

Digital Capability and Sustainable Enterprise Development in Manufacturing MSMEs: A Case Based Approach from Kerala

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ABSTRACT

Sustainability refers to doing business in a manner that avoids or minimizes adverse impacts on the environment and the broader community. MSMEs play a significant role in the broader organizational ecosystem. Although substantial research exists, there remains a lack of complete understanding of how economic and sustainability components can be effectively integrated. This paper examines the case of a successful Enterprise ACM Naturals Pvt Ltd which shows how innovations in Information and Communication Technologies (ICT) can be adopted by Indian MSMEs to enhance overall business sustainability across economic, social, and environmental dimensions. It is in oleoresin production and highlights the firm's growth following ICT adoption after Covid - 19. Given the rapid rate of advancement in exponential technologies, MSMEs must proactively embrace ICT tools to remain competitive and sustainable in the market. The paper evaluates the firm's environment using SAP-LAP and SWOT analysis frameworks which can be highly useful for SME Entrepreneurs to evaluate their firm and can develop their strategies.

Methodology: Using a case study approach in the MSME manufacturing sector, the paper demonstrates that both technology adoption and sustainability perspectives must be considered simultaneously to effectively innovate business models.

Keywords: MSME, ICT adoption, business sustainability, MSME future, sustainability, entrepreneurship

INTRODUCTION

Micro, Small, and Medium Enterprises (MSMEs) play a crucial role in the broader organizational ecosystem, particularly in developing economies where they often serve as the primary employers, encompassing start-ups and youthful firms. These enterprises are recognized as key drivers of innovation and sustainability. Despite the existence of substantial research, there remains an incomplete understanding of how to effectively integrate economic and sustainability elements. The dynamic nature of markets, driven by upcoming technologies, adds complexity to predicting trends that are both innovative and sustainable. This challenge makes it difficult for organizations to manage risks and emphasizes the need for a comprehensive approach that merges economic and sustainability components with entrepreneurial opportunities in the markets (Ratten, 2020).

India is ranked 46th out of 132 countries on the Global Innovation Index 2021, according to a study by the Institute for Competitiveness for NITI Aayog (WIPO, 2021). Like larger companies, Micro, Small, and Medium Enterprises (MSMEs) can adopt Information and Communication Technology (ICT) for innovative practices and sustainable growth. ICT adoption facilitates cost-effective innovation development, making it crucial for integrating into corporate operations, especially considering the majority presence of small businesses in the world's economies. Entrepreneurs in MSMEs should undergo training to leverage technologies for sustainable business growth and innovation. As ICT has proven to be a highly effective tool for development. Gender-equal participation can be promoted through ICT, contributing to economic growth and creative solutions to sustainability challenges. Entrepreneurial approaches need to be dynamic and flexible, with ICT serving as a

general-purpose technology indispensable for productivity enhancements and innovative activities (Bresnahan & Trajtenberg, 1995). A robust ICT infrastructure is essential for accessing global markets, and improved interoperability and standards can enhance information exchange and participation in e-commerce platforms.

Sustainability concerns have gained global importance, and the Government of India has implemented various initiatives, including schemes by the Ministry of MSME, to support MSMEs (Ministry of MSME, 2022). The UN recognizes the significances of MSMEs, which accounts for 90% of businesses, 60-70% of employment, and 50% of GDP worldwide (United Nations, 2021). Sustainable Development involves economic, ecological, and social objectives, known as the Triple Bottom Line (TBL), and ICT plays a crucial role in achieving sustainability by supporting business processes, technology components, and understanding of processes. Therefore, a seamless ICT ecosystem is essential for the innovation and sustainable growth of MSMEs. Hilty and Hercheui conducted a comprehensive analysis of the role of Information and Communication Technology (ICT) across ecological, social, and economic dimensions. They highlighted ICT's potential as a tool for empowering impoverished communities and fostering development in underdeveloped regions. The implicit expectation is that increased adoption of ICT in these areas would contribute to a reduction in the overuse of natural resources (Hilty and Hercheui, 2010). Applying Grounded Theory, Xiong and Qureshi (2013) employed a technology adoption model to investigate and elucidate how firms can achieve Sustainable Development through the utilization of ICT. Through axial coding, they aimed to articulate the mechanisms through which ICTs can facilitate sustainable development.

Disruption from new technologies tends to cause high volatility within the marketplace. As a result, it becomes difficult to predict trends that can both be innovative and sustainable which would allow businesses to effectively manage risk. It also helps managers understand that the economics and sustainability components can be merged with entrepreneurial opportunities in the markets (Ratten, 2020). Similar to large companies, each MSME must adopt ICT for their innovative practices and sustainable business growth which further makes it much cheaper and easier to bring innovations. The integration of ICT into corporate operations is crucial. In the world's economies, small business is in the majority, and the importance of the potential of ICT in the sectors is to be strongly considered (Martin and Wright, 2005).

Transformative kind of technology adoption results from more innovative techniques such as AI-powered chatbots for automating customer support and reduce response times improving efficiency (Huang & Rust, 2021). These chatbots can provide instant responses to customer queries, offer personalized recommendations, and handle basic transactions, freeing up human resources for more complex tasks. Overall, these ICT innovations have enabled MSMEs to overcome traditional barriers and compete in the digital economy. In recent years, there have been several innovations in the Micro, Small, and Medium Enterprises (MSME) sectors in India through the adoption of Information and Communication Technology (ICT) and more innovations can transform the way MSMEs operate, enabling them to become more efficient, competitive, and resilient through E-commerce platforms which provide a convenient way for MSMEs to showcase and sell their products or services to a global audience, Digital Payment Solutions, where MSMEs can now offer customers various online payment options, including mobile wallets, payment gateways, and digital banking. These systems streamline transactions, reduce cash handling, and improve the overall customer experience. Cloud-based services have allowed MSMEs to access scalable and cost-effective computing resources, such as storage, software applications, and data analytics. MSMEs can gain access to advanced tools and technologies without having to invest heavily into building out their infrastructure using this technology. MSMEs can utilize social media as a means of marketing and promoting their goods or services, communicating with consumers, and establishing awareness for their brands. Social media marketing is also an affordable way to connect to a defined audience and drive traffic to their websites or online stores. Any valuable insights that may have been garnered through customer interactions can be collected from using social media, allowing MSMEs to better explain their decisions and enhance business activities, as well as enhance the experiences of potential customers by evaluating the large number of records produced by using social media.

