



Innovative Skills for an Old Vocation

Innovative Skills for Production Planning

WP 04



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1 Introduction

This manual is a joint product of all partners from the Erasmus+ project "Innovative Skills for an Old Vocation" (ISOV, 2024-1-DE02-KA220-VET-000254492, <https://isov-project.eu/>). As all sectors, the sector of industrial footwear production faces the mega-trends of globalisation, digitalisation and sustainability. Main aims of the project are the development, pedagogical structuring and piloting of courses for apprentices, students and/or employees in industrial footwear production in Germany, Portugal and Romania, based on scientifically developed impact analyses on which of the dimensions of the trends influence which of the 18 Spheres of Activity (SoA) of the sector. The courses and the manuals refer to 12 chosen concrete SoA in which the participants are working, are supposed to work, or want to work.

Basic materials for the courses are the manuals. As the estimated impact of the dimensions respective sub-dimensions of the trends differ between partner countries and as the equipment of training providers with modern technology is differing, as well, the manuals follow a modular structure:

Chapter 2 documents the, partly shortened or updated, "state of the art" manual from previous projects "Integrating Companies in a Sustainable Apprenticeship System" (ICSAS, <http://icsas-project.eu/>) respective "Developing Innovative and Attractive Continuous Vocational Education and Training (DIA-CVET, <https://dia-cvet.eu/>).

Chapters 3-5 illustrate the expected impact of the various (sub-)dimensions of the 3 trends in the near future (up to 5 years) on the work-processes of the chosen SoA.

This approach has the huge advantage that, for example, if the sub-dimension "additive manufacturing" is estimated to have high impact on a certain SoA and a training provider has no 3-d printer, he can, with respect to this sub-dimension, rely on the "old" manual referring to subtractive manufacturing – but still impart the impact of other subdimensions, where the equipment is available.

Finally, chapter 6 offers a case study of apparent good practice, demonstrating not only what, but also exemplarily how to teach.

Or, to put it different, this manual should not be read as a "receipt", where all condiments should be added or imparted in a fixed row and a defined quantity – but as a "toolbox", aiming at inspiring trainers to impart not only "state of the art" knowledge, skills and competences (KSC) – but to prepare their apprentices, students or participants in continuous vocational education and training (CVET) for upcoming work-processes.

2 Manual from previous project

2.1 Production Planning

2.1.1 Introduction

Current market conditions, with instability, increased competition and specific customer requirements, have called into question the traditional ways of production organization, increasingly resorting to flexible automation.

Gone are the days when the organization of work was marked by the rigid division of functions, fragmentation of tasks, specialization of knowledge, hierarchy and centralization of information.

With the aim of achieving the production of complex and quality articles, in accordance with customer requirements and through production variation in terms of products, volumes and processes, organizational aspects have become decisive in a new logic aimed at the implementation of production strategies based on automation on the one hand and flexibility on the other.

Nowadays, the trend is accentuated in the substantial increase of production in small series, prototypes, and a lot of diversifications. In this context, market uncertainties and fluctuations are controlled by adaptability and flexibility parameters, based on competitiveness factors that, in addition to prices, consider quality, design, meeting deadlines and specific customer satisfaction.

In this context, the organization of production, and in particular the Planning and control of production, faced with the introduction of new and diversified requirements, underwent adjustments associated with the new logic required of companies, where the core of modernization is reflected in the development of the specific flexibility of each unit, in association with new forms of work organization and new information management systems.

Flexibility cannot, therefore, be considered a technical phenomenon, pure and simple, but rather a technical-organizational phenomenon. It refers not only to the use of flexible equipment, but also to the adaptability of people who exploit the new technological potential.

When we intend to follow the strategy of flexibility and quality, it could be wrongly thought that to achieve this objective, the acquisition of computer-assisted technologies will suffice, maintaining strict management methods with marginalization of the human factor.

However, when the results fall short of expectations, it is recognized, sometimes belatedly, that a flexibility strategy necessarily involves two aspects: quantitative employment flexibility and organizational flexibility. In the first situation, quantitative employment flexibility corresponds to operational flexibility, where new organizational principles, flexible structures and leadership styles open to participation lead to different practices of decentralization of production levels (division of large companies into autonomous units), task enrichment, group work and quality circles.

In the second situation, organizational flexibility is part of a logic centered on the human factor, according to which competitiveness depends not only on new equipment, but also, and mainly, on specifically human capabilities.

The reinforcement of the competitive advantages of the companies passes, therefore, by the search of adequate management methods, that consider in a comprehensive way aspects such as layout, planning and control, human resources, new technologies, productivity, quality. In this Manual we are going to talk about Production Planning.

2.1.2 Define Planning

Planning can be defined as the thought that precedes the action, that is, the activity that consists of establishing goals and setting organizational objectives, as well as preparing specific action plans and compliance deadlines.

Basically, planning is fixing the future and working day-to-day to achieve that future effectively.

When planning, the company is anticipating actions, it is determining its needs for materials, people and other important resources.

Planning must therefore be a structured and disciplined activity. Without these assumptions, it is impossible to achieve the goals and objectives set.

We can talk about:

- Long-term planning, where strategic issues are addressed. Usually performed at the top management level and considered as a guiding element for all functions and/or business areas of the company;
- Medium-term planning, where tactical issues are dealt with. Usually performed at department or business level;
- Short-term planning, where operational issues are dealt with. Usually performed at the function level (cut, sew, assembly).

Gone are the days when companies determined the selling price of their products or services based on the cost of production plus a margin (profit). The rules of the game have changed radically, and more and more the price is defined in the market, and in this way, for profit to be a reality, there remains the alternative of reducing costs.

To reduce costs, companies need to eliminate activities and resources that do not add value. The market is increasingly competitive, more unstable and aggressive. But that's where companies must compete.

Customers, for their part, gradually imposed their strength, demanding from their suppliers:

- more frequent deliveries and in smaller quantities;
- reduction of finished product stocks;
- price reductions, crushing suppliers' margins;
- reduction of response and delivery times;
- flexibility and innovation in processes, products and services.

Companies that fail to keep up with the pace of market evolution are irrevocably doomed to lag and disappear. To maintain a pace, at least equal to that of the market and its competitors, it is necessary for companies to adopt concrete measures.

Spending the day "putting out fires", "covering here to uncover there" is not a valid option. Companies need to adopt formal procedures for planning and controlling their operations.

Computer systems are an important but not sufficient tool, especially if the methodology to be used in planning and controlling operations is not defined first.

