Motivating Growth in Low-tech Manufacturing Industries: A Case Study of the Israeli Footwear Industry

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Intensive manual labor enterprises in the developed world face challenges competing with products imported from countries where manufacturing costs are low. This reduces the volume of domestic production and leads to rapid loss of knowledge and experience in production processes. This study focuses on the Israeli footwear industry as a case study. Qualitative methodologies were applied, including in-depth interviews and field observations. A literature review on previous research, and contemporary trends was conducted. The field research examines challenges along the value chain in small factories. It finds that mass production paradigms impose a decentralized process between designers and manufacturers and therefore do not leverage local potential into a sustainable competitive advantage for small factories. The proposed solution is a digital and technological platform for small manufacturing plants. The platform mediates and designs the connections between production, technology, and design and enables the creation of a joint R&D system.

Keywords: New Product Development Innovation, Design Management, Sustainable Development, Open Innovation, System Design

Introduction

Over my ten years as a designer, developer and teacher of footwear, I noticed that the local market was showing a growth in designers opening a local brand. On the other hand, the producers I was working with were not growing as a result and were struggling for survival.

looking at the problem through a wider lens, I realized that in fact many low-tech traditional industries in the mature economies are now facing a similar challenge. This challenge affects levels of low-skilled employment and deepens social gaps. It also causes a loss of opportunities for the development of new innovative knowledge, which relies on manufacturing 'know how' of producers who: "actively pursue strategies to maintain competitiveness and increase the value added of products and processes" (Hansen & Winther 2015)

Returning to my local case study of footwear in Israel, I began my research by asking, how might we sustain growth in local manufacturing industry? The research plan followed the value chain of footwear production: design, development, production and market.

Traditional production of footwear relies on manual labor and is considered a low-tech industry.

Changes in global and local market conditions have led to a reduction in local footwear manufacturing. In Israel today, there are only a handful of functioning industrial footwear factories. There are also a few dozen
micro-factories, reduced by market conditions to small-scale production, and an almost complete reliance on manual labor. These are on the cusp between factory and workshop. They maintain production relations with the local design industry and thus, in practice, enable organic growth in the industry. And yet, mapping of the local footwear market indicates that products developed by small manufacturers for local designers are not competitive in the saturated domestic market. This threatens local knowledge and capabilities. As a result of the research insights, the research question was rephrased for the process of developing a solution: How might we preserve knowledge in the footwear manufacturing industry in Israel, and leverage it to create new knowledge and a sustainable economic practice that can compete in the global market?

As a designer I began to wonder how might we design the system of production instead of the product it makes.

The proposed solution is a digital and technological platform for small manufacturing plants. The platform mediates and shapes the connection between production, technology and design. It therefore enables the creation of a joint R&D system with the potential to develop strategies, production methods and innovative products, while overcoming the barriers of the global market and leveraging the advantages of personal contact with the consumer.

**Literature Review**

Local industry does not exist in a vacuum. It is influenced by and reacts to large and complex systems globally and locally. In this review, the impact of market conditions on local production was examined to identify issues that could serve as a basis for creating opportunities for intervention, as defined in the research question.

The following is a list of the topics reviewed:

1. **Recent changes in global market conditions.**  
   This includes how innovation and creating new knowledge has become a currency companies use to compete with countries with low manufacturing costs.

2. **Changes in global production trends.**  
   This includes changes in the relationship between producers and consumers, as well as economic strategies that have been developed to suit these changes, while maintaining a sustainable economic practice.

3. **Innovation in low-tech manufacturing industries.**  
   This includes practices of creating new knowledge in the low-tech industry and dealing with barriers to leverage it for innovative practice.

4. **Reciprocal relations in the fields of production and design.**  
   This includes the relationships that exist between participants in the Israeli footwear industry and points out to the potential for innovation in production skills.