Mobile applications to provide enhanced services to their customers and these apps enable customers to place orders, track shipments, access customer support, and receive personalized offers, resulting in improved customer engagement and loyalty. Furthermore, In every part of MSME business even in supply chain management, Through the development of technologies such as the Internet of Things (IoT), RFID technology

and blockchain, the ICT industry has been transformed (Queiroz et al., 2020). MSMEs can use these technologies to gain better visibility into their inventory and supply chain operations in real-time and provide more transparency in their operations. By implementing these technologies, MSMEs will be able to leverage their operations, provide better customer experiences and create new opportunities for growth. Many companies are using Environmental, Social and Governance (ESG) metrics to assess the ethical impact of their organisation and evaluate their sustainability practices. (Kotsantonis et al., 2016). The shared value opportunity ie, from doing well financially to doing good on impact of initiatives.

Preserving finite resources for the well-being of future generations and environmental health is imperative. Firms, regardless of their size and type, are increasingly placing emphasis on sustainable innovation due to ongoing changes in their external and internal environments during the digital transformation stage, leading to the emergence of new business models (Nasiri et al., 2021). Gyimah and Adeola (2021) conducted an examination of critical factors influencing sustainability in retail services. These factors include record-keeping, financial control, capital, planning, parents' status, marketing skills, and trade businesses. Other research explores the role of Information and Communication Technology (ICT) in fostering the sustainable growth of Micro, Small, and Medium Enterprises (MSMEs) and developing strategies for sustainable innovation. The Sustainable Development Goals (SDGs) have propelled firms to innovate in a sustainable manner. Sustainability through ICT involves creating, enabling, and promoting sustainable patterns of production and consumption (Hilty and Aebischer, 2015). In this paper a Technology Innovation Implementation (TII) perspective suggested by (Singh. D, 2019) has been taken.

The case study method is important in research for several reasons. It allows for an in-depth, multi-faceted exploration of complex issues in real-life settings, making it particularly useful when there is a need to obtain a comprehensive understanding of a specific event or phenomenon of interest. The method also enables researchers to generate a detailed understanding of a complex issue in its natural context, and it is recognized for its value in various fields such as business, law, policy, and health services research (Crowe et al., 2011).

Researchers in the area of Information Systems (IS) research have historically utilized the case study method as a viable form of research as evidenced by (Alavi et al., 1992) and that IS research should be done using the case study method (Sauer, 1993), and that it allows for a comprehensive understanding of how technology is used in organizations (Myers, 1997). The case study method has been described as a research strategy that allows for an in-depth view of a phenomenon occurring within its context (Yin, 2003). Therefore, this research used a case study methodology that looked at two organizations that have adopted and successfully integrated ICT into their organizational processes. The use of the case study methodology to enhance understanding of the impact of ICT adoption on the firms studied was in accordance with the study objective. Data collection consisted of semi-structured interviews, document analysis, and observation. Owner-managers and heads of the IT department of each organization were interviewed in order to learn about their experiences and perceptions of using ICT in the organization. The data were organized, coded, and categorized by theme. Review of relevant literature was also completed to assist with constructing probing questions for the interviews.

The case tries to understand the status of problems faced by the MSMEs and to identify the levels of adoption against their sustainability levels. Semi-structured interviews, secondary data, field notes, and the Qualitative data were analysed thematically using a socio-economic-ecological dimensions against sustainability. SAP-LAP.

RESEARCH METHODOLOGY

This study follows a qualitative, exploratory case study design. The case study method was selected because it follows an in-depth understanding of how and why ICT adoption decisions are made. The case also contextualises specific organisational and environmental settings.

ACM Natural Products Pvt Ltd headquartered at Malappuram, Kerala was selected through purposive sampling method. It is an information-rich, transformation case that was identified as an ideal case for the hypothesis that ICT adoption supports the Sustainability of MSMEs. The single case research design is justified when the subject being studied serves as a revelatory case. ACM Naturals fits the requirement of a revelatory case because it

operates as an MSME by Indian regulatory standards defining an MSME (turnover based), yet it is a complex, capital and resource intensive botanical manufacturing process and it also caters to an export focused market. (i) it operates as a manufacturing MSME in the spice oleoresin and herbal extract sector, an industry where ICT adoption is not trivial (ii) it has undergone multi-stage ICT adoption from basic computerisation to integrated ERP-based costing systems and digital marketing and (iii) it is accessible for in-depth primary data collection, having consented to multiple rounds of stakeholder engagement. The company's progression from micro to medium-scale enterprise over the period 2016–2023, driven in part by deliberate technology investments in the post-COVID period, makes it a theoretically informative case for examining the relationship between digital capability and sustainability performance.

Contrary to the general MSMEs in retail and local markets, ACM Naturals faces intense international regulatory requirements, such as EU organic certification and fair-trade standards etc. This along with the proactive and tech savvy management prompted the company to adopt advanced technologies, and hence an ideal candidate to evaluate how the ICT adoption impacts environmental, economic, and social performance.

Data Collection

Primary data were collected through semi-structured interviews conducted via video conference with five key informants spanning multiple functional domains of the organization

Table 1. Interview Respondent

Respondent	Designation	Functional Area
R1	CEO and Managing Director	Strategic leadership, ICT investment decisions
R2	Senior Engineer	Production technology, process optimisation
R3	Management Personnel	Operations and quality management
R4	Stake holder	Service quality

The use of multiple informants across hierarchical levels and functional departments was deliberate, enabling triangulation of perspectives on ICT adoption from strategic intent (R1) to operational implementation (R2, R3, R5) and market-facing outcomes (R4). Interviews were conducted in a semi-structured format using a pre-designed protocol with open-ended questions on the firm's ICT adoption history and current digital capabilities, perceived impacts on economic, social, and environmental sustainability; and (c) challenges, barriers, and enabling factors encountered during adoption.

Secondary data sources complemented the primary interviews and included in company financial records and revenue data (2017–2023), the firm's official website (acmnaturals.com), product catalogues, quality certifications (FSSAI, FSSC 22000, GMP, HACCP, Spices Board, Kosher, Halal, US FDA), and publicly available MSME registration and sector reports.