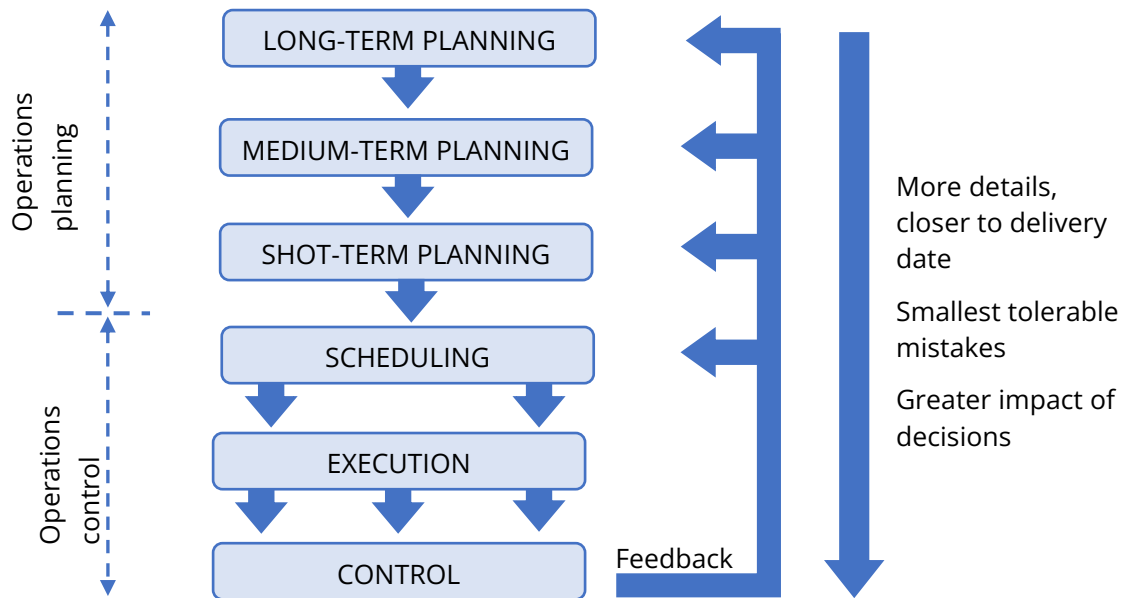


Fig. 1: Planning and control of operations.

2.1.3 Planning and Control in Footwear

2.1.3.1 Characteristics of sector orders

After presenting the collections to customers, they send requests for samples. These may correspond to the models presented in the collection or to “variants” of these models. By variant is understood a model with some difference in relation to the model that gave rise to it, but whose moulds do not refer to alteration. There is also the possibility that the client himself presents models of his creation.

The request for samples and any subsequent changes may also be followed by the request for a confirmation sample.

At this stage, the customer sends his purchase order (N.E.). Generally, at the beginning of the season, orders refer to a reasonable volume quantity. Closer to the end of the season, new N.E. may appear with requests for shortages, that is, orders that are normally urgent that repeat models already ordered but in much smaller quantities.

The following trends continue to occur:

- The number of models and variants requested by customers is increasing;
- Given the uncertainty of the market and the consequent difficulty in making medium-term forecasts, customers take less risk in initial orders, i.e., they order more models and less quantity per model;
- Consumer demands are higher in terms of design and innovation. As such, the traditional two collections per year “Autumn/Winter” and “Spring/Summer” are more faded, with new models being introduced a little throughout the year;
- Delivery times that used to be short only for out-of-stock orders are now practically short for all orders;
- Finally, the sale price is increasingly imposed by the market, not being complacent with companies that try to impute, in their products, costs derived from their bad organization and their waste of resources.

A customer purchase order can contain only one or several references. Reference means a perfectly defined model/variant to which an identification number has been assigned.

In productive terms, it is important to treat each reference individually, that is, as if it were an order.

The fact that a customer requests, for example, 5 different references with the same delivery time, does not oblige them to be manufactured simultaneously, not even in sequence.

It may be of interest to intermediate production to manufacture other orders.

It is usually preferable, whenever possible in terms of delivery times, to group together the manufacture of the same references and even the same models, even if they are of the same reference. The objective is to obtain gains in the operators' work rate.

Combining these two needs arises the concept of internal purchase order (N.E.I.). This consists of a document with characteristics suited to the production needs regarding the customer's purchase order information. This document has the following basic characteristics:

- Each N.E.I. refers to a single reference;
- The quantities requested from this reference may be used for several customer orders.

2.1.3.2 Manufacturing plan concept

The minimization of the number of lasts to be used in the assembly requires that a range of sizes with the necessary quantities per size arrive at this section. In other words, it is not possible to make the assembly profitable if, for example, the sewing produces all pairs of size 40 first, followed by all pairs of size 41 and so on.

To avoid this type of situations, the concept of Manufacturing Plan (MP), also called Manufacturing Order (MO) emerged. The MP represents a production order for a partial order quantity.

Each internal order is therefore divided into a certain number of MP, whose quantities per size are proportional to the "weight" of that size in the total order.

The total number of pairs in the MP, similarly to the number of pairs per batch, must be determined considering the characteristics of the company, namely about:

- Need for assembly cycle lasts
- Number of pairs per lot
- Average daily production
- Average amount of different sizes present in orders.

Let's see the influence of each of these factors on the number of MP pairs, with practical examples:

1. Need for assembly cycle lasts

If we have an assembly system that requires 150 pairs of lasts, for example, then the MP cannot be less than 150, so that each MP allows at least one assembly cycle to be produced.

2. Number of pairs per lot

If this quantity is 10 pairs/lot, for example, then it is convenient that whenever possible all lots have this quantity. At most, there will be one lot in each size for adjustment, if the quantity ordered is not a multiple of 10.

2.1.3.3 Manufacturing preparation

Between the arrival of the purchase order and the start of manufacturing, there is a series of procedures that have to be taken in order to prepare the manufacturing itself.

All these steps must be followed by the planner:

1. Ensure the existence of a technical file, operating range and line balance.
2. Monitor the supply of materials, from the issuance of requisitions
3. Decide which tools to use:
 - For cutting, whether cutting dies, moulds, or automatic cutting. Check even if the model is already scaled;
 - For assembly, calculate the lasts needed and check if there is a need for reinforcement in any size(s);
 - Check if there is a need for other tools, for example; leakers, stamps, etc.;
4. Program and ensure the execution of the test series
5. Verify the complete issuance of documents, labels and tags.

2.1.4 Scheduling of orders

The schedule consists of distributing the orders over the weeks, according to delivery times and the availability of resources.

The calculation of labor requirements is carried out by each section based on production capacity and production times estimated by the methods and times bureau.

To determine the capacity, it is necessary to study the process, the time it takes to execute the operations and the respective cost. And so, the installed capacity stands for the capacity of the area with the lowest productive capacity (known as a bottleneck) of a production line.

It is obtained by the combination of monitoring indicators (KPI's) of the 3M's (Men, Machines, Methods):

Equipment: which stands for utilization rate

Human resources: which is productivity

Methods: covering manufacturing time

There are, however, several other factors that must be considered, the most important of which are:

1. Supplies

If on the one hand, the dates planned for the delivery of the materials requested to suppliers are calculated by the planning sector, on the other, this sector may also be obliged (and this is frequently) to change its plan due to changes imposed by the supplier, on the date of delivery of the materials.

2. Tools

For example, the use of group of lasts whose total amount of pairs is less than the need for lasts of the assembly cycle, requires that this section has two models with different lasts for manufacturing. They should be two order models with relatively close delivery times and whose lasts, although different, do not oblige large adjustments to the machines, which would cause productivity breaks.

If there is subcontracting it is important to check if the tools (cutting dies or moulds in the case of cutting or lasts in the case of assembly) may be borrowed to the subcontractor without the risk of being lacking in the company.

3. Training plan

The versatility of the workers is extremely important for the correct functioning of a section. Such versatility can only be achieved if the company invests in training. A training plan must be prepared annually, the implementation of which, in the case of operators, must coincide with the low season in terms of volume of orders.

The planner has an important role in the elaboration of these training plans.

4. Preventive maintenance of equipment

Like the operator training plan, the preventive maintenance plan must be coordinated with the manufacturing plan.

5. Work rhythm

It is known that the change of models causes breaks in the operators' work rhythm, namely in terms of sewing, since it is the section where the changes are more accentuated.

It is therefore in the best interest, whenever possible, to launch the same or similar models in production, one after the other.

