparative thing, but it is more of a in House kind of data analysis and data collection. | data driven decision making |
| 5:9 | We tried to first, as I said, we tried to create awareness. Then second, we keep small training sessions | Knowledge and experience sharing<br>Training and capacity building |
| 5:10 | t the end we bimonthly or by 6 month we keep one more kind of session.Yeah, to check whether they are comfortable using it or they have adapted with it or not. | Bottom-up involvement |
| 5:11 | Tally is basically for financing | Digital tools: accounting |
| 5:12 | They teach us about the software and they teach us how to use it. So the first the company that we are partnering with to imply | Training and capacity building |

| | Quotation Content | Codes |
|---|---|---|
| 5:13 | We need to constantly evolve. | Customer and Competitor pressure |
| 5:14 | As of now, digitalization, use of a I or software is the next is the upcoming thing. So the sooner we imply those kind of things in our companies, the faster we will grow. | Customer and Competitor pressure |
| 5:15 | with Odoo but yeah they are also good company but that was not suitable for what we are doing or what we wanted that's why we didn't pass to those but. | Technical barriers |
| 5:16 | Data we can generate the more future planning we can do. | data driven decision making<br>Long term strategic perspective |
| 5:17 | All the at actual data we can get the the more savings we can do in the future or we can understand the patterns of how how the trend is going, whether like you can analysing with a couple of months of data whether this next month is going to be a good month or a bad month for us. | Performance-driven motivation |
| 5:18 | Little bit resistance. | knowledge gap |
| 5:19 | More awareness with the people. | Knowledge and experience sharing |
| 7:1 | So we use a cat Cam software AutoCAD Fusion 360 Hypermil where in the talks to also start using a solid Cam | Digital tools: design and engineering<br>Digital tools: manufacturing process and inputs |
| 7:2 | There are essential software enterprise solutions that we use that is very integral to our manufacturing competency | Digital tools: business process |
| 7:3 | s that has been prevalent since for several years is tally. | Digital tools: accounting |
| 7:4 | Being a data first company using data to drive decision making. | data driven decision making |
| 7:5 | then use that data to drive efficiency, increase productivity. | data driven decision making |
| 7:6 | nd also having empowering our not just top management but also our middle management practicall | Bottom-up involvement |
| 7:7 | . I ended up consulting with a few other family owned businesses who are | Customer and Competitor pressure |
| 7:8 | One its customer driven you know customer says I am not going to give you this big ticket project if you cannot begin using an ERP then they are forced to make that transition | Customer and Competitor pressure |
| 7:9 | a a a big loss of some kind and and they they're trying to figure out why that happened | Performance-driven motivation |
| 7:10 | A production dashboard and a productivity tracker. | Digital tools: project management |
| 7:11 | t's been a big learning for me and for my team and so they are actively involved in the building of the software. | Knowledge and experience sharing |
| 7:12 | I would definitely say get your people involved | Bottom-up involvement |

