A Work Project, presented as part of the requirements for the Award of a Master's degree in Management from the Nova School of Business and Economics.

Development of an Assetless Internationalization Plan for 3DWAYS – Inside-out status-quo analysis of 3DWAYS

STUDENT FULL NAME

Dominic Frehner (59966)

Work project carried out under the supervision of:

Miguel Pita

17/12/2024

ABSTRACT

This thesis develops an internationalization strategy for 3DWAYS, a Portuguese supply chain management company, to expand into niche markets in Europe's sustainable manufacturing sector. Utilizing an assetless model, 3DWAYS provides tailored solutions to clients addressing supply chain transparency, efficiency, and sustainability challenges. Combining internal and external analysis and competitive insights, Germany and the UK are identified as target markets in the medical technology and smart home niches. A go-to-market strategy details positioning, partnerships, and marketing initiatives, concluding in an implementation roadmap. A financial impact assessment quantifies incremental profits, offering actionable insights to establish 3DWAYS as a European supply chain intermediary.

Keywords: Internationalization, Market Selection, Go-to-market Strategy, Financial Impact

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209).

0. CONTEXT – GROUP PART

0.1 Introduction

In today's global economy, resilient and innovative *Supply Chain Management* (SCM) is vital for competitive success, especially amid disruptions like geopolitical tensions and sustainability demands. 3DWAYS, a Portuguese company, addresses these challenges by offering its clients sustainable manufacturing and supply chain solutions, thereby providing a hands-on end-to-end service ranging from material sourcing, supplier selection, and production supervision to project management and product development. It does so by acting as an intermediary between hardware-selling firms (its clients) and suppliers or manufacturers while leveraging an asset-light business model. Having built a broad supplier network over time, 3DWAYS provides transparent, resilient, and sustainable services to firms of all kinds of sizes from industries such as medical devices, consumer electronics, and micro-mobility.

The core of 3DWAYS' business model is built around mediating between corporations – 3DWAYS' clients – and a robust network of suppliers, focusing on sustainable sourcing, procurement, and manufacturing practices while implementing supply chain optimization measures without engaging in prototyping or direct manufacturing itself. By outsourcing production to the most suitable supplier partners and overseeing the end-to-end supply chain, 3DWAYS ensures efficiency and sustainability while reducing costs for its clients.

3DWAYS, currently active in Portugal, aims to scale its operations across Europe through an assetless internationalization strategy. This thesis develops a strategic roadmap by analyzing market opportunities, competitive landscapes, and industry trends in key European countries. It evaluates 3DWAYS' internal capabilities and external conditions to provide actionable insights on segment targeting and market entry, positioning 3DWAYS as a relevant manufacturing and supply chain intermediary in the chosen niches.

0.2 Project structure and scope

As *Figure 1* outlines, this thesis is structured into five phases, beginning with an internal assessment of 3DWAYS' current operational strengths and weaknesses, followed by an external analysis of its macroeconomic business environment, market conditions, and competitive landscape. Subsequently, a shortlist of potential countries and industries for market entry is identified, setting the foundation for a targeted *Go-To-Market* (GTM) and positioning strategy for the selected market segments. Eventually, a financial potential assessment is conducted that illustrates the viability of this expansion plan.

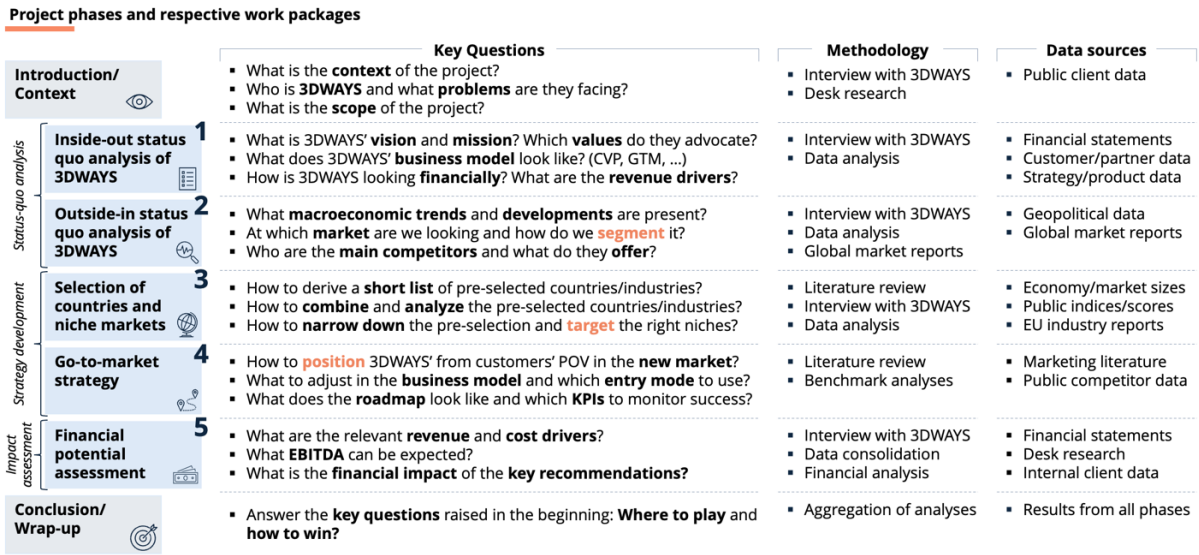

Figure 1: Project structure and respective work packages

The research draws on primary and secondary data, incorporating insights from client interviews, financial data, and industry benchmarks as well as literature reviews, ensuring a robust and evidence-based approach. By systematically evaluating 3DWAYS' potential for European expansion, this thesis aims to offer a roadmap that aligns with the company's mission of fostering sustainable manufacturing practices as well as efficient and resilient supply chains for its customers.