6. Intermediate stocks

The planner has to consider the problem of intermediate stocks very carefully. On the one hand, high intermediate stocks give rise to high financial burdens with "in progress" and a low flow with consequences for the response time. On the other hand, with low intermediate stocks there is a risk that there will be ruptures and some of the sections may stop.

Some principles that minimize the possibilities of this happening are:

- Interleave low sewing time models with high sewing time models
- Bear in mind the need for a higher stock when subcontracting some operations such as special sewings, braiding, etc.

7. Subcontracting, overtime and flexible working hours

The subcontracting of any phase of the process should be seen as an alternative that can solve problems of momentary overload. A systematic use of subcontracting depends on the strategic decisions of each company, and there must be clear rules for the planner on when and under what conditions this resource can be used. The same applies on delivery to the use of overtime.

The flexibility of working hours makes it possible to increase production capacity when the volume of orders is higher, compensating for a decrease in production capacity when the volume of orders is lower.

The Production Plan integrates all the programming variables of the order book to meet foreseen needs. It is the plan that uses the order information in conjunction with the product structure (material's list), existing stocks and average production times for each item to set a plan for production orders or order for each constituent item of the final product.

It identifies what to produce, how much to produce and when to produce or order to satisfy the independent demand dictated directly by the market.

2.1.5 Production control

Timely and reliable production control is essential for effective planning. Production control consists of monitoring in a quantitative way what has been produced in a given period of time.

There are from simple weekly control systems only for the product that is dispatched, to sophisticated computer systems that provide "on-line" (real-time) productivity data by section and even by operator.

The level of demand of the control system should be developed with the increase of requirements in terms of information needs, that is, there is no point in having complex control systems, for example, "online", if the data are only analyzed at the end of the day.

Often, for example, the production order is drawn up in such a way as to have a data collection system.

Based on the production control data, there may be a need to carry out replanning in order to incorporate the accumulated deviations since the last (re)planning.

Another objective of production control is to obtain data to calculate productivity. For this to be possible, it is important to identify the number of operators present in each section.

2.1.6 Why does Planning fail?

Here are some alerts for the reasons why planning often fails in companies:

- There is a natural tendency to consider that everything in our company is more complex than usual;
- Inability to understand planning as a rational and complete process;
- Lack of decision-making power of the planner;
- Lack of training and information for the planner;
- Taste for improvisation, that is, there is no real commitment to the plan;
- Unrealistic plan;
- Tendency to plan mentally. The plan must be written and disclosed;
- The plan must be prepared in meetings where the people in charge are present and have an active participation. This is the only way to create a real commitment to the plan.

2.2 Information Management

Depending on the company (size, organization of departments, distribution of activities, etc.), part of the activities related to production planning may be included in other departments.

The management of information and communications within and outside the company, with customers and suppliers, and even between internal departments, represents an important tool for working and supporting correct business management.

To increase efficiency and better manage all information, companies use different software systems in production planning and control. The main categories of software are ERP (Enterprise Resource Planning), PDM (Product Data Management) and PLM (Product Lifecycle Management).

The main modules of an ERP that are related to Production Planning and Control are:

- Materials/Suppliers/Purchase Orders
- Stock management
- Models
- Customers
- Orders
- Production Planning
- Subcontracting Planning
- Documents for Production
- Production Monitoring.
- Documents for Shipping

A correct management and sharing of information, adapted to the characteristics of products and productions of each company, is therefore fundamental to increase its levels of flexibility, productivity and even quality.

An ERP method integrates information on inventories, process time, stock levels, replenishment times with commercial product delivery commitments.

It works inside a server and can modify the plan automatically, based on the results during the selected period.

Alert issues if delays endanger the goals aimed at (typically delivery date to the customer). In this method performance indicators (KPI's) are used to monitor progress in the execution of orders and correct any deviations in time.

Measurement indicators in ERP are typically those that are related to the number of parts produced, the processing time, and costs.

The actual results are compared with the theoretical estimates (planned). Indirectly, productivity indicators can be used.

2.3 Conclusion

Faced with the emergence of new strategic models, the organization of production in companies tends to depend not only on the type of technology chosen, but also on a new paradigm based on the creation of flexible organizational frameworks and investment in human resources.

Organizing production is thus a fundamental means to achieve specific objectives:

- Be more efficient, that is, use available resources in the appropriate dimension and without waste.
- To be more effective, that is, to achieve excellence in customer service, which implies aspects such as speed of delivery and product compliance.

There is no single “recipe” for achieving these goals. On a case-by-case basis, the best solutions and the best balance in the use of the best tools for the organization must be found. Production Planning and Control will be a fundamental ally here, in coordinating the factors that influence the company's performance and achieving customer satisfaction.

The most important conclusions are:

- The productive flows must be designed to maximize the efficiency of the taken measures;
- The Production Plan integrates all variables to develop a plan that allows you to respond to the needs of orders;
- To determine the capacity, you should study the process, the time it takes to execute an operation and the respective cost;
- The ERP integrates all variables and manages a plan that is updated periodically according to the obtained results;
- Performance indicators are used to monitor progress in the execution of orders and to correct any deviations in time.

3 Globalisation in Production Planning

With production plants and partners spanning multiple countries, structuring the production planning department strategically is of the utmost importance. Operational success relies entirely on crystal-clear communication and well-structured, centralized digital documentation for both internal and external stakeholders.

To ensure operational readiness, organizations must establish a common language (typically English) and standardized communication mediums. All correspondence and data must be securely documented with accessible, role-based permissions for relevant stakeholders. A frequent source of disruption arises from information silos—specifically, when critical data is restricted to a single team member, inadvertently keeping essential colleagues out of the loop. Internally, this challenge can be effectively mitigated through a transparent knowledge-exchange culture, a clean, uniform, and intuitive data storage structure, and regular team-building initiatives.

When managing foreign partners, the implementation of strict yet fair standard operating procedures, quality norms, and unified measurement systems is critical. Concurrently, organizations must remain culturally aware and closely monitor local national holidays to ensure reliable planning and maintain strong partner relations.

A primary example of seasonal supply chain disruption is Chinese New Year. Production and shipping capacities become highly volatile or entirely unavailable before, during, and immediately after the holiday. This is driven by a pre-holiday rush as companies attempt to push through orders, leading to overburdened logistics networks. In the post-holiday phase, production quotas frequently fluctuate due to incomplete workforce returns and a temporary loss of operational routine. Consequently, proactive planning is essential to minimize bottlenecks and delays throughout the supply chain (SVI Content Team, 2026)¹. Additionally, one must keep in mind that dates can shift due to different calendar system in some parts of the world, like the Chinese lunar calendar.

Stage	Timing	What It Means
Order cutoff window	6–8 weeks before CNY	Last reliable window for new orders
Capacity starts declining	3–4 weeks before CNY	Workers begin leaving; quality control becomes less stable
Logistics bottleneck	1–2 weeks before CNY	Freight rates spike; trucking capacity drops
Full factory shutdown	1 week before CNY through official holiday end	No new production; only pre-made stock can ship
Reopening	Day 7–8 of the new year	Factories reopen, but many workers are still returning
Full capacity restored	1–2 weeks after reopening	Depends on workforce return rate and raw material supply

Tab. 1: Typical production and logistics milestones leading up to and after Chinese New Year (SVI GLOBAL)

3.1 Markets and consumers

Production capacity shift towards automated high scaled factory output and/or flexible product lines with fast changing small ranges and customisable features. To get hold within the competitive market more brands offer mix and match products and integrate customers through website guided made to order processes.