| | Quotation Content | Codes |
|---|---|---|
| 7:12 | I would definitely say get your people involved | Bottom-up involvement |
| 7:13 | So if you have a lot of capital and you have very little constraints in terms of Investments or the resources to make investments? | financial constraints are limited |
| 7:14 | we have an affordable solution and then and one that is sustainable a | Long term strategic perspective |
| 7:15 | n and bring cross functional stakeholders together and manage this whole thing right for someone like my father who's never dealt with a software project, he may just want to just buy something off the shelf and perhaps a premium option | Pilot and phased adoption |
| 7:16 | Premium solution or off the shelf solution is user friendly and coorders to the business needs. | user friendly technology |
| 7:17 | investing in state of the art machinery and our machines are significantly, much more expensive than home grown brands. So we typically buy Japanese machine tool builder brands and for. | Digital tools: automated machinery |
| 7:19 | I realised the the benefits of building custom software far outweigh Me, me relying on a 3rd party software | building custom softwares |
| 7:20 | I am making significant investment upfront but for the next 20 years I don't have to worry about maintenance or you know | Long term strategic perspective |
| 7:21 | So for me my learning has been I have to be more patient because I am essentially changing their 20 years of operating. | patience towards employees |
| 7:22 | So there was an initial resistance, I would say some inertia that that we have to overcome because the the sentiment was, oh, you know, we have been doing things a certain way | knowledge gap |
| 7:23 | Quick wins or rather wins Early in the in the project is important to keep that momentum going if there's a lot of roadblocks and a lot of setbacks in the beginning, then its harder for people to believe in adopting technology. | Pilot and phased adoption |
| 7:28 | we definitely bring in consultants to physically training classroom training workshopsthe other. | Training and capacity building |
| 7:29 | 34 years of experience and he says I have done. You know, I have deployed all of these projects across other organizations and here's, you know, he provides case studies and and and and also speaks from experience | Knowledge and experience sharing |
| 7:30 | . I mean I would say our people are getting much more comfortable, but we are not there yet There's still a lot of reliance On our younger engineers to | Knowledge and experience sharing<br>patience towards employees |

| | Quotation Content | Codes |
|---|---|---|
| 7:36 | So we have a very egalitarian culture here and so its not top down at all in certain instances. | Heirarchical structure |
| 7:37 | Competition definitely plays a big role in in that in the sense that you look at, you know what, 35 years ago when my father founded the company, we were the only company and the first to set up CNC manufacturing firm in this region in, in the city that we are in. | Customer and Competitor pressure |
| 7:38 | A projects you know and also the the government should should have incentives and programs in place to support MSMES given the significant working capital needs | External Resources |
| 7:39 | So initially the you know there was a lot of resistance, but now?Its relatively less so so because they are already seeing the value in some of the technologies that they have just started to use. | Performance-driven motivation |
| 7:40 | I see a lot of curiosity | Bottom-up involvement |
| 7:41 | And a lot of the times they they provide an input and say this would work. This wouldn't work for us. So they definitely see the value in experimentation. | Pilot and phased adoption |
| 7:42 | One thing that I would say is its important to have one person championing for digitization, right? | Champion advocacy |
| 7:43 | I would say it's primarily been short term benefits, | Pilot and phased adoption |
| 7:44 | I think its very much tied to leadership.Consistency is important and | Long term strategic perspective |
| 7:45 | y any manager can have access to our financial data like they can see what our revenue is, how much our expenses are like. There's there's no hiding of of any of them, | Transparent, inlclusive communication |
| 7:46 | Realities of running a business in in in a country like India, right? We don't have the best WiFi and you know and so you have to work with the constraints that you presented with. | Technical barriers |
| 7:47 | the change management. | change management |
| 7:48 | These people who've been part of the growth of the company in the early stages.To them, continue to grow with you. | Transparent, inlclusive communication |
| 8:1 | e 7 functions and all right from the management up to the.And commercial upto supply Its every every every function has its team head functional head. They are responsible for the performance and the efficiencies of that particular function. | Heirarchical structure |
| 8:2 | cesses?I1: So let me start with the sales and the sales and | Digital tools: sales and marketing |

