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EMERGING TOPICS FOR LONG-TERM RESILIENCE IN MANUFACTURING

CHALLENGES AND OPPORTUNITIES FOR MANUFACTURING SMEs IN DEVELOPING COUNTRIES

Group Leader
Felipe Lechuga
CEO, Lemaco

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CONTRIBUTORS

Germee Abesamis

CEO, Dearest

Dante Arrigoni

President, Asociación de Industrias Metalúrgicas de Chile, ASIMET

Germán Omar Barrionuevo

Student, Pontificia Universidad Católica de Chile

Felipe Cevallos

CEO, Reborn Electric

Roberto Fantuzzi

President, Asociación de Exportadores y Manufacturas, Asexma Chile

Iván La Fe-Perdomo

Student, Pontificia Universidad Católica de Chile

Carlos Mortera

International Director, Latin America,
AMT - The Association for Manufacturing Technology

Afia Owusu-Forfi

Founder/President, Coders Who Travel

Carlo Piccinato

General Secretary, Confartigianato Imprese Lombardia

Alessandra Pizzo

Professor, Universidad Diego Portales

Jorge Ramos-Grez

Professor, Pontificia Universidad Católica de Chile

David Romero

Professor of Advanced Manufacturing, Tecnológico de Monterrey

Sathish Kasilingam

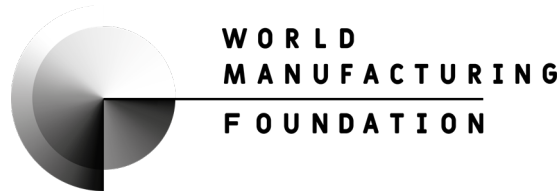
PhD Student, West Virginia University
Member, Young Manufacturing Leaders

Kirill Sukhochev

Student, Politecnico di Milano
Member, Young Manufacturing Leaders

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**EMERGING TOPICS FOR LONG-TERM
RESILIENCE IN MANUFACTURING**



This whitepaper, published in October 2021, is part of the “Back to the Future: Emerging Topics for Long-Term Resilience in Manufacturing” initiative, promoted by the World Manufacturing Foundation, a non-profit organisation with a mission to spread industrial culture worldwide. The initiative involved global focus groups, each exploring a relevant theme for building a resilient manufacturing sector. Each focus group developed a whitepaper identifying key propositions to enable the manufacturing community to thrive in the long term.

The views and opinions expressed by whitepaper contributors are given in their personal capacity and do not necessarily reflect the views of the organisations for which they work or committees of which they are members.

For more information on the project and to read other topic-focused whitepapers that are part of the initiative, please visit <https://worldmanufacturing.org/report/back-to-the-future-emerging-topics-for-long-term-resilience-in-manufacturing/>

INTRODUCTION

Small and Medium Enterprises (SMEs) are considered one of the pillars for economic expansion and represent the most important contributory sector in developing countries worldwide. Therefore, it is of great importance to identify gaps and provide recommendations to enhance this sector's possibilities for sustained growth in the years to come.

In recent times, manufacturing SMEs have struggled, apart from organisation-related problems deriving from their size, with the irruption of the fourth industrial revolution and the consequences of the COVID-19 pandemic. These, among other factors, currently have SMEs immersed in a challenging period of changes, and resilience is key for the survival of this very important sector, especially in developing countries.

This document explores the current state of SMEs in developing countries by performing an analysis of different regions and making a comparison with the experiences of first-world nations to provide context. From there, a set of opportunities are identified and serve as a starting point for a set of recommendations that point towards strengthening the resilience of manufacturing SMEs in developing countries, given their importance in the global economy. Every recommendation is targeted for the different stakeholders involved in the ecosystem.

CONTEXT

SMEs play the leading role in the overall development of developing countries, not only in the private sector, influencing the level of education and employment, but also in the work of institutions, policymaking, and trends of countries such as from their export and import strategy up to their positioning on the global arena. This high significance can be depicted through

their innovations, creation of new jobs, participation in Gross Domestic Product (GDP), independence in action, initiation, and stimulation of competition, etc¹. According to recent studies, SMEs account for about 90 to 95 percent of all enterprises around the world and account for more than 70 percent of all products and services². Moreover, SMEs are also seen as figures of merit in regional development, owning around 60% of private-sector employment.