¹ SVI Content Team. (2026, May 8). Chinese New Year production delays: How to plan ahead. SVI Global Ltd. <https://www.svgloballtd.com/manufacturing/chinese-new-year-production-delays/>

Modern production planning in the footwear industry has transitioned from managing predictable, long-lifecycle product portfolios to coordinating fragmented, demand-driven networks. Historically, the sector relied on a rigid, two-season calendar (Autumn/Winter and Spring/Summer). Driven by globalised consumer expectations, the market now demands continuous micro-collections and near-instantaneous lead times (Chang, C. W., 2022)².

For production planners, this compresses the traditional 18-month design-to-market timeline into narrow windows of a few weeks. Planners no longer structure long-term master production schedules (MPS). Instead, they manage dynamic, rolling horizons where customer purchase orders are continuously adjusted to mitigate the risks of overproduction and stockouts.

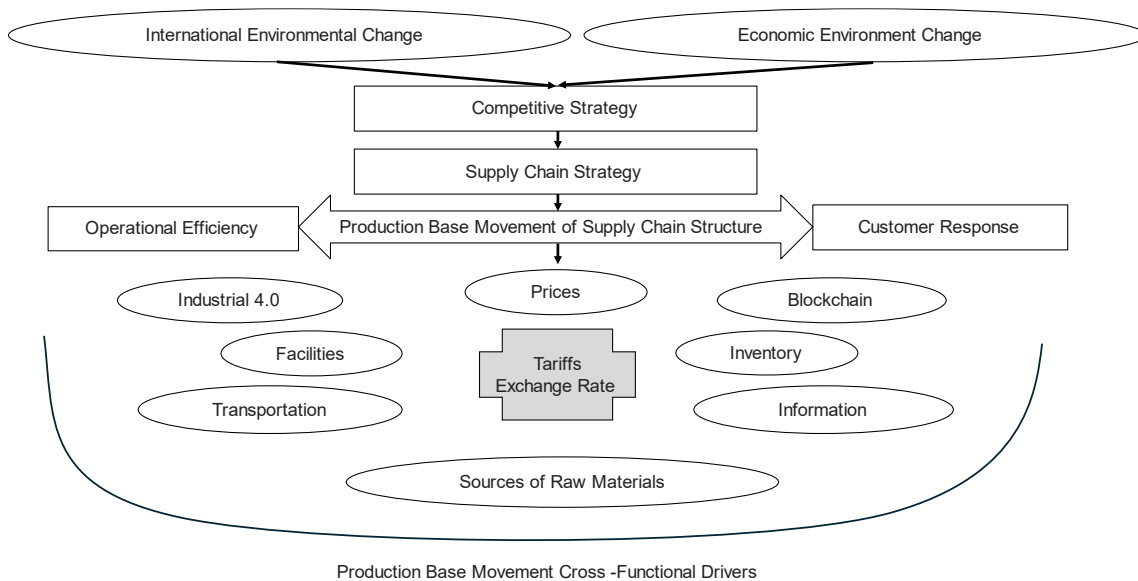


Fig. 2: Group knowledge sharing decision-making transfer supply chain model (Che-Wei Chang 2022).

3.2 Economic and social factors

The footwear industry remains inherently sensitive to regional labour costs, tariff adjustments, and macro-economic volatility. For decades, production planning logic dictated the relocation of manufacturing bases to developing economies to leverage low labour costs - shifting from early hubs in Taiwan and South Korea to mainland China, and subsequently to Southeast and South Asian nations such as Vietnam, Indonesia, and Bangladesh.

However, escalating geopolitical frictions, targeted import tariffs, and persistent freight volatility have forced a structural reassessment of global supply chain vulnerability. High labour-cost savings are increasingly offset by transit delays, inventory carrying costs, and vulnerability to trade disruptions. Consequently, planners are shifting from pure cost-minimization logic toward quantitative, multi-criteria decision frameworks to evaluate complex trade-offs among labour costs, exchange rate fluctuations, tariff structures, and lead-time flexibility. This dynamic has driven a dual strategy: maintaining cost-efficient Asian hubs for stable base volume while

² Chang, C. W. (2022). Supply chain movement risk in the sneaker industry: an empirical study. *Quality & Quantity*, 56(3), 1073-1092.
https://www.researchgate.net/publication/352306359_Supply_chain_movement_risk_in_the_sneaker_industry_an_empirical_study

strategically expanding nearshoring capabilities (such as Mexico for North America or Near-East/Eastern Europe for the EU) to enhance agility and mitigate systemic risk³.

Planning Dimension	Offshore Manufacturing	Nearshore / Localized Manufacturing
Primary Driver	Labor cost minimization	Lead-time compression & market reactivity
Batch Sizing (MP)	Large-volume lots (high inventory cushion)	Small-series, agile batches
Supply Chain Risk	High (subject to tariff changes, shipping delays)	Low (short-circuit logistics)

Tab. 2: Comparison Offshore vs Nearshore Manufacturing

3.3 Demography

Demographic shifts exert a dual pressure on footwear production lines, fundamentally altering labour availability, skill distribution, and operational continuity across global manufacturing networks. Because footwear manufacturing historically relies on a mix of highly specialized craftsmanship and high-volume manual assembly, fluctuations in population structures directly dictate factory floor efficiency. Production planning frameworks can no longer treat labour as a static variable; instead, they must dynamically absorb regional demographic realities to maintain optimal throughput (International Labour Organization, 2026)⁴.

The global footwear manufacturing sector is currently caught between two opposing demographic extremes, each presenting distinct operational hurdles:

- **Mature Hubs (Skilled Labor Attrition):** In traditional manufacturing hubs—such as Southern Europe (e.g., Italy, Portugal) and established East Asian clusters (e.g., coastal China, Taiwan)—the industry faces an acute shortage of skilled manual labour. This crisis is driven by an aging workforce compounded by low generational replacement rates. Younger demographics increasingly pursue tertiary education and service-sector careers, viewing factory floor roles as economically unattractive. Consequently, specialized skills like precision pattern cutting, complex stitching, and hand-lasting are at risk of extinction as veteran artisans retire without successors (APICCAPS, 2025)⁵.
- **Developing Hubs (High-Turnover Volatility):** Conversely, in emerging manufacturing regions across Southeast Asia (e.g., Vietnam, Indonesia) and parts of South Asia and Africa, the macroeconomic challenge is reversed. Rapid urbanization draws massive, youthful populations from rural areas into industrial zones. While this creates a large aggregate labor pool, it is characterized by high turnover rates. Workers frequently migrate between factories for marginal wage increases or return to rural provinces seasonally, creating a volatile workforce baseline (World Employment Confederation, 2026)⁶.

³ Chang, C. W. (2022). Supply chain movement risk in the sneaker industry: an empirical study. *Quality & Quantity*, 56(3), 1073-1092.
https://www.researchgate.net/publication/352306359_Supply_chain_movement_risk_in_the_sneaker_industry_an_empirical_study

⁴ International Labour Organization. (2026). *AI, demographic shifts, and automation in manufacturing* (Asia-Pacific Region Employment Trends Report). International Labour Office.

⁵ Portuguese Footwear, Components, Leather Goods Manufacturers' Association. (2025). Automation and robotics as a growth engine for the footwear industry. <https://www.worldfootwear.com/news/automation-and-robotics-as-a-growth-engine-for-the-footwear-industry/11137.html>.