| | Quotation Content | Codes |
|---|---|---|
| 8:18 | there was some mental blocks that a person had to overcome, and it comes to your team members because nobody likes change in their day to day work. | knowledge gap |
| 8:19 | So there was a lot of change management. | change management |
| 8:20 | prepare for the migration on the training program. They run parallelly so we completed the training program. | Training and capacity building |
| 8:21 | s. So basically its its the operations or the CEO or somebody who got the P&L in his focus, right? S | Authority-driven adoption |
| 8:22 | You know what they learn from watch out there. In terms of. New development or new innovation? Should I? So that's that's how it should. It should know it should. It should go from bottom up right now. It flows from top down. | Bottom-up involvement |
| 8:23 | we still follow a hierarchical structure wherein there is somebody who is monitoring. There is a somebody who is a boss or for somebody, right? So you you eventually end up having yes, men around you wil | Authority-driven adoption |
| 8:24 | it doesn't work out because at the end of the day they are not adopted. They are mentally not. They have done mentally satisfied with the adoption of the technology. They will probably not use it or sluggishly use it. You know they would just for the name sake and it will lose the purpose of of that particular technology. | Authority-driven adoption |
| 8:25 | We keep it open, we give them options, we we ask them their opinions so that they feel that they are heard. | Bottom-up involvement |
| 8:26 | We would eat that kind of room for uncertainties unclarity because my way of working has been very simple. | knowledge gap |
| 8:27 | But then we keep some room open to accept those kind of uncertainties to address those uncertainties and ask questions, clarify and then move on with the next phase of. | knowledge gap |
| 8:28 | You know there are system integrators or partners of that particular tool who are in front of us. We try and take services from them. | Training and capacity building |
| 8:29 | I see that there are few senior members in the team right? So There is some kind of a slowness in terms of adopting. | Age-related resistance |
| 8:30 | if you have a young leader and if you have a person who who knows how to | Champion advocacy |
| 8:31 | our industry does not allow us to look at the competitorr to see what kind of technology they are using in House, right | Customer and Competitor pressure |

| | Quotation Content | Codes |
|---|---|---|
| 8:31 | our industry does not allow us to look at the competitorr to see what kind of technology they are using in House, right. | Customer and Competitor pressure |
| 8:32 | Goal in terms of performance. | data driven decision making<br>Performance-driven motivation |
| 8:33 | You had broken eyes with your team members or with the stakeholders regarding adopting our technology.Show them the part in terms of how you and the organization are gonna support you to adopt this particular technology | Bottom-up involvement |
| 10:1 | Yeah, actually we have a common system that is CRM. You actually I think you know about CRM system. | Digital tools: business process<br>Digital tools: sales and marketing |
| 10:2 | If you talk about the manufacturing units and an organization, so basically they are using CRM, SAP | Digital tools: business process |
| 10:3 | they are also playing a vital role because if you do a doing a mass production then you just need to adopt the automated lines or some technologies which will boost your production | Digital tools: automated machinery<br>increased productivity |
| 10:4 | we are using some automated lines also they are and some robots also to And mass production or to minimise minimise the lead time of the order the main focus is to how to reduce the lead time and provide the services. | decrease lead times using DT |
| 10:5 | we just need to have a patience.Patience is actually a big thing. Everybody doesn't have a patient, but you just need to have a patience in everything | patience towards employees |
| 10:6 | Canva is a software which he which can design the demographics of a of your product | Digital tools: design and engineering |
| 10:7 | Just say for example in AutoCAD. So if we if we have a premium one | Digital tools: design and engineering |
| 10:8 | doing the marketing side its its actually a marketing process. So they we as we are using and also its for initial stage you can use a free version of this | Digital tools: sales and marketing<br>Pilot and phased adoption |
| 10:9 | We talk about its actually a hierarchically hierarchically. So w | Heirarchical structure |
| 10:10 | But in case if you have some good ideas or some initiative or if you want to speak so we have we are open to speak for every person | Transparent, inlclusive communication |
| 10:11 | . So I was heard that Sir, I have an idea that. | Bottom-up involvement<br>Transparent, inlclusive communication |
| 10:12 | We have a some training sessions. | Training and capacity building |
| 10:13 | We just take a feedback from our employees also that we are we are thinking that we just need to change or we just giving them | Knowledge and experience sharing |