This project analyzes key internal and external factors for 3DWAYS' European expansion. Objectives include assessing current capabilities, analyzing market landscapes, selecting target countries and industries, and developing a GTM strategy with financial recommendations for a

profitable entry. The scope is limited to status-quo analysis, strategic planning, and an impact assessment, excluding certain activities.

Specifically, the project excludes significantly adjusting the current services offered, designing new service offerings, and considering countries or industries outside of Europe. It also does not cover the actual implementation or long-term monitoring of the proposed market entry strategy. Having a clear definition of the scope ensures that the project remains targeted and achievable within the given timeframe and resources, focusing solely on strategic situation analysis, internationalization strategy development, implementation and monitoring planning to support 3DWAYS' European market entry aspirations.

0.3 Target picture

The solution framework for 3DWAYS' internationalization strategy, as demonstrated in *Figure 2*, shows how the five phases build upon and interlock with each other, each contributing to a comprehensive plan aimed at achieving profitable market entries in selected European niche markets. This structure enables a systematic exploration of critical decision points – *"Where to play"* and *"How to win"* – by leveraging 3DWAYS' resources and capabilities as well as its assetless model within the European context.

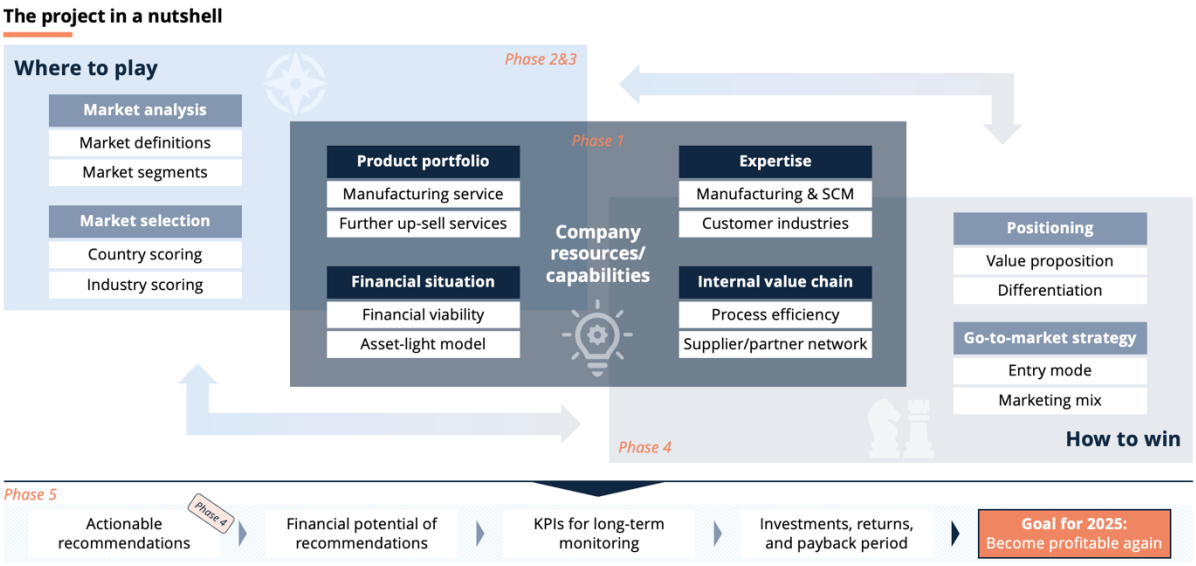

Figure 2: Solution framework for 3DWAYS' assetless internationalization plan

The first phase focuses on evaluating 3DWAYS' internal resources and core competencies, including its product portfolio, expertise in industries like medical devices and consumer electronics, its asset-light business model, and internal value chain. Moreover, its financial statements from past periods are analyzed to gain a better understanding of the firm's current financial situation. This analysis identifies strengths and areas for improvement, forming the foundation for aligning internal capabilities with the external environment in the GTM strategy.

Phases two and three focus on identifying *"Where to play"* by first analyzing and segmenting markets in scope before scoring potential European markets and industries based on quantitative and qualitative criteria. Phase two assesses macroeconomic opportunities and defines key segments, while phase three evaluates their attractiveness based on criteria such as market potential, industry fit, and cultural distance. This approach yields a shortlist of target segments aligned with 3DWAYS' strengths and strategic goals.