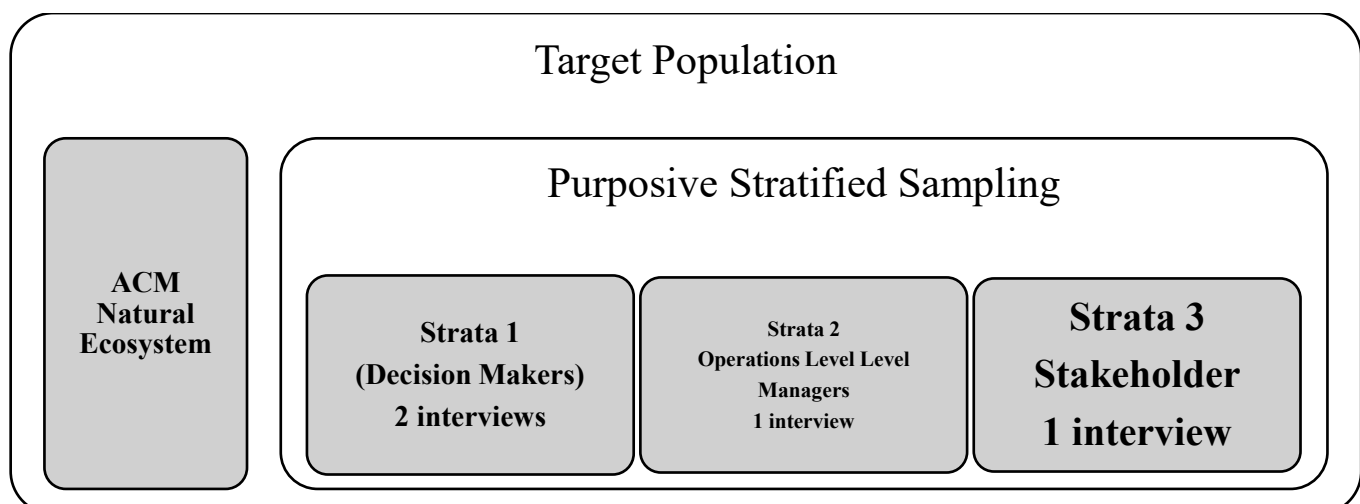


Fig.1. Interview Schedule

Analytical Framework

The collected data were analysed using the SAP-LAP (Situation–Actor–Process / Learning–Action–Performance) framework (Sushil, 2000; 2012). SAP – LAP analysis provides a structured lens for examining the contextual conditions, key actors, and organizational. This was complemented by a SWOT analysis to identify strategic implications.

CONCEPTUAL FRAMEWORK

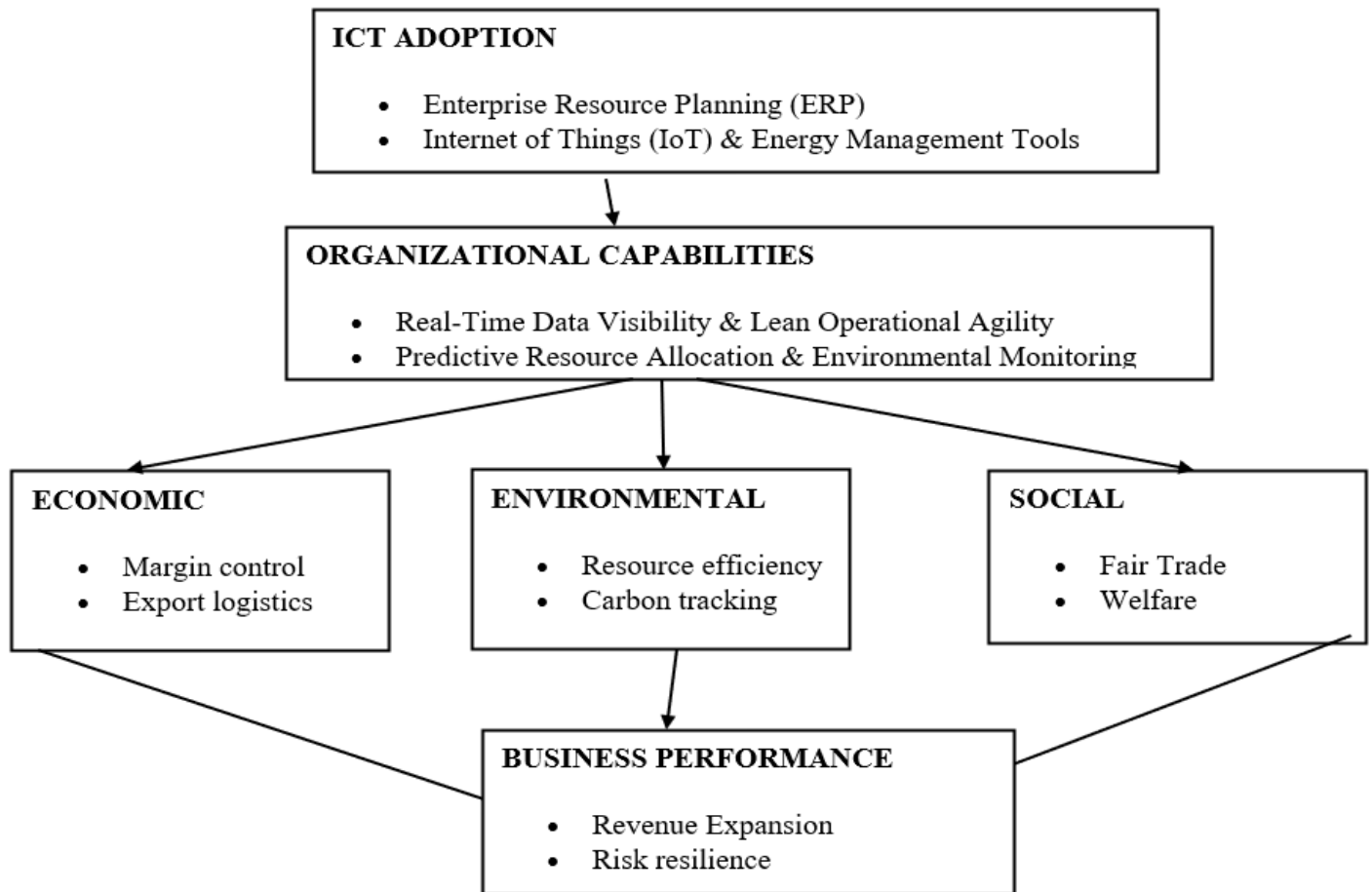


Fig .2. Conceptual Framework

Limitations

This study is based on a single case, which limits statistical generalisability. The findings represent an in-depth understanding of one firm's ICT adoption experience within the Kerala manufacturing MSME context. Future research applying the SAP-LAP framework comparatively across multiple MSMEs and sectors would extend and validate these findings.