| | Quotation Content | Codes |
|---|---|---|
| 10:14 | So we are using a I tools in the marketing sector. | Digital tools: AI for marketing |
| 10:15 | we have some external sources also who will provide some training in QS exchange to our trainers, which to ours higher authorities | Training and capacity building |
| 10:16 | See, government government will be helping these people see they are helping SMEs by giving their subsidies on some of the tools or some of the events also in margin side in, in manufacturing side. So if you talk about the SEZ Zone, Special economic zone, if you have your, if you have your manufacturing unit over there. So you are a tax free, you don't need to pay any taxes to. | External Resources |
| 10:17 | or example the HR department, they are not able to manage the manpower, manpower, ask they are they find the difficulty or they find a challenge while making a wages of the employees. So we can also take the opinion from them and doing the market research and acting upon that we can take a new software. | Transparent, inlclusive communication |
| 10:18 | but everyone will see in a long term effect. Everyone knows that that's the reason R&D teams will be developed in an organization because they these teams will be will work on a will work and everyone knows that sometimes the product will goes up, sometime it will. | Long term strategic perspective |
| 10:19 | As I already, as I already told that we have very friendly culture in our organization, each and every person has its own opinion and we can matter this opinion. | Bottom-up involvement |
| 10:20 | On this adoption of technology that on that time there is risks, risks will become but. If you if you talk about my organization so we can, we are very friendly each and everyone will sit in a same table and work on a same table. So risk part will be minimise, will minimise to some extent. | knowledge gap |
| 10:21 | Once we adopt the technology, we can use in a trial purpose, not not adopting technologies to a long term. First of all we we just adopt for a simple for a Few days, very few days if the if the things are going good then we can adopt these technology. | Pilot and phased adoption |
| 10:22 | And you just more focused on your competitor, what what they are trying, what they how they get the, how they get more customers so and marketing was you also know that marketing plays an important role and digitalization is a part of that? | Customer and Competitor pressure |

**Figure C.1:** Codebook IN

| | Quotation Content | Codes |
|---|---|---|
| 1:1 | Just free the free version of OneDrive to put the files together, and once we said OK, let's take a step to report professionalization. | pro OSS |
| 1:2 | We communication like Outlook, OneDrive, teams, those are the main communication tools. | Digital tools: communication |
| 1:3 | we implemented exact online at first, which is an ERP system | Digital tools: business process |
| 1:4 | So last year I switched to Odoo and it's a it's a it's a new tool on the market from Belgium if I'm correct. | Digital tools: business process<br>Digital tools: project management |
| 1:5 | the customer relationships modules with sales and the back office so. There's like one complete flow for sales.So for no for client outreach, so lead generation lead generation to sales.To opts to project delivery. | optimised project flow |
| 1:6 | or their design or for the R&DI use it for for keeping. | Digital tools: design and engineering |
| 1:7 | So that would save me a lot of time. | DT saves time |
| 1:8 | I think that decision was.Ultimately made by the CEO because it was the the the It's not a cheap program.But who pitched it? Was the designer, right? He said. I thought let's I wanna switch to this program. It will. I'm just more familiar with it. It will increase my speed. | impact driven decision process |
| 1:9 | But on the other hand, it's scalability. It's really something we look at. Righto, can we use it now? But can we use it also with when we're with 100 employees? | Long term strategic perspective |
| 1:10 | And then after a while it's OK now you have to figure it out, and if you have any questions you can contact. If you have a bug or any issue you can contact the.Support desk from them, but leave me alone. | individualistic approach to adoption |
| 1:12 | So we have the we have a service supplier, right? | dont depend on external services/trainings |
| 1:13 | o I think the AI tools that are available to use as a external help desk.That works. That works wonderfully. | Digital tools: AI |
| 1:15 | I think at the moment it's just incremental changes. | agile company |
| 1:16 | I think short term pain is really difficult for a new 2, but so if you have a tool which is gonna be short term pain but long term gain that will be very hard to accept by the people who are going to use it. | short term goal due to being a start up |
| 1:17 | let's just keep the feedback, get the feedback and keep on improving.And we we've also built in a couple of feedback loops to make sure that we get all the feedback we need. | feedback sessions |
| 1:18 | Either either cost cutting or revenue improvement. | ROI is a driver |
| 1:19 | Ease of use. | Ease of use of technology |
| 1:20 | It has so for digital tool selection I have not come across anywhere where government support has been in factor. | No Governmental aid |
| 1:21 | My advice would be to start setting up your processes and see | change management |