Phase four focuses on *"How to win"* by developing a tailored GTM strategy for the selected segments. It emphasizes strategic positioning, demand-generation strategies, and different entry modes. The plan includes building partnerships and distribution channels to overcome trust barriers, secure initial contracts, and establish a long-term market presence. Finally, an implementation roadmap and a risk assessment analysis are provided.

The final phase evaluates the internationalization plan's financial potential through revenue, cost, and profitability projections supported by scenario and sensitivity analyses to ensure robust financial targets.

At an overall level, these interconnected phases aim to achieve 3DWAYS' overarching objective of becoming profitable by the end of 2025 through successful expansion into at least two strategically selected European niche markets. Each phase is built upon the insights derived from previous stages, forming a cohesive, evidence-based roadmap that aligns with 3DWAYS' mission to facilitate efficient, resilient, and sustainable supply chain solutions across Europe.

1. INSIDE-OUT STATUS-QUO ANALYSIS OF 3DWAYS – DOMINIC FREHNER

In this chapter, an internal analysis was conducted to provide a comprehensive understanding of 3DWAYS, focusing on the company's mission, capabilities, resources, and current activities, to assess how well it is positioned to leverage market opportunities. This analysis builds the foundation for the external market analysis and allows for the selection of the right market segments to target in line with 3DWAYS' mission, service offering, and value proposition.

1.1 Overview

This subsection aims to define who the company is, by outlining its mission and highlighting the core values that guide its operations.

1.1.1 Mission

3DWAYS (2024g) states that its mission is built on the core principle of empowering the inventor in everyone, to bring innovative and impactful products to market in a faster and smarter way. To achieve this, 3DWAYS aims to streamline the process for those looking to bring their innovations to the market, providing support through all stages of product development, from concept to launch. 3DWAYS' mission is supported by three main pillars: *(i) economic*, *(ii) social*, and *(iii) product*. The *(i)* economic pillar highlights 3DWAYS' commitment to operating in a financially responsible manner, ensuring profitable growth that creates value for its stakeholders. The *(ii)* social pillar reinforces 3DWAYS' commitment to creating a positive social impact by operating in ways that improve the quality of life locally, nationally, and globally. Lastly, the *(iii)* product pillar highlights 3DWAYS' focus on designing and manufacturing sustainable and impactful solutions for its clients (3DWAYS 2024g).

1.1.2 Vision

The company's vision revolves around conscious product development and manufacturing. 3DWAYS emphasizes minimizing both the environmental and financial impact of its clients

during the product testing phase. The company's approach includes encouraging creative engagement by providing a gamified experience for inventors, measuring the purpose and impact of inventions early in the process, and ensuring a focus on sustainable and responsible development practices (3DWAYS 2024g).

1.1.3 Values

One of 3DWAYS' core values is thinking rigorously. In other words, choosing the right approach for each client is based on reasonable thinking. It is also about getting things right and acting with urgency. 3DWAYS states that: *"[…] we want to push the world to create better products and services"* based on the processes and tools the company currently uses (3DWAYS 2024g). Finally, 3DWAYS strives to deliver impactful results and increased innovation through trusted partnerships (3DWAYS 2024g).

1.2 Business model

This subsection outlines how 3DWAYS creates, accesses, delivers, and captures value. It also provides a detailed overview of the internal value chain. To properly assess 3DWAYS' business model, Eisenmann's (2012) business model analysis framework was utilized. This framework was chosen as it addresses all critical aspects of a business – value creation, access, delivery and capture – ensuring a comprehensive and robust business overview, see *Figure 3.*

Figure 3: Business model analysis framework (based on: Eisenmann, 2012)

1.2.1 Value creation: Customer value proposition

The customer value proposition focuses on understanding the customers by identifying their specific needs, proposing suitable solutions, and defining reasonable pricing (Eisenmann 2012). 3DWAYS primarily targets large European corporations and startups operating in specialized sectors, such as medical devices, smart cities, and micro-mobility. 3DWAYS addresses several key challenges faced by its customers. One significant issue is the lack of visibility across their entire supply chain network, which leads to inefficiencies and delays. Customers also encounter difficulties in scaling their production due to a shortage of vetted and reliable manufacturers. Another critical challenge lies in optimizing the balance between cost, lead time, and quality assurance when managing multiple components of the supply chain (3DWAYS 2024c).

To address these challenges, 3DWAYS creates value by helping the client identify the most suitable manufacturing options for specific products. The company also implements structured and automated processes to help clients secure optimal prices, timelines, and quality standards, thereby maximizing their profit. Beyond these operational benefits, 3DWAYS also supports its clients in achieving their sustainability goals (3DWAYS 2024c).

3DWAYS has incorporated a pay-per-order pricing model that includes a 10% commission paid by suppliers based on client orders. Rather than paying upfront, the customer only pays for the actual quantity ordered and the manufacturer only pays 3DWAYS' commission on the quantity ordered, giving both parties flexibility. Moreover, 3DWAYS currently elaborates on whether a flexible pricing model could be more beneficial to match the manufacturer's *Willingness-to-Pay* (WTP) (see *Chapter 1.2.4* for more information) (3DWAYS 2024c).