**Recent changes in global market conditions**

Globalization and the information revolution affect the global production market. In recent decades, there has been a dramatic shift of production from places where production costs are high to places they are low. This was driven by the fall of trade barriers and the opening of previously closed markets. (Buciuni & Pisano, 2015). The communication revolution reduced communication costs between geographic regions to almost nothing and led to the creation of a knowledge society (Audretsch & Thurik, 2000). In the “knowledge economy” the acquisition, creation, and utilization of knowledge provide a competitive advantage between companies (Hansen & Winther 2015). This had changed production clusters and the structure of companies’ supply chains. The surge in global production enables R&D to be carried out in one place while products are manufactured elsewhere. This now-common practice creates value in sectors that deal primarily with intangible assets such as intellectual property. The textile, clothing, and leather production sectors were significantly affected by the opening of trade borders (Buciuni & Pisano 2015) since they are traditionally based on manual labor and therefore easier to transport.
Changes in global production trends

Changes in the production model

According to Hegel & Brown (2008), there are two models for resource mobilization: Push, created by the Industrial Revolution, and Pull, created by the Knowledge processes, and predicting consumer behavior. Push-type production is characterized by: forecasting demand, high economic investment, production of surplus stock, and work with intermediaries that weaken consumer attachment (Deloitte, 2015). The Push model is less competitive in contemporary changing market conditions (Hegel & Brown, 2008). The Pull model of on-demand production allows for reduced investment and inventory costs. It relies on technology enabling direct access to consumers (Deloitte, 2015). Future models of production will have to consider new market trends (Deloitte, 2015):

A. Increased consumer power. Unwillingness to compromise on standards of mass production. Growing desire for authenticity, customization, and niche markets.

B. “Smart” products with new technological capabilities. Transition from material products to those that enable access to services.

C. Technologies enabling rapid, small, and local production.

D. Elimination of mediation between manufacturer and customer.

Business strategies in the PULL model

Mass Customization (MC) is a business strategy that aims to sell products that are mass-produced but are adapted to the needs of customers, at a near-standard production cost (Bruneo & Nielsen 2016). Together with the benefit of inviting customer input and responsiveness, as a business model, this offers significant cost advantages by eliminating inventory costs resulting from forecasting and purchasing (Anderson 2011).

Koren, Shpitalni, Gu & Hu (2015), propose an advanced Pull model, an open platform enabling individualized mass production. They suggest that using individually optimized production and open platform principles will lead to a sustainable industry and innovation. They note customized production is enabled by modular architecture and flexible production systems, such as Additive Manufacturing.

Innovation in low-tech manufacturing industries

Innovation has been defined as the effort invested by companies in research and development (R&D) (Cardoso & Torkkeli, 2014). Indices for measuring innovation include the number of R&D studies and the number of people committed to R&D in a company.

Patents are a primary product of innovation and create opportunities. However, while patents are compatible with technology and science-oriented industries, they are not commercially viable for sectors characterized by rapid change. Design, training, consulting, and practical knowledge are key resources for innovation, particularly in low-tech industries (Cardoso & Torkkeli, 2014).

Knowledge resources of low-tech industries

Hansen & Winther (2015) distinguish between two types of innovation: cumulative and radical. Cumulative innovation refers to ongoing improvement of a product or process (“to do what we already do better”). Radical innovation is a complete change of the product or process in the market (“to do something we did not do before”). Norman & Verganti (2012) note two major drivers of radical innovation: technological invention and changing the meanings of existing technology.

Hansen & Winther (2015) further differentiate between analytical and synthetic bases of knowledge. In an analytical knowledge base, scientific data coding is the input and output of the knowledge creation process. In a synthetic knowledge base, existing and tacit knowledge acquired through practice and use are used in new product development.