| | Quotation Content | Codes |
|---|---|---|
| 1:20 | It has so for digital tool selection I have not come across anywhere where government support has been in factor. | No Governmental aid |
| 1:21 | My advice would be to start setting up your processes and see if you can find tools that match that, but also reevaluate your tool selection after like a year. | change management |
| 1:22 | for smaller tools I think.Mostly the the decision maker would be me.I'm mostly in. I'm the mostly these responsible owner of most of the tools are in the company.But large it's mostly financial driven, but so large decisions like switching to Odo.I pitched that to our CEO and he he he final approval on that.Because the main. Yeah. So financials are also of course, always important. | Heirarchical structure |
| 2:1 | or main design tool is SolidWorks which is it's a CAD program to to build models and whatnot. | Digital tools: design and engineering |
| 2:2 | Then we also use a a software called Abacus, which is done to simulate SIM | Digital tools: design and engineering |
| 2:3 | For the the commercial side to have A crm customer relationship management system, we use HubSpot which is which is a commercially quite. | Digital tools: sales and marketing |
| 2:4 | And I think those are the the main softwares and then we use some organizing softwares such as notion which is it's a task manager | Digital tools: project management |
| 2:5 | We have our own server where we store our store, our own data and files and things like that. So that works quite similar to how notion worked, but we're transitioning more and more to notion right now. | Digital tools: cloud storage<br>Digital tools: project management |
| 2:6 | The own tools we make, we usually base them off, another open source tool or something like that. So now we're very open to it and we're doing it, yeah. | pro OSS |
| 2:7 | Time is a is very valuable resource and having someone develop these tools instead of just using open source ones is is quite labor intensive | OSS saves time to develop new software |
| 2:8 | So management place, we're a very flat company | Flat heirarchy |
| 2:10 | Then they will themselves test it as well, and if they like it, then they announce it to other engineers and they usually write a a short manual of how to use it, how to implement it. | Documentation and transcripts |
| 2:12 | very open towards new tools and the more tools the better as long as there is a choice to to implement them or not | open to trying new tool |
| 2:13 | Otherwise it will be like a an overflow of tools and then they they could take more time than than they give. | Ease of use of technology |
| 2:15 | we always try to work as modular as possible. So we don't like having to be dependent on something, and that alone helps with the with uncertainties, like if it doesn't work, that's alright | dont depend on external services/trainings<br>modular way to DT |

| | Quotation Content | Codes |
|---|---|---|
| 2:15 | we always try to work as modular as possible. So we don't like having to be dependent on something, and that alone helps with the with uncertainties, like if it doesn't work, that's alright because we can. We don't have to use it, we'll we'll find another way. | dont depend on external services/trainings<br>modular way to DT |
| 2:16 | if that's needed to help help make things as easy as possible to implement and to integrate into our own systems. | |
| 2:17 | We will, we will have a company wide meeting to talk about it. Everyone can raise their own concerns and how we feel about implementing it and then there will be, yeah, we'll have discussion screen that and. | collaborative |
| 2:18 | Training and there's a lot of talented people to to help implement things if that's needed, but it's all done. Most of it is done internally. | Less appreciative of training |
| 2:19 | To it always being a choice for the individual, there will always be, say, some people who who don't like a certain tool and won't use it as much, and that will have some sort of negative effect, but. | individualistic approach to adoption |
| 2:20 | So I I don't think we're that influenced by by outside. | Less influenced by competitive landscape |
| 2:21 | I think how much time it will save versus the initial cost of the time to to to implement it | time v cost evaluation |
| 2:22 | we try to be quite an agile company | agile company |
| 2:23 | ut yeah, of course you always try to think long term, but being a smaller company, a smaller scale up those Long term plans. | short term goal due to being a start up |
| 2:24 | We need to be focusing on what we're doing and what we what we want to achieve | internal inefficiences drive DT |
| 2:26 | think licensing is quite a a a big part like we choose like you only have so much capital you can spend on licensing. | licensing is expensive |
| 2:27 | If there is good documentation and good support from from technologies that would make things easier to implement We would value that higher than, say, a cheaper product that's that's harder to integrate. | Documentation and transcripts |
| 2:28 | Maybe the downside of having a flat hierarchy if if it's up to everyone of the Individual engineers then there's, then there can be a lot of variance, and then it's that could halter say communication or something down last time. | downside of flat heirarchy |
| 3:1 | Yes, we we use business central. | Digital tools: business process |
| 3:2 | We have SharePoint as a sort of common piece where we need to put everything in. | Digital tools: cloud storage |
| 3:3 | We have a sales director and we have a business development director and then xyz is in the office. She's do just a normal office work and I'm doing the business development. So and in | Flat heirarchy |