⁶ World Employment Confederation. (2026). Global labor volatility and the impacts of rapid urbanization on industrial sectors (WEC Global Insights Report). World Employment Confederation. <https://wecglobal.org/insights>

To mitigate these divergent demographic pressures, production planning and scheduling modules must deploy region-specific strategies:

- **Automation-First Scheduling (Scarce Labor Markets):** In regions plagued by labour scarcity, production planning must pivot from labour-centric scheduling to asset-centric scheduling. Advanced Planning and Scheduling (APS) systems must heavily prioritize automated machine utilization rates—such as automated CNC leather cutters, robotic lasting machines, and computer-controlled stitching units. Manual labour is treated as the ultimate system constraint; planners schedule human operators exclusively for non-automatable, high-value tasks, organizing production sequences to ensure automated machinery runs at near-continuous capacity (Overall Equipment Effectiveness (OEE) optimization) with minimal human intervention (Deloitte & The Manufacturing Institute, 2026)⁷.
- **Dynamic Buffer and Onboarding Integration (High-Turnover Markets):** In regions characterised by high labour turnover, production planning models must account for continuous workforce variability, including fluctuations in operator availability, experience levels, and process proficiency. Planning based solely on theoretical maximum efficiency can lead to unrealistic schedules and increased disruption when production conditions deviate from assumptions. Therefore, manufacturers should incorporate appropriate capacity and time buffers into the Master Production Schedule (MPS) to absorb variability and maintain stable production flow (Hopp & Spearman, 2011)⁸. In addition, standard production times should reflect the actual capability of the workforce and be regularly updated as operators gain experience. Learning-curve effects demonstrate that productivity generally improves as workers repeat tasks and acquire process knowledge (Yelle, 1979)⁹. In footwear manufacturing, work measurement approaches and production engineering tools, such as SATRA's time measurement methodologies, support the definition of realistic standard times and the continuous improvement of production efficiency (SATRA Technology Centre, 2015, 2025)¹⁰.

⁷ Deloitte & The Manufacturing Institute. (2026). Advanced planning systems and constraint optimization in modern manufacturing industries (Industrial Survey Framework Report). Deloitte Development LLC. <https://www.deloitte.com/insights>

⁸ Hopp, W. J., & Spearman, M. L. (2011). *Factory physics* (3rd ed.). Waveland Press.

⁹ Yelle, L. E. (1979). The learning curve: Historical review and comprehensive survey. *Decision Sciences*, 10(2), 302–328. <https://doi.org/10.1111/j.1540-5915.1979.tb00026.x>

¹⁰ SATRA Technology Centre. (2015). Developing efficient production processes. *SATRA Bulletin*. <https://www.satra.com/bulletin/>

3.4 Qualification / Training / Knowledge

As manufacturing configurations evolve from fragmented, manual skill-based assembly tasks toward increasingly automated and digitally connected production systems, the requirements for human capital are changing. Rather than eliminating the need for skilled workers, automation shifts their role from direct manual execution toward supervision, process control, problem-solving, and optimisation. Operators increasingly need competencies in managing cyber-physical production systems, interpreting real-time performance indicators, responding to deviations, and performing rapid product or model changeovers on automated production lines (International Labour Organization (ILO) & Organisation for Economic Co-operation and Development (OECD), 2018, International Labour Organization, 2023)^{11,12}.

A practical example in the footwear industry is the operation of direct injection moulding systems, such as those supplied by DESMA¹³. Modern direct soling production lines can be integrated with robotic systems for tasks such as roughening, adhesive application, handling, or quality inspection. Consequently, employees require not only machine operation skills but also a broader understanding of automated workflows, process parameters, and digital production data.

To prevent operational bottlenecks caused by skill shortages, production planning should be increasingly connected with structured competence management and training matrices. Workforce availability and qualification levels need to be considered alongside production requirements. Dynamic scheduling approaches, which allow companies to adjust workforce allocation according to changing demand, employee availability, and operational priorities, can support this flexibility. Such approaches are particularly valuable in environments with fluctuating production volumes or high product variety (MyShyft, 2025)¹⁴.

Training activities should therefore be integrated into annual production planning, with dedicated learning periods strategically positioned during lower-volume production phases whenever possible. This enables companies to increase cross-functional workforce versatility while maintaining delivery reliability during peak periods. In combination with skills matrices and digital workforce planning tools, this approach supports a more resilient production organisation.

Addressing current and future workforce shortages requires not only technological adaptation but also improvements in job attractiveness and employer identity. Younger generations increasingly expect meaningful work, recognition, career development opportunities, and a clear sense of belonging. Transparent training pathways, recognised qualifications, and structured progression models—including sustainable and predictable remuneration development—can contribute to making manufacturing careers more attractive. In competitive labour markets, additional benefits such as flexible working arrangements, employee development programmes, and improved workplace conditions can become important factors in attracting and retaining skilled personnel.

¹¹ International Labour Organization (ILO) & Organisation for Economic Co-operation and Development (OECD). (2018). Approaches to anticipating skills for the future of work. International Labour Organization. <https://www.ilo.org/publications/approaches-anticipating-skills-future-work>

¹² International Labour Organization. (2023). The ILO strategy on skills and lifelong learning 2030. International Labour Organization. <https://www.ilo.org/publications/ilo-strategy-skills-and-lifelong-learning-2030>

¹³ <https://www.desma.de/en/machines/direct-soling/>

¹⁴ MyShyft. (2025). Dynamic Shift Scheduling: What It Is and Why It Matters. MyShyft., <https://www.myshyft.com/blog/dynamic-shift-scheduling/>

3.5 Compliance

Modern international market entry is strictly contingent upon verifiable compliance with evolving environmental, social, and corporate governance (ESG) frameworks. Regulatory mandates—such as the European Union’s Corporate Sustainability Due Diligence Directive (CSDDD) and Ecodesign for Sustainable Products Regulation (ESPR)—legally obligate footwear brands to ensure full traceability throughout their supply chain, from raw material extraction to final assembly¹⁵.

Production planners must embed these compliance checkpoints directly into their material requirements planning (MRP) systems. An internal purchase order (N.E.I.) can no longer be released to the factory floor unless the upstream component suppliers (e.g., tanneries, chemical suppliers, out-sole moulders) have cleared verified socio-environmental audits.

¹⁵ Retraced. (2025, February 27). Footwear supply chain strategies for a more resilient future. <https://www.retraced.com/blogs/magazine/footwear-supply-chain-strategies-for-a-more-resilient-future#:~:text=Alongside%20ESPR%2C%20brands%20must%20prepare,end%E2%80%91of%E2%80%91life%20treatment.>

4 Digitalisation in Production Planning

4.1 New Era of Robots

The integration of advanced robotics marks the transition of the footwear sector from a labour-intensive craft to an automated, high-precision industry. Historically, operations like leather roughing, cementing, and complex upper stitching resisted automation due to the non-rigid, variable nature of natural materials. Today, vision-guided robotic arms equipped with 3D scanners dynamically adapt toolpaths to process flexible materials with sub-millimeter precision (SATRA Technology, 2021, Heley Adhesive, 2025).¹⁶¹⁷

A prominent industrial application of this paradigm is the Advanced Shoe Factory 4.0 (ASF 4.0)¹⁸ in the Auvergne-Rhône-Alpes region of France. Established as a highly automated manufacturing unit by Chamatex alongside shareholders Babolat, Millet, and Salomon, ASF 4.0 utilizes robotic assembly lines to manufacture technical sports footwear locally. By automating complex assembly phases, the facility achieves the cost-competitiveness required to compete with traditional Asian manufacturing hubs, while reducing the production lifecycle and enhancing regional responsiveness.