A synthetic knowledge base can help companies shift from standard products towards customized products (Hansen & Winther, 2015). Most low-tech companies rely on synthetic knowledge, which is globally available and context-specific. They innovate through collaboration, redesign, and tapping into knowledge repositories (Bender & Leastadius, 2005, as cited in Hansen & Winther, 2015).
The inherent innovative potential of low-tech industries

Innovation creates potential for growth, but involves risk (Bougrain & Haudeville, 2002, as cited in Cardoso & Torkkeli, 2009). In small or medium-sized companies, it is difficult to allocate resources to high-risk projects. Several strategies have been proposed to address this. First, internal and extra-sectoral networks and cooperative structures can minimize risks to individual companies from the insecurities inherent in innovation (Cardoso & Torkkeli, 2009). Second, inter-sector collaboration among craft industries can drive innovation and growth through evolution of techniques, discovery of new materials, and application of new tools, which can be applied to multiple industries (British Craft Council, 2016). Third, a case study of managerial innovation and collaboration in the footwear industry in northern Italy finds that a “Knowledge Integrator” enables sharing knowledge related to production, ideas, design, and global markets (Buciu & Pisano, 2015). This led to an integrative supply chain, development of original knowledge, and a competitive advantage for all partners.

Reciprocal relations in the fields of production and design.

Production skills


According to Sennet (2009), craftsmanship adds quality to the world around us. The quality of work is embedded in an ethic to do a good job for its own sake. The development of skills becomes implicit knowledge, enabling discovery of new techniques and achievement of different results. Knowledge-building is a circular, operational process that transforms implicit knowledge into explicit knowledge. This process requires many iterations of trial and error. Niderer (2009) points out that craftwork can express values that transcend time, space, and social boundaries. Its strength is based on an authenticity and intimacy with the object, which is absent from mass-produced products.

Design-production relations in the development of a new product

The combination of design, craft, and manufacturing has the potential to create innovation (Temeltaş, 2017; Wolley, 2011; Yair, Press & Tomes, 2001). Craftsmanship enables the selection of appropriate materials, structures, and technologies (Wolley, 2011). Ongoing involvement of design throughout the new product development process has a high potential for radical innovation (Roper, Micheli, Love & Vahter, 2016). The designer’s contribution to the production process may be expressed in various stages of knowledge creation (Temeltaş, 2017). In craft industries, product development tends to be cumulative rather than collaborative. Products are derived from predefined capabilities.

Research Methodology

The research methodology included interviews with 11 informants from the industry and three experts. The interviews were recorded, analyzed, and categorized. A literature review was conducted on relevant issues in the field and global market trends. The study sought to deepen understanding of the various users and their relationships in the footwear industry in Israel. While developing the proposed solution at the final part of this paper, design thinking methodologies where applied including ideation meetings, prototyping and co-design.

The system is divided into five main axes corresponding to the stages of footwear production: market, design, technical development, production, and design training. These axes enable a broad perspective within the short research time. Informants represent different points of contact with various delegates in terms of enterprise size, place of production, and seniority.
<table>
<thead>
<tr>
<th>Research informants:</th>
<th>Fields of knowledge:</th>
</tr>
</thead>
<tbody>
<tr>
<td>An independent designer with a local brand. Seniority of 7 years.</td>
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<tr>
<td>An independent designer with a local brand. Seniority of 20 years during which she manufactured in Israel and China.</td>
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<tr>
<td>Designer &amp; developer. Seniority of 2 years as developer in a large footwear brand which produces in Israel.</td>
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<tr>
<td>Footwear developer. 20 years seniority in a large footwear brand which produces in Israel.</td>
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<tr>
<td>Retired developer. 50 years of seniority during which he was the owner of a manufacturing factory that closed and worked in most of the large factories that existed in Israel.</td>
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<tr>
<td>Lecturer of footwear in an Israeli academy. Seniority of 30 years as a designer and developer.</td>
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<tr>
<td>Owner of a small-scale manufacturing factory which produces for local independent designers. Production in his factory relies on a small team of skilled manual laborers. Recently introduced advanced digitized machinery.</td>
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<tr>
<td>Owner of a micro-scale manufacturing factory which produces for local independent designers as well for its own independent local brand. Relies on a team of 4 skilled manual laborers.</td>
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<tr>
<td>Owner of a medium-scale manufacturing factory which produces for its own local and international brand.</td>
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<tr>
<td>Initiators of a leading Israeli footwear fair which has been operating for the last 9 years. One of the initiators had a store of locally made shoes and the second is an independent shoe designer with seniority of 10 years.</td>
<td></td>
</tr>
<tr>
<td>A mass market buyer in a leading footwear importing company in Israel.</td>
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<tr>
<td>Owner of a public company that imports international footwear brands for the mass market and leather for the local market.</td>
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<tr>
<td>International footwear forecaster who advises leading global footwear companies and establishes an international footwear school that combines technology, business and design.</td>
<td>Over-view</td>
</tr>
<tr>
<td>Head of the traditional industry division of the innovation authority of Israel.</td>
<td>Over-view</td>
</tr>
<tr>
<td>An anthropologist who researches material culture and preservation of knowledge who researched and wrote a book about the footwear industry in Israel.</td>
<td>Over-view</td>
</tr>
</tbody>
</table>