The colossal transformation caused by the fourth industrial revolution in the world of manufacturing has forced companies of all sizes and sectors to embrace drastic inner and outer changes, for instance, the adoption of data-driven Artificial Intelligence (AI) solutions, new approaches to digital marketplaces, e-commerce and supply chain strategies, staff reduction, infrastructure modifications, etc. However, digitalisation and digital transformation are difficult to integrate into manufacturing SMEs in developing countries due to digital servitisation at a very early stage in most of these companies in developing countries, that can lead to loss of competitive positions. The main barriers that they are facing nowadays are both organisational and customer-related³.

On the other hand, the challenges that SMEs are actually facing can be categorised into organisation-related and system-related. From the organisational point of view, the main problem of SMEs is their size. Consequently, small entrepreneurs suffer from a lack of finance, and low levels of human resources and technological capabilities. On top of that, insufficient management competencies, the lack of a skilled workforce, deficiencies in marketing strategies, low efforts in R&D, and a lack of innovative technology are also significant elements responsible for the unstable growth of SMEs^{4,5}. Regarding system issues, there is usually a lack of consciousness among these SMEs concerning the true significance of corporate governance, and in some cases, an aversion to adopting these methods due to the high costs of implementation. Moreover, corruption, trade barriers, the role of governments, and particularly bureaucracies in the

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legal and regulatory framework are also crucial points that hinder the progress of SMEs.⁵

During the industrial development, there has been an ongoing discussion about how far automation will go. The standard view used to be that everything that could be automated should be automated, and humans replaced with machines. Some years ago, we were reading headlines like “A robot will take your job” in the news; rather than thinking in binary terms, i.e., either machine or human, we need to think human plus machine. Then we can achieve new efficiency levels that neither machines nor humans can achieve alone.

In the factory of the future, humans, robots, and AI work together. The biggest challenge is that we need to become more innovative when it comes to production. Countries’ competitiveness can be reached when producers become manufacturers by developing their R&D and technology design so that it adds value for national export products. It is crucial to be more competitive across the whole value chain. A lack of harmonised certification systems and regulatory environmental standards reduces the market power for companies for export. In this aspect, the role of the Government is essential.

Developing countries’ experiences

Latin America

One of the main differences between developed and developing countries lies in the level of industrialisation. Developing countries are either in the process of industrialisation or are pre-industrial and almost entirely agrarian. Developing countries comprise less than 40% of global GDP. In 2018, around 12.8% of the value added to the GDP in Latin America and the Caribbean was generated by the manufacturing sector (Figure 1). This share has been decreasing since 2015, when the manufacturing sector represented roughly 13.5% of the value added to the region’s GDP⁶.

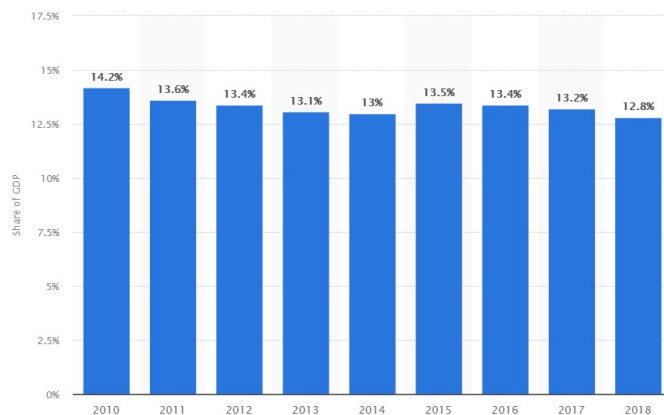


Figure 1. Percentage of the value added to the gross domestic product (GDP) in Latin America and the Caribbean (2010-2018) [6].

In 2019, South America showed a homogeneous added value of around 12.4% of GDP. The country with the highest percentage was Paraguay with 18.78%, and Chile presents the lowest percentage, at barely 10.14%.