4.2 Artificial Intelligence (AI)

The Volatility of Modern Footwear Demand

Traditional supply chain planning frameworks heavily rely on historical moving averages, autoregressive integrated moving average (ARIMA) models, or basic support vector machines (SVM) to project future inventory needs. However, the footwear and apparel industry operates under extreme volatility characterized by incredibly short product lifecycles, highly fickle consumer preferences, and sudden digital trend spikes. Traditional deterministic planning frameworks routinely collapse during sudden macroeconomic shifts or large-scale market disruptions because they assume a linear or stable continuity of past patterns. When these baseline models fail, manufacturers face a costly double-edged sword: massive overstocks that force steep retail markdowns, or severe stockouts that result in lost revenue and degraded brand loyalty. Industry data indicates that shifting from these legacy systems to advanced AI-driven forecasting can reduce overall supply chain errors by 20% to 50% while simultaneously mitigating lost sales due to out-of-stock scenarios by up to 65% (McKinsey, 2023)¹⁹.

Decoding EL-ANFIS: Blending Neural Networks with Fuzzy Logic

To navigate these stochastic uncertainties, modern planning frameworks implement advanced machine learning architectures, most notably the Enhanced Adaptive Neuro-Fuzzy Inference

¹⁶ SATRA Technology. (2021). The shoe factory of the future? SATRA Bulletin. <https://www.satra.com/bulletin/article.php?id=2675>

¹⁷ Heley Adhesive. (2025, September 27). The meaning of robotics in footwear production: Unveiling. Heley – Shoes and Leather Adhesive Solutions. <https://heleyadhesive.com/unveiling-meaning-of-robotics-in-footwear-production/>

¹⁸ Salomon. (2021, October 12). First automated footwear factory opens in France. Salomon. <https://www.salomon.com/en-us/sg/a/first-automated-footwear-factory-opens-in-france>

¹⁹ McKinsey & Company. (2022). AI-driven operations forecasting in data-light environments. <https://www.mckinsey.com/capabilities/operations/our-insights/ai-driven-operations-forecasting-in-data-light-environments#/>

System (EL-ANFIS). As demonstrated by Vyas and Jain (2025)²⁰, the EL-ANFIS framework successfully merges the pattern-recognition capabilities of artificial neural networks (ANNs) with the approximate reasoning capabilities of fuzzy logic. While traditional neural networks require massive, rigid datasets, the fuzzy logic component allows the system to process qualitative, highly variable inputs - such as shifting digital consumer trends, macroeconomic indicators, and historical weekly sales metrics - by utilizing linguistic variables and membership functions. The underlying architecture relies on a multi-layered structure (typically involving fuzzification, rule evaluation, firing strength normalization, and defuzzification layers) to map complex, non-linear demand patterns. By capturing these intricate variables, the system accurately forecasts model-level and size-level variations in shoe demand with up to 99% accuracy, allowing manufacturers to close inventory gaps before they result in financial loss (Vyas & Jain, 2025)²¹.

Dynamic Production Scheduling and the Bullwhip Solution

The true operational value of these precision forecasts is realized when they are directly synthesized into master production schedules (MPS) and execution-ready dynamic scheduling frameworks. In a multi-tiered supply chain, a minor fluctuation in consumer demand at the retail level can amplify drastically as it moves upstream toward material suppliers, a disruptive phenomenon known as the bullwhip effect. By leveraging real-time, AI-driven demand data, manufacturing facilities can pivot from rigid daily or weekly planning cycles to highly flexible, intra-day dynamic scheduling. This granular visibility enables production planners to align shop-floor capacities, labour availability, and raw material logistics directly with localized demand signals. Consequently, firms can systematically minimize warehouse safety stocks, optimize asset utilization, and establish a resilient buffer against systemic risks. As highlighted by Rinaldi et al. (2022)²², the integration of such advanced quantitative models is paramount for modern supply chain risk management, providing the operational agility necessary to absorb catastrophic macro-environmental shocks and pandemic-driven supply constraints without destabilizing the enterprise.

²⁰ Vyas, A., & Jain, S. (2025). An AI Enabled Framework for Accurate Shoe Demand Forecasting and Supply Chain Optimization Using Enhanced Adaptive Neuro Fuzzy Inference System (EL ANFIS). *Smart Moves Journal Ijoscience*, 11(2), 19–29. <https://ijoscience.com/index.php/ojsscience/article/view/545>

²¹ Ibid.

²² Rinaldi, M., Murino, T., Gebennini, E., Morea, D., & Bottani, E. (2022). A literature review on quantitative models for supply chain risk management: Can they be applied to pandemic disruptions? *Computers & Industrial Engineering*, 170, Article 108329. <https://pmc.ncbi.nlm.nih.gov/articles/PMC9197564/pdf/main.pdf>

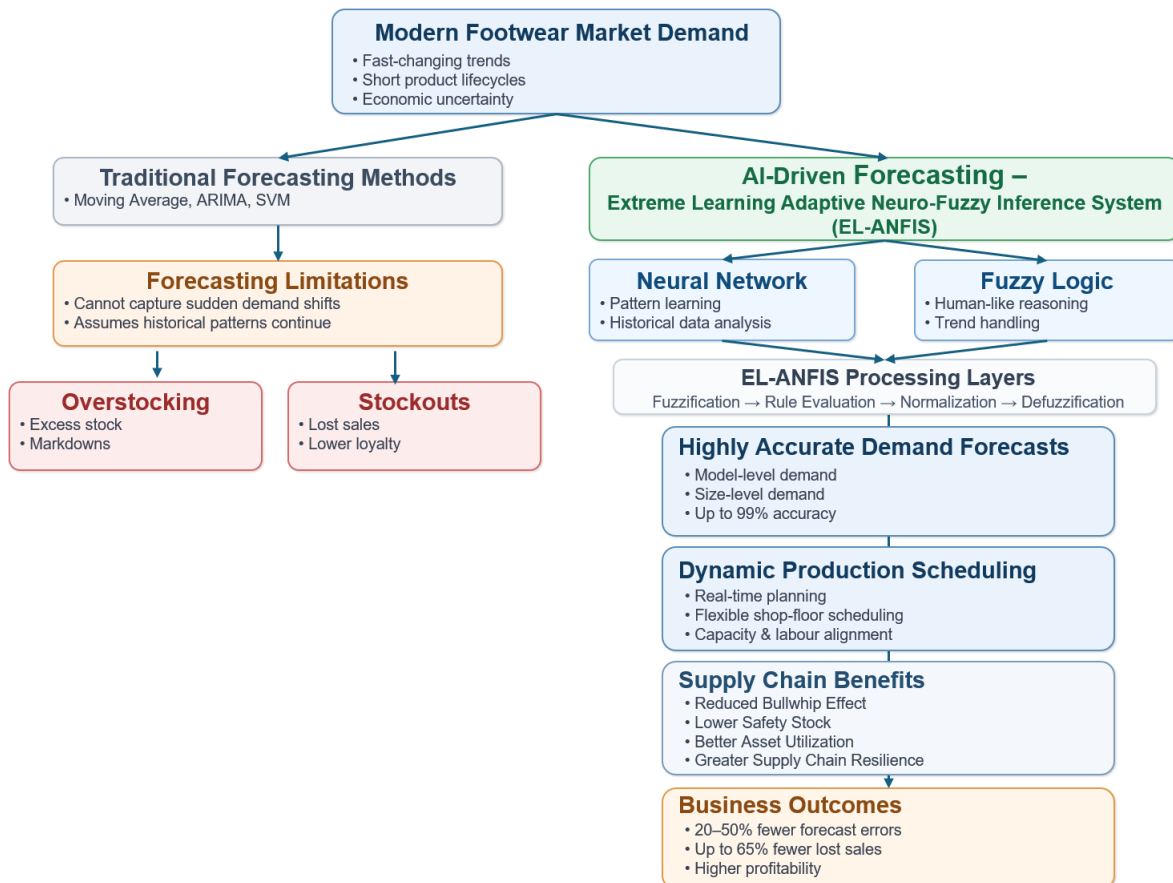


Fig. 3: EL-ANFIS Flowchart: From Market Volatility to Better Footwear Decisions. How AI-driven forecasting improves demand prediction, production planning, and supply chain performance, ©PFI.