**Figure 1: Research informants rationale**

**Variables prior to field research**

This short-term study (four months) did not enable representation of all participants in the field. The researcher’s professional experience in the field enabled access. However, some informants might have viewed the researcher as a potential competitor. The proximity of the researcher to the field is liable to distort the data due to prior assumptions.
Approval was received for recording each interview. Factory managers granted prior approval for interviews with workers. The purpose of the study was explained prior to the interviews. There was a request not to disclose details of confidential business information.

**Research findings and insights**

**General background: The effect of opening trade borders on the local ecosystem.**

Until the 1980’s, footwear factories in Israel were family enterprises based on professional knowledge brought from the owners’ countries of origin. They were protected from a competitive environment. In the 1980’s, the Israeli government began to open the domestic market to foreign competition, in response to inflation. The local market was flooded with previously unavailable products, which varied in quality and price.

**Background finding: The high production costs channel local production to medium- high-priced niche products**

At present, there are three medium-sized factories and 30-40 small-scale factories in Israel. Footwear production costs in Israel are four times higher than imported footwear. The average expenditure on footwear in Israel in the mass market is around $62 US. Footwear produced in small factories in Israel costs between $110-350 to the final consumer. Operating in a niche segment reduces the target audience. The local market is small, as Israel is country of 8.5 million inhabitants.

“It doesn't pay off to produce here, it is suicidal - unless you have something very special.” (importer of leather and footwear in a leading company in the market)

“The biggest challenge in the local market is to get people to buy from me, there is a lot of competition and the market is small.” (independent local designer)

**Differences in strategy between large and small producers**

**Insight: Medium-large factories emphasize professional management. Small factories specialize in professional knowledge of footwear.**

Since the 1980’s, many factories closed due to competition with global markets. The remaining enterprises have taken various approaches to survive in the new conditions. Large factories introduced professional management and strategic knowledge external to the field of footwear. Their products are of a functional nature aimed at a niche market such as comfort and outdoor. In contrast, small factories specialize in professional knowledge of footwear and are service providers for local designers who design stylish boutique footwear.

**Secondary insight: The nature of the product affects planning, development, and production.**

The findings show that large factories produce independent brands of functional character, which meet physiological needs (convenience and outdoor use) of customers in local and global niche markets. Small factories usually do not have an independent brand. They provide their services to local designers and produce fashionable products. The Israeli fashionable footwear market has a diverse price range and has been flooded in recent years by global retailers.

The literature indicates different processes of design and development for functional versus fashionable products. Functional products remain relevant long-term. Their development is a process of improving existing products and streamlining production. Fashionable products have a short shelf life. The pace of their development process is high and most of the production line changes every season.

**Secondary insight: The factory’s work practices change production costs and, accordingly, the factory’s profitability.**

Large enterprises produce in large quantities; they can therefore lower the cost of production through mechanized production. On the other hand, small factories that work with a variety of designers fail to maintain production lines that are broad enough to operate machinery; they therefore produce manually at a higher cost.
Secondary insight: The work practices of the enterprise impact the employees’ knowledge base and its ability to adapt flexibly to changes.

Large production lines can be divided into many workstations. Thus, workers do not need to have professional skills for all steps in the manufacturing chain, and they are sometimes only familiar with a few specific workstations.

In contrast, small factories that rely on a varied but small customer base have small-scale, diverse production lines that require skilled workers who have a broad, flexible, professional knowledge base.