As an example for developing countries, Mexico has reached more than just servitisation; it has managed to bring together design and manufacturing and created an environment for the evolution of the manufacturing economy. Factories in Mexico acted as assemblers for U.S. multinational companies in the aerospace and medical sectors; benefitting from the rise of a qualified workforce, opportunities for further growth arise. Companies need to integrate supply chain management, for example, inspection and design platforms and enterprise resource planning (ERP) in general. Nowadays, Mexico is shifting from an industrial base to industrial infrastructure.

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Gross value added by economic activity, 2018
(% of total gross value added)

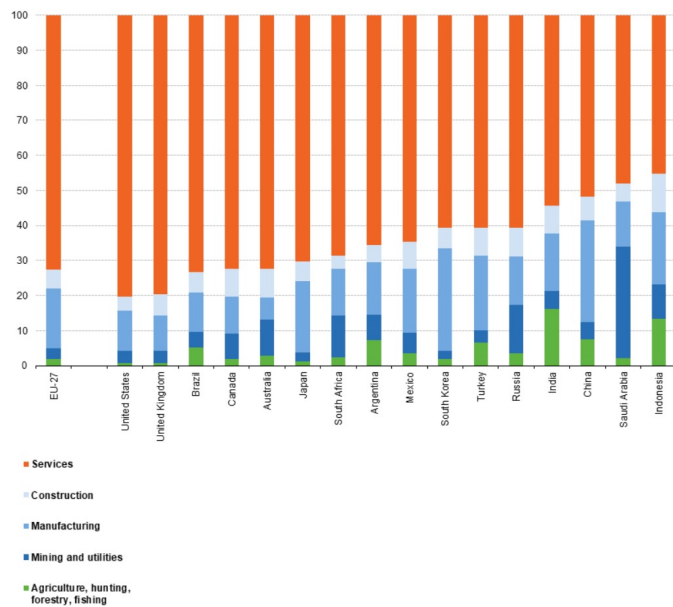


Figure 2. Gross value added by economic activity [7].

The backward linkage (or multiplier effect) shows how much additional output is generated by a dollar's worth of final demand for each industry. Every dollar in final sales of manufactured products supports \$1.33 in output from other sectors—this is the largest multiplier of any sector⁷. Manufacturing plants, therefore, have a powerful and positive impact on economic development. However, this tendency is changing as developed countries leave manufacturing and focus on services and products with a high added value (Figure 2). As manufacturing is migrating to emerging economies with cheap labour, it appears to be an opportunity for developing countries to learn and develop their manufacturing capabilities.

Taiwan

Taiwan's economic development has been powered over the years by the export-oriented strategies of its SMEs, which have led to an economic take-off and decades of rapid expansion. Since the 1970s, Taiwan's SMEs have been exporting their technology and services to the U.S. market, and in recent times they have also expanded toward mainland China and Southeast Asia. From the 1950s to the mid-1980s, Taiwan's manufacturing SMEs transformed from light industries, such as textiles, plastic processing, shoemaking, and to-

ols and hardware, to industrial original equipment manufacturers supplying electric parts and other intermediate goods to developed countries like the U.S. market. Since the very beginning, Taiwan's SME manufacturers have been active in building distribution, marketing, and service networks through foreign agents and dealers. However, since 2000, the mainstream trend has picked up the pace to fulfil Taiwan's U.S. orders through mainland China's production ("Made in China by Taiwan")⁸.

India

Nowadays, India is becoming the new destination for global manufacturing, and a considerable number of manufacturing agents, management practices, and philosophies are finding their way into Indian industries. According to Panizzolo et al.⁹ and other studies, India ranks second in manufacturing competitiveness. Its talented pool of professionals is promptly grasping the procedures, techniques, methods, and strategies required to reach success in the highly competitive global markets. In Indian territory, significant companies from Europe, the U.S.A., and Japan have found a place to design, develop, and manufacture innovative products due to Indian industries being considered an active element in the whole value chain. So far, India has taken advantage of the increasing level of education, jumped directly to the service industry, and is currently trying to go back to manufacturing.