Case: ACM Natural Products Pvt Ltd

Company Profile: ACM Naturals is a manufacturing company located in Nilambur Dist. Malappuram. The company has 50 employees and was established in 2016 and deals and the company is engaged in the manufacturing of Curcumin, essential oils and Oleoresins from turmeric, ginger, pepper, nutmeg, etc. The operations of the company are primarily managed by the directors of the company. During the 5 year of functioning, the company shown substantial growth in production and acquiring new client base. Now, company is planning for an expansion of the unit to meet the sales order by increasing the production. The company has a culture of adopting technologies for improving the quality and the productivity of the firms. The company's goal is to achieve customers satisfaction.

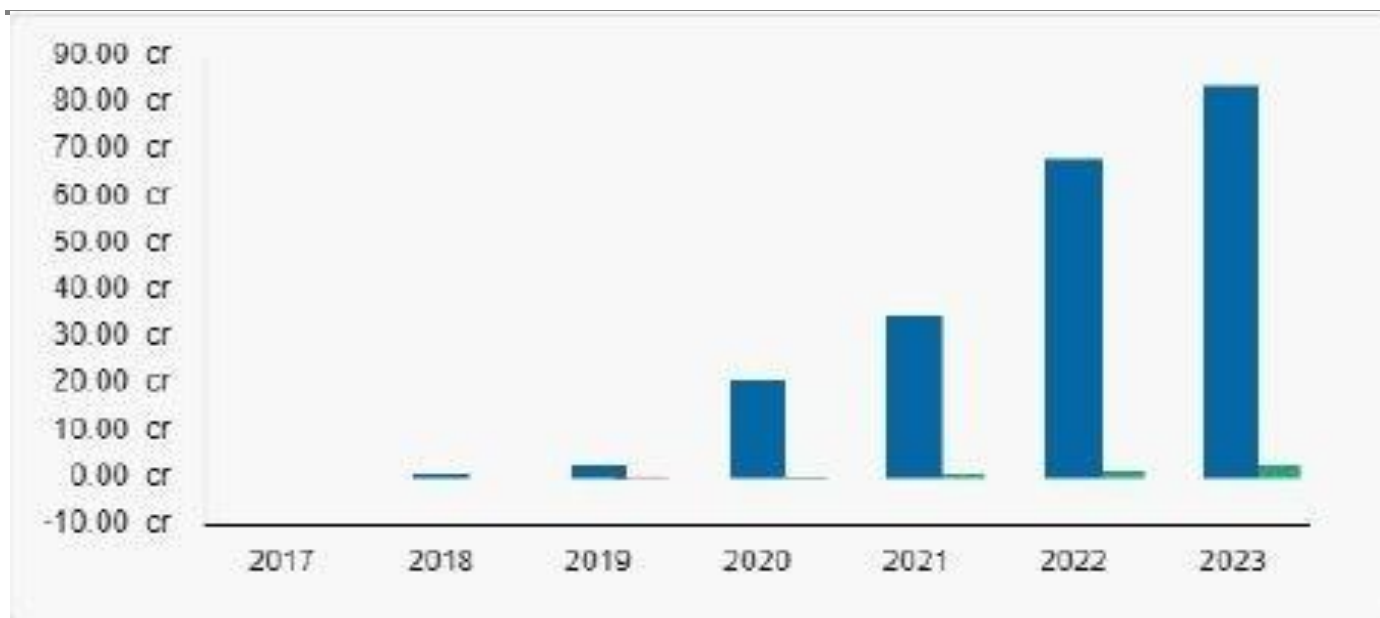


Fig.3. Revenue Growth of ACM naturals

Product Category: The Corporate is engaged in the business of trading of natural mineral products.

Acm Natural Products offers a wide range of products and services, including:

- Ayurvedic & Herbal Extracts
- Spices Extracts
- Ayurvedic Powder and Medicinal Herbs
- Herbal Powder
- Essential & Aromatic Oils
- Spice Oil

Customers

The major customers are

- Sami Labs Pvt. Ltd.,
- Greenleaf Extractions Pvt. Ltd.,
- Cheekode Traders,
- Botanic Healthcare Pvt. Ltd.,
- Bioingredia Natural Pvt. Ltd.,
- Elixir Extracts Pvt. Ltd.
- Hddes Extracts Pvt. Ltd., Sri Lanka,
- Nature Inc, USA.

SAP-LAP Analysis

Situation

A strong foundation is built from having a core staff who are committed to making products for their customers and building that same connection all over the globe. This consists of a small team led by the entrepreneur with

1 Manager/Supervisor as the direct report and other staff as potential employees. The company itself has kept the traditional format and appearance developed by the first owner. The new owner has not implemented any significant changes in how the company operates in terms of location or physical structure of the plant. ACM has been the leading supplier of raw materials for all major manufacturers of pepper oleoresins in South India. Headquartered in Kerala, the spice hub of India, ACM could broaden its magnitude and cater to the demand of the industry throughout years. Increased production capacity over the past few years. In initial times, they were only one product but after 2016 they have upgraded their technology and increased their production capability. The magnitude of the firm has improved.

Currently, there are over 20 different products under 3 main categories. Most of the equipment and machines purchased for the unit were manufactured in India by large-scale manufacturers operating within India. During 2019, Company has faced a major hit during the pandemic and the profit reduced. After the Covid, they have more focused on further technology upgradation including ICT for their sustainability. The major challenge faced during the adoption were majority of the workmen are employed as casual labor who were paid nominal wages. Workmen category lack technology awareness. However, they have managed the crisis with adequate numbers of multi skilled employees are there due to dependency on individuals there is less activeness and but with proper vocational training they overcame it. Employment trust in small-scale is a major challenge in the post covid era. There is always a lack of support and co-operation between Financial organization to promote technology and remove barriers.