A large plant relies on mechanized and complex production lines. Therefore, creating a change in the production system requires heavy financial and logistical investment. On the other hand, a small plant is capable of changing the type of product produced and the production system relatively easily while relying on the knowledge of its employees.

This insight has helped identify the potential ability of small factories to adapt and implement faster, radical changes. The rest of the insights presented will therefore focus on small factories.

Disconnected manufacturers

**Key insight:** Service providers have lost the ability to respond appropriately to market conditions.

Small-scale manufacturers and service providers are alienated from the distribution system and end users. They remain dependent on the marketing and distribution capabilities of local designers.

Secondary insight: The development process replicates manufacturers’ capabilities and does not encourage innovation.¹

Designers are in direct contact with consumers. They mediate knowledge about customers for the factory, in the form of product design. The literature suggests that collaboration between craft and design encourages innovation. A continuous, rather than collaborative, product development process tends to replicate known capabilities. The development process adjusts the design to the production line, but designers are not involved in the production process itself.

“People do not think creatively about the production process because they are not exposed to it ... If a designer understood how things were made he could make better designs and if he felt the system was limiting he could redesign the production process.” (trend forecaster)

“When production and design were a single department, the designer brought a design that had a technological change in the performance and composition of the shoe. The approach to the shoe was completely different ... and required a new production line and new equipment. This line became so successful that gradually most of the production changed to this method.” (senior development expert)

The distance between producers and consumers prevents them from identifying needs and offering a new value proposition. Manufacturers lack tools that allow them to offer an independent identity to customers.

Secondary insight: Designers’ distribution challenges affect their ability to increase production. This prevents growth of small enterprises.

Most local designers use the same suppliers, distribution methods, and production methods, resulting in similar products. This congests the local market, preventing growth without additional resource investment.

Independent designers in Israel lack sufficient time and money to create efficient distribution networks and reach beyond the local market. Their distribution and marketing are often not based on professional business knowledge. Distribution depends on their ability to invest in development of an online shop, work with distributors, maintain a physical store, and sell at local fairs. Their distribution is mainly to local markets.

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¹ *The creation of new knowledge that is the basic condition for innovation.*
“What designers need is help with advertising. ‘Shuphuni’ (the largest fair of Israeli shoes) gives them a big opportunity as a window display.” (small manufacturer).

“The main obstacle to growth is lack of market. Going abroad is a much more complex operation” (entrepreneur of local shoe fair)

Inability to reach a wide market prevents designers from increasing production. The reliance of footwear manufacturers on the distribution capabilities of designers prevents them from influencing factories’ production quantities.

Secondary insight: Identifying commercial and market realities is necessary for cooperation and innovation.

Small factory managers lack business and professional knowledge, leading to nonprofitable investment decisions and preventing return on investment.

Example 1: Manufacturer A invested in an advanced cutting machine and software. This increased product quality and improved the development process but did not return the investment due to lack of sufficient production.

Example 2: Manufacturer B invested in creating a website for direct sale to customers but did not consider the costs of digital marketing necessary for promoting it.

From a factory to a workshop

Key insight: The mass production model is not economically feasible for a workshop that produces in small series.

Most small factories were formerly medium-large family enterprises with independent brands and a mass production model.

“It’s like producing just samples all the time. It does not permit for a flowing production line that can allow a sale or a production line to earn.” (a senior development woman and a lecturer for footwear)

Manual production requires fewer employees, but each must have a broad skill set and responsibility for the final product. Therefore, manual production is a “work of risk”.

Small factories operate more like workshops than like industrial mass production plants. Their small series production line is not profitable and traps them in survival mode. However, the literature indicates producing in small series presents an opportunity to move from a PUSH (build to stock) model to a PULL (made to order) model. To stimulate the innovative potential inherent in craft work, it must be combined with elements from other disciplines.

Survival mode

Key insight: Survival mode does not enable development of long-term strategies and differentiation from competitors.

A long-term strategy requires investment of time and economic resources. When the owner is struggling to maintain the business, investment of resources constitutes an existential risk.