1.2.2 Value access: Go-to-market strategy

The GTM strategy embraces the strategic set-up of distribution channels and a demand generation strategy to increase brand and product awareness and conversion rates. 3DWAYS

not only collaborates with clients[1] but also manufacturers[2], and incubators[3] to drive demand and reach new potential customers. These partnerships facilitate client outreach and generate a sense of trust among the stakeholders while allowing 3DWAYS and its partners to share resources, drive demand, and create synergies. 3DWAYS also collaborates with a certification agency called iSQ which provides technical certifications in fields like welding, non-destructive testing, electrical systems, quality management, and occupational safety, aimed at ensuring compliance, safety, and quality in high-demand industries (iSQ 2024). For some projects, 3DWAYS needs to make sure that the chosen manufacturers have these certifications to ensure that they meet the standards required by the client. However, iSQ has not brought in any client leads as they are unwilling to connect clients with 3DWAYS (3DWAYS 2024c).

Another way of reaching clients – though not fully explored yet – is using AI tools like Apollo.io to enable direct client outreach. Apollo.io is an AI-powered sales intelligence and engagement platform with over 275 million verified contacts and 93 million companies that helps businesses find prospects, automate outreach, and improve lead generation (Apollo 2024a). 3DWAYS has tried using Apollo.io to directly reach potential customers, such as via email or LinkedIn. However, using this AI-powered tool was less effective, with a conversion rate of only 1% due to untailored and overly generic AI messages. Hence, of the 3,000 people contacted, only 30 responded, of which zero became clients (3DWAYS 2024c).

To increase demand generation, 3DWAYS focuses on building relationships, offering potential clients a free analysis of their three most costly supply chain components. In many cases, these analyses reveal significant cost savings opportunities, with over 90% of cases showing improved efficiency and sustainability (3DWAYS 2024c).

[1] E.g. Siemens, Carris, Metropolitano de Lisboa, Mitsubishi etc.

[2] E.g. Simoldes for injection molding, Apametal for metal work or Codi for 3D prints

[3] E.g. Beta-I, Nova SBE Haddad Entrepreneurship Institute, Nova SBE Innovation Ecosystem, Startup Lisboa

In addition to distribution channels and demand generation, other critical factors affect 3DWAYS' ability to access new markets. Firstly, inspecting factories is an inherently time-consuming process, which can result in delays and complexities within the supply chain. For example, in a scenario where 3DWAYS grows too fast, there may not be enough suitable partner factories to meet the increased manufacturing demand from its clients. Another significant challenge is the limited number of manufacturers with the capacity to produce specific items, which constrains 3DWAYS in handling all sorts of customer requests. Finally, 3DWAYS faces the challenge of identifying reliable and efficient project managers who can execute projects in a timely and high-quality manner. Moreover, these project managers must also be well-connected to the local factories to ease the supply chain process (3DWAYS 2024c).

1.2.3 Value delivery: Technology & operations

The technology and operations part of the business model deals with 3DWAYS' internal processes, value chain, and vertical integration. There are three ways in which 3DWAYS engages with clients, but once contacted, the process from reviewing the client's document to starting the production process tends to be similar across different projects (3DWAYS 2024c).

First, there is the *"Client-to-partner outreach"* in which the customer contacts a partner (e.g., manufacturer or start-up incubator), who then connects the potential customer with 3DWAYS. Once involved, 3DWAYS reviews the documentation and contacts the client to discuss the approach. In this scenario, the client benefits from being connected directly to 3DWAYS through a trusted partner. Moreover, the partners benefit from this interaction with 3DWAYS' clients as they can foster a relationship – upon successful project completion between 3DWAYS and the client – with them that may lead to future business opportunities as the smart traffic lights project in *Chapter 1.5.1* showed (3DWAYS 2024c).

Second, there is the *"Client-to-3DWAYS outreach"* in which the client directly contacts 3DWAYS, typically via their website, to discuss project requirements. This cuts the need for a

partner as an intermediary, streamlining communication and ensuring that the client and 3DWAYS can align faster on documentation, requirements, and production. However, it is important to note that customers rarely contact 3DWAYS directly due to its low brand awareness – something that needs to be tackled in *Chapter 4* (3DWAYS 2024c).

Finally, there is the *"3DWAYS-to-client outreach"* in which 3DWAYS actively reaches potential clients using tools like Apollo.io, email, or phone. Once a client expresses interest, 3DWAYS handles the next steps, from aligning requirements to managing the production process. However, 3DWAYS often faces a trust barrier when reaching out to clients directly, as potential clients do not know 3DWAYS's capabilities yet (3DWAYS 2024c).

To better understand the entire internal value chain of the company, a flowchart was made in *Figure 4*. The entire workflow revolves around ensuring that 3DWAYS facilitates each step in the process – whether through a partner or direct outreach – with a clear process that involves reviewing documentation, selecting manufacturers, overseeing quotes, and ensuring the production is completed on time (3DWAYS 2024c).