Iran

Considering the "Iran Small Industries and Industrial Parks Organization (ISIPO)," the number of manufacturing enterprises in Iran is 88,352, of which 80,476 enterprises refer to small units, while 4,362 are medium-sized businesses.¹⁰ The Iranian industrial manufacturing organisation has been funded mainly through authorising technology from all over the world and, in some instances, by doing reverse engineering. In 2001, the Iran Small Industries Organization (ISIO) formulated strategies, policies, and rules for small enterprises and supported them to increase their employment rate at industrial levels.

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The central core of Iran's economy (more than 80%) is influenced by large governmental and quasi-governmental organisations. However, 98% of the contribution to the industry sector is made by SMEs. In fact, 70% of job opportunities and 50% of GDP across the economy depend on small businesses.¹¹

Industrialised countries' experience

USA

As a result of the COVID-19 crisis, 26.5 million jobs were lost in the U.S.A. alone.¹² Consequently, to date, global stocks have suffered a downturn of at least 25%. U.S. GDP shrank by around 24% in the second quarter of 2020, and the manufacturing sector experienced considerable contractions due to several factors such as the reduction of domestic demand for non-food goods, decreasing foreign demand for U.S. goods exports, supply chain disruptions, and plant closures.¹³

Nonetheless, in the U.S.A., SMEs set up 99.7% of employer firms and have created 49.2% of jobs in the private sector.¹³ SMEs boost innovation and competitiveness and are responsible for 44% of U.S. economic activity.

European Union

Expressly, in the European Union (E.U.), SMEs represent 99% of all enterprises. Additionally, the European Commission has introduced a European action plan for promoting circular economy (C.E.) practices, setting goals to increase the sustainability of products and services delivered to the common market.

The actual application of C.E. to economic systems and industrial processes considers a variety of new concepts such as looped and performance economy¹⁴, regenerative design¹⁵, industrial ecology¹⁶, the blue economy¹⁷, etc., all of them directly linked to the concept of a closed loop (CL), which is the core of C.E. practices. This criterion of CL is characterised by zero waste processes in the supply chain, which is based on the reuse or recycling of products or by cross-industry integration. These processes may take place in-house or bring

in external partners, giving rise to a genuinely efficient and sustainable business ecosystem.

In that same line of acting, E.U. businesses have adopted procedures that encourage the whole economic system to reuse products instead of consuming them (also known as "waste as a resource"¹⁸). These C.E. practices involve extending the life cycle of products and reducing waste and CO₂ emissions, all key attributes contributing to enhancing companies' value creation. The manufacturing sector is particularly the spearhead in the adoption of C.E. thinking. In this sector, several companies have revisited their manufacturing operations to enhance circularity¹⁹.

Japan

Japan's SMEs were initiated after World War II in 1945, and they are considered the golden eggs of the future because every company starts as a small factory (e.g., Honda and Sony). Even though the Japanese electronics and automotive industries are well-known and globally competitive, they cannot produce finished components by themselves. As a result, most of the devices required by those industries are made by SMEs.²⁰ In Japan, the contribution of SMEs is approximately 99% of total business, which has brought employment for the majority of the population and accounted for a large proportion of economic output. Those SMEs play a significant role as the backbone of the service sector and support as an essential part of the manufacturing industry and incredibly as a strong export supply chain.²¹

Opportunities identified from an in-depth literature review

In free-market economies and due to the effects of globalisation, the development, implementation, and execution of suitable operational schemes and, in particular, marketing strategies, is the only route to developing a sustainable, enduring, and profitable business. Hence, in these conditions, for SMEs, carrying out each of the well-known approaches so far has become a barrier to achieving the desired success, especially for this category of companies operating in developing countries.

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The foremost development opportunity for SMEs is to take advantage of the continuous diffusion of information and communications technologies (ICT). Firstly, the infrastructure of ICT is a primary concern, and many developing countries are attempting to internationalise ICTs and balance their limited incomes to catch up with advanced economies quickly. The fair uses of ICT resources will enable SMEs to attract and retain skilled employees both within and across the border, as they are essential to maintaining the growing expectations. These approaches, such as funding, empowerment, and use of technology by SMEs, are vital. In addition, some potential advantages of implementing ICT can be highlighted, for instance, new market access, an increase in firms' profitability, improved labour productivity, etc. Finally, the adoption of information technology in SMEs will enhance the overall operational efficiency of the entire company.