“It’s hard to manage a factory when you manage the nuts and bolts.” (senior developer in a medium-large scale factory, former manufacturer)

Secondary insight: Differentiation and competitive advantage result from new knowledge or a new value offered to the customer.

In open markets in a competitive global capitalist economy, knowledge building is an indispensable resource enabling innovation.

“Traditional industry is defined as an industry whose knowledge is known. There is no change of knowledge here.” (owner of a medium-large factory)
Creation as identity

**Key Insights:** Many factories in Israel were originally family enterprises, and the threat of losing their identity leads small manufacturers to perform radical changes in order to survive. Even when the enterprise is unprofitable, they try to maintain it.

"Whoever knows how to do, has to do. When I closed my factory, it was as if I was frozen. I was like a bird that had its wings cut off." (a small manufacturer)

Decentralization versus union

**Key insight:** Creating partnerships in the footwear industry may reduce risk in development of knowledge and innovative products.

The reports of the Israeli Association of Craftsmen and the Israeli Association of Industry and Trade have not covered the footwear industry since 2007, due to its minimal contribution to the economy. This reflects the political attitude to the field.

Decentralization of the industry isolates each participant in their daily challenges and with limited resources. For small manufacturers, designers, and suppliers, unsafe investments endanger survival. Decentralization eliminates potential power and the ability to manage it systemically in current market conditions.

Risk of innovation can be minimized through internal and extra-sectoral cooperative networks, use of a knowledge coordinator (KI), and combining resources. This enables each network member to reach its potential and a competitive advantage.

Summary of findings and insights

The above insights were aimed to identify challenges and barriers in the industry which prevent its growth and threaten its existence.

The first major insight differentiated between two types of factories in the Israeli footwear industry: medium-large and micro-small. These differ in management, strategy, product character, distribution, product development, production quantities, job character, and employee skill. A comparison of these enterprises highlighted their strengths and weaknesses and led to the identification of opportunities for intervention specifically with small producers. From this point onwards, the research focused solely on these small factories/workshops.

Four areas of opportunity were observed:

- **Motivation** - Small producers are willing to make radical changes in order to survive and maintain their identity.

- **Knowledge** - The labor force in the small enterprises is more skilled and has broad responsibilities and therefore a broad knowledge of the entire production process.

- **Flexibility** - Working with a variety of small producing clients in a market where the product turnover is high (fashionable shoes), established a working paradigm on small series that requires flexibility in planning and manufacturing.

- **Cost of changes** - Small plants rely on skilled manual labor with relatively simple machinery. In contrast, the automation infrastructure in large enterprises is complex and extensive. It follows that change in small enterprises would mean retraining a well-skilled workforce and introducing new technology, and this would be considerably cheaper than the replacement of large existing automation infrastructures and the training of a new workforce.

Along with the opportunity zones, barriers were observed that prevent small enterprises from realizing their potential:

- **Disconnection** - manufacturers have lost their ability to sense their environment and therefore respond appropriately to market conditions. This is reflected in the lack of independent distribution capabilities and working for customers that limit their knowledge of their end users. This detachment usually leads to the conservation of previously known abilities, and therefore does not encourage the creation of new knowledge.
**Survival practice** - the designers’ distribution challenges influence the factory’s ability to increase its production. The practice of mass production is not economic for a workshop which produces small quantities and leads to a state of continuous survival. This survival mode does not allow the mental and economic well-being needed to develop long-term strategies and differentiation from competitors.

A **scattered industry** - The Israeli footwear industry does not provide a significant profitable economic return, and therefore is not integrated by government agencies. There is no independent industrial association. This means that the industry is not valued, has no systemic vision, and has no collective power.

Drawing from the insights, the following **principles** led towards the proposed solution:

**Additional perspectives** from different disciplines must be introduced to the industry. This could serve as a basis for the development of strategies, production methods, and innovative products. **Collaboration** could help facilitate investments for innovative products and reduce the risk that comes with innovation.