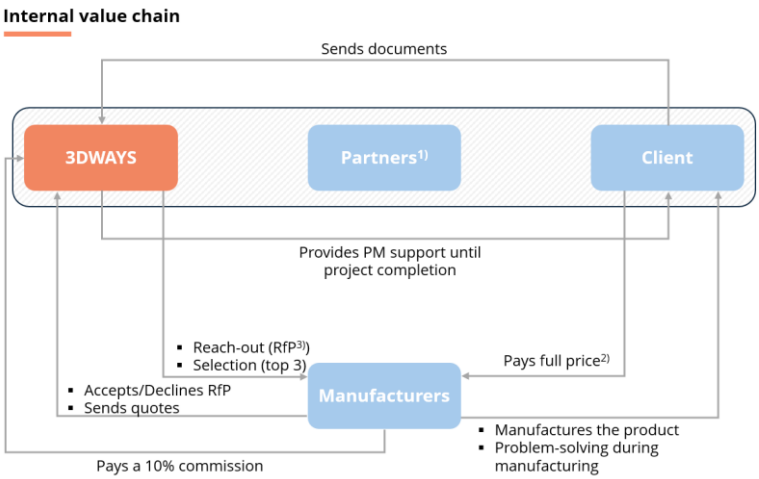

Figure 4: Flowchart of internal value chain (based on: 3DWAYS 2024b)

To provide a more detailed view, a blueprint of the manufacturing process was created, as outlined in *Figure A-1* in the appendix. In the beginning, 3DWAYS has an initial call with the potential client to agree on the approach. The client then sends the documentation (e.g., requirements and specifications) to 3DWAYS which carefully reviews them. After 3DWAYS

understands the customer's needs, it starts with selecting suitable manufacturers and sends out *Requests for Proposals* (RfP) to the manufacturers. The manufacturers can then decide whether to agree to the terms and conditions of 3DWAYS' request or not. If they deny it, the process ends. However, as 3DWAYS sends out various RfPs, usually more than one manufacturer agrees to the requests and sends the quotes (incl. price, timeline, and special conditions). As soon as 3DWAYS receives enough offers, it will then continue with selecting the manufacturer. To provide the customer with a broad range of offers, 3DWAYS usually selects three suppliers based on the following criteria: The cheapest, the fastest, and the one with the lowest risks. The three offers (incl. price and timetable) will then be presented to the client. In step 13, the customer can select the most favorable manufacturer. As soon as 3DWAYS receives the customer's approval, the respective manufacturer will be informed to start production. During the production process, 3DWAYS is kept updated by the manufacturer about the timeline and issues that may occur. Simultaneously, 3DWAYS provides project management support to its stakeholders[4] by closely tracking the milestones and resolving issues until project completion. Lastly, the final product is sent from the manufacturer to the customer (3DWAYS 2024c).

3DWAYS delivers value by ensuring its supply chain ecosystem is equipped with factories, innovation drivers such as incubators and accelerators, and on-demand specialists[5]. The company also supports the intellectual property of its customers, protecting it through non-disclosure agreements with manufacturers. In addition, depending on the confidentiality, risk, and complexity of a product, 3DWAYS ensures that only certain parts are sent to individual manufacturers. For example, if a product has five components, the manufacturer will only receive three components, thereby reducing the risk of revealing the full design, features, and functionalities. Moreover, 3DWAYS is not allowed to cross-sell customers' end-products to

[4] Manufacturers, clients, partners

[5] E.g., Material engineers, bio designers, and thermodynamic physicists

other potential clients. For example, if 3DWAYS develops a product for Siemens, it is neither allowed to sell any sketches nor the product itself to Siemens' competitors (3DWAYS 2024c).

1.2.4 Value capture: Profit formula

The last pillar of the business model, the profit formula, deals with the monetization of 3DWAYS' product and service offering and the analysis of the potential market size, considering the cost structure and profit drivers (Eisenmann 2012). 3DWAYS' profit formula is driven by a commission-based model, where – in most cases – the suppliers pay a 10% fee per order, invoiced every quarter. The customer is not liable for any supplementary costs, as the commission is remunerated by the suppliers instead of being incorporated into the customer's order price. This model encourages suppliers to collaborate with 3DWAYS, as they can circumvent the expenditures and efforts of their sales teams while still acquiring business through the company's network. The commission structure enables 3DWAYS to offer customers competitive pricing and superior solutions, thereby enhancing customer satisfaction and loyalty. However, some manufacturers have recently indicated that a 10% fee is too high, especially for large order volumes (> €30,000), and that their WTP would be closer to 5%. This complaint will be tackled and re-evaluated when introducing the GTM strategy (3DWAYS 2024c).

The business model outlined so far has focused primarily on the manufacturing services of 3DWAYS. In addition to these services, the company also offers a product development service (see *Chapter 1.3.1*). However, there are notable differences between these two service offerings in terms of how 3DWAYS drives profit. For manufacturing projects, the customer lifetime value tends to be higher than for design projects. The reason for this is that such projects usually allow 3DWAYS to benefit from recurring purchases (10% commission on a pay-per-order basis), whereas design projects are more often one-time purchases. Moreover, manufacturing projects are often more scalable, as existing resources can be used to reduce costs per unit for

each new project.