Macharia and Wang propose some essential interventions to leverage the potential contributions of ICTs in the creation of job opportunities.²² In the first place, training and development are needed to increase the employability and ability of young people to create their own ICT business. Government creates public coworking spaces and business incubators and accelerators, and technology centres to provide workspaces and business support services. The establishments connect business startups with institutions, manufacturers, and employment exchange platforms and marketplaces for final customers.

Such ecosystems enable SMEs to access international markets and communicate relevant information about the services or products they offer. Digital platforms significantly improve efficiency in any market, lowering the information asymmetry to make direct savings in administrative costs and time. Digitalisation is a long-lasting trend here to stay, set by big players in the supply chain and supported by the governments of most countries. Results in manufacturing are lowering the idle time of machinery park, increasing efficiency, the transparency of cooperation and the specialisation of factories.

Examples are hybrid cloud MES and ERP systems with deep analysis of AI for forecasting demand and downtime between factories on the platform. Design outsourcing platforms are also in high demand for manufacturers, for instance, due to seasonal changes in the load of staff members. Finally, it is essential to create awareness of digital job opportunities among youth through social media, local content projects, business process outsourcing, and one-stop shops.

Another well-regarded opportunity for SMEs is adopting green business practices, which can be motivated either by cost and competitiveness concerns or social responsibility. In the case of small U.S. Midwestern manufacturing enterprises it has been demonstrated that informal pressure through government incentives and support programmes, as well as through peer-learning via industry associations, appear to be more effective in helping these SMEs to further 'go green'.²³

Promoting and adopting circular economy (C.E.) practices have also been indicated to be effective for increasing the economic performance of SMEs. Blasi et al. [16] used a web-scraped dataset of companies' websites to capture and analyse the online advertising efforts of a sample of Italian manufacturing companies engaged in C.E. practices. The results obtained showed that SMEs that fall into the lower- medium-performing range might benefit from intensively signalling their circularity on their website.

Arora et al. developed a novel approach to measure the evolution of firms' capabilities and agility by using firms' archived website data from the Wayback Machine.²⁴ Their work was fed by publicly posted web information that is essential for many firms' marketing and sales efforts and may reflect important strategic content, particularly for SMEs. They also contributed to the knowledge by using a computational machine-learning technique to quantify firms' changes over time and employed different non-overlapping sources to measure dynamic capabilities and performance.

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In the case of European SMEs, most have faced logistical challenges in addition to demand disruptions, although the severity has differed across firms and industries. That is why the following policy interventions need to be sensitive to the different types of SMEs instead of adopting a one-size-fits-all approach, shifting towards a more structural and longer-term approach based on promoting their renewal and growth through innovation, internationalisation, and networking.²⁵

One outstanding idea is KITT4SME (platform-enabled KITs of arTificial intelligence FOR an easy uptake by SMEs), which targets explicitly European SMEs and mid-caps to offer them scope-tailored and industry-ready hardware, software, and organisational kits, delivered as a modularly customisable digital platform that seamlessly introduces artificial intelligence to their production systems.

A practical concept for enhancing the organisational performance of manufacturing industries is to implement Total Quality Management (TQM) policies, which is a crucial survival tool for all kinds of industries. However, some SMEs in countries like India are reluctant to adopt TQM.²⁶ From a theoretical point of view, TQM is considered to be a comprehensive management system followed by most organisations in the corporate world, which focuses on customer focus, continuous improvement, the involvement of everyone, and maximising the performance of processes²⁷.

OPPORTUNITIES AND RECOMMENDATIONS

1. *Make a roadmap for the industrial policy plan for the next five years.*

The creation of this is crucial because it gives a framework for companies to clarify in which direction they are heading. It allows everybody to plan ahead and achieve better results in the future.

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SMEs Provide information about problems and needs to industry associations, along with data about the company's core competencies and activities. This will help analyse the market's actual situation and issue appropriate regulations and set trends.

Industrial associations Collect information from SMEs and MNEs, then formulate requests to the public sector, evaluating the commodities for the industry.

Government Research the problems submitted from different sides, including statistical analysis within research institutions. They then set policies, issue subsidies, and give general directions to the public sector.