**Project Outputs**

The insights helped reframe the research question as follows: *How might we preserve knowledge in the footwear manufacturing industry in Israel, and leverage it to create new knowledge and sustainable economic practice that can compete in the global market?*

The RQ formulated the basis for proposing a solution:

1. “Preserve existing knowledge by leveraging” - a mixture of existing knowledge with new disciplines.
2. “Sustainable” - beneficial for the producer, consumer and the social and ecological environment.
3. “Competitive economic practice” - creation of knowledge enabling a competitive advantage, differentiation, and added value to the consumer.

This preliminary research and ideation session yielded two outcomes. The first is the collaborative design of a product and its manufacturing process. The second, a derivative of the first, is a technological digital platform to be used by small manufacturers.

**First outcome – Design of a product and its manufacturing process**

First, since the research identified the manufacturers’ disconnection as one of their main challenges, a new model of a shoe and its production process were co-designed with a local manufacturer. During this process the researcher served as a knowledge integrator (KI), mediating knowledge on market trends, consumers, and advanced production technologies.

This led to the selection of a triple bottom line business strategy which allows for sustainable innovation.

Following by are the characteristics and decisions that compound the design of the product and its manufacturing process:

**Consumer trends:** The rise of online consumption has changed consumer expectations from service providers and products: Consumer power increased, niche markets expanded, and consumers began to express a growing desire to be involved in product design and its adaptation to their lifestyle. An example of this trend in footwear is the steep drop in sales of tailored products and the growth of a new segment, **Athleisure**, indicating a leisurely and sportive lifestyle.

**Production and distribution trends:** New technologies enable lean production, such as Additive Manufacturing, and enable small-scale, rapid, local production and personalized products. For example, smartphone applications assist in the collection, transfer, and analysis of consumer physiological data. These trends change the value chain of products, and the need to mediate between producer and customer. Inventory costs related to forecasting and purchasing are reduced.

**Product Characterization:** The strategy focused on one main product that would offer personal value through 3D foot scanning and manufacturing of a footbed and 3D printed soles. This enabled a lean and uniform production process to be developed. Product development drew from a sustainable “design for disassembly” perspective. The market segment is unisex, everyday wear, and leisure. Distribution and marketing are online.
Figure 2: The shoe design – made from 3 materials that are attached to each other only by sewing. The insole - sole is a one-piece 3D printed according to a specific foot.

Product Value Chain Mapping: Following the characterization of the product, a process of in-depth research was initiated. Meetings were held with experts in fields related to the value chain of the product as a system. The experts helped map out the steps required for development.

Sustainable product development: Recyclable materials are used. The shoe is connected by sewing, without adhesives. This allows for simple disassembly of the product at the end of its life cycle.

Development of the production process: Intervention in the existing production line with the assistance of the manufacturer has allowed for reduction of the number of workstations from 12 to 6. The manufacturing process allows for connecting shoe parts only by sewing.

3D scanning and printing technology enable employees to respond to new production capabilities and needs in planning the production line. This enables production of a single model with endless modes of expression adapted to the consumer’s foot structure, style, and values. This model can be executed within a single, uniform, and continuous assembly line. It therefore reduces the production cost of the shoe.

Consumer Value Proposition - Product: Durable footwear customized to physiological data.

Consumer value proposition: purchasing experience: Personal recommendation from a professional, personal acquaintance. An illustration of the product and the consumers’ shopping experience can be seen in the Know-Me Video.

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2 A senior development man in a large footwear factory, two entrepreneurs in the field of additive manufacturing, materials specialist, e-commerce, digital marketing, programmer of orthopedic software for three-dimensional.

3 Some of the meetings with experts were conducted with the manufacturer and at his initiative, and the researcher mediated some meetings.

4 https://youtu.be/YwVwDeEwhUk
Second (following) outcome - Development of the Know-Me platform

Cost calculations of the value chain of the product introduced in the prior chapter revealed an economic barrier to manufacturers. Gaps were found between the shoe production costs at the plant and the costs of operating the digital site, marketing, and data analysis. This led to a shift from a system serving a single enterprise to one serving multiple enterprises and offering a variety of products to consumers.