For example, 3DWAYS agreed to a small manufacturing project with Oceano Fresco that brought in only €200 in revenue. However, 3DWAYS saw a large upselling potential if it managed to convince the client of its capabilities and therefore agreed to this rather unusual, small project. Since the client was very satisfied with 3DWAYS' manufacturing project, both parties signed an add-on contract for a design project of around €80k. Therefore, manufacturing projects serve as a trust mechanism between the client and 3DWAYS in order to sign larger contracts after the client is satisfied with the initial product (3DWAYS 2024c).

On the contrary, design projects tend to have higher margins, but also higher risks, such as problems that may arise during the project (e.g. unclear/changing design requirements, designs may not be feasible for production, cost overruns, scarcity of materials, etc.) (3DWAYS 2024c).

Additionally, some manufacturers prefer not to work with 3DWAYS through the standard commission-based model where they would need to pay a commission. Instead, these manufacturers choose a model where 3DWAYS pays them directly and then invoices the client afterward. This means that the whole transaction structure between 3DWAYS, the manufacturer, and the customer changes fundamentally and requires a lot of flexibility, especially for 3DWAYS. The reason why some manufacturers choose this model is that they are used to only doing business where they are paid upfront and are reluctant to change their existing process as it would create challenges in their vendor management. As of now, they provide 3DWAYS with the client's quarterly financial statements from which 3DWAYS then invoices the agreed percentage (3DWAYS 2024c).

Moving on from the monetization model to 3DWAYS' cost structure, dividing it into fixed and variable costs, in 2023, 62% of the total costs were fixed personnel expenses plus *Depreciation and Amortization* (D&A), whereas 38% were variable *Cost of Goods Sold* (COGS) plus external

services[6], (see *Chapter 1.4.2, Figure 7* for more details) (3DWAYS 2024c). If 3DWAYS can turn around its high fixed costs, it can achieve a lean operating model that allows for better scalability and cost control as the company grows.

In summary, 3DWAYS' business model emphasizes optimizing clients' supply chains for agility, efficiency, and sustainability, offering a highly customized service to customers that helps them meet their operational and environmental goals.

1.3 Product portfolio

This section examines the product range offered by 3DWAYS and analyzes the structure of the company's product strategy. It also evaluates the products quantitatively to gain a better understanding of their revenue contribution and importance to the company.

1.3.1 Qualitative portfolio analysis

3DWAYS' current offer focuses on two services, *(i) manufacturing* and *(ii) product development*, while the previously offered *prototyping* service has been discontinued due to low margins. The *prototyping* service was primarily focused on providing 3D printed products produced in 3DWAYS' prototyping factory. The company also offers *(iii) other products*, a smaller residual part of its offering that includes machine sales, shipping, and others. Moreover, it is important to note that 3DWAYS has recently selected *manufacturing* as its core business while *product development* and *other products* are intended to be additional up-selling services to existing clients who have already purchased the manufacturing service (3DWAYS 2024c).[7]

Starting with 3DWAYS' main service offering *(i) manufacturing*, the company helps clients achieve sustainable, efficient, and automated production and supply chain management processes. The service starts with the material selection phase, in which the most appropriate

[6] The categorization of fixed and variable cost was based on assumptions since no cost accounting (direct costing) system is available/used by 3DWAYS.

[7] The internationalization plan primarily focuses on the manufacturing service. The other two offerings, especially product development, can be seen as up-selling options.

materials are selected based on the specific requirements of the product in question. This is followed by the sourcing phase, aimed at sourcing the necessary electronic and mechanical components. Finally, process selection ensures that appropriate production methods are used to achieve maximum efficiency with the highest sustainability standards. In the subsequent phase, 3DWAYS takes responsibility for ensuring the smooth operation of supply chains, and meeting quality standards and deadlines while increasing transparency. The use of decentralization is demonstrated by the adoption of near-shore production to increase flexibility and reduce supplier dependency and costs. The final assembly and quality assurance stage ensures that the final product meets the required quality and assembly standards (3DWAYS 2024a).

As mentioned before, 3DWAYS' second service offering called *(ii) product development* – though more intended to be a potential upsell service – facilitates the transformation of initial concepts and product ideas into fully developed products. This is achieved by providing the essential 3D models, drawings, and documentation required to efficiently manufacture and certify the final product. The development process begins with a requirements analysis that addresses the business and technical needs of the project. This is followed by the gathering of user insights through user experience research, which then informs subsequent design refinements. In the ideation and sketching phase, 3DWAYS produces the initial design concepts. Product design then further optimizes these concepts for manufacturability. In the next step, the user experience testing uses focus groups to validate the effectiveness of the design. Finally, the documentation phase supports investment and certification, ensuring compliance with regulatory and quality standards for market readiness (3DWAYS 2024a).

1.3.2 Quantitative portfolio analysis

Moving now from the qualitative product portfolio assessment to the quantitative analysis, 3DWAYS' product portfolio reveals significant shifts in the relative share of revenue generated by the four offerings: Prototyping, manufacturing, product development, and other products.

From 2022 to 2024, there is noticeable volatility in each product's contribution to total revenue, as seen in *Figure 5* (3DWAYS 2024f).