| | Quotation Content | Codes |
|---|---|---|
| 3:2 | We have SharePoint as a sort of common piece where we need to put everything in. | Digital tools: cloud storage |
| 3:3 | We have a sales director and we have a business development director and then xyz is in the office. She's do just a normal office work and I'm doing the business development. So and in the end to be honest is who is the business development director. | Flat heirarchy |
| 3:4 | She's hidden in the room and she's doing her thing. And if I see what she's doing, I'm like, oh, what, you know, its lets go way behalf be above what I what I can and what I what I should do because she is really the one who's making all the decisions implementing all the programs implemented, giving everybody training and then the guys from from the ITU were doing it really the the real work they put | Champion advocacy |
| 3:5 | . She takes days in training people when they don't understand. | Champion advocacy |
| 3:6 | so I think it's it's it's very the being positive about what you want to introduce helps enormously in in the reaction of the stuff. | change management<br>open to trying new tool |
| 3:7 | xyz sends the invoices to the states. They say OK, pay it and then she pays it because everything we know in in United States, | Authority-driven adoption |
| 3:10 | What they do is we all our trainings are being trans are being taken, you know, on and like you do now and transcript it into paperwork. And she makes a sort of shortcuts in the steps you need to take to enter an order, enter a quote, and it's all placed on SharePoint. | Documentation and transcripts |
| 3:11 | Yes we have one boss and we have a CCEO&ACOO and below that there is a whole. But even the highest even Bob the CEO is very accessible. He's not being protected by whoever they are all success. We were all together at the show. All the bosses were there. We had fun together and it's like you are with your friends. You know you can say everything you it's really it's so much. | family-style culture and accessibility<br>Heirarchical structure |
| 3:12 | It's we are like one big family. | family-style culture and accessibility |
| 3:13 | everybody is important. If you work in the warehouse or if you whatever its everybody is important. | Transparent, inlclusive communication |
| 3:14 | we had a we had a girl from Nicaragua working and government Trump came on and they arranged that she got married with a friend earlier than expected because otherwise she would have been kicked out of the country. | family-style culture and accessibility |
| 3:15 | . So that's a long term decision you make in the end, but during the whole time that it was implemented we worked with it and | Long term strategic perspective |