Lack of support from Governmental agencies for mentor service, awareness on technical up-gradation, procuring supply of imported material, help to export the materials and supply of hire or purchase of imported good and machine is almost negligible. The high cost fuel and power expenses and cost of electricity during the period were the major challenges. The competition is medium both in domestic and international market in terms of superior quality and procurement of raw materials for ACM Natural Products Ltd. Service aspects that have value added to the industry from the customers perspective.

Table.2. SWOT of ACM Naturals

Table. SWOT Analysis of the Enterprise

Aspect	Strengths	Weaknesses	Opportunities	Threats
Entrepreneurial Capability	- Dedicated leadership with strong guidance from the entrepreneur through various phases. - Resilience in managing crises such as the COVID-19 pandemic with minimal disruption. - Experienced management team composed of skilled engineers and managers. - Clear vision for growth through expanded product range and increased production capacity.	- Reliance on traditional industry layouts and processes with limited modernization. - Limited external recruitment, resulting in fewer fresh ideas and perspectives. - High dependence on the entrepreneur and key management personnel.	- Opportunity to introduce innovative business practices and modern management approaches. - Build stronger networks with entrepreneurs and industry leaders. - Enhance entrepreneurial competencies through training and development programs.	- Rapid changes in market conditions and consumer preferences. - Succession risks if key individuals leave or retire. - Increasing competition from more agile and innovative firms.

Technology Infrastructure Capability	• Adoption of ICT for record management, costing, and communication. • Increased production capacity through technology upgrades after 2016. • Database-driven cost-estimating software ensures consistent quotations and estimates.	• Limited adoption of non-conventional machining technologies. • Workforce has limited technology awareness and training. • High operational costs due to fuel and electricity tariffs.	• Upgrade to advanced and transformative technologies for improved efficiency and sustainability. • Implement comprehensive technology training programs. • Utilize ICT for digital marketing and stronger online presence.	• Rapid technological obsolescence. • Cybersecurity risks and potential data breaches. • Challenges in integrating new technologies with existing systems.
Government Initiatives	• Potential access to government funding, training, and other support services. • MSME-specific policies may provide incentives and operational benefits.	• Limited government assistance in technology upgrading and infrastructure support.	• Maximize available government programs for MSME development, innovation, financing, and capacity building.	• Sudden policy changes may affect business operations, funding opportunities, and regulatory compliance.

Actor

Management of ACM Natural Product Limited, Manager of the firm, Supervisor, workforce sand the suppliers of the company, customer’s feedback and suggestions are the ‘Actors’.

Process

ACM possesses a competent system for turning the raw material into high quality products in the fine fraction. All products are made with natural essentials. The company keeps all of its records in its computer set-up. There are various process which need to be identified for better tracking and procurement at the time of production. Now it becomes a breeze to keep a record of parts supplied, inventory or production. Only conventional technique is used for production, although some process new technologies are used. The installation of a complete Non-conventional machining processes is not yet installed. All materials used are tested. The best part is that ACM also implemented costing software in 2020. It's an integrated database cost estimate program. It includes manufacturing data and cost models that will assist the company to be consistent in their estimates and quotes. The software is used with compatibility of Computerized Store Management System. The customers are linked to the industry through phone, fax and e-mail, video conferences and social media tools. Ginger, Turmeric and Pepper are the raw materials used in industry. The manufactured and semi manufactures products are transported thru tempos to nearest road or rail transport and by air carrier for delivery to the customers. It is not yet able to attract govt. support in developing an adequate international marketing strategy for ACM. No interest or inclination has been shown by the technical institutes in the region to market their resources and industry is mostly unaware of what technical institutes are capable of and how they can be useful to ACM.

Learning-Action-Performance synthesis

Small-scale industry has various challenges before it. ACM has grown into a Medium scale from a Micro to small to a medium, highly with the support of technology adoption including ICT. The pandemic and phase change presented a number of significant hurdles for the company during this period, forcing them to invest heavily into their research and development capabilities, their technology infrastructure, and in marketing (via ICT) to mitigate these challenges. The industry has produced several products that have helped save time through the use of computer software, although few companies have produced any software to help in the development of designing software or the creation of process planning.

ACM needs to prove itself and gain recognition as MSME which has specific advantages like flexibility, concentration and strong internal communication with the adoption of ICT. ACM is now accelerating toward achievement but there is a big gap among its competitors. It also has to go for more marketing and after sale and services. All quality and production standards, managerial policies and quality control have to be more successful with its current resources. A management team with Engineers and Manager people is the strong point of ACM for all its phases of technology adoption which paved the way for its sustainability.

Implementation of ICT

By implementing new technology innovations reducing travelling and waste from manufacturing means that people can become more productive because of enhanced technical training and experience of working in the industries have given them a competitive advantage. As such, industries must promote this to their workers/staff. Companies usually use multiple skill enhancement for their workers; this can reduce worker error when doing their duties and create a team-oriented atmosphere that facilitates problem-solving. Companies often choose to recruit via external organisations with experienced workers and will often do so when the company was relatively small. However, during this time, when the company was an established company that relied upon its own experience-based knowledge to train up its better employees (operatives and intermediates), they are no longer able to rely on this model and therefore had implemented affordable technological advancements by making greater investments into technological advancements. But it still need to adopt further more transformative technologies to enhance both economic and ecological sustainability is crucial. Matching employees to projects should go beyond their experience and consider their interests. Employee creativity is maximized when they are passionate about their work and challenged to stretch their skills. Therefore, providing opportunities for deep engagement in work and genuine progress is essential.

Ensuring that finance schemes are easily accessible and effective is vital for entrepreneurs to derive maximum benefits. Interaction with private institutes for funding should be encouraged to explore additional options. The government has a role in providing relevant information and support to empower MSMEs, aiding them in standing on their own feet. Additionally, support should be extended to adopt new techniques that are non-hazardous, eco-friendly, economically viable, and environmentally friendly. Government regulation is needed to ensure equality among states regarding policies, concessions, and offers to foster industrial growth, and all possible opportunities should be seized by Government Entrepreneurship Initiatives (GEI).