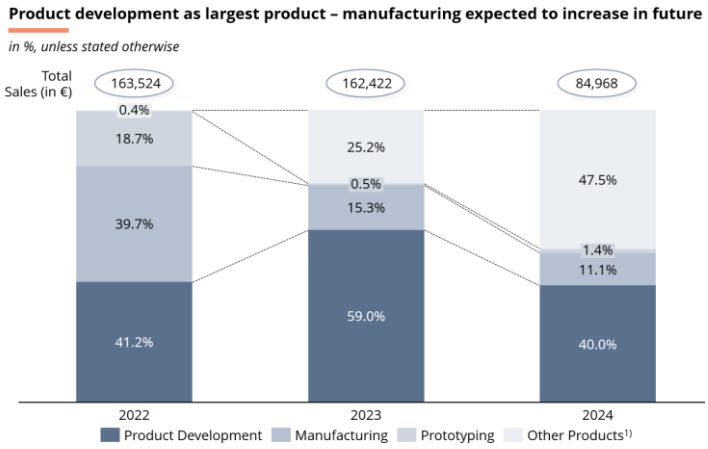

Figure 5: Revenue split by product (based on: 3DWAYS 2024f)

In 2022, product development accounted for 41.2% of total revenues, manufacturing for 39.7% and prototyping for 18.7%, with only a minimal contribution from other products. In 2023, however, product development's share increased significantly to 59%, while manufacturing fell to 15.3% and prototyping dropped to 0.5%, reflecting 3DWAYS' decision to discontinue the latter service. In 2024, product development continues to dominate, accounting for around 40% of total revenues, while manufacturing accounts for only 11.1%. Other products such as standardized products, machine sales, or shipping are not relevant to this project, nevertheless, this rubric represents a significant share in 2024 of 47.5%. Although the share of manufacturing revenue declined from around 40% in 2022 to 20% in 2024, it is expected to rise again due to the strategic realignment to focus on the manufacturing service as 3DWAYS' core business and the assetless shift starting in 2025 (3DWAYS 2024f). The assetless shift will be discussed in more detail in the following *Chapter 1.4*.

In general, the high volatility of the shares per segment is mainly due to the high dependence on large projects which will be further elaborated on in *Chapter 1.5*. However, the strategic decision to discontinue the prototyping service while declaring the manufacturing service as the future core business contributed a lot to the volatility as well (3DWAYS 2024f).

1.4 Financial analysis

The purpose of this subsection is to explain how 3DWAYS' revenues and costs have developed over time and to provide an in-depth analysis of the EBITDA margin to get a clearer picture of 3DWAYS' profitability. In addition, this chapter will discuss the assetless model and its impact on 3DWAYS' profitability and business strategy. In order to gain a better understanding of 3DWAYS' core business, all non-core items such as "other income" have been removed and an income statement and balance sheet have been prepared for both the core and non-core businesses. The reformulated statements are shown in *Figure A-2* in the appendix.

Assessing 3DWAYS' financial situation and resources is crucial, especially with regards to the GTM strategy and financial impact assessment in the later stages of this project.

1.4.1 Revenue

As shown in *Figure 6*, 3DWAYS' sales have grown since 2019 by approximately 4.3% per year. In 2020, sales reached a peak of €275k, a figure largely influenced by significant contracts signed in 2019 but only fully recognized in the following year. However, this growth could not be sustained, and in 2021 sales fell significantly. The reason for this downward movement is related to the COVID-19 pandemic and the resulting crisis. Since 2021, however, sales have stabilized and show an annualized growth rate of 10.3% (3DWAYS 2024d).

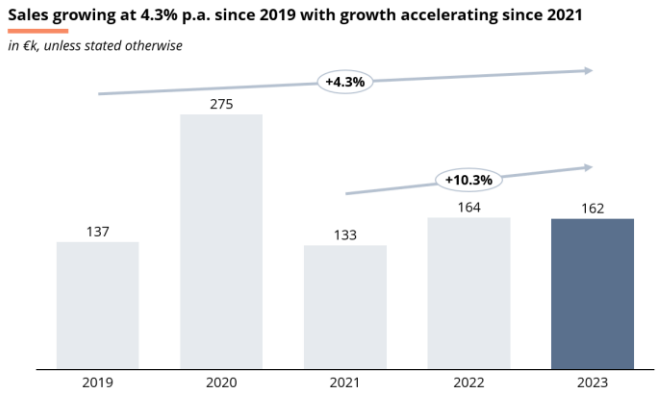

Figure 6: Sales development (based on: 3DWAYS 2024c)

1.4.2 Cost

When analyzing the cost structure of the company between the years 2019 to 2023, the variable

costs (external supplies and service & COGS) and fixed costs (personnel expenses and D&A) were considered from 3DWAYS' financial statements, outlined in *Figure 7* (3DWAYS 2024d). Since 3DWAYS has no cost accounting system implemented, the categorization of fixed and variable was made based on assumptions, acknowledging the fact, that e.g., in COGS some fixed costs might be included.