Scientific and Educational Establishments Assist SMEs in the gathering of relevant information, provide public information about the relevant activity for the industrial agenda and stay in touch with the industrial stakeholders.

2. *Diversify core competencies among SMEs*

Determination of a market niche is essential for an SME to sustain local competition and increase the country's efficiency in the global market. Modern ICT and digital cloud platforms allow for the collecting, analysing, and further use of data to predict high or low demand for manufacturing companies. Big data analysis allows the creation of forecasts for a company to find relevant suppliers to prevent bottlenecks in production in advance. Thanks to ERP systems, outsourcing becomes more transparent; thus, a company's core competencies can be developed instead of doing the work of a reliable supplier.

SMEs Reduce MUDA (no-value-adding activities, Japanese tr.) and idle assets.

Industrial associations Play the role of mediators between MNEs, SMEs, Digital platforms, raising awareness and visibility of highly specialised manufacturers.

Government Provide policies and support to control visibility and availability of competencies forming a transparent and efficient supply chain composition.

Scientific and Educational Establishments Play an important role by spreading scientific opinion on conferences and forums, analytical research executed by universities and tested by specialists. Universities can shape the industry's human resources gap by raising scholarships for some qualifications and also improve their involvement with SMEs by supplying internships and research programmes for the companies focused on improving SMEs' competences and specialisation.

3. *Reduce information asymmetry*

R&D and manufacturing should become closer, considering that R&D activity in 70% of cases is related to manufacturing. We should keep in mind the difference between producer and manufacturer. For a country, going in this direction means more value-added for export. This is a great challenge for SMEs, especially in developing countries.

SMEs Get access to centralised information services, for instance: HR, materials, and suppliers' list. Companies should share their data in advance.

Industrial associations Collect data and needs from producers and aggregate the request to Government. They create lists and catalogues of company data on platforms, reducing information asymmetry.

Government Create events and clusters where business meets University R&D departments.

Scientific and Educational Establishments Provide an open catalogue of outsourcing R&D services, and samples of R&D outsource contracts entered into. They provide the industry with manufacturing facilities such as laboratories for small batch or prototype production.

4. *Human resources specialisation*

SMEs in developing countries usually do not have administrative and technological qualifications comparable to those of SMEs in developed countries. Lengthening the value-added cycle on the international market requires a jump in the competitive qualification level. Industry 4.0 competencies can bring competitive advantage; currently, industry 4.0 starts with the same base everywhere.

SMEs Consult with HR specialists and looking at trends, incorporate the use of software in their operation. They participate in Industrial Associations and collaborate with scientific and educational establishments to detect workforce skills gaps and opportunities.

Industrial associations The final guide and a recommendation can be discussed with regard to events organised by associations. They define guidelines for the specialisation of human resources based on specific industry needs.

Government Issue general directions to educational establishments and provides opportunities for technical education for minorities (women, immigrants, the unemployed with no high school attendance) to get more appropriate workforce resources. Sets trends and certification for technical education. Provides SMEs with incentives for workforce education focused on relevant technological and practical development.

Scientific and Educational Establishments Develop a qualified workforce, promote and train using up-to-date technical programmes and allocate available student places according to industrial sector needs (industry 4.0).

5. *Sustainability and shared economy*

Shifting from natural resources to sustainable sources is a global trend and a requirement. Conscious material usage and machinery downtime fulfilment makes savings in energy and other resources. There is a place for

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digital transformation in terms of overall economies of scale in a country and to speed up the growth of a separate SME.

SMEs Dedicate time and necessary resources for the integration of digitising cloud solutions. The use of modern ICT technologies and business models allows the creation of a web platform listing competences of companies to allow the sharing of their idle assets. Digitised data gathering can be subsidised if requested by SMEs of industrial associations. SMEs should aim for increased efficiency with the aid of government funding and research from universities.

Industrial associations Unified ICT tools promoted within the whole industry habilitate the agility of automated matching and then monitoring SMEs in supply chains.

Government Limit the usage of natural resources and, in parallel, ease the process of requesting facilities and subsidies for sustainable and renewable energy usage. These policies are crucial for local companies to enter the international market.