Table.3. SAP-LAP analysis of ACM Naturals (SAP-LAP framework by Sushil, 2000; Sushil, 2012)

Component	Details
Situation	• Small group of dedicated teams. • Traditional layout and outlook. • Leading supplier of raw materials for pepper oleoresins. • Headquartered in Kerala, India. • Production capacity increased post-2016. • Expanded product range to over 20 products under three categories. • Most equipment manufactured in India. • Faced profit reduction during the pandemic. • Focused on technology upgradation including ICT post- pandemic. • Challenges: Casual labor, lack of technology awareness, employment trust, limited government support, high fuel and power tariffs.
Actor	• Management of ACM Natural Products Ltd. • Manager and Supervisor. • Workforce. • Suppliers.

	Customers.
Process	- Mechanism to convert raw materials into superior quality products. - Record management through computerized systems. - Adoption of some new technologies. - Testing of raw materials. - Costing software for consistent estimates and quotes. - Communication with customers via telephone, fax, email, video conferences, and social media. - Transportation of products via road, rail, and air.

Recommendations and Suggestions

From this study we analysed that ICT adoption is crucial for enhancing the sustainability of MSMEs across economic, environmental, and social dimensions. While there are challenges to overcome, strategic initiatives and support can facilitate the integration of ICT, driving sustainable growth and development in the MSME sector.

Table 4. levels of sustainability against ICT adoption levels

Levels of ICT Adoption / Benefits	Cost Efficiency	Scalability	Disruption
Informational	Application of open-source software for basic data collection and storage, reducing software license costs.	Implementation of cloud-based solutions for data backup and retrieval, allowing flexible storage options.	Adoption of digital platforms for market research, providing insights into customer preferences and market trends.
Transactional	Utilization of digital payment systems to reduce transaction costs associated with traditional banking methods.	Implementation of e-commerce platforms to reach a wider audience and efficiently manage increased sales volumes.	Use of blockchain technology for secure and transparent transactions, disrupting traditional financial processes.
Transformational	Implementation of AI-driven automation to optimize processes, reduce labor costs, and improve productivity.	Adoption of Internet of Things (IoT) solutions for real-time monitoring and control of manufacturing processes, enabling scalable production.	Use of machine learning algorithms for predictive analytics, transforming decision-making and business strategies.

Table.5. Levels of adoption Vs ICT adoption benefits (Prasad & Krishna, 2023) For Economic Sustainability construct

Levels adoption	ICT	Social sustainability	Economical sustainability	Environmental sustainability
Informational		Conduct online surveys, social media polls, feedback from stakeholders	Monitor and analyze market trends and competition to make informed business decisions	Online tools for monitoring and analyzing energy consumption and environmental impact to identify areas for improvement

Transactional	Use of e-commerce platforms to promote products that support social causes or are produced in socially responsible manner	Implement online payment systems to reduce transaction costs and streamline payments	Use of electronic invoicing and payment systems to reduce paper usage and associated environmental impact
Transformational	Implemented AI-powered chatbots or virtual assistants to address social issues promptly	Implement Industry 4.0 technologies such as IoT, big data, and automation for optimization	Use predictive analytics to optimize energy consumption and reduce carbon footprint

The ICT tools, such as enterprise resource planning (ERP) systems, customer relationship management (CRM) software, and digital marketing platforms, can streamline operations, by ACM Naturals enhanced the productivity, and reduce costs. E-commerce platforms and online marketplaces enable MSMEs to reach broader markets, increasing sales and revenue potential. It also came to understand that ICT fostered innovation by providing access to new technologies, market trends, and business intelligence, enabling MSMEs to remain competitive.

For Environmental Sustainability construct

The ICT solutions adopted like smart sensors helped ACM to monitor and optimize their use of resources, reducing waste and energy consumption. As the digital tools reduce the need for paper, contributing to deforestation reduction and lowering the carbon footprint.

For the Social Sustainability construct

The adoption has Improved Working Conditions through flexible working arrangements, remote work opportunities, and better communication tools. The Continuous ICT integration encourages ongoing employee training and development, leading to a more skilled and knowledgeable workforce. It has also improved engagement in social media and other communication platforms allowed the company to engage more effectively with their communities, fostering social goodwill and supporting local causes.

Table.6. Strategies for ACM for leveraging technology

SWOT Analysis	Strengths – S Techno Managerial Persons, Multi Skilled labours, ERP, Cost analysis software, Advanced ICT adoption, Backward integration Superior quality, International customers	Weaknesses – W Lack of access in Govt schemes Unit expansion Climate challenges Lack of training programs
Opportunities – O New Markets Competency in operations and Quality Infrastructure investments	SO Strategies - Maximise market presence - Upgradation of technologies, - develop techno managerial skill for other employees - Core IT Infrastructure development	WO Strategies - Expand market using govt digital support (ONDC, GEM etc) - Ensure supply during all seasons - Impart training along with infrastructure
Threats–T High Investment rate for implementation Strategic alliances Increasing operation costs	ST Strategies - Trustful alliances can help to reduce investment costs - Proper adoption of technology can reduce operational costs over a period of time	WT Strategies Automation of operations timely training for multiskilled employees

SO Strategies: Utilizing Strengths to Exploit Opportunities

To Maximize Market Presence:

Expand To Other Countries: Work with current international customers to investigate other parts of the globe as potential markets. Attend trade shows and expos to display products to potential customers.

Brand and Promote: Make significant investments in advertising and promotional strategies to increase brand awareness. Use all available digital methods (e.g., social media, SEO, content) to reach as much of the potential customer population as possible.

Diversify Products: New products or product lines should be developed for each of the various markets. The company's reputation for providing exceptional quality will be used to develop new products for various marketplaces.

Technology Upgrade:

High End Manufacturing Technologies: Automated production technology, non-conventional machining techniques, and IoT-enabled equipment will allow the company to improve quality and reduce production costs so it can be more competitive.

R&D: Create new or build upon existing R&D capabilities that allow for continuous improvement of products to remain competitive. Partner with universities or other research organizations will help keep your company at the forefront of technology adoption.

