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Modelling Success Factors for Sustainable Growth of the Handicraft Industry in Extreme Weather Region

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Abstract
The handicraft industry of Ladakh is where culture, economy and environment meet. Despite the potential, the sector faces many challenges - limited market access, outdated production methods and fluctuating demand. Key elements like supply chain and logistics, awareness of government policies, environmental practices, contingency planning, training opportunities, lean management, online presence, marketing, product visibility, social innovation and supplier networks are identified through literature review and stakeholder interviews. Interpretive Structural Modelling (ISM) is used to examine the contextual relationships among key success factors for the handicraft industry in Ladakh. The findings of the analysis demonstrate that supply chain and logistics, awareness of government policies, environmental practices, contingency planning, and social innovation emerged as the independent variables, while lean management, handicraft product visibility, and supplier network act as dependent variables. The key success factors, such as training opportunities, online presence, and marketing, act as the linkage variables between independent and dependent variables. Supply chain and online presence are key to market and product visibility. Social innovation and contingency planning can drive resilience and adaptability in economic and environmental changes. The findings of the study suggest that the Government should collaborate with local institutions to conduct regular training workshops for artisans. These workshops should focus on skill enhancement, marketing strategies and sustainable production techniques. This research provides practical tips to harness these success factors to turn the handicraft industry into a sustainable and competitive sector without losing its cultural heritage.

Keywords- Contingency planning, Interpretive structural modelling, Social innovation, Sustainable growth, Handicrafts.

1. Introduction

Handicraft is a cultural and economic asset in rural and remote areas like Ladakh. While it has so much to preserve and generate livelihoods it needs innovative and structured solutions for growth. Handicrafts in Ladakh are part of our heritage and economy. Ladakh is home to a rich tradition of pre-historic handicrafts, including Pashmina shawls, intricate wood carvings, thangka paintings, and traditional pottery. These crafts are deeply rooted in local culture and serve as a significant component of the region's artistic heritage. The handicraft sector not only embodies the cultural identity of the artisans but also acts as a critical economic lifeline for communities in the peripheral areas of Ladakh, providing both livelihood and a means to

preserve traditional practices amidst modernization. But balancing tradition, contemporary markets and sustainability is a significant obstacle for the industry.

Indian handicraft industries are a massive employer for rural and marginalised communities and promote inclusivity. The handicraft sector in Ladakh serves as a significant contributor to the regional economy, with its woodwork, jewellery, and textile products garnering national acclaim for their craftsmanship and cultural significance. In Ladakh, handicrafts reduce dependence on agriculture and seasonal tourism and provide uninterrupted employment. By working with national initiatives like Atmanirbhar Bharat and Make in India, the sector can connect conventional crafts with global markets and increase its share of GDP.

The Indian government has many initiatives to promote and sustain the handicraft sector as it is culturally, economically and socially important. These policies support artisans with financial help, skill development, market access infrastructure development and preservation of traditional knowledge and practices (Apparel Views, 2024; Singh, 2024). The National Handicrafts Development Programme (NHDP) is the flagship programme that focuses on skill upgradation of artisans, improvement of product quality and design innovation and marketing to make the sector global (Development Commissioner Handicrafts, 2022). Similarly, Ambedkar Hastshilp Vikas Yojana (AHVY) is a cluster-based programme that facilitates integrated activities like skill upgradation, product innovation and market linkages to uplift the socio-economic status of artisans (Official website of Development Commissioner (Handicrafts), Ministry of Textiles, Government of India). Comprehensive Handicrafts Cluster Development Scheme (CHCDS) aims to modernise infrastructure in handicraft clusters to address the issues of unorganised production and limited technology use and to scale up the production to ensure sustainable livelihoods of artisans (Ministry of Textiles, 2024). One District One Product (ODOP) initiative showcases the unique crafts and products of each district and supports market visibility and export potential (Bansal, 2024). Pashmina wool and Thangka paintings are the key products in Ladakh. Prime Minister's Employment Generation Programme (PMEGP) empowers artisans by providing financial assistance to set up micro-enterprises, and increase production capacity and market reach (Khan et al., 2018).

In Ladakh, the government has taken targeted measures to support the local handicraft industry. Geographical Indication (GI) tagging of Pashmina products has preserved the products' authenticity and quality, increased the market demand, and given artisans a competitive edge (Reach Ladakh Bulletin, 2024). Looms of Ladakh Cooperative empowers women artisans through the sustainable production of Pashmina products, gives them economic independence, and preserves traditional skills (Nath, 2024). Artisan clusters in Changthang and Wanla are producing high-quality Pashmina wool, wood carvings and Thangka paintings for local livelihood and preservation of cultural heritage. Ladakh Handloom and Handicraft Corporation and regular handicraft exhibitions are also providing training, branding and marketing opportunities to artisans (Development Commissioner Handicrafts, 2025).

Besides, Export Promotion Council for Handicrafts (EPCH) is also supporting the sector's export potential by providing marketing assistance, quality certifications and international exposure (EPCH, 2025). But despite all these efforts, there are many challenges. Lack of awareness of schemes, bureaucratic delays and inadequate infrastructure are hindering artisans in remote areas like Ladakh to fully benefit from these initiatives. To maximise the impact of these policies, there is a need to increase artisan awareness, streamline the process and address the implementation hurdles (Development Commissioner Handicrafts, 2025). The various schemes and policies enacted by the Government of India demonstrate a robust commitment to the handicraft sector. However, the success of these initiatives is contingent upon addressing systemic challenges to facilitate sustainable growth and promote socio-economic empowerment among artisans. A significant hurdle in the effective implementation of these programs arises from a lack of

awareness among artisans regarding available resources, compounded by bureaucratic lethargy that can delay processes and allocation of benefits. Addressing these issues is crucial for realizing the full potential of these initiatives in enhancing the livelihoods of artisans.

India has a huge handicraft sector, with each region having its craft, which reflects its geography and culture. Ladakh is known for Pashmina wool, Thangka paintings and woodwork, which is part of the region's culture and spirituality. These sustainable and eco-friendly crafts adhere to global standards while preserving their unique identity. Changthang, Wanla, Likir, and Turtuk in the Union Territory of Ladakh function as centres for the creation of this indigenous craft. The regions are renowned for their thangka paintings, exquisite pashmina textiles, intricately crafted wooden sculptures, and distinctive Balti handicrafts. These artisanal products reflect the rich cultural heritage and traditional craftsmanship of the Ladakh. Besides, the infrastructure has coherent and market economy links throughout the region, but these are constrained by the climatic conditions.

Handicrafts represent cultural heritage, and livelihoods are significant but come across various obstacles. Access to the market is the key. The artisans in Ladakh are physically cut off as they don't have access to bigger markets. The review of the literature highlights the insufficiency of infrastructure, like poor road connectivity and no internet platforms, which worsens the situation. Artisans are impeded from meeting global demand due to climatic conditions, geographical constraints, and infrastructure limitations.

Another difficulty is the reliance on conventional procedures, which, while culturally significant, frequently prove inefficient and uncompetitive in today's rapid global marketplaces. The utilisation of antiquated tools and techniques diminishes production, causing artisans to lag behind industries that have embraced contemporary technology. The craftsmen struggle to uphold the stringent quality and consistency requirements demanded by global markets, hindering their ability to compete with mass-produced goods.

Furthermore, seasonal demand, strongly associated with tourism, renders the industry highly susceptible. In places like Ladakh where tourism peaks in specific months artisans face financial instability during off season. The fluctuation in demand not only affects their income but also their ability to maintain production. Seasonality creates challenges in financial planning and resource management especially for artisans who solely depend on handicraft sales for their livelihood.

Financial constraints are another barrier to growth. Many artisans face difficulties in getting credit and cannot invest in modern tools and expand their business. A lack of financial support mechanisms and bureaucratic hurdles prevent artisans from availing resources to scale up their businesses. Artisans are unable to introduce new production methods or optimize their business processes if they do not receive funding, which ultimately inhibits the growth of the industry.

To enhance the performance of the handicraft sector in Ladakh, a multi-dimensional approach is essential. Utilizing Interpretive Structural Modelling (ISM), researchers have identified, evaluated, and ranked the critical challenges facing in the Micro- Small and Medium Enterprises (MSMEs) (Panghal et al., 2022; Prasad et al., 2022). This methodological framework enables a comprehensive exploration of interconnections among various issues, thereby fostering a culturally rich and economically viable handicraft market. Based on the above-mentioned gaps and practices and research, this study will have the following proposed research objectives:

1) What are the main growth strategies for the sustainable development of the handicraft industry in Ladakh?
2) What is the relationship among the proposed growth strategies for the sustainable development of the

handicraft industry in Ladakh?
3) How can we classify the proposed growth strategies for the sustainable development of the handicraft industry in Ladakh based on their driving power and degree of dependence?

This study aims to identify and classify the critical success factors for the holistic development of the handicraft industry in Ladakh. The research findings provide a framework to ensure that stakeholders make realistic, culturally appropriate proposals, balancing the preservation of traditional craftsmanship with modern market demands. The governments should be primarily aware of these primary parameters which are as follows: (i) government policies, (ii) supply chain logistics and training opportunities, (iii) technology awareness, (iv) productive presence, (v) marketing techniques, and (vi) sustainable model. Supporting supply chains and market access is essential for the development of national and global supply chains for artisans to thrive across geographical and systemic barriers. Raising artisans' awareness of government policies and specialised training helps them to use their resources effectively.

Contemporary marketing tools and the visibility of products through online platforms can align traditional crafts with contemporary consumer demands. The findings indicate the necessity of reconciling cultural preservation with innovation to ensure traditional crafts endure while satisfying contemporary market requirements. This would establish a resilient and inclusive ecosystem, economically and socially empower craftspeople, and enhance the worldwide competitiveness of the handicraft sector.

This study uses Interpretive Structural Modelling (ISM) in the handicraft sector and analyses challenges and success factors specific to Ladakh. By organizing these elements, actionable recommendations that combine tradition with sustainability and marketability can be developed. Unlike previous studies, this study creates a framework that integrates traditional crafts with structured interventions to address systemic issues, increase market access and empower artisans. This is not limited to Ladakh only but can be applied to other regions with similar issues. By addressing both cultural preservation and economic development this study contributes to global debate on artisanal heritage and sustainable economy and gives new and actionable ideas.

This paper examines the development of a framework for the handicraft sector with a focus on sustainable growth. Section 1 introduces the handicraft sector, its cultural, economic and social significance and the challenges of limited market access, old techniques, financial constraints and environmental concerns. Section 2 reviews the literature, summarising research on the sector’s economic potential, sustainability practices and policy frameworks and what this study will fill in the gaps. Section 3 explains the methodology and model analysis, using ISM to systematically identify and rank the success factors and understand the relationships between the challenges and enablers in the sector. Section 4 shows the results and analysis, the top drivers being supply chain logistics, government policy awareness, product visibility and balance between cultural preservation and market demands. Section 5 discusses the theoretical and policy implications, roles of different stakeholders and opportunities for collaboration to open up the market, artisan livelihoods and environmental sustainability. Section 6 concludes with recommendations for a way forward to merge traditional with strategic, engage stakeholders, and achieve long-term socio-economic and environmental sustainability for the handicraft sector.

2. Literature Review

Literature on the handicraft industry talks about its economic, cultural and social importance and the challenges it faces in adapting to the modern market. This section reviews existing research and identifies gaps in technology, sustainability and policy that are needed for the sector to grow.

2.1 Sustainability of the Handicraft Sector

Handicrafts require an equilibrium between cultural preservation and market demand. Sweta and Sundararaman (2021) highlight that Ladakh serve as significant centers for diverse livelihoods and traditional craftsmanship in India. To ensure sustainability, outdated approaches, lack of market access and budget constraints must be eliminated. Their research points the way to sustainable business practices that are economically just and culturally authentic. The research suggests what is missing in sustainable practices, but they argue for a framework that links environmental concerns with economic planning and cultural beliefs (Datey et al., 2023; Yadav et al., 2022). To ensure sustainability, outdated approaches, lack of market access and budget constraints must be eliminated. Their research points the way to sustainable business practices that are economically just and culturally authentic.

2.2 Proposed Strategies

The proposed strategies are identified using literature review, fieldwork, surveys, and expert opinions. In the fieldwork, 89 participants were interviewed using a semi-structured questionnaire. The list of questions is mentioned in the manuscript appendix. The 89 participants were from different sectors of the handicraft industry, including basket making, clay moulding, copper handicraft, footwear, handloom cloths, handmade carpets, handmade yarn, metal ware, pottery, stone carving, and wood carving (**Figure 1**). A comprehensive, multi-faceted strategy is essential, coupled with both immediate recommendations and long-term initiatives, to ensure the sustainable development of the handicraft sector in Ladakh. Some immediate measures could be to ensure financial relief for artisans through microfinance schemes, availability of raw materials through centralised procurement centres, providing digital literacy to artisans to directly sell to consumers, conducting awareness campaigns on sustainable practices, and simplifying government regulations.

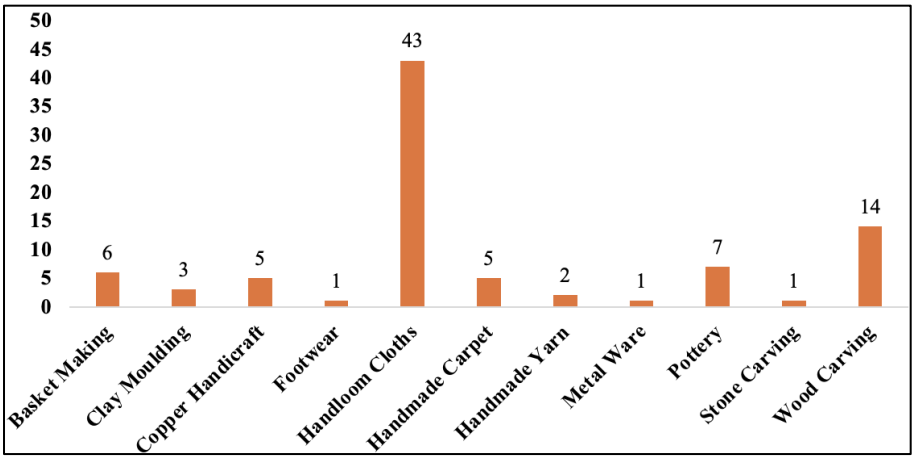

Figure 1. Details of respondents in survey.

Operational decisions, which are short-term measures (1-3 years), should focus on capacity building through training workshops, e-commerce platforms for local handicrafts, and financial subsidies for sustainable practices. Leverage tourism through craft villages and workshops and artisan participation in exhibitions to expand markets. Strategic decisions, which are long-term measures (5-10 years), should focus on artisan cooperatives for bulk purchasing and fair wages, infrastructure like artisan hubs, and school handicraft education. Policies should formalize the sector with artisan registration, quality certification and GI tags for unique crafts. Emphasis on sustainable modernization, eco-friendly practices and mentoring will support long-term growth. Regular reviews and policy updates will ensure relevance and impact.

2.2.1 Supply Chain and Logistics

The study says that improving logistics and streamlining supply chain management can increase the efficiency and scalability of the handicraft sector (Pant and Pandey, 2015). Developing better transportation networks, centralised procurement systems, and technology-driven inventory management is the key to overcoming these challenges. Robust supply chain practices can reduce costs, minimise waste and ensure the quality of raw materials and finished products.

Supply chain and logistics are the key to artisans in Ladakh. By increasing market access and reducing the cost of material procurement and product distribution, artisans can innovate and scale up. This is the way to growth and global competitiveness for the handicraft sector. Efficient logistics gives market access and ensures timely delivery of raw materials so artisans can avoid production delays and loss of income.

2.2.2 Awareness of Government Policies

Knowledge of government policies is the key to empowering artisans and for sustainable development of the handicraft sector. Shah (2016) says despite many initiatives the impact of government schemes in places like Jammu and Kashmir (which is similar to Ladakh) is limited due to a lack of awareness among artisans. Many artisans are not aware of the financial, skill development and marketing support available to them which restricts the benefits of these schemes.

Majeed et al. (2023) say the handicraft sector is the second largest employer in India, but the reach and impact of government policies are hindered by a lack of information. They also recommend awareness campaigns and local government involvement to bridge the gap and encourage artisans to utilize resources more effectively. The carpet industry in Kashmir has been revived by the government's policy measures, but there are still limitations in terms of lack of awareness and access to the same programs available in other handicraft sectors in backward regions (Majeed, 2018).

However, Kumalasari (2019) provides an international overview of how local government policy initiatives can influence the growth of creative industries. Research suggests that local methods of disseminating policy information and also working directly with artisans can increase participation and equitable development.

The Amended Technology Upgradation Fund Scheme (ATUFS), introduced in 2016, serves as the backbone of the modernization of textile and handicraft sectors in India under the ‘Make in India’ initiative (Ministry of Textiles, 2024). It aims to enhance manufacturing efficiency, reduce import dependence, and improve product quality through technology interventions. In the Union Budget 2025-26, ₹635 crore has been allocated under ATUFS to fortify the textile industry by promoting exports, employment, and sustainable production (Press Information Bureau, 2024).

For the handicraft industry in Ladakh, ATUFS is important as it allows artisans to merge modern weaving techniques with traditional craftsmanship, making products like Pashmina wool textiles and Buddhist Thangka paintings more durable and marketable. The scheme encourages technology adoption in fabric processing so artisans can access better looms, eco-friendly dyeing techniques, and advanced finishing processes. It also aligns with the region’s economic needs by creating employment opportunities, especially for women artisans, and supporting skill development programs.

Besides improving production quality, ATUFS helps expand market access for Ladakh’s handicrafts by making them more competitive in domestic and international markets. The scheme promotes sustainable and zero-waste production, which is essential for the region's fragile ecosystem. By encouraging energy-

efficient textile processes and environmentally friendly material sourcing, the scheme helps artisans maintain traditional methods and meet contemporary sustainability standards. The financial assistance provided under ATUFS ensures that small-scale weavers and handicraft producers can modernise without compromising their cultural heritage (Apparel views, 2025).

2.2.3 Environmental Practices

For the handicraft industry in eco-sensitive areas like Ladakh, sustainable practices are a must. Tran et al. (2021) highlight the role of eco-friendly practices like renewable energy and biodegradable materials in the global supply chain. Agarwal et al. (2023) say sustainable practices in MSMEs increase resilience to environmental and market fluctuations and urge skill development among artisans. Ghosh et al. (2020) show how traditional knowledge like Changpas resource management strategies can inform comprehensive environmental policies. Ciftci and Walker (2017) highlight the sustainability of locally sourced materials and traditional practices with modern design to benefit more. Choudhary and Mishra (2022) align Indian handicrafts with fair trade principles and environmentally conscious consumers to make them marketable and reduce environmental impact. Integrating traditional knowledge with modern sustainability practices will ensure environmental balance, market competitiveness and long-term sustainability of the industry.

2.2.4 Contingency Planning

Contingency planning is key for artisan businesses in Ladakh, where they face demand fluctuations, climate change and market disruptions. The resilient contingency plan enables businesses to navigate uncertainty and enhances organizational agility by establishing pre-defined responses to unexpected events, ensuring that production can continue during off-seasons. Effective contingency planning for the handicraft industry with product and market diversification can empower the supply chain to counter tourism-driven disruptions. Moreover, the viability of supply chains is essential in the handicraft industry for expanding local supply networks and developing sustainable infrastructure to tackle logistical challenges in remote areas. The contingency plans enable the supply chain to effectively address environmental risks. Government initiatives like ODOP promote artisan resilience but lack awareness and local implementation. Good plans should build upon these policies and bring artisans, authorities and stakeholders together to ensure resources during a crisis. Training and skill development help with adaptability. Modern techniques with traditional knowledge and government and NGO support ensure artisans can earn livelihood and sustain their craft.

2.2.5 Training Opportunities

According to Darokhan (1997), training will be a game changer in increasing artisans' productivity and also market access. Remote places like Ladakh will need training which will include traditional as well as modern skills for artisans to upskill themselves to be globally competitive in the market. For example, the craftsman producing traditional Pashmina wool needs training in modern weaving techniques and eco-friendly dyes so that they can be standardised and yet remain within their own culture.

The government of India has understood the importance of skill development for artisans through programs like NHDP and AHVY. These programs train and provide financial support and marketing support to artisans so they can upskill and get better market access. DC Handicrafts has been conducting workshops and training artisans on traditional crafts and modern techniques. Such training is necessary to bridge the gap between traditional craft and modern consumer demand.

Despite these initiatives by the government, literature shows that there is a huge gap in the availability and accessibility of training programs, especially in remote areas. Despite the availability of training opportunities, most artisans in remote regions of India, such as Ladakh, encounter challenges including

geographical obstacles to accessing these programs, a lack of awareness, and financial difficulties. Successful programs being run by organizations like Looms of Ladakh and many other community-driven projects are providing customized training for specific handicraft forms, Thangka painting, Pashmina wool weaving and wood carving (Nath, 2024). These projects provide training along with market exposure so that artisans can upskill, and know consumer trends and global demand in the market. The training programs with modules on entrepreneurship can help artisans diversify their income sources, reduce dependence on seasonal markets and create a sustainable business model. These programs can empower artisans to navigate modern retail platforms, expand their reach and increase their sales potential, locally and globally.

2.2.6 Lean Management

Lean is about efficiency, waste reduction, and more with less. Although it is often associated with manufacturing, it applies to handicrafts as well, where artisans face inefficiencies, high costs, and challenges in maintaining quality while meeting market demands. According to research by Chouiraf and Chafi (2018), lean practices reduce waste in production and increase the efficiency of resource utilisation without the loss of quality. One of the basic principles of lean is continuous improvement, which means small incremental changes that add up to big improvements. The training of artisans on lean can benefit better resource utilisation even in traditional craftsmanship. Implementing lean in this handicraft sector can reduce production time, reduce material cost and minimise defects altogether, which are the key factors for artisans to compete in any global market. However, implementing lean in the handicraft sector has its challenges. The major hurdle is resistance to change, especially when tradition runs deep in that industry. Artisans would not want to adopt methods that can change the cultural fabric of their craft. There is need to overcome this resistance by providing enough training and showing learning in cultural traditions. The lean approach can help reduce the environmental footprint of the handicraft sector through better resource utilisation and waste reduction. Lean transcends the artisanal level to the whole supply chain. Improving coordination and cooperation among artisans, suppliers, and distributors, lean can smoothen the logistics process and minimise lead time. The lean management can help improve the procurement of raw materials and ensure the timely delivery of finished products, which is vital in fulfilling demand in both the local and global markets. Artisans can save on raw material wastage, process and cost in business. In a place like Ladakh, where resources are scarce, lean can be super effective in maximising output with minimal inputs and hence making handicraft businesses more sustainable.

2.2.7 Online Presence

Having an online presence has many benefits for the handicraft industry. First, it opens up new markets beyond local and national boundaries. Etsy, Amazon and India Mart are some of the platforms where artisans can showcase their products to a global audience, overcoming the challenge of limited market access that many small-scale producers face. The international reach of these platforms allows the artisans to diversify their customer base and sell more during the off-season when the demand for traditional tourism is low.

Apart from e-commerce platforms, social media marketing is also a big player when it comes to promoting handicrafts. This also helps to build a story with every product with regards to uniqueness, cultural heritage and craftsmanship that defines each product. Social media is very effective in engaging consumers with artistic products. Artisans can tell their stories to customers through Instagram or Facebook and make their products more attractive and marketable.

Digitisation and initiatives under digital India can help boost the handicraft sector in Ladakh. By using online marketplaces, digital marketing, e-commerce platforms and digital payment systems, artisans can go beyond geographical boundaries. Digital India, launched in 2015, aims to build the online infrastructure,

increase internet connectivity across the country, and deliver government services digitally and universal digital literacy. One of the notable developments is the Open Network for Digital Commerce (ONDC), a government-backed project to democratise digital commerce by giving equal opportunities to small and medium enterprises. By joining ONDC, artisans can access a larger customer base and benefit from a decentralised e-commerce ecosystem. Also, India Handmade under Digital India showcases India's handloom and handicraft products globally and provides artisans with digital tools and visibility to succeed. Using these digital channels can increase sales, better profit margins and sustainable growth for the handicraft sector in Ladakh (Digital India, 2015).

A professional website, along with search engine optimization (SEO) practices, will ensure that artisans' products appear in search results when customers search for specific handicrafts. With the use of SEO tools, artisans can reach the targeted keywords related to their craft. So, it has more chances of selling the products as people look for one-of-a-kind or handmade things. Artisans need to be trained in digital literacy, e-commerce and online marketing to be successful in the digital market. Even highly skilled artisans may struggle to navigate digital platforms effectively without adequate training, which can hinder their ability to optimize their online presence and fully capitalize on digital marketing opportunities. Also, shipping, payment, and customer service handling will become problems for artisans who do not have experience in e-business operations.

2.2.8 Marketing

Marketing is fundamental to the handloom sector, as it enhances artists' visibility and establishes a brand identity (Darokhan, 1997; Sweta and Sundararaman, 2021). In the regions of Ladakh, effective marketing strategies are essential for handicraft business owners striving to navigate the challenges of limited market access and the influx of mass-produced textiles. Leveraging social media platforms enables artisans to effectively present their craftsmanship, narrate the intricacies of their work, and foster direct engagement with consumers. This approach not only helps in building a loyal customer base but also establishes a profound emotional connection with the audience, enhancing the perceived value of their handmade products in a competitive marketplace. Highlighting craftsmanship and cultural heritage through visual storytelling works. Global marketplaces like Etsy, India Mart and Amazon give artisans a wider reach beyond geographical boundaries and expand their customer base. But digital marketing requires training in tools like SEO, product photography and market trends. The products from Ladakh are eco-friendly and traditional and appeal to conscious consumers. Social media and global platforms can help increase their sales and reach.

2.2.9 Handicraft Product Visibility

Visibility of products is key to the growth and sustainability of handicrafts in Ladakh. Better visibility means that artisans can access larger markets, attract customers and make sales (Sweta and Sundararaman, 2021). E-commerce platforms such as Etsy, Amazon and India Mart are breaking geographical barriers and giving artisans global visibility. High-quality images and detailed descriptions make it more appealing to customers. Social media platforms such as Instagram, Facebook and Pinterest help artisans showcase their craft, build an emotional connection and highlight cultural aspects through visual storytelling. Regular postings, engaging content and collaboration with influencers increase awareness. Collaboration with retail stores, regional tourism boards and artisan markets increases physical presence. Department of Textiles and DC Handicrafts events, trade shows, exhibitions and partnerships with retailers increase product visibility. Collaborations with multinational companies expand distribution channels and global sales.

2.2.10 Social Innovation

Social innovation is the roadmap to the growth and sustainability of handicrafts in Ladakh. It provides

solutions to social challenges, improves the lives of artisans and protects cultural heritage. Community-based cooperatives and partnerships empower artisans by pooling their resources, sharing their expertise and negotiating for better market access and fair prices. They help them deal with fluctuating demand and limited resources. Environmentally friendly production methods**,** such as the use of sustainable materials and renewable energy, make products more marketable, especially in global markets that value sustainability. Technology-driven innovations such as online platforms for marketing and sales are expanding the reach of artisans and enabling them to compete in the global market. These innovations, including cooperatives and community-led projects, are making the artisan sector more inclusive, equitable and sustainable.

2.2.11 Supplier Network

The supply chain in Ladakh is characterised by geographical barriers and scarcity of raw materials. Building relationships with local suppliers of wool, textiles and dyes can increase the sustainability of the handicraft sector. Local sourcing reduces transportation costs and carbon footprint, supports the local economy and access to materials suitable for traditional craftsmanship and eco-friendly alternatives where possible. Expanding the supplier network beyond local resources to national and international suppliers will open up new opportunities for innovation. Artisans can get access to a wider range of materials, tools and technologies that can improve the quality and variety of their products. Plus, effective communication between artisans, suppliers and government agencies will improve supply chain management, reduce delays in the supply chain and produce goods in time for the market. By addressing the challenges with traditional knowledge, modern technology and strategic interventions, the sector can sustain itself in the long term and benefit artisans and the region.

The literature review, fieldwork, and expert opinions highlight several key factors essential for the sustainable growth of the handicraft industry in Ladakh. These success factors include supply chain management, logistics, awareness of government policies, environmentally sustainable practices, contingency planning, training opportunities, lean management, online presence, effective marketing, product visibility, social innovation, and strong supplier networks. In the next section, the research methodology used to analyze the contextual relationships among these success factors will be explained, followed by an ISM analysis.

3. Research Method and Model Analysis

This research uses interpretive structural modelling to develop a structural model to study the relationship among proposed strategies for enhancing sustainable growth of the handicraft industry in Ladakh (India). Business owners and policymakers can use the proposed structural model and analysis in strategic decision-making for the holistic growth of the region. The details of the research methodology are mentioned in **Figure 2**.

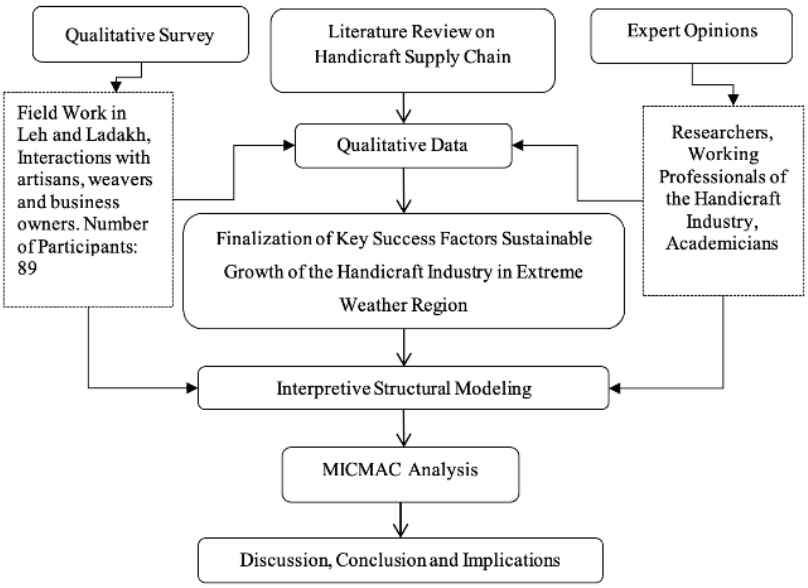

Figure 2. Research methodology.

3.1 Interpretive Structural Modelling

Prof. J. Warfield first introduced interpretive structural modelling (ISM) (Warfield, 1974). To examine the multifaceted supply chain management and socioeconomic factors, ISM can be used as a systematic tool to identify contextual interactions among considered elements associated with sustainable growth of the handicraft industry in Ladakh. In this model, a set of success factors that define the scope of the problem are presented to the participants.

The various steps involved in the ISM technique are:

3.1.1 Step 1: Identification of Elements

The key success factors for sustainable growth are identified through an extensive Literature review, expert opinions, and interviews with artisans, weavers, and business owners in Ladakh. The proposed strategies for the sustainable growth of handicraft industry in the Ladakh are described in section 2.2, and listed as follows: (1) Supply Chain and Logistics, (2) Awareness of Government Policies, (3) Environmental Practices, (4) Contingency Planning, (5) Training Opportunities, (6) Lean Management, (7) Online Presence, (8) Marketing, (9) Handicraft Product Visibility, (10) Social Innovation, (11) Supplier Network.

3.1.2 Step 2: Establishing a Contextual Relationship

The inter-relationship among the proposed strategies is shaped by the valuable feedback gathered from a diverse group of stakeholders, including skilled weavers, talented artisans, business owners, patrons of handicrafts, knowledgeable academicians, dedicated researchers, and influential policymakers. Their insights play a crucial role in understanding the dynamics of the handicraft industry, ultimately informing and enriching the strategies put forth.

3.1.3 Step 3: Data Collection and Development of Structural Self-Interaction Matrix (SSIM) of Elements

The data collection for interpretive structural modelling was done with the help of 30 participants, and the

majority rule was used to prepare the structural self-interaction matrix (SSIM). The following symbols are used to indicate the interaction direction between two proposed strategies (let's denote them as i and j):
V: Success factor i will help achieve success factor j;
A: Success factor j will help achieve success factor i;
X: Success factors i and j help achieve each other.
O: Success factors i and j are unconnected.
The structural self-interaction matrix (SSIM) is presented in **Table 1**.

3.1.4 Step 4: Development of a Reachability Matrix from Self-Interaction Matrix (SSIM) and Transitivity Check

This step converts the SSIM (Structural Self-Interaction Matrix) into an Initial Reachability Matrix by replacing symbols with binary numbers. The resulting binary matrix contains only 0s and 1s and follows specific rules:

a. For every 'V' encountered at position (i, j) in the SSIM, the reachability matrix will have a 1 at (i, j) and a 0 at (j, i).
b. For every 'A' at position (i, j) in the SSIM, the reachability matrix will have a 0 at (i, j) and a 1 at (j, i).
c. For every 'X' at position (i, j) in the SSIM, the reachability matrix will have a 1 at both (i, j) and (j, i).
d. For every 'O' at position (i, j) in the SSIM, the reachability matrix will have a 0 at both (i, j) and (j, i).

These rules dictate how the symbols in the SSIM are translated into the binary format of the reachability matrix. The final reachability matrix is developed from the initial reachability matrix. We examine transitive relationships to construct the final reachability matrix for the proposed strategies for sustainable growth of the handicraft industry in Ladakh. A transitive relationship means that if element X is connected to element Y and element Y is connected to element Z, then element X is also connected to element Z.

3.1.5 Step 5: Level Partitioning of Reachability Matrix

The proposed strategies for the sustainable development of the handicraft industry in Ladakh are organized by levels, with reachability and antecedent sets prepared for all success strategies. Strategies that share the same values in both the reachability set and the intersection set are categorized as level 1 and assigned the top position in the ISM hierarchy of challenges associated with implementing these strategies. After the first iteration, the success strategies identified at level 1 are removed, and the process is repeated with the remaining strategies until the hierarchical levels for each success strategy are established.

3.1.6 Step 6: ISM Hierarchical Graph and MICMAC Analysis

A directed graph is created by arranging the proposed success strategies at their respective levels (**Figure 1**). Direct links are established based on the relationships indicated in the reachability matrix. This flowchart summarizes all iterations according to their relative weightings. Cross-Impact Matrix Multiplication Applied to Classification (MICMAC) analysis is applied to classify the proposed strategies into four categories: dependent, independent, linkage and autonomous variables (**Figure 2**). The proposed strategies are plotted on the graph with dependence power on the x-axis and driving power on the y-axis. The proposed strategies are categorized into four groups based on their dependence on and driving power over each other.

3.2 Model Analysis

Using these key success factors and the steps that are mentioned in subsection 3.1, we have done the Interpretive Structural Modelling (ISM) and MICMAC Analysis (**Figure 2**). The key results are presented in the tables mentioned below.

Table 1. Structural self-interaction matrix (SSIM).

Variables	1	2	3	4	5	6	7	8	9	10	11
1		A	X	V	V	V	V	V	V	X	V
2			V	V	V	V	V	V	V	V	V
3				V	V	V	V	V	V	X	V
4					V	V	V	V	V	A	V
5						V	X	X	V	A	O
6							A	A	V	A	X
7								X	V	A	V
8									V	A	O
9										A	A
10											V
11											

Table 1 presents the Structural Self-Interaction Matrix (SSIM), with the responses categorized as V, A, X, and O, as outlined in subsection 3.1. **Table 2** provides the initial reachability matrix, displaying the data in binary format, using 1s and 0s, as described in subsection 3.1. Additionally, **Table 2** includes the calculations for dependence and driving power for each strategy, which are derived from the column and row-wise summation of the binary data.

Table 2. Reachability matrix (RM).

Variables	1	2	3	4	5	6	7	8	9	10	11	Driving power
1	1	0	1	1	1	1	1	1	1	1	1	10
2	1	1	1	1	1	1	1	1	1	1	1	11
3	1	0	1	1	1	1	1	1	1	1	1	10
4	0	0	0	1	1	1	1	1	1	0	1	7
5	0	0	0	0	1	1	1	1	1	0	0	5
6	0	0	0	0	0	1	0	0	1	0	1	3
7	0	0	0	0	1	1	1	1	1	0	1	6
8	0	0	0	0	1	1	1	1	1	0	0	5
9	0	0	0	0	0	0	0	0	1	0	0	1
10	1	0	1	1	1	1	1	1	1	1	1	10
11	0	0	0	0	0	1	0	0	1	0	1	3
Dependence power	4	1	4	5	8	10	8	8	11	4	8	

Table 3 displays the final reachability matrix after reviewing and updating it for transitivity. The updates for transitivity were applied to the following success strategy pairs: 5 to 11 and 8 to 11. These updates were conducted following the procedure outlined in subsection 3.1.4.

Table 3. Final reachability matrix (RM).

Variables	1	2	3	4	5	6	7	8	9	10	11	Driving power
1	1	0	1	1	1	1	1	1	1	1	1	10
2	1	1	1	1	1	1	1	1	1	1	1	11
3	1	0	1	1	1	1	1	1	1	1	1	10
4	0	0	0	1	1	1	1	1	1	0	1	7
5	0	0	0	0	1	1	1	1	1	0	1*	6
6	0	0	0	0	0	1	0	0	1	0	1	3
7	0	0	0	0	1	1	1	1	1	0	1	6
8	0	0	0	0	1	1	1	1	1	0	1*	6
9	0	0	0	0	0	0	0	0	1	0	0	1
10	1	0	1	1	1	1	1	1	1	1	1	10
11	0	0	0	0	0	1	0	0	1	0	1	3
Dependence power	4	1	4	5	8	10	8	8	11	4	10	

After conducting the transitivity check and finalizing the reachability matrix, level partitioning was carried out according to the rules outlined in subsection 3.1.5. The results of the first level partitioning iteration are presented in **Table 4**. Following this initial level, Strategy 9: Handicraft Product Visibility has been identified as the level 1 strategy.

Table 4. 1st Level partitioning iterations.

Elements	Reachability set	Antecedent set	Intersection set	Level
1	1, 3, 4, 5, 6, 7, 8, 9, 10, 11,	1, 2, 3, 10,	1, 3, 10,	
2	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11,	2,	2,	
3	1, 3, 4, 5, 6, 7, 8, 9, 10, 11,	1, 2, 3, 10,	1, 3, 10,	
4	4, 5, 6, 7, 8, 9, 11,	1, 2, 3, 4, 10,	4,	
5	5, 6, 7, 8, 9, 11,	1, 2, 3, 4, 5, 7, 8, 10,	5, 7, 8,	
6	6, 9, 11,	1, 2, 3, 4, 5, 6, 7, 8, 10, 11,	6, 11,	
7	5, 6, 7, 8, 9, 11,	1, 2, 3, 4, 5, 7, 8, 10,	5, 7, 8,	
8	5, 6, 7, 8, 9, 11,	1, 2, 3, 4, 5, 7, 8, 10,	5, 7, 8,	
9	9,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11,	9,	1
10	1, 3, 4, 5, 6, 7, 8, 9, 10, 11,	1, 2, 3, 10,	1, 3, 10,	
11	6, 9, 11,	1, 2, 3, 4, 5, 6, 7, 8, 10, 11,	6, 11,	

After the initial level of partitioning, the subsequent levels, second, third, fourth, fifth, and sixth, were completed, with results provided in **Tables 5** to **Table 9**.

The final partitioning results at the last level are presented in **Table 10**. The resulting hierarchical model of the analysis is shown in **Figure 3**, created using the final level partitioning results detailed in **Table 10**.

Table 5. 2nd Level partitioning iterations.

Elements	Reachability set	Antecedent set	Intersection set	Level
1	1, 3, 4, 5, 6, 7, 8, 10, 11,	1, 2, 3, 10,	1, 3, 10,	
2	1, 2, 3, 4, 5, 6, 7, 8, 10, 11,	2,	2,	
3	1, 3, 4, 5, 6, 7, 8, 10, 11,	1, 2, 3, 10,	1, 3, 10,	
4	4, 5, 6, 7, 8, 11,	1, 2, 3, 4, 10,	4,	
5	5, 6, 7, 8, 11,	1, 2, 3, 4, 5, 7, 8, 10,	5, 7, 8,	
6	6, 11,	1, 2, 3, 4, 5, 6, 7, 8, 10, 11,	6, 11,	2
7	5, 6, 7, 8, 11,	1, 2, 3, 4, 5, 7, 8, 10,	5, 7, 8,	
8	5, 6, 7, 8, 11,	1, 2, 3, 4, 5, 7, 8, 10,	5, 7, 8,	
9		1, 2, 3, 4, 5, 6, 7, 8, 10, 11,		1
10	1, 3, 4, 5, 6, 7, 8, 10, 11,	1, 2, 3, 10,	1, 3, 10,	
11	6, 11,	1, 2, 3, 4, 5, 6, 7, 8, 10, 11,	6, 11,	2

Table 6. 3rd Level partitioning iterations.

Elements	Reachability set	Antecedent set	Intersection set	Level
1	1, 3, 4, 5, 7, 8, 10,	1, 2, 3, 10,	1, 3, 10,	
2	1, 2, 3, 4, 5, 7, 8, 10,	2,	2,	
3	1, 3, 4, 5, 7, 8, 10,	1, 2, 3, 10,	1, 3, 10,	
4	4, 5, 7, 8,	1, 2, 3, 4, 10,	4,	
5	5, 7, 8,	1, 2, 3, 4, 5, 7, 8, 10,	5, 7, 8,	3
6		1, 2, 3, 4, 5, 7, 8, 10,		2
7	5, 7, 8,	1, 2, 3, 4, 5, 7, 8, 10,	5, 7, 8,	3
8	5, 7, 8,	1, 2, 3, 4, 5, 7, 8, 10,	5, 7, 8,	3
9		1, 2, 3, 4, 5, 7, 8, 10,		1
10	1, 3, 4, 5, 7, 8, 10,	1, 2, 3, 10,	1, 3, 10,	
11		1, 2, 3, 4, 5, 7, 8, 10,		2

Table 7. 4th Level partitioning iterations.

Elements	Reachability set	Antecedent set	Intersection set	Level
1	1, 3, 4, 10,	1, 2, 3, 10,	1, 3, 10,	
2	1, 2, 3, 4, 10,	2,	2,	
3	1, 3, 4, 10,	1, 2, 3, 10,	1, 3, 10,	
4	4,	1, 2, 3, 4, 10,	4,	4
5		1, 2, 3, 4, 10,		3
6		1, 2, 3, 4, 10,		2
7		1, 2, 3, 4, 10,		3
8		1, 2, 3, 4, 10,		3
9		1, 2, 3, 4, 10,		1
10	1, 3, 4, 10,	1, 2, 3, 10,	1, 3, 10,	
11		1, 2, 3, 4, 10,		2

Table 8. 5th Level partitioning iterations.

Elements	Reachability set	Antecedent set	Intersection set	Level
1	1, 3, 10,	1, 2, 3, 10,	1, 3, 10,	5
2	1, 2, 3, 10,	2,	2,	
3	1, 3, 10,	1, 2, 3, 10,	1, 3, 10,	5
4		1, 2, 3, 10,		4
5		1, 2, 3, 10,		3
6		1, 2, 3, 10,		2
7		1, 2, 3, 10,		3
8		1, 2, 3, 10,		3
9		1, 2, 3, 10,		1
10	1, 3, 10,	1, 2, 3, 10,	1, 3, 10,	5
11		1, 2, 3, 10,		2

Table 9. 6th Level partitioning iterations.

Elements	Reachability set	Antecedent set	Intersection set	Level
1		2,		5
2	2,	2,	2,	6
3		2,		5
4		2,		4
5		2,		3
6		2,		2
7		2,		3
8		2,		3
9		2,		1
10		2,		5
11		2,		2

Table 10. Level partitioning (LP).

Elements	Reachability set	Antecedent set	Intersection set	Level
1	1, 3, 10,	1, 2, 3, 10,	1, 3, 10,	5
2	2,	2,	2,	6
3	1, 3, 10,	1, 2, 3, 10,	1, 3, 10,	5
4	4,	1, 2, 3, 4, 10,	4,	4
5	5, 7, 8,	1, 2, 3, 4, 5, 7, 8, 10,	5, 7, 8,	3
6	6, 11,	1, 2, 3, 4, 5, 6, 7, 8, 10, 11,	6, 11,	2
7	5, 7, 8,	1, 2, 3, 4, 5, 7, 8, 10,	5, 7, 8,	3
8	5, 7, 8,	1, 2, 3, 4, 5, 7, 8, 10,	5, 7, 8,	3
9	9,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11,	9,	1
10	1, 3, 10,	1, 2, 3, 10,	1, 3, 10,	5
11	6, 11,	1, 2, 3, 4, 5, 6, 7, 8, 10, 11,	6, 11,	2

The results of the level partitioning analysis indicate that the visibility of handicraft products is the Level 1 strategy with the highest dependence power. Lean management practices and supplier network strategies fall into Level 2. Level 3 strategies include training opportunities, the online presence of handicraft products, and their marketing. Contingency planning is identified as the Level 4 strategy. Supply chain logistics, environmental practices, and social innovation are categorized as Level 5 strategies. Finally, awareness of government policies is recognized as the Level 6 strategy with the highest driving power. The analysis shows that awareness of government policies has the highest driving power but the lowest dependence power, while the visibility of handicraft products has the highest dependence power but the lowest driving power. Awareness of government policies impacts supply chain logistics, environmental practices, and social innovation. The MICMAC analysis reveals that supply chain logistics, awareness of government policies, environmental practices, contingency planning, and social innovation are independent variables (**Figure 4**). In contrast, training opportunities, online presence, and marketing are dependent variables. Lean management, supplier networks, and handicraft product visibility are linking variables. The independent variables, such as supply chain logistics, awareness of government policies, environmental practices, contingency planning, and social innovation, have higher driving power and the dependent variables, such as training opportunities, online presence, and marketing, have lower driving and higher dependence power. The Independent variables drive the dependent variables, and the linkage variables explain the relations between independent and dependent variables.

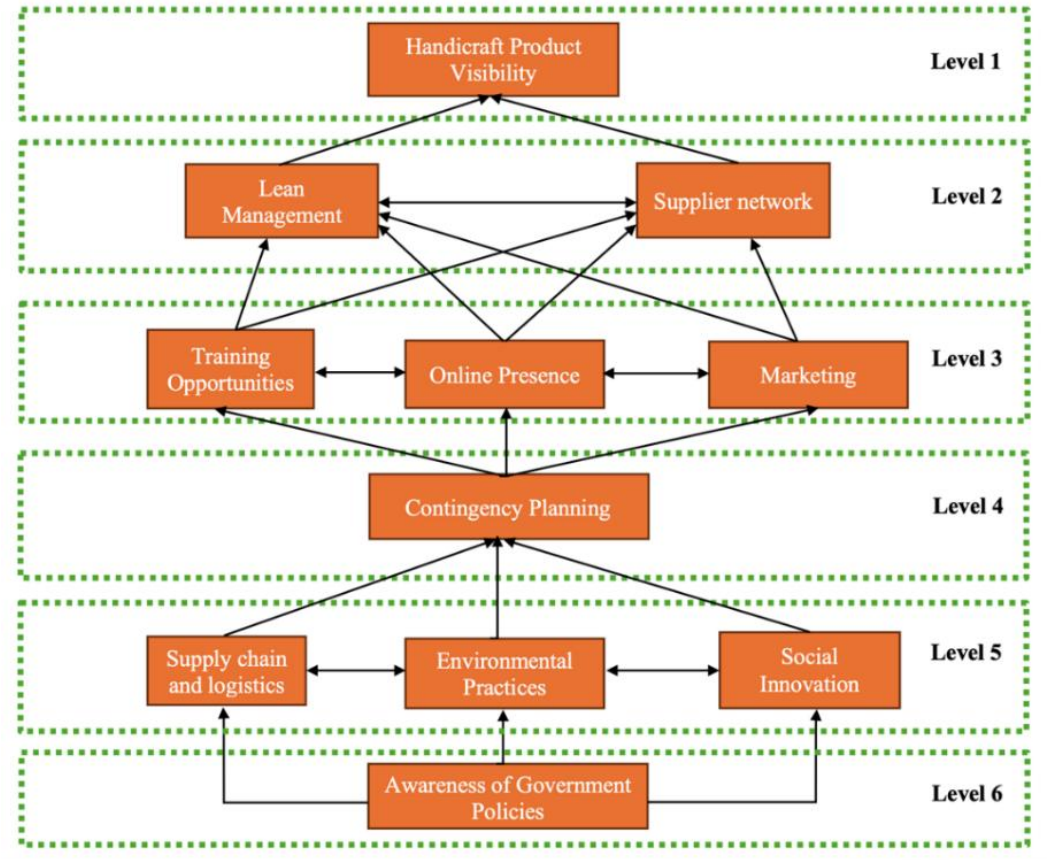

Figure 3. ISM Relationship model.

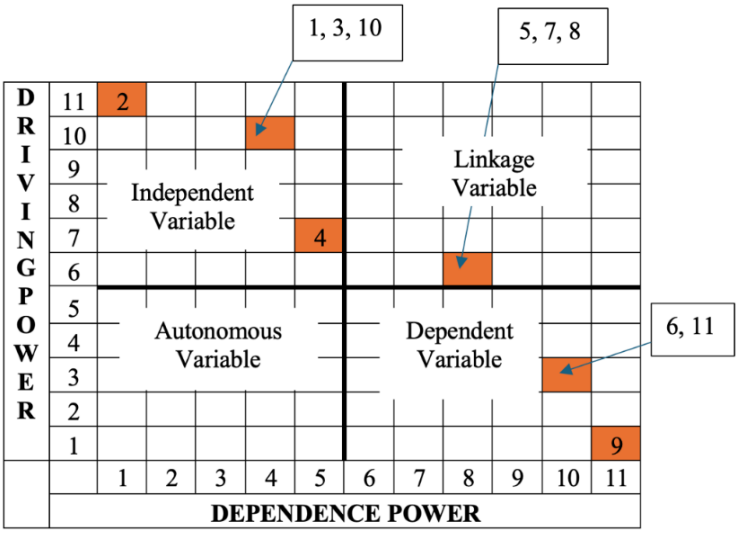

Figure 4. MICMAC Analysis.

4. Discussion

The analysis indicates that awareness of government policies is a crucial driving factor that significantly influences the growth of the handicraft industry in Ladakh. When weavers, artisans, and business owners are informed about these policies, it can motivate them to take advantage of available schemes and implement best practices within the industry. This increased awareness can also facilitate skill development and training initiatives, ultimately contributing to the overall advancement of the handicraft sector.

Understanding government policies is crucial for fostering effective supply chain and logistics management in the handicraft industry. Such awareness enhances operational efficiency, promotes environmentally sustainable practices, and drives social innovation. Enhancing the efficiency of the handicraft supply chain and logistics systems can yield substantial benefits for the industry. This improvement not only generates returns for individual stakeholders but also fosters holistic growth across the entire sector. The integration of eco-friendly practices is especially important. Utilizing organic materials, biodegradable components, plastic-free alternatives, and natural dyes and finishes can markedly improve the appeal and acceptance of handicraft products among consumers. Emphasizing sustainable harvesting techniques and sourcing natural fibre-based materials further contributes to this cause, ensuring that the production processes are environmentally responsible and resonate with the values of a growing consumer base that prioritizes sustainability. Moreover, adopting a social innovation strategy can be transformative for artisans and weavers. Such an approach fosters collaboration and resilience within the handicraft supply chain, ensuring that it remains robust and adaptable to changing market conditions. By enabling these innovative artisans, the sector can establish a more robust and sustainable handicraft ecosystem that is positioned for both economic viability and social advancement.

The intricate web of supply chain management, coupled with effective logistics, sustainable environmental practices, and a forward-thinking approach to social innovation, can significantly empower the handicraft industry. By integrating these elements, the industry can cultivate robust and flexible contingency plans that are essential for navigating the uncertainties posed by extreme weather conditions. This comprehensive strategy ensures seamless operations and enhances the sector's overall resilience and adaptability, allowing artisans and businesses to thrive even in challenging circumstances.

For the long-term growth of the handicraft industry, it is essential to establish comprehensive training opportunities tailored for weavers and artisans. Such training enhances individual skills and boosts overall productivity, ensuring that traditional craftsmanship is preserved while embracing modern technologies. Moreover, developing a robust online presence for handicraft products opens doors to a global marketplace, significantly increasing sales potential. This digital approach creates opportunities for reaching new customer segments, allowing artisans to engage directly with consumers. Artisans can eliminate intermediaries, streamline transactions, and facilitate secure digital payments by showcasing their unique craftsmanship online. In addition to these strategies, implementing effective marketing approaches is crucial. These strategies can dramatically improve product visibility, broaden market horizons, and emphasize the rich cultural narratives behind the crafts.

Adopting lean management practices in the handicraft industry is crucial for minimizing waste, enhancing cleanliness, improving inventory management, boosting quality, reducing defects, and optimizing resource use. Additionally, there is a need for supplier network development and management in the Ladakh handicraft industry for the consistent material supply from the remote locations of Lah and Ladakh to the production facilities, saving cost, streamlining operations and enhancing collaborations. The collective approach, which includes strategies like training, online presence, collaboration, and effective marketing, can significantly enhance product visibility. Growth strategies are classified into four categories: dependent, independent, linkage, and autonomous. Supply chain and logistics, awareness of government policies, environmental practices, contingency planning, and social innovation are grouped together as the independent variable, leading to adopting lean management practices, improved visibility of handicraft products, and better supplier network development. Strategies such as training opportunities, online presence, and effective marketing approach can be the linkage strategies between independent and dependent strategies.

5. Implication

This research is crucial for all stakeholders in the handicraft industry in Ladakh, including government agencies, weavers, artisans, business owners, and researchers. This study's key theoretical and practical implications are outlined in the following subsections.

5.1 Theoretical Implication

The study indicates that awareness of government policies is crucial for the sustainable growth of the handicraft industry in Ladakh. This awareness can significantly impact skill development, supply chain management, and adopting sustainable practices within the industry. Effective management of the handicraft supply chain is vital for enhancing operational efficiency and productivity in handicraft production. Adopting sustainable practices within the handicraft industry can significantly meet consumer demand for eco-friendly products. The analysis shows that social innovation, including community-based collaborations and partnerships, is crucial for developing contingency plans to address extreme weather conditions. The study's findings contribute to the theoretical framework by outlining three categories of proposed success strategies: dependent, linkage, and independent.

5.2 Managerial Implication

The multi-dimensional decisions, including operational and strategic decisions, are proposed for sustainable growth of the handicraft industry. Decision-makers in the handicrafts sector can enhance the skills of weavers and artisans in Ladakh by utilizing their understanding of government policies. They should also prioritize the use of organic materials in the production of handicraft products. Furthermore, business owners should specifically focus on implementing lean management practices within micro, small, and medium-sized handicraft units in Ladakh. The disruptions in the handicraft supply chain during extreme

weather conditions can be minimized by adopting robust, strong supplier networks and efficient contingency planning. The customized skill development program and related modules can improve productivity, enhance handicraft design and quality, and reduce defects. In order to improve the visibility of handicraft products in Ladakh, the decision-makers should focus on online presence and effective marketing strategies.

6. Conclusion

The study explored the antecedents of sustainable growth of the handicraft industry in Ladakh. The primary goal of this research was to identify and set the structural model for the success strategies for the sustainable growth of the handicraft industry in Ladakh. This paper used literature review, expert opinion, field visits-based interview data, and content analysis findings to identify the key success strategies. The research aimed to investigate the inter-relationship among the proposed success strategies using ISM model. The study sought to provide insights into the classification of supply chain and socioeconomic-based proposed strategies using the MICMAC analysis.

The study's findings indicate that the awareness of government policies among key stakeholders in the handicraft industry in Ladakh represents the strategy with the highest driving power, classified as a sixth-level strategy. In contrast, the visibility of handicraft products is identified as the strategy with the highest dependency power, categorized as a first-level strategy. The findings of the study indicate that supply chain logistics, environmental practices within the handicraft industry, and social innovation function as fifth-level strategies. These factors can encourage decision-makers to formulate contingency plans for extreme weather conditions. The study also found that providing training opportunities for weavers and artisans, enhancing the online presence of handicraft products, and developing a marketing strategy serve as linking variables between the independent variables (supply chain logistics, awareness of government policies, environmental practices, and social innovation) and the dependent variables (lean management, handicraft product visibility, and supplier networks). This research yields a structured framework of effective strategies for the sustainable growth of the handicraft industry. It also highlights the interrelationships among these strategies, which can serve as a valuable resource for policymakers focused on developing the industry.

These findings contribute to ongoing discussions on the sustainable growth of the handicraft industry, especially in regions that are highly affected by extreme weather conditions. This study advances the understanding of the inter-relationship between supply chain and socio-economic dimensions-based success strategies. The implications of this research include the need for a strong focus on awareness of key developmental policies by the central Government of India among the stakeholders of the handicraft industry. This research indicates that skill development programs can enhance the quality of handicraft products, increase productivity, and reduce waste. This research provides a structural framework for policymakers, which can add value to the strategic decision-making process.

This study provides valuable insights through exploratory analysis, but it has some limitations. One key limitation is the absence of empirical evidence demonstrating the interrelationships among the proposed success strategies. Future research is necessary to statistically validate the relationships among the growth factors' antecedents from various stakeholder perspectives. In conclusion, this study highlights the key success strategies for the sustainable growth of the handicraft industry located in the extreme weather region. To summarize, this research underscores the significance of supply chain management and socio-economic factors in the handicraft industry.

Overall, the findings point to focus on the need for awareness of government policies such as NHDP, AHVY, CHCDS, ODOP, and so forth. This study paves the way for the sustainable growth of handicraft industry in Ladakh. The results of this study align with the central Government of India's policies aimed at the holistic development of Ladakh. This research provides a valuable contribution to current practices in the handicraft industry by proposing a multifactor approach for strategic planning by policymakers.

Conflict of Interest
The authors share no conflict of interest.

AI Disclosure
The author(s) declare that no assistance is taken from generative AI to write this article.

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Appendix

List of questions asked to artisans, weavers, and business owners:

(i) How can artists better adapt to shifting consumer preferences and market demands with the help of predictive analysis?
(ii) What environmental issues does the handicraft industry in Ladakh currently face?
(iii) How can a more environmentally friendly industry be created by balancing modern sustainability methods with traditional talent?
(iv) What are the possibilities for applying waste management to handicraft production?
(v) What part can eco-labelling or certification schemes play in encouraging sustainability in the handicraft sector?
(vi) How can traditional practices and traditional knowledge be incorporated into modern economic theories to support regional artisans?
(vii) What potential effects can implement new models have on regional community development and policy initiatives?
(viii) What obstacles or difficulties can arise when applying innovation frameworks into practice, and how might they be overcome?
(ix) What issues arise for the industry and artisans throughout the whole process of producing and marketing handicrafts?
(x) What are the best ways to get government agencies and IT specialists to participate and engage actively?
(xi) How can cooperative ecosystems support industrial knowledge sharing, talent development, and resource access?
(xii) What measures may be applied to assess the influence of joint projects on the sustainability and economic expansion of the handicraft sector in Ladakh?
(xiii) Which government policies do you avail to produce handicrafts? Explain.
(xiv) What are the problems artisans face in availing of government schemes related to handicrafts?
(xv) In which way do artisans contribute to social innovation through their work?
(xvi) Is there any specific program run by the government to empower women/ or especially for women?
(xvii) Do the government provide handicraft training to artisans for skill development and new design inventions?

(xviii) Do you (artisans) register Under the Special Central Assistance to Tribal Sub Plan (SCA To TSP) Scheme?
(xix) Are there any kind of handicraft exhibitions organised by the government for artisans?
(xx) Do you participate is handicraft exhibitions? What are the benefits you get from such exhibitions?

References

Agarwal, V., Mathiyazhagan, K., Malhotra, S., & Pimpunchat, B. (2023). Building resilience for sustainability of MSMEs post COVID-19 outbreak: an Indian handicraft industry outlook. *Socio-Economic Planning Sciences, 85*, 101443. https://doi.org/10.1016/j.seps.2022.101443.

Apparel Views (2025). *Union budget 25-26 to boost textile and apparel industry*. https://www.apparelviews.com/union-budget-25-26-to-boost-textile-and-apparel-industry.

Bansal, N. (2024). One district one product (ODOP). *KPMG*. https://kpmg.com/in/en/blogs/2024/06/one-district-one-product-odop.html.

Choudhary, A., & Mishra, P. (2022). Indian handicrafts: a sustainable future of utilitarian comsumer goods. *Ushus-Journal of Business Management*, *21*(3), 1-23. https://doi.org/10.12725/ujbm.60.1.

Chouiraf, F., & Chafi, A. (2018). Lean manufacturing for handicraft production: a new production system to enhance productivity and competitiveness of craft enterprise. In *2018 4th International Conference on Optimization and Applications* (pp. 1-6). Mohammedia, Morocco. https://doi.org/10.1109/icoa.2018.8370562.

Ciftci, H.G., & Walker, S. (2017). Design for grassroots production in eastern Turkey through the revival of traditional handicrafts. *The Design Journal*, *20*(sup1), S2991-S3004. https://doi.org/10.1080/14606925.2017.1352808.

Darokhan, M.D. (1997). Handicraft development in Ladakh. in recent research on Ladakh 6. *In Proceedings of the Sixth International Colloquium on Ladakh, Leh 1993* (pp. 67-82). Motilal Banarsidass Publishing House. India.

Datey, A., Bali, B., Bhatia, N., Khamrang, L., & Kim, S.M. (2023). A gendered lens for building climate resilience: narratives from women in informal work in Leh, Ladakh. *Gender, Work & Organization, 30*(1), 158-176. https://doi.org/10.1111/gwao.12667.

Development Commissioner Handicrafts (2022). National handicrafts development programme (NHDP) and comprehensive handicrafts cluster development scheme (CHCDS) (2022-23 to 2025-26). *Ministry of Textiles*. https://handicrafts.nic.in/cmsupload/26412023074138nhdp_guidlines.pdf.

Development Commissioner Handicrafts (2025). Home | Official website of Development Commissioner (Handicrafts), Ministry of Textiles, Government of India. https://handicrafts.nic.in.

Digital India (2015). *Digital India*: *Power to Empower*. https://www.digitalindia.gov.in/about-us/.

EPCH (2025). *Export Promotion Council for Handicrafts (EPCH)*. Retrieved from https://www.epch.in.

Ghosh, C., Saha, A.R., & Dolma, K. (2020). Life in Ladakh (India): the Changpas of Changthang. *International Research Journal of Social Science, 9*(2), 57-63.

Khan, W.H., Jamal, A., & Shah, A.H. (2018). Achievements of khadi and village industries board J&K: a study of prime ministers employment generation programme. *South-Asian Journal of Multidisciplinary Studies, 4*(6), 36-43.

Kumalasari, G.W. (2019). Local government policy model of Indonesia rattan handicraft creative industry in Trangsan village. *Humanities & Social Sciences Reviews, 7*(3), 87-91. https://doi.org/10.18510/hssr.2019.7313.

Majeed, I. (2018). Carpet handicraft industry in Kashmir: an overview. *International Journal of Research and Analytical Reviews, 5*(4), 976-989. https://www.ijrar.org/papers/ijrar1944343.pdf.

Majeed, I., Bhat, A.H., & Azam, R. (2023). The role of government in promoting handicraft industry: a case study of Kashmir. *ShodhKosh: Journal of Visual and Performing Arts*, *4*(1), 429-442. https://doi.org/10.29121/shodhkosh.v4.i1.2023.356.

Ministry of Textiles (2024). Technology upgradation fund scheme. *Ministry of Textiles, Government of India*. https://texmin.nic.in/schemes.

Nath, A. (2024). Sustainable collective looms of Ladakh celebrates a staggering diversity of local architecture. Architectural Digest India. https://www.architecturaldigest.in/story/sustainable-collective-looms-of-ladakh-celebrates-a-staggering-diversity-of-local-architecture-abhilasha-bahuguna/.

Panghal, A., Sindhu, S., Dahiya, S., Dahiya, B., & Mor, R.S. (2022). Benchmarking the interactions among challenges for blockchain technology adoption: a circular economy perspective. *International Journal of Mathematical, Engineering and Management Sciences, 7*(6), 859-872. https://doi.org/10.33889/ijmems.2022.7.6.054.

Pant, S.C., & Pandey, M. (2015). Supply chain challenges: a case study of Uttarakhand woolen handicrafts industry. *International Journal of Management, IT and Engineering, 5*(6), 140-155.

Prasad, S., Rao, A.N., & Lanka, K. (2022). Analysing the barriers for implementation of lean-led sustainable manufacturing and potential of blockchain technology to overcome these barriers: a conceptual framework. *International Journal of Mathematical, Engineering and Management Sciences*, *7*(6), 791-819. https://doi.org/10.33889/ijmems.2022.7.6.051.

Press Information Bureau (2024). Boosting domestic manufacturing: ATUFS allocations in the Union Budget 2025-26. Retrieved from https://pib.gov.in/pressreleasepage.aspx?prid=2099411.

Reach Ladakh Bulletin (2024). Ladakh's Pashmina wool receives GI Tag: union minister presents certificate to Lt Governor. *Reach Ladakh Bulletin*. https://www.reachladakh.com/news/social-news/ladakh-s-pashmina-wool-receives-gi-tag-union-minister-presents-certificate-to-lt-governor.

Shah, M.R. (2016). An assessment of handicraft sector of J&K with reference to central Kashmir. *Arabian Journal of Business and Management Review*, *6*(5), 1-6. https://doi.org/10.4172/2223-5833.1000258.

Singh, S. (2024). *A decade of reforms: the evolution of education and skill development*. India Foundation. https://indiafoundation.in/articles-and-commentaries/a-decade-of-reforms-the-evolution-of-education-and-skill-development/.

Sweta, R.R., & Sundararaman, B. (2021). A case study on sustainable business of Indian art and craft industry. In *Proceedings of the First International Conference on Combinatorial and Optimization,* Chennai, India. EAI. http://dx.doi.org/10.4108/eai.7-12-2021.2314520.

Tran, T.H.U., Lau, K.H., & Ong, C.E. (2021). Adoption of social sustainability practices in an emerging economy: insights from Vietnamese handicraft organizations. *Sustainable Production and Consumption, 28*, 1204-1215. https://doi.org/10.1016/j.spc.2021.07.034.

Warfield, J.N. (1974). Developing interconnection matrices in structural modeling. *IEEE Transactions on Systems, Man, and Cybernetics, SMC-4*(1), 81-87. https://doi.org/10.1109/tsmc.1974.5408524.

Yadav, U.S., Tripathi, R., Yadav, G.P., & Tripathi, M.A. (2022). Proposal of a global handicraft index for sustainable development: a visionary approach for small industry and developing strategies for handicraft (rural industry). *European Journal of Sustainable Development Research, 6*(2), 1-9. https://doi.org/10.21601/ejosdr/11909.