| | Quotation Content | Codes |
|---|---|---|
| 3:16 | And then also user friendliness. | Ease of use of technology |
| 3:17 | Yeah, if it's easier to work with. Yeah. If it's user friendly and if it's easy to work with and everything goes quicker | Ease of use of technology |
| 3:18 | If you if you take one or 2 employees who really know how how automation works and have to work with it and let them play with it and then testing, testing, testing, making. | rigorous testing |
| 3:20 | but I don't know how he's going to because he is 57 or whatever. He doesn't know how it works and he's also not open to it, | Age-related resistance |
| 3:23 | . If if you are, if you are the one who is introducing stay positive. Because if you your yeah. OK. Yeah. We have bought a new program. | Champion advocacy<br>open to trying new tool |
| 3:25 | if you you refuse to use something, then it's your problem. Then you need to find. Then you gotta clean become a clever or whatever | individualistic approach to adoption |
| 9:1 | So we use a local ERP, this is | Digital tools: business process |
| 9:2 | Which or it was once open source, I'm not sure if it still is called open bravo. | pro OSS |
| 9:3 | my responsibilities come back into it is when we started to divest our energy and attention to both Rike and Pipedrive, which is our CRM | Digital tools: sales and marketing |
| 9:4 | So I I know that we have a CNC machine, for example, that's sometimes | Digital tools: automated machinery |
| 9:5 | So there is a degree of hierarchical structure in place required also, for example for safety, right. So that's one element within. | Heirarchical structure |
| 9:6 | On the other hand, as a company culture, of course, we try to really ensure flat hierarchy. | Transparent, inlclusive communication |
| 9:8 | We believe of course that everybody Regardless of their job perspective or job, role has their own level of expertise and the the the task of that is to leverage that expertise. | individualistic approach to adoption<br>respecting individual expertise |
| 9:9 | So for example, I work from with project managers, but I also work with people who are administrative, right? | collaborative |
| 9:11 | I would say that the initial project is under the responsibility of the CEO, right? So they've kind of taken this responsibility on themselves to ensure. | Authority-driven adoption |
| 9:13 | We have this back and forth and then we I don't know, over a few meetings for a couple of weeks, months depending how quickly it goes, we rectify this. | change management<br>feedback sessions |
| 9:14 | And then the next steps are to do training and to actually implement it, | |
| 9:15 | Some people have lots of knowledge about production, transportation, whatever it is, but especially if they're a little bit older, the IT skills may not be 100% at the same level as | Age-related resistance |

| | 4: Thesis Interview_II1 | 5: Thesis interview_II2 | 7: Thesis Interview_II4 | 8: Thesis Interview_II3 | 10: Thesis interview_II5 | Totals |
|---|---|---|---|---|---|---|
| Digital tools: accounting | | 1 | 1 | | | 2 |
| Digital tools: AI for marketing | | | | | 1 | 1 |
| Digital tools: analytics | | | | 1 | | 1 |
| Digital tools: automated machinery | 1 | | 1 | | 1 | 3 |
| Digital tools: business process | 2 | 1 | 1 | 1 | 2 | 7 |
| Digital tools: cloud storage | | | | 1 | | 1 |
| Digital tools: communication | | | | | | 0 |
| Digital tools: design and engineering | 1 | | 1 | 1 | 2 | 5 |
| Digital tools: manufacturing process and inputs | | | 1 | | | 1 |
| Digital tools: project management | | | 1 | | | 1 |
| Digital tools: sales and marketing | | | | 1 | 2 | 3 |
| Totals | 4 | 2 | 6 | 5 | 8 | 25 |

**Figure C.3:** Appearance of digital technology count$_{IN}$

| | Quotation Content | Codes |
|---|---|---|
| 11:1 | We have SolidWorks and one is | Digital tools: design and engineering |
| 11:2 | OrcaFlex | Digital tools: design and engineering |
| 11:3 | We we kind of wanted to use 3D experience which is connected to SolidWorks | Digital tools: design and engineering |
| 11:4 | So a lot of documentation word, but all of it is stored we use SharePoint | Digital tools: cloud storage |
| 11:5 | And it finally, nowadays people really like teams. | Digital tools: communication |
| 11:6 | or ERP, we had exact which is like our accounting software, but also for our invoices and all. | Digital tools: accounting |
| 11:7 | So you need these tools. So I was able to hire people for the tool and with experience in that tool. So there was never an integration question as such. | individualistic approach to adoption<br>Less appreciative of training |
| 11:8 | The solution will be more that you know you either need to hire somebody with more experience.To then train another person, because I I I I mean so far we've handled it and just let it happen, but that never works out. So people.Just they get the training and then after that they just keep struggling because the gap is due just too big between what we are expecting or need and what they are able to do. | dont depend on external services/trainings |
| 11:9 | Because also the work needs to get done because it's just too much for the external support they they're not able to do our work. So they can explain how their tool works. But after that you have to just practice. | dont depend on external services/trainings |
| 11:10 | I don't think we're the most flat. I think they're more way more flat companies, more, much more open minded.So somewhere in in between, It's a mix. Well, I think this company has struggled with it. You know that with the balance between you know hierarchy and and and being there for the peop | Flat heirarchy<br>Heirarchical structure |
| 11:11 | It definitely helps to have people, you know, young people that are open to new ideas that are just not happy with just settling for something that's always been done in certain way so. | Age-related resistance |
| 11:12 | I think the biggest thing at the moment is the use of AI. | Digital tools: AI |