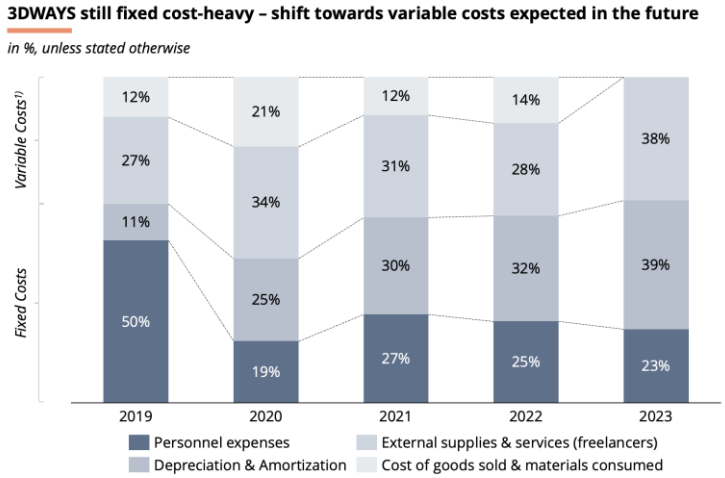

Figure 7: Cost structure over the years (based on: 3DWAYS 2024c)

A notable development in the graph is the relative decrease in personnel costs from 50% in 2029 to 23% in 2023. Due to lower revenues between 2021 and 2023, the owner of 3DWAYS has decided to pay himself a proportionally lower salary to ensure that the company remains financially stable. Also, the COGS were eliminated in 2023 due to the abandonment of the 3D printing services which was the only product requiring physical materials. Therefore, the variable costs experienced a slight decrease from 42% in 2022 to 38% in 2023. Overall, 3DWAYS remained fixed cost-heavy in 2023 as the company's relative share in fixed costs is 62% whereas its variable costs only accounted for 38% of the total costs. Therefore, 3DWAYS is currently reliant on fixed costs, which limits the company's flexibility in managing its cost structure. For instance, if 3DWAYS were to reduce its cost per unit, there would be no change in the fixed costs. However, due to a shift towards an assetless model where tangible assets – mostly 3D printers – are fully depreciated, 3DWAYS' fixed costs are expected to decrease drastically. Hence, the cost structure will be more focused on variable costs (3DWAYS 2024d).

1.4.3 Profitability

To assess 3DWAYS' operational profitability, an analysis of the core EBITDA margin has been conducted, see *Figure 8.* 3DWAYS' core EBITDA was calculated by deducting all operating expenses except D&A from its revenue.

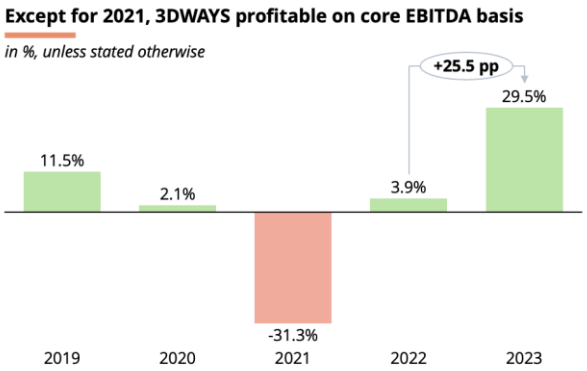

Figure 8: Core EBITDA margin from 2019 to 2023 (based on: 3DWAYS 2024c)

Figure 8 shows an EBITDA margin decrease from 11% in 2019 to 2% in 2020 followed by a sharp drop to -31% in 2021, as the core costs heavily increased and were proportionally higher than 3DWAYS' revenues. In 2023, the margin rose significantly up to 29%, reflecting improved operating performance, mainly due to the absence of COGS in that year (3DWAYS 2024d).

To better understand each component of 3DWAYS' core EBITDA margin, a profit and loss waterfall was built, as outlined in *Figure 9.*

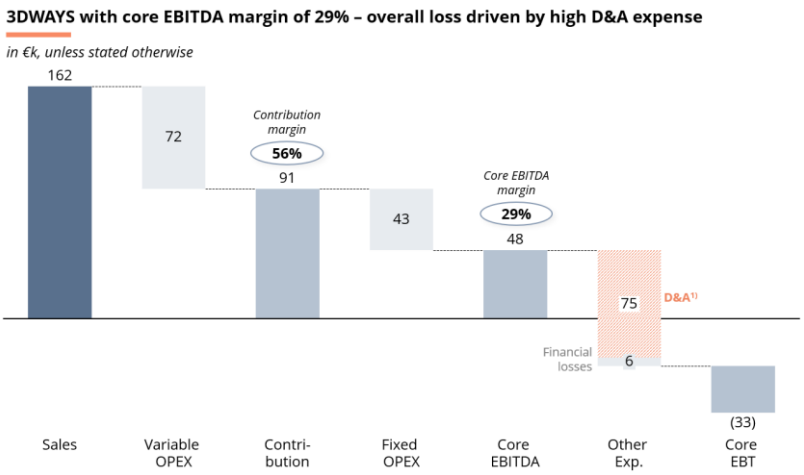

Figure 9: Profit and loss waterfall 2023 (based on: 3DWAYS 2024c)

In 2023, 3DWAYS generated a contribution margin (revenue minus variable costs) of €91k,

which covered its fixed operating expenses of