Techno-Managerial Development of Other Employees:

Training: Periodic workshops and training programs will help employees develop techno-managerial competencies such as project management skills, data analytic skills, and ability to use advanced information communication technology tools.

Leadership training: Leadership programs to support the development of mid-level management employees for potential promotion to senior management roles will ensure there are qualified future leader candidates.

Core IT Infrastructure Development:

ERP System Enhancement: Continuously upgrade the ERP system to integrate all aspects of the business, including supply chain management, human resources, and customer relationship management.

Cloud Computing: Adopt cloud-based solutions for better data management, scalability, and cost-effectiveness. Ensure robust cybersecurity measures are in place to protect sensitive information.

Data Analytics: Invest in data analytics tools to gain insights into market trends, customer behavior, and operational efficiencies. Use these insights to make informed strategic decisions.

WO Strategies: Overcoming Weaknesses by Exploiting Opportunities

Expand Market Using Government Digital Support (ONDC, GEM, etc.)

ONDC (Open Network for Digital Commerce): Leverage this government initiative to access a wider market. ONDC helps MSMEs to connect with buyers across India, improving market reach and sales.

GEM (Government e-Marketplace): Register on GEM to supply products to various government departments and public sector units. This platform provides a reliable and consistent market for products.

Ensure Supply During All Seasons:

Climate-Resilient Practices: Implement climate-resilient agricultural practices and supply chain strategies. Use technology for weather forecasting and planning to mitigate the impact of adverse climate conditions.

Diversified Sourcing: Source raw materials from multiple regions to reduce dependency on a single source and ensure continuous supply during adverse climatic conditions.

Impart Training Along with Infrastructure:

Skill Development Programs: Collaborate with technical institutes and vocational training centers to provide specialized training programs for employees. Focus on both technical skills and soft skills.

Infrastructure Investment: Alongside training, invest in modern infrastructure that supports advanced manufacturing techniques. This includes upgrading facilities, machinery, and IT systems to support the trained workforce.

ST Strategies: Utilizing Strengths to Mitigate Threats

Trustful Alliances Can Help to Reduce Investment Costs:

Strategic Partnerships: Form alliances with technology providers, research institutes, and other SMEs to share the costs and risks associated with large investments. Joint ventures and co-development projects can be beneficial.

Industry Consortia: Join industry consortia or clusters that provide access to shared resources, technology, and funding opportunities. This can reduce individual investment burdens.

Proper Adoption of Technology Can Reduce Operational Costs Over Time:

Automation and Robotics: Implement automation and robotics in manufacturing processes to reduce labor costs and increase precision and efficiency.

Energy-Efficient Technologies: Adopt energy-efficient technologies to reduce energy consumption and operational costs. This includes installing solar panels, energy-efficient machinery, and optimizing production processes.

WT Strategies: Overcoming Weaknesses and Mitigating Threats

Automation of Operations and Timely Training for Multi-Skilled Employees:

Automated Systems: Invest in automation for routinised work/tasks/process such as order processing, stock management and quality control. This reduces the dependency on manual labor and minimizes human error.

Continuous Training: Provide ongoing training programs to keep employees updated with the latest technologies and practices. Encourage a culture of continuous learning and improvement.

Skill Rotation Programs: Implement skill rotation programs where employees rotate through different roles to gain diverse skills and experience. This builds a more flexible and resilient workforce.

The company ACM Naturals Pvt Ltd possesses both resiliency and promise by making it an ideal candidate for seizing the opportunity to capitalize on its advantages through ICT adoption. The managerial persons worked especially in areas related to developing entrepreneurial skill sets, enhancing technology-related capabilities, and leveraging available government incentives. To enhance entrepreneurial capability; ACM Natural Products Ltd has exhibited a tremendous degree of resiliency and growth under the leadership of an entrepreneur. Currently, much of the company's success relies on a small number of committed individuals (i.e., current employee base

includes the entrepreneur). Subsequently, the company's ability for long-term success may be compromised if the current employee base does not eventually become larger than its current size. Therefore, it is very important that the company build its leadership team by using experienced individuals and advisors who bring new ideas and strategies to the table through their experience, but also by using the company's resources to develop a succession planning strategy to provide stability and continued success for the company until succession planning is complete, and/or the results of the planning efforts are visible (e.g., transition of key personnel out of their jobs).

In terms of its technological infrastructure capability; ACM Natural Products Ltd has improved its operational efficiencies and consistency of estimates and quoting through the use of information and communication technologies (ICTs) and database costing software. Additionally, the company still needs to upgrade its technological base even further in order to remain competitive, and be able to support modern manufacturing processes effectively. Similarly other MSMEs investing in non-conventional machining technologies (e.g., laser cutting, 3D-printing, etc.) and other cutting-edge technologies will allow the company to improve production efficiency and product quality.

Addressing the technological skill gaps within the workforce is equally important. Comprehensive training programs should be implemented to enhance the technological skills of casual workers and other employees. This includes the provision of vocational training and multi-skilling development programs that will not only improve the internal capacity of the workforce but will also reduce reliance on external sources of labour. Cybersecurity must be prioritised as well, in order to protect sensitive information and guard against the possibility of cyber-attacks. The implementation of robust cybersecurity solutions, along with regular audits and training, will give ACM the tools to defend itself against future threats.

As a B2B company, ACM has largely underutilised the growth potential that digital marketing through ICT tools provides for an integrated digital marketing strategy. A properly developed digital marketing plan that incorporates social media marketing, email marketing, and search engine optimisation will create increased engagement with customers and increased market share. ACM has not received much support from government programs, however there are many opportunities to tap into this area. ACM should search for information regarding the various government programs that support MSMEs and actively participate in each program and process. This includes applying for subsidies, grants, and financial incentives to upgrade technology and infrastructure.

ACM should partner with industry organisations and associations to advocate for coherent government policies and assistance across the various states. By being involved in policy discussions and forums, ACM will be able to represent the industry's best interests while influencing the outcome of regulations that are favourable to them. Additionally, the reduction of bureaucratic barriers will facilitate improved operations. Having a dedicated internal department or hiring consultants that will help navigate government regulations and streamline the process of obtaining approvals will save both time and money.