Scientific Research and Educational Establishments Research market trends, publishing results that predict demand for specific goods. They undertake research for improving the efficiency of energy and materials and energy flow that can be the starting point for the agenda for decarbonised manufacturing.

6. *Digitalisation and innovation*

SMEs are the backbone of production chains, and the general problem is their visibility or exposure to the market. There is no clear understanding of their structure, competencies, and availability. Most important SMEs are invisible to new clients that want to find a substitute for their supply chain. Moreover, working with most SMEs is not transparent when compared to MNEs. The network effect can arise if the cooperation is unified and centralised, where every stakeholder benefits. The Covid situation helped SMEs to come closer

to technology. Industrial policy can be more effective in developing countries if it is based on science and education.

SMEs Commit to learning the benefits of digital transformation. For the optimisation of the value-creating supply chain, ICT-based instruments of analytics, communication, and transparency are required: for instance, the next level of QI, the public rating of reliable suppliers, and forecast of demand. Target promotion of idle assets available to be used for outsourcing orders.

Identify opportunities for obtaining revenue from services, based on digital platforms, associated with their manufactured goods.

Government Provide support for supply chain digitalisation processes for SMEs and industrial associations. It issues policies for product certification, thus, creating an environment for digitalisation and export, protecting commercial data leakage by law. It can facilitate and subsidise digital transformation.

Industrial associations should gently oblige SMEs to digitalise by offering cooperation with well-structured global supply chains. They can warranty some listing platforms as being trusted; therefore, members can store any sensitive data which has been uploaded there for further automatic analytics. Associations can allow a big trusted MNE to lead the new digitalised supply chain.

Scientific and Educational Establishments can train specialists in a broad range of ICT services (ERP, MES, data-powered software etc.)

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CONCLUSION

Current times present many challenges but also great opportunities for SMEs in developing countries. In order to face the challenges and for these opportunities to be taken, a proper environment of collaboration needs to be created amongst the different manufacturing stakeholders.

The synergistic integration of SMEs, industrial associations, scientific bodies, academia and governments, is crucial to generate an ecosystem of cooperation where each actor has a clear participation in the development of manufacturing. This is especially relevant for developing countries, since manufacturing is key to achieving a higher level of development.

It is essential for governments to be aligned with manufacturing and focus their efforts on planning based on the region's key competitive advantages. This aspect should be oriented by the academy, giving solid foundations so as not to leave SMEs unprotected.

Digital technologies have given rise to a new era of lean manufacturing, which extends the lean philosophy to the cyber world (e.g., lean automation) for example, by making 'physical-to-digital' conversions, known as 'digital transformations' or 'digitalisation', of value-adding activities in order to pursue new digital manufacturing levers to eventually realise higher productivity levels, higher quality, an optimised use of resources, and increased production throughput.

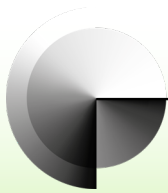
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REFERENCES