**Figure C.2:** Codebook NL

| | 1: Thesis interview_NL3 | 2: Thesis Interview_NL1 | 3: Thesis Interview_NL2 | 9: Thesis Interview_NL4 | 11: Thesis Interview_NL5 | Totals |
|---|---|---|---|---|---|---|
| Digital tools: accounting | | | | | 1 | 1 |
| Digital tools: AI | 1 | | | | 1 | 2 |
| Digital tools: automated machinery | | | | 1 | | 1 |
| Digital tools: business process | 2 | | 1 | 1 | | 4 |
| Digital tools: cloud storage | | 1 | 1 | | 1 | 3 |
| Digital tools: communication | 1 | | | | 1 | 2 |
| Digital tools: design and engineering | 1 | 2 | | | 3 | 6 |
| Digital tools: project management | 1 | 2 | | | | 3 |
| Digital tools: sales and marketing | | 1 | | 1 | | 2 |
| **Totals** | 6 | 6 | 2 | 3 | 7 | 24 |

**Figure C.4:** Appearance of digital technology count$_{NL}$

| | 4: Thesis Interview_II1 | 5: Thesis interview_II2 | 7: Thesis Interview_II4 | 8: Thesis Interview_II3 | 10: Thesis interview_II5 | Totals |
|---|---|---|---|---|---|---|
| Collaborative | 25.00% | 29.41% | 25.00% | 20.83% | 23.53% | 24.53% |
| Communication | | | 6.25% | | 17.65% | 4.72% |
| External influence | 12.50% | 11.76% | 15.63% | 8.33% | 11.76% | 12.26% |
| Hierarchy | 6.25% | 11.76% | 3.13% | 16.67% | 5.88% | 8.49% |
| Learning and experimentation | 25.00% | 11.76% | 18.75% | 20.83% | 23.53% | 19.81% |
| Motivation and Strategic orientation | 18.75% | 17.65% | 18.75% | 12.50% | 11.76% | 16.04% |
| Risk management and resistance | 12.50% | 17.65% | 12.50% | 20.83% | 5.88% | 14.15% |
| **Totals** | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

**Figure C.5:** Cultural sensitivity map: IN

| | 1: Thesis interview_NL3 | 2: Thesis Interview_NL1 | 3: Thesis Interview_NL2 | 9: Thesis Interview_NL4 | 11: Thesis Interview_NL5 | Totals |
|---|---|---|---|---|---|---|
| Communication | | 7.69% | 21.05% | 18.75% | | 12.31% |
| Heirarchy | 9.09% | 7.69% | 31.58% | 12.50% | 16.67% | 16.92% |
| Indiviualism | 9.09% | 7.69% | 5.26% | 12.50% | 16.67% | 9.23% |
| Learning and experimentation | 9.09% | 30.77% | 10.53% | 18.75% | 16.67% | 16.92% |
| Market and External focus | 18.18% | 15.38% | | 6.25% | 33.33% | 10.77% |
| Motivation and Strategic orientation | 36.36% | 15.38% | 15.79% | 12.50% | | 16.92% |
| Risk management and resistance | 18.18% | 15.38% | 15.79% | 18.75% | 16.67% | 16.92% |
| **Totals** | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% | 100.00% |

**Figure C.6:** Cultural sensitivity map: NL