4.3 Big Data

Industrial internet-of-things (IIoT) sensors distributed across modern cutting, sewing, and assembly lines generate a continuous stream of operational big data. By aggregating real-time parameters—such as machine cycling times, tool temperatures, and operator handling speeds—planners gain absolute visibility over shop floor execution.

Big data analytics platforms continuously parse these streams to cross-examine the classic 3M indicators (Men, Machines, Methods). Rather than conducting retrospective, end-of-day productivity reviews, planners deploy predictive algorithms that detect subtle cycle-time drifts. This allows them to identify emerging line bottlenecks and calculate live line balances before significant manufacturing delays occur.

The use of Big Data for “Predictive Maintenance” can be read in detail in the Quality Control Manual.

4.4 3D Printing

Additive Manufacturing, or 3D printing, has fundamentally restructured the economics of product customization and small-series manufacturing plans (MPs). In conventional manufacturing, producing a new outsole design requires high capital investments in custom metal injection moulds and cutting dies, which forces long development cycles and massive minimum order quantities.

By adopting industrial 3D printing systems, manufacturers can bypass tooling limitations entirely. Planners can print complex components, such as elastomeric midsoles featuring highly intricate variable lattice geometries, directly from digital computer-aided design (CAD). This eliminates tooling lead times, reduces raw material scrap rates, and allows the economic manufacturing of customized or single-pair batches within a standard industrial production framework.

4.5 Combination of Digitalisation and Sciences

The convergence of advanced digital technologies with material and biomechanical sciences has enabled the automation of the entire product engineering pipeline. Through the integration of 3D biometric foot scanning, cloud-based orthotic algorithms, and finite element analysis (FEA), raw biological data is seamlessly translated into functional industrial designs.

When a consumer's unique foot structure is digitally mapped, FEA algorithms simulate localized stress profiles to automatically adjust the density profile of a shoe's structural components. The production planning software ingests this scientific data to automatically output exact material recipes, customized toolpaths, and automated machine programs, eliminating manual intervention from the initial order to final product verification.

4.6 Virtual and Augmented Reality

Virtual Reality (VR) and Augmented Reality (AR) have evolved into practical, high-utility tools within modern footwear production facilities. During the initial design-to-manufacturing handoff, global engineering teams utilize immersive VR environments to evaluate digital prototypes, drastically reducing the time and material waste associated with physical sample rounds.

On the live production floor, operators equipped with industrial AR headsets receive real-time, spatial guidance for complex setup adjustments and equipment changeovers. Furthermore, if a bottleneck or mechanical failure occurs on an automated assembly line, remote technical specialists can use AR annotation overlays to guide local maintenance staff through diagnostic and repair workflows, safeguarding continuous factory throughput.

Additionally, the implementation of digital twin technology can support production planning and management. More on the topic of Digital Twins can be found in the STEM Manual.

5 Sustainability in Production Planning

5.1 Green awareness

Broadening global ecological awareness has shifted sustainability from a voluntary marketing position to a mandatory industrial operational criterion. End-consumers and regulatory bodies increasingly evaluate manufacturers based on comprehensive Life Cycle Assessment (LCA) data, tracking metrics like total carbon equivalents emitted per pair produced ($\text{kg}\backslash\text{CO}_2$) (Quantis, 2018).²³

For production planners, green awareness requires the systematic integration of carbon accounting directly into standard ERP architectures. When generating manufacturing schedules, planners must evaluate carbon footprints alongside traditional metrics like processing costs and labour hours. This operational shift prioritizes regional material sourcing and carbon-optimized logistics paths to meet strict corporate and regulatory emissions caps.

5.2 Sustainable design & circular economy

An idea for a production planning shift could be to focus on high quality shoes, designed for repairability and to integrate cooperations with cobblers or self-managed repair shops into the whole product life cycle. With this approach customers can rely on the products longevity and serviceability and thus stay loyal to the brand.

Production facilities can also be fitted for repairs from the beginning or shift towards the latter when orders for new products decline and customer repair requests stay frequent.

Adopting a circular economy framework requires a fundamental departure from the traditional linear "take-make-waste" industrial model. Standard footwear production presents severe recycling challenges because a single shoe often consists of up to 65 distinct components bonded together with permanent, toxic chemical adhesives (Dissanayake & Weerasinghe, 2021).²⁴

To achieve circularity, modern production planning relies heavily on the principles of Design for Assembly (DfA) and Design for Disassembly (DfD).

Modern sustainable can utilize mono-material inputs (such as 100% Thermoplastic Polyurethane) paired with glueless mechanical interlocking mechanisms or snap-fit assemblies. This process can also be achieved by 3D printing components or even entire shoes.

This structural architecture allows the entire shoe to be mechanically ground down and re-inserted into the raw material stream at its end-of-life state without prior chemical separation. Planners must structure complex reverse logistics pipelines and remanufacturing schedules to manage this incoming stream of recycled feedstock alongside virgin material inventories (Ghimouz et al., 2023)²⁵.

²³ Quantis. (2018). Measuring fashion: Environmental impact of the global apparel and footwear industries study. Refashion. <https://media-pro.refashion.fr/2025/10/measuring-fashion-environmental-impact-of-the-global-apparel-and-footwear-industries-study.pdf>

²⁴ Dissanayake, D. G. K., & Weerasinghe, D. (2021). Towards circular economy in fashion: Review of strategies, barriers and enablers. *Circular Economy and Sustainability*, 1-21.

²⁵ Ghimouz, C., Kenné, J. P., & Hof, L. A. (2023). On sustainable design and manufacturing for the footwear industry – Towards circular manufacturing. *Materials & Design*, 233, Article 112224. <https://doi.org/10.1016/j.matdes.2023.112224>

5.3 Energy and Process Efficiency

Optimizing energy and process efficiency on the factory floor is an effective mechanism for simultaneously reducing operational overhead and corporate environmental footprints. Heavy manufacturing equipment, such as vulcanization ovens and injection moulding systems, represent significant baseload energy consumers.

Planners optimize process efficiency by deploying advanced nesting software algorithms that dynamically arrange pattern pieces across raw leather hides or synthetic rolls, maximizing material utilization and reducing landfilled scrap. Furthermore, production schedules are strictly optimized to group high-energy processing cycles sequentially. This prevents the energy-intensive cooling and reheating cycles of industrial machinery, maximizing thermal efficiency and aligning shop floor execution with modern, lean manufacturing principles.

Additional information on efficient energy usage can be found within the STEM manual.