It is important to make it easier for small and medium-sized enterprises (SMEs) to access financial support. Financial institutions can develop proprietary financial products and programs that specifically serve SMEs. This will provide the much-needed financial capital required to expand and grow a business. In addition to these financial sources, ACM should seek out alternative financial sources such as venture capital, angel investment, and crowdfunding as a means of diversifying their funding sources and widening their investment opportunities beyond traditional sources of finance. Using ACM's strengths and addressing ACM's weaknesses through a series of strategic initiatives related to its entrepreneurial capability, technology infrastructure and support from government programs provide ACM with the best position possible to drive sustainable growth and long-term success. By diversifying its leadership team, fostering innovation, upgrading technology, enhancing workforce skills and working closely with government programs and policies, ACM will be able to achieve its long-term goals.

Government Support Mechanisms for MSME Technology Adoption

Several central government schemes provide critical support for MSMEs seeking to integrate ICT and adopt sustainable manufacturing practices. The *Digital MSME Scheme* (Ministry of Micro, Small & Medium

Enterprises [MoMSME], 2019), launched in 2017 under the CLCS-TU framework, aims to digitally empower MSMEs by motivating adoption of ICT tools and cloud-based applications in production and business processes. Complementing this, the *Credit Linked Capital Subsidy Scheme* (MoMSME, 2000) facilitates technology upgradation by providing an upfront capital subsidy of 15% on institutional finance availed for eligible plant and machinery, directly reducing the financial burden of modernisation for micro and small enterprises. For quality and environmental performance, the *MSME Sustainable (ZED) Certification Scheme* (MoMSME, 2022) promotes Zero Defect Zero Effect manufacturing practices through a graded certification framework (Bronze, Silver, Gold), enabling MSMEs to align with international standards while improving resource efficiency and market credibility. The *Lean Manufacturing Competitiveness Scheme* (MoMSME & National Productivity Council, 2019) supports operational excellence by deploying lean consultants within MSME clusters to reduce wastage, optimise inventory, and enhance process efficiency. Finally, *MSME Technology Centres* (MoMSME, 2023) function as common facility hubs providing access to precision tooling, testing, skill development, and sector-specific technology consultancy, particularly for enterprises with limited in-house technical capacity.

CONCLUSION

One ongoing struggle within the ICT adoption research is the characterization of technology adoption as a singular step-wise process going from recognition to use to becoming fully immersed without addressing the different types of contextual factors that influence how and at what speed these adaptations take place within small businesses. The ACM case challenges this linear process in several interesting ways. Rather than a pre-existing strategic document directing them towards new technology adoption, the organization adopted ICT via incremental, reactive instances of technology change due to production constraints, customer needs and disruption caused by the COVID-19 pandemic. The organization nonetheless reached a reasonably high level of technical sophistications including using integrated systems for estimating costs, computerized inventory control and multiple methods of communication with its customers leading us to believe that the occurrence of opportunistic technology adoptions, when supported by skilled information systems managers, can lead to comparable technological success to those instances when technologies were adopted following an explicit sequential strategy.

The application of the SAP-LAP framework in ACM's circumstances yield methodological findings as well. It was clear that the framework's three-part structure; "Situation", "Actor", "Process", was well suited to illustrate the relationships through which technology is adopted in an MSME environment, where the entrepreneur, the employees (workforce) and the supply network are inseparable and, therefore, rely on each other. Most traditional ICT adoption models, such as the Technology Acceptance Model and its derivatives are based on the behavioural intent of individuals; however, using the SAP-LAP lens directs attention to the organisation and environmental conditions that are facilitating or inhibiting the adoption of technology at the level of the firm. For Manufacturing MSME's this is more relevant than the "individual" as the decision to adopt new technology is rarely made by a single individual and requires concurrent changes in skills and processes as well as supplier relationships in order for it to be successful.

There is a long-standing theoretical debate regarding the ICT sustainability literature as to whether the primary role of ICTs in terms of sustainability is primarily economic in nature, and that there are secondary to incidental social and environmental benefits from effective use of ICT (or vice versa, that ICTs can be purposefully deployed concurrently for all three sustainability purposes). As per the ACM case evidence, the mixed findings on this subject suggest the following: For firms seeking to improve their economic position (lower transaction costs, improving accuracy in costing, increasing reach to clients), the economic "benefits" were the ones that could be identified and assessed as measurable. The environmental benefits associated with the use of ICTs in the firm, e.g., reduced paper usage and using smart sensors to monitor energy use, were qualitatively significant, but they were secondary to the way in which the firm articulated its overall ICT strategy. The social benefits associated with the use of ICTs in the firm, e.g. improved working conditions and increased employee skills, were associated with the firm's operational requirements, rather than having been identified as goals of its sustainability strategy. Overall, the case study evidence indicates that at the current state of development for the manufacturing MSMEs included in ACM's case studies, the TBL concept of simultaneous multi- dimensional sustainability is an aspirational rather than operational goal for these firms (Hilty & Aebischer, 2015; Nasiri et al, 2021).

This study has several limitations, which have implications for future research opportunities. The nature of single-case research designs is that they provide insights into the depth of a specific case but do not allow for generalising the results to other MSMEs. Therefore, additional research using a comparative study that applies the SAP-LAP framework across multiple manufacturing firms within the same industry or across various industries would allow for the assessment of whether ACM's experience is typical or unusual to other manufacturing firms. Also, because this research relied on interviews and documents as their sources of data, it was not possible to measure some aspects of ICT impact — especially environmental impacts — with precision. Therefore, longitudinal studies that track ICT spending against sustainability outcomes, using quantitative data along with qualitative data, would provide a much stronger basis for determining the overall impact of ICT on MSMEs. Lastly, there is also very little theoretical development on how government-sponsored digital marketplace platforms (such as ONDC) are likely to change the structures of MSME markets; research examining adoption behaviours, network effects, and distributional impacts of ONDC-registered MSMEs would significantly add to both the literature on ICT adoption and digital commerce. Potential for future studies, The study established the relation between ICT adoption and sustainability performance of MSMEs in general but there could be varying modes and models of performance depending on the MSME sector, market and nature of business. This is an excellent opportunity to dig deeper into the subject and formulate sector specific trends in ICT adoption and the challenges.

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