- ¹ Ramadani, V., The importance of angel investors in financing the growth of small and medium sized enterprises. *International Journal of Academic Research in Business and Social Sciences*, 2012. 2(7): p. 306-322.
- ² Auzzir, Z., R. Haigh, and D. Amaratunga, Impacts of Disaster to SMEs in Malaysia. *Procedia Engineering*, 2018. 212: p. 1131-1138.
- ³ Peillon, S. and N. Dubruc, Barriers to digital servitization in French manufacturing SMEs. *Procedia CIRP*, 2019. 83: p. 146-150.
- ⁴ Carrigan, M., et al., The Fine Jewellery Industry: Corporate Responsibility Challenges and Institutional Forces Facing SMEs. *Journal of Business Ethics*, 2017. 143(4): p. 681-699.
- ⁵ Naradda Gamage, S.K., et al., A Review of Global Challenges and Survival Strategies of Small and Medium Enterprises (SMEs). *Economies*, 2020. 8(4): p. 79.
- ⁶ "Manufacturing, value added (% of GDP) - Latin America & Caribbean | Data." [Online]. Available: <https://data.worldbank.org/indicator/NV.IND.MANF.ZS?end=2020&locations=ZJ&start=2020&view=map&year=2019>. [Accessed: 09-Sep-2021].
- ⁷ O. Regnerova, D. Šálková, and P. Šánová, "The Importance of Industry in Modern Economies of the Globalized World in the 21st Century," *SHS Web Conf.*, vol. 92, p. 04021, 2021.
- ⁸ Shu-Yen, W. and W. Tsungche, SMEs' Strategic Transformation on Export Development in Response to the U.S. Reindustrialization-Case Study in Taiwan. *Ritsumeikan International Affairs*, 2017. 15: p. 19-44.
- ⁹ Panizzolo, R., et al., Lean manufacturing in developing countries: evidence from Indian SMEs. *Production Planning & Control*, 2012. 23(10-11): p. 769-788.
- ¹⁰ Ahadi, S. and S. Kasraie, Contextual factors of entrepreneurship intention in manufacturing SMEs: the case study of Iran. *Journal of Small Business and Enterprise Development*, 2020. 27(4): p. 633-657.
- ¹¹ Kalhor, N. *SMEs in Iran; a brief introduction*. 2016.
- ¹² Lambert, L., Real unemployment rate soars past 20% and the US has now lost 26.5 million jobs. *Fortune*, (April 23, 2020), 2020.
- ¹³ Eggers, F., Masters of disasters? Challenges and opportunities for SMEs in times of crisis. *Journal of Business Research*, 2020. 116: p. 199-208.
- ¹⁴ Stahel, W., *The performance economy*. 2010: Springer.
- ¹⁵ Lyle, J.T., *Regenerative design for sustainable development*. 1996: John Wiley & Sons.
- ¹⁶ Graedel, T.E. and B. Allenby, Matrix approaches to abridged life cycle assessment. *Environmental Science & Technology*, 1995. 29(3): p. 134A-139A.
- ¹⁷ Pauli, G.A., *The blue economy: 10 years, 100 innovations, 100 million jobs*. 2010: Paradigm publications.
- ¹⁸ Lacy, P. and J. Rutqvist, *Waste to wealth: The circular economy advantage*. 2016: Springer.
- ¹⁹ Blasi, S., B. Crisafulli, and S.R. Sedita, Selling circularity: Understanding the relationship between circularity promotion and the performance of manufacturing SMEs in Italy. *Journal of Cleaner Production*, 2021. 303: p. 127035.

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- ²⁰ Prause, M., Challenges of Industry 4.0 Technology Adoption for SMEs: The Case of Japan. *Sustainability*, 2019. 11(20): p. 5807.
- ²¹ Hirano, M. and D. Tobino. Successive Innovations in Global and Local Markets: Strategies of Global Niche Top Enterprises in Japan. in 2018 Portland International Conference on Management of Engineering and Technology (PICMET). 2018.
- ²² Chege, S.M. and D. Wang, Information technology innovation and its impact on job creation by SMEs in developing countries: an analysis of the literature review. *Technology Analysis & Strategic Management*, 2020. 32(3): p. 256-271.
- ²³ Ashton, W., S. Russell, and E. Futch, The adoption of green business practices among small US Midwestern manufacturing enterprises. *Journal of Environmental Planning and Management*, 2017. 60(12): p. 2133-2149.
- ²⁴ Arora, S.K., et al., Measuring dynamic capabilities in new ventures: exploring strategic change in US green goods manufacturing using website data. *The Journal of Technology Transfer*, 2020. 45(5): p. 1451-1480..
- ²⁵ Juergensen, J., J. Guimón, and R. Narula, European SMEs amidst the COVID-19 crisis: assessing impact and policy responses. *Journal of Industrial and Business Economics*, 2020. 47(3): p. 499-510.
- ²⁶ Sahoo, S. and S. Yadav, Total Quality Management in Indian Manufacturing SMEs. *Procedia Manufacturing*, 2018. 21: p. 541-548.
- ²⁷ Prakas Majumdar, J. and B.M. Manohar, Why Indian manufacturing SMEs are still reluctant in adopting total quality management. *International Journal of Productivity and Quality Management*, 2016. 17: p. 16-35



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World Manufacturing Foundation
Via Pantano, 9 - 20122 Milano, Italy
worldmanufacturing.org