6 Case study and Project Work

6.1 Case Study

This case study is based on real-life experiences and typical situations encountered in business practice; however, it has been compiled into a fictional case study and anonymised. Names, company details, key figures and specific events have been altered so that the companies and individuals involved cannot be identified.

Planning Through Disruption

A future-ready production-planning strategy for a footwear manufacturer

Company Background

VelaStep Footwear is a medium-sized European footwear manufacturer specialising in casual and outdoor footwear for retail customers across Europe. The company employs 420 people at its assembly site in Portugal and works with component suppliers in Portugal, Turkey, China and Vietnam. Its annual production volume is approximately 1.6 million pairs.

VelaStep competes through dependable delivery, attractive design and a mid-market price point. The company operates with two seasonal collections, but its customers increasingly expect shorter lead times, smaller repeat orders and greater flexibility. Although VelaStep uses an ERP system, several important planning data sets are still maintained in spreadsheets and exchanged through e-mail. As a result, planners do not always have a consistent and up-to-date view of material availability, production progress and supplier status.

For the upcoming Spring/Summer season, the company plans three main product families: the TrailLite 200 outdoor shoe, the CityFlex 110 casual sneaker and the CoastWalk 60 sandal. CityFlex 110 is expected to be one of the key commercial products of the season. It uses a synthetic upper, textile lining and TPR outsole and has an original volume plan of 180,000 pairs.

A Changing Production Situation

It is early September, and VelaStep has eight weeks to finalise its production plan for the Spring/Summer season. Following a sales meeting, the commercial outlook changes significantly. Demand for CityFlex 110 increases by 35,000 pairs, while the expected volume for TrailLite 200 is reduced by 25,000 pairs.

At first sight, the revised demand could appear manageable. However, several operational issues make the decision more complex. The TPR outsole supplier can meet the revised CityFlex demand only through a split production schedule. This would create additional handling, longer lead times and less buffer in the outsole warehouse. At the same time, the CityFlex upper construction already creates a bottleneck in stitching, while assembly-line absenteeism has increased from 4% to 9% during the last month. Actual line output is therefore only 910 pairs per day, compared with a planning standard of 1,050 pairs per day.

VelaStep's operational KPIs also show that the company is under pressure. On-time delivery has fallen to 88%, below the target of 95%, while schedule adherence has dropped to 81%. First-pass quality is also below target, with rework particularly concentrated on the CityFlex upper attachment. Finished-goods inventory is high for TrailLite but low for CityFlex, illustrating that the

company has stock in the wrong place while facing shortages in the product family with growing demand.

A Material Decision Under Pressure

While the planning team is trying to stabilise the CityFlex production plan, the commercial and sustainability teams raise an additional question. A new synthetic upper material with recycled content is available for CityFlex. The material could support VelaStep's sustainability ambitions and potentially improve the material profile of the product.

However, the decision cannot be based on recycled content alone. The new upper has a production lead time that is two weeks longer than the existing material. Wear, bonding and chemical-compliance checks have not yet been completed, and the supplier has not confirmed whether it can provide consistent primary data for the material footprint. The production team also expects that the new material may require different bonding parameters and an additional trial run.

VelaStep therefore faces three possible options. It can continue with the existing upper material, which has validated quality and a stable lead time but does not offer an improvement in material content. It can run a controlled pilot for 20,000 pairs, generating quality, process and data evidence before scaling up. Alternatively, it can immediately switch the full CityFlex programme to the new material, which could increase recycled content at scale but would create substantial risk for delivery reliability, product performance, data credibility and production stability.

The Decision

VelaStep's Operations Director must now decide how the company should protect delivery performance in the short term while building a more resilient and future-ready production-planning system for the longer term.

The decision must consider the revised customer demand, constrained supplier capacity, reduced actual line output, incomplete material approval and inconsistent planning data. It must also define how VelaStep should improve collaboration between Production Planning, Sourcing, Quality, Product Development, Sustainability and suppliers.

If you were part of the VelaStep production-planning task force, would you prioritise immediate delivery protection, a controlled pilot of the new material or a full material switch? Which operational risks require immediate action, and which structural improvements should VelaStep implement over the next 12 months to improve data quality, planning reliability and production resilience?

6.2 Structure of the project work

1. Assignment Title

Developing a Future-Ready Production Planning and Control Strategy for a Footwear Manufacturer.

2. Assignment Purpose

This project assesses your ability to analyse the future readiness of a footwear manufacturer's production planning and control (PPC) system. Students will evaluate how emerging trends are likely to influence production planning over the coming years and develop a strategic roadmap to increase resilience, flexibility, competitiveness, and sustainability.

Rather than focusing solely on today's production planning methods, the project emphasizes anticipating future developments, evaluating risks and opportunities, and proposing appropriate strategic responses.

3. Task Description

You are acting as a production planning consultant for a footwear manufacturer that wants to prepare its production system for future challenges.

Your task is to analyse the current production planning approach and develop recommendations that ensure the company remains competitive over the next **5–10 years**. Your work must include:

Current Situation Analysis

- Brief description of the company's production system and value chain
- Identification of the current production planning approach
- Definition of relevant production planning KPIs (e.g. delivery reliability, lead time, inventory, capacity utilisation, OEE)

Future Trend and SWOT Analysis

Analyse how **globalisation, digitalisation and sustainability** are expected to influence production planning. Conduct a SWOT analysis for the company's production planning system considering future developments. The SWOT should identify:

- Strengths
- Weaknesses
- Opportunities
- Threats

and discuss how future trends influence each category.

Risk Assessment

Identify the most significant future risks for the production planning system. For each risk, evaluate:

- likelihood
- potential impact
- mitigation measures

Possible risks include:

- supply chain interruptions
- labour shortages
- volatile customer demand
- cyber security threats
- increasing sustainability regulations
- rising energy prices
- dependence on critical raw materials

Strategic Improvement Plan

Develop a future-oriented production planning strategy that addresses the identified risks and opportunities. Your recommendations should explain:

- which technologies should be introduced;
- how production planning should evolve;
- how organisational structures and workforce competencies should change;
- how sustainability should be integrated into planning decisions;
- how resilience and flexibility can be increased.

4. Deliverables

- Overview of the footwear production planning system
- Production planning KPI summary
- Future trend analysis
- SWOT analysis
- Risk assessment matrix
- Strategic roadmap with recommended improvement measures
- Final conclusions and recommendations

5. Expected Learning Outcomes

Students will be able to:

- Understand production planning and control in the footwear industry
- Analyse how future developments affect production planning systems
- Perform a strategic SWOT analysis
- Assess operational and strategic risks
- Develop future-oriented production planning strategies
- Integrate digitalisation, sustainability and globalisation into production planning
- Recommend practical measures to improve resilience, flexibility and competitiveness

6. Grading Criteria

Criterion	Description	Points
Current Production Planning Analysis	Understanding of the existing production planning system, processes and KPIs	15
Future Trend Analysis	Quality of analysis of globalisation, digitalisation and sustainability and their impact on production planning	20
SWOT Analysis	Identification and evaluation of strengths, weaknesses, opportunities and threats	20
Risk Assessment	Identification, evaluation and prioritisation of future risks, including mitigation measures	20
Strategic Improvement Plan	Feasibility, innovation and justification of proposed future production planning strategy	15
Clarity & Structure	Logical structure, readability and professional presentation	5
Presentation Quality	Effective use of tables, figures, SWOT matrix, risk matrix and oral presentation	5

Tab. 3: Grading Criteria

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