The proposed solution, Know-Me, is a technological digital platform that designs:

- Direct contact between manufacturer and consumer
- Lean and modular production processes
- A database that can be converted into business opportunities

The platform model is based on an open platform linking online shopping opportunities to strengthen the connection between manufacturer and consumer. Three design values were defined as guiding principles for the platform value proposition to the end consumer: personalization, personal connection, and environmental impact (locally and globally).

Value proposition to consumers: Artisanal approach to a digital relationship

A review of the changes in production processes between pre-industrial craft production and global mass production identified values that could be leveraged as a new value proposition to consumers. These include the nature of the consumer-producer relationship, generic versus personalized products, and implications of the production process.

![Figure 4: Production overview. New technologies facilitate the return to artisanal production values (craft) in a new digital configuration in the glocal (global/local) system.](image)

The primary value offered and marketed to the consumer: **Personalized product and communication.** The online selling site enables reception of physiological and other data from the consumer. In turn, the consumer receives personal and professional recommendations from the manufacturer.

The added value to the consumer: The possibility of buying a product with sustainable value and responsibility for the end of the product’s life. During the buying process, consumers can select the material, reflecting their worldview. Also, they have an opportunity to get acquainted with the manufacturing process and the manufacturer.

The value of sustainability is expressed in a product designed for disassembly. It can be collected from the customer at the end of its use, easily disassembled, and the materials recycled and/or reused. This enables the following sequence of production on demand: designing modules and production infrastructure > customer personalizes & customizes the design > purchase > manufacture.
Values to manufacturers

The platform offers the manufacturer accompaniment on three levels:

A. Product development process and production process

On-Boarding - The platform assists in co-developing a product and manufacturing process prior to the start of work. This is designed to adapt the product to a relevant target audience with a clear marketing value while maintaining an economically feasible production process and developing existing knowledge in the plant. The platform is used as a knowledge integrator.

Development of the production process - Development and design of the product takes place together with creation of a production infrastructure based on principles of minimal modules and workstations. This minimizes inventory of raw materials and eliminates excess stocks. It introduces technology to the plant that enables personal production on demand. This holistic process simultaneously considers product design, production, employee skills, and customer experience.

B. Support for ongoing activities

In daily operations, the platform manages the sale site, digital marketing, customer service, digital operation of the site and its applications, and transferring files needed for technological production (for instance 3D printing). The platform collects data and makes it accessible to the manufacturer. This is reflected in digital inventory management, production instructions for workstations, and communication with suppliers.
C. Database and future R&D processes

Digitization can revitalize local production. New technology in the production process enables development of manufacturing capabilities. Data on customers’ behavior and foot physiology will help identify opportunities for further development. This combination enables an interconnected and sustainable production process that can be continually updated and improved.

In the long term, the platform will enable creation of a unified network of an updatable and decentralized production process, which can be connected to additional workshops and industries to create new opportunities. The platform will unite plants in the collection and analysis of data, logistics, marketing, and distribution. It will allow for individualized production processes for different manufacturers, enabling a wide range of products for customers on the selling platform.

Environmental and ecological values

Short-term: Design for disassembly enables recycling or reusing materials. Eliminating final product inventory by producing on demand and reducing raw materials inventory.

Long term: Products will be offered to a local and global clientele. After identifying consumers outside the original production location, the platform will locate local producers in the new geographic location and initiate local production of the product near that customer.

Summary

The research presented in this paper finds that improving the connection between production and design within the footwear industry and with other industries may enable the creation of new knowledge regarding the product and the consumers. This can lead to a competitive advantage for the Israeli footwear industry and serve as a potential growth engine for local production.

The proposed solution is a platform used as a digital and technological platform for micro-small manufacturing plants. The platform mediates and shapes the connection between production, technology, and design.
enables creation of a joint R&D system with the potential to develop strategies, production methods, and innovative products. It overcomes barriers of the global market and leverages the advantages of personal contact with the consumer.

The platform can serve as an infrastructure for developing a system that creates innovation. It could minimize the inherent risk of investing in innovation by creating a co-production and co-R&D network for manufacturers.

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