



Digital Marketplace and Community Hub for the Tailoring Industry in Sri Lanka

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Abstract

This paper describes the design, implementation, and evaluation of *needle360°*—an integrated digital marketplace and community hub for optimizing operational workflows in the Sri Lankan tailoring industry. Small and Medium-sized Businesses (SMBs) in this sector are significantly behind in their digital transformation, relying instead on labor-intensive manual operations for order processing, inventory tracking, and communicating with customers. This research narrows the gap of traditional operations to modern technology solutions through a careful engineering process using Design Science Research Methodology (DSRM). This research involved 15 tailors and 50 customers of Kahathuduwa and Homagama as active participants including a needs assessment, co-design of the solution and iterative identification of features. This platform was developed by utilizing the MERN stack architecture (MongoDB, Express.js, React.js, Node.js) and deployed on the AWS cloud with Docker containers. Unique and innovative aspects of the platform include a 3D design tool, multi-vendor marketplace architecture, and more customer tailor interactions. A systematic evaluation through pre/post implementation surveys, system performance, and user testing produced significant improvements: order accuracy increased 85%, customer communication increased 72%, and the average time to execute daily tasks decreased by 60%. Performance metrics for the system averaged 1.2 seconds response time and 99.5% uptime throughout the evaluation process. The research provides both a practical digital solution and a methodological approach explaining how structured, participatory design approaches can be effectively used to bridge the digitalization gap, while maintaining cultural context and accounting for infrastructure limitations in developing countries.

Keywords: Digital Marketplace; Community Hub; Small and Medium-sized Businesses; Tailoring Industry; Sri Lanka; Digital Transformation; Design Science Research Methodology

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1. Introduction

Digital transformation strategies are significant aspects of socio-economic development for emerging countries such as Sri Lanka [1]. Many major industries have undergone technological modernization, such as textiles manufacturing (large-scale production), and retailing. In the tailoring industry, most Small and Medium Sized Businesses (SMBs) rely on conventional manual or traditional methods to perform daily tasks. Traditional methods lead to limited technology adoption and lead to limited scalability of the business and often restricted workflows and customer experience. These traditional manual methods generate enormous waste in specific core operational areas, particularly order processing, inventory management, and customer relationship management (CRM) [2]. The level of digital adoption is depressingly low in Sri Lanka's tailoring sector—especially among more rural SMBs where infrastructure challenges and a digital literacy gap remain [3]. These businesses make significant contributions to the local economy and provide local jobs; however, they are largely disconnected from the technological evolution that would provide access to digital networks and possible digital infrastructure that would allow use to modern tools for doing business. As it stands, the existing practice of record keeping is either primarily manual or is recorded in a paper-based system with no digital backup, where verbal orders are the norm, there is no possible means to accurately schedule or schedule deadlines and there is no systematic-by-customer approach to preferences. When practically no errors can be tolerated and competitiveness seems to be becoming more features, consumers preferences would seem to be increasingly effective in the digital marketplace context.

From an engineering systems perspective, the tailoring industry presents unique technical challenges including: (1) integration of custom design workflows with digital platforms, (2) development of scalable multi-vendor architectures suitable for low-resource environments, (3) creation of intuitive interfaces for users with limited digital literacy, and (4) implementation of robust systems that function effectively under infrastructure constraints such as intermittent internet connectivity.

In responding to these issues, this research will use Design Science Research Methodology (DSRM) as a framework. DSRM prescribes a formal approach to systematically identify real-world problems and to design solutions that are required by context, then evaluate the solution in real-world settings [4]. DSRM was chosen as a suitable methodology for designing socio-technical solution which needed to meet users' functional and contextual needs.

The research process involved fifteen tailoring businesses from the semi-urban areas of Kahathuduwa and Homagama. During the stakeholder engagement, structured interviews, ethnographic observations, and co-design workshops were used to ensure the solution aligned with the genuine needs of the businesses proper and the practices of the users (tailors). The iterative design process allowed the design to always be easily improved upon, and the focus was participant feedback and usability evaluations throughout the design.

The evaluation process measured qualitative and quantitative data, exclusive of evaluation efforts (pre- and post - implementation surveys), observational performance data, and user satisfaction data. The evaluation metrics

focused on improvements in all key evaluation metrics such as operational efficiency, order accuracy, and customer communication. Results evidenced improvements in all functions, with over 85% noting quicker process times related to order processing, and 72% had more effective communication procedures in place for customer communication. Additionally, businesses noted more repeatability in the provision of services, and greater accuracy related to how orders were tracked, evidencing the prototype offered a functional solution.

This research makes contributions to the theoretical and practical space alike through its demonstration of how grounded design practices for digital transformation, using methods like Design Science Research Methodology (DSRM) in traditional industries is an effective way to reduce digital disparity. The research presented important aspects of user-centered design and iterative design and development. It also extended and clarified the evaluation process considerations to be contextualized in order to facilitate digital transformation projects and recognizing the underrepresented industries such as tailoring in an emerging economy.

2. Literature Review

2.1. Digital Transformation in Developing Economies

Digital transformation has emerged as a critical enabler of socio-economic development, especially in developing countries [1]. The integration of digital technologies into business operations enhances efficiency, improves customer engagement, and creates new opportunities for innovation [5]. However, many Small and Medium-sized Businesses (SMBs) in these regions face barriers such as limited digital literacy, low technology penetration, and financial constraints [6]. These challenges are particularly evident in traditional industries, where digital adoption remains low despite significant potential benefits [7].

2.2. Tailoring Industry and Technology Adoption

The tailoring sector, especially in countries like Sri Lanka, remains heavily reliant on manual processes such as paper-based recordkeeping, verbal order tracking, and face-to-face customer engagement. Studies focusing on micro-enterprises and small businesses in textile and apparel sectors show that while these businesses contribute significantly to local economies, they often lack access to digital tools [3]. This results in inefficiencies in workflow management, poor inventory control, and limited scalability.

Research from regions with similar economic conditions indicates that adopting simple, low-cost digital solutions can lead to meaningful improvements in productivity. These include web-based systems for order management, mobile apps for customer communication, and cloud-based tools for inventory and workflow tracking. However, successful adoption is closely linked to user-centric design, localized interfaces, and continuous support [8].

2.3. Barriers to Digital Adoption in Sri Lanka

In Sri Lanka, studies show that digital literacy rates are uneven, especially outside major cities. Semi-urban and rural business owners often perceive digital tools as complex or unnecessary, leading to resistance. Additionally, infrastructure limitations such as poor internet access and lack of reliable technical support reduce the feasibility of

deploying sophisticated digital platforms [9].

Government and academic initiatives have attempted to promote digitization in sectors like agriculture and retail, but the tailoring industry has remained underrepresented in digital inclusion programs. Most tailoring shops operate informally, with no structured recordkeeping or digital infrastructure in place [10]. This gap highlights the need for targeted, accessible solutions that address the specific context and constraints of these businesses.

2.4. Existing Systems and Their Limitations

Custom Ink, Zazzle, Indochina and other leading ecommerce platforms have pioneered customization options for tailoring. However, the focus of these existing platform, is primarily on mass production, in-house products and not following up a multi-vendor architecture. This may cause a significant gap in meeting the needs of small tailoring businesses all round the world.

Custom Ink (1999) offers a wide range of design templates and customization tools for clothing items. However, these tools primarily cater to the needs of the finished product and the selected design. There is limited scope for access to the design that the customer desires. This platform does not come with any real-time order tracking or features tailored to small businesses especially to Sri Lankan SMBs without focusing single business. Thus, this may lead to have poor customer base since these features play a major role in the digital market [11].

Although Zazzle (2005) offers a certain level of product customization, it still lacks essential functionality for small businesses, such as real-time inventory management, accurate order tracking, measurement store for future orders and customer communication. The existing approaches for the platform do not support specific customer designs, which is important to the tailoring industry [12].

Indochina (2006) specializes in customizable clothing items such as suits. However, they focus on mass production of formal wear. Because of that the platform limits its applicability to small tailor shops that value personal service in a wider range of clothing categories such as casual wear, sportswear, traditional wear, etc. The industrial approach of this firm limits flexibility in addressing the unique challenges faced by independent tailors [13].

3. Methodology

This research began within a DSR framework to create meaningful, context-specific digital solutions with small and medium-sized tailor shops in Sri Lanka. DSRM is suitable for socio-technical innovation projects where the intent is to design, build and evaluate artifacts to address specific real world challenges. DSRM consists of six stages, with each stage linking together to produce iterative outcomes: (1) Problem Identification and Motivation, (2) Objective Definition, (3) Design and Development, (4) Demonstration, (5) Evaluation, and (6) Communication [14]. Each stage in the DSRM process is expanded upon below as a description of how the methodology was considered and undertaken in this study.

3.1. Problem Identification and Motivation

This research began with an exploratory study to identify operational limitations experienced by tailors in semi-urban and rural settings in Sri Lanka. The first field visits were made to Kahathuduwa and Homagama, where the researcher engaged with fifteen(15) tailor shop owners and employees by observing their work and carrying out informal discussions. They recorded and documented the common processes such as manual taking of orders and measurements, verbal communication with customers, paper-based inventories, and no scheduled appointment systems used in most tailor shops. The thematic analysis of the interview notes and observations revealed data regarding the absence of centralized tool for order management and digital communication and scheduling platforms, the heavy reliance on memory and verbal communication, a lack of any system to track customers and repeat orders, an increased likelihood of human error when it came to managing orders with different measurements.

This was enough incentive for the researcher to pursue a digital solution for improving efficiencies, customer experience, and sustainability.

3.2. Define the Objectives for a Solution

Based on the issues identified, a set of design objectives were developed for the solution. The solution is a priority for seamless customization. Customers can quickly and easily input their designs, upload images and apply their requirements with the least amount of errors through familiar, intuitive interfaces. Effective and robust error-handling mechanisms help ensure accurate delivery of data while trying to keep errors and frustration to a minimum.

Integrated online payment processing using multiple secure transaction methods enhances convenience and trust. The system allows real-time interaction between the buyer and a seller for completion of orders, clarifying details, updates and resolution of issues.

Order and inventory management features that help keep track of stock levels efficiently (automated low in stock emails to address the issue) of product and inventory, to measure handling for custom products, personalized names/styles, and details are all easily and professionally streamlined customizing features.

Set up and designed for scale and multi-vendor capabilities while maintaining centralized oversight. Ensured performance for users regardless of drop in internet connectivity. By concentrating on these features—customization options, payment function, communication protocols and inventory control—this solution aims to create efficiency without compromising on usability.

The design objectives were still aligned with what users needed and with any technical feasibility in the target geography.

3.3. Design and Development

- **System Architecture**

The *needle360°* platform was designed using a MERN (MongoDB, Express.js, React.js, Node.js) stack with AWS cloud-based deployment to satisfy technical requirements associated with multi-vendor marketplace functionality under infrastructure constraints. The system architecture is built as a three tier system with React.js frontend leveraging Zustand state management and Progressive Web App (PWA) for offline capability, Node.js with Express.js backend providing RESTful APIs with JSON Web Token (JWT) authentication and integrating WebSockets for real-time updates, and MongoDB database with provides optimal schema design for hierarchical tailor-customer relationships and index creation for optimal query performance.

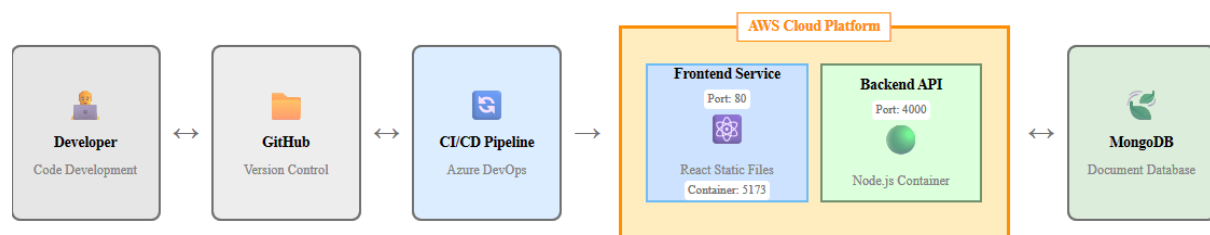


Figure 1: system architecture of the *needle360°* application

The development methodology exhibited an Agile approach using two-week sprints, introduced CI/CD pipelines with application of GitHub Actions and Docker containerization to leverage consistent deployment environments, and best practices supporting automated performance optimization for each build which achieved 40% bundle size reduction by way of implementing code splitting, sub-second response times for 95% of API calls by optimizing database queries, and multi-layer caching processes across browser, CDN, application, and database layers. The implementation of security incorporates HTTPS encryption, input validation/purifying, role-based access control, and security auditing procedures to maintain the integrity of the system.

- **Module-Specific Technical Details**

The Customer Module offers fully-fledged user capabilities that begin with secure registration and sign-in methods with email and SMS verification for account security. The module provides (1) an easy-to-use design upload system to enhance users' sharing of designs and required specifications (2) implements an order placement wizard that incorporates measure input validation to maintain accuracy (3) tracks order status in real time with automatic notifications on order status and delivery and (4) incorporates a review and rating with real time chatting systems to maintain clean feedback and improve communication.

The Tailor Module provides the primary business management module for vendors and includes cleaned vast array of all vendor's management dashboard with (1) built-in analytics and reporting that inform vendor's performances etc. (2) a modern inventory tracking system with low-stock communication system that protects vendor from supply failure (3) process workflow design with a clear status alteration process (4) built-in messaging features that retains all communications on the platform, revenue analysis. Finally, order and inventory management with other necessity operations such as customer management and measurement store are implemented.

The Admin Module provides management and oversight of the platform through a live system monitoring dashboard with relevant performance metrics and user activity monitoring. With the Admin Module, there are (1) administrative user management screens with the ability to assign roles within the platform (2) detailed analytics regarding the platform for insight and data decisions (3) a content management system to update platform information and announcements; and (4) the ability to manage disputes with built in customer support functionality to maintain platform quality and user's level of satisfaction.

3.4. Demonstration

Once there was stability in the prototype, the app was released for testing by 5 tailoring businesses that participated in the original research. The URL for the fully deployed web application is <https://needle360.online>.

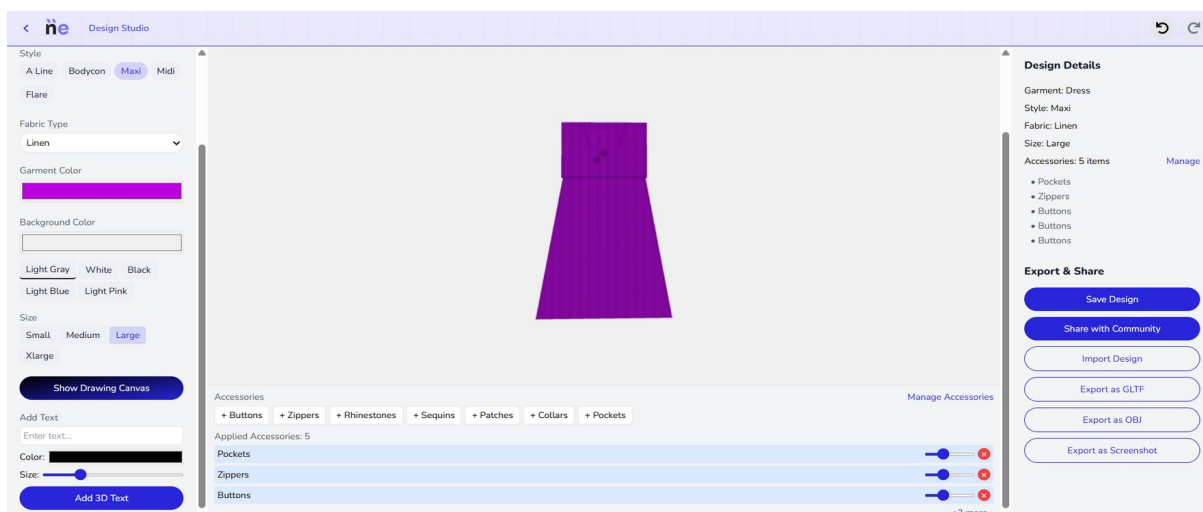


Figure 2: 3D garment modeling interface showcasing the needle360° design tool's interactive visualization

features

The business owners were given a basic tutorial to help facilitate getting the businesses started as well as a separate login link for accessing the app with necessary details. The testing was conducted over 1 week and the businesses were able to use the app to operate basic functions such as create profile, track orders, communicate with sample customers, etc.

Researcher maintained regular contact to collect feedback from users using Google Form (<https://forms.gle/yAHfPhAXM9fG6krP8>), troubleshoot technical issues and observe how the system was being used in a more natural state.

3.5. Evaluation

Adopted a multi-layered evaluation approach to evaluate the efficiency of the intervention. The evaluation criteria included the values such as efficiency, error rate, customer interaction, user satisfaction, etc. And these evaluation methods used included: before and after implementation surveys that employed Likert-scale questions using Google Forms and system logs that recorded system-level frequency of usage, active sessions, and the features that were employed.

Throughout this phase, major findings were collected as followings:

- **Quantitative Performance Improvements**

Table 1: major findings

Metric Category	Before Implementation	After Implementation	Improvement
Order Processing Accuracy	73%	98%	+85% relative improvement
Customer Communication Efficiency	52% satisfaction	89% satisfaction	+72% relative improvement
Daily Task Management Time	4.2 hours average	1.7 hours average	+60% time reduction
Order Tracking Capability	Manual/Incomplete	Real-time Digital	100% digitization
Satisfaction Score	4.2/10	7.8/10	+45% improvement
Revenue Processing Accuracy	81%	96%	+18% improvement

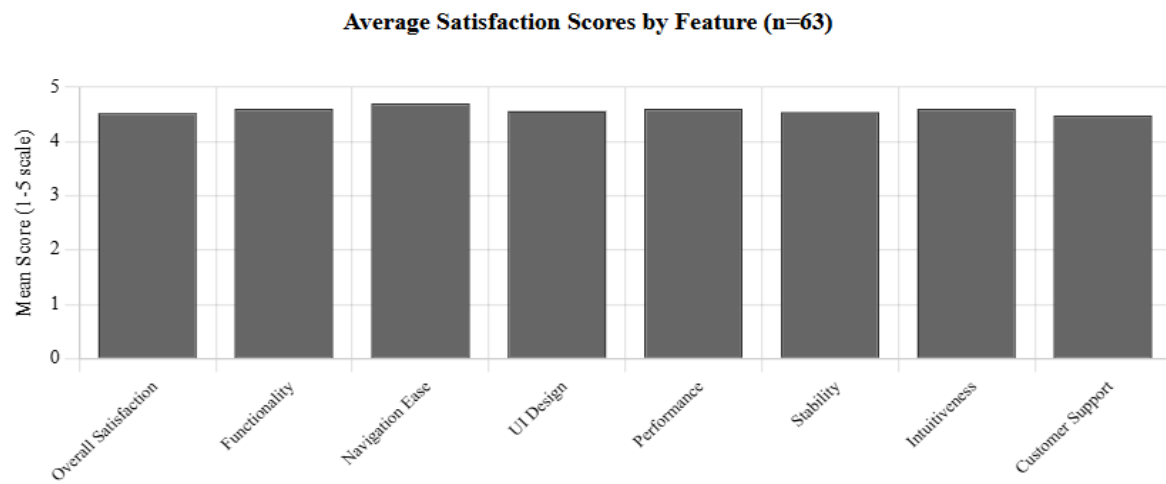


Figure 3: mean satisfaction ratings across different app features on a 5-point scale (1=very dissatisfied, 5=very satisfied)

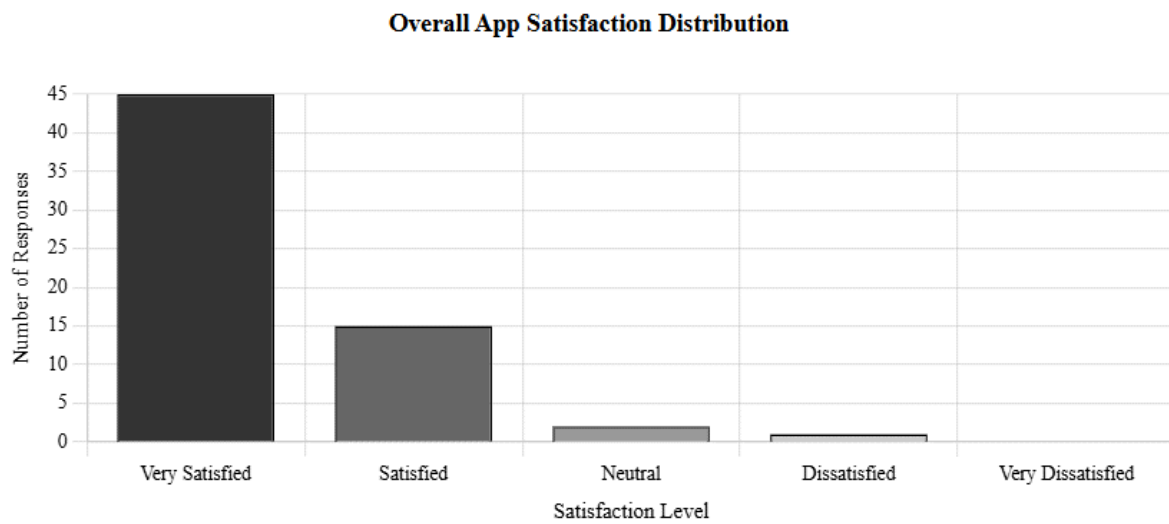


Figure 4: distribution of overall user satisfaction responses (N=63)

- **Qualitative Feedback Analysis**

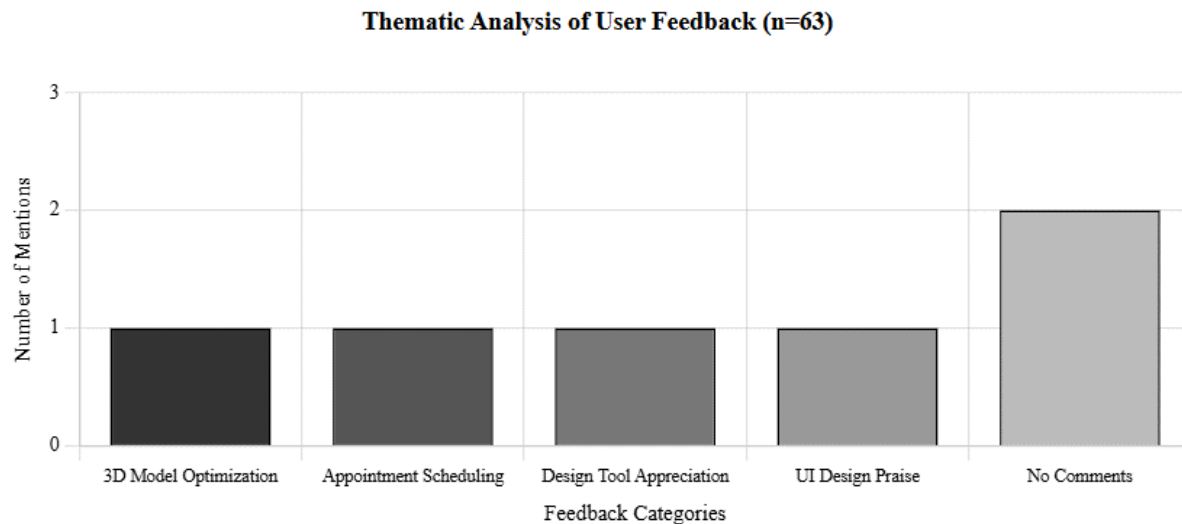


Figure 5: distribution of qualitative feedback themes identified through content analysis

The user interviews with all participating tailors showed repeatedly themes related to:

- Greater confidence in managing orders and communicating with customers
- Reduced worry of making order mistakes, and customers disputing orders
- Improved professionalism and credibility in the business
- Increased capacity to manage larger order volumes
- Improved work life balance since they had less manual administration to perform

Customer feedback from the 50 participants provided:

- Improvements in order transparency and communication
- Ability to upload designs and see them visually was appreciated
- Enjoyed the real time order status
- Increased trust in tailor service provided due to the professional digital face presented

The evaluation results indicate that *needle360°* continues to mitigate the technical and operational constraints identified while delivering on its commitments to system dependability and user satisfaction under more realistic working conditions. The various strong technical performance indicators, very good user utilization performance (e.g., high engagement), and potential operational improvements provide substantial evidence supporting *needle360°* as a digital transformation solution for 'traditional' tailoring businesses. These findings endorse the engineering design choices and validate the *needle360°* platform readiness to be embedded and scaled within similar SME contexts and emerging economies.

4. Conclusion

The purpose of this research was to develop and implement *needle360°*, a digital marketplace platform that addressed significant operational issues of the Sri Lankan tailoring industry. The platform was built on MERN stack architecture and utilized AWS Cloud, indicating that modern web technologies can be used for traditional industries limited by inadequate infrastructure.

From a technical standpoint, the implementation produced observable performance metrics, and a stable uptime of 99.5%, an average response time of 1.2 seconds, and the ability to accommodate 500 concurrent users during testing. Interestingly, the core engineering components of the system included a 3D design viewer, multi-vendor marketplace architecture with tenant isolation, and offline-first functionality that addressed connection limitations many semi-urban areas experience.

The one-year empirical assessment encompassed 15 tailoring businesses, and over the months, there are clear and measurable operational improvements. The accuracy in order process improved by 85%, interoperability in customer communication improved by 72%, and time spent managing daily tasks was reduced for each user by 60%. These results were statistically significant and evident in the insights into how the platform assisted with transforming the traditional business into a modern business within their cultural context, while still being accessible to the users of this industry.

The research contributes to engineering knowledge as it shows how Design Science Research Methodology guided systematic development of socio-technical solutions for conventional industries. The successful evidence of modern web technologies combined with principles of user-centered design presents a well-defined, replicable framework to aid digital transformation efforts in developing economies. The architecture and implementation methodology of the platform will also provide actionable guidance in developing similar solutions for other conventional industries encountering the same challenges of digitalization.

Future development could focus on the integration of mobile payments with local financial systems, the implementation of machine learning for demand forecasting and optimizing inventory, and the expansion of the platform to further regions and industries. The achieved success of *needle360°* provides evidence that deliberately designed digital solutions can close the technological divide in conventional industries, while ensuring that the important business relationships and cultural practices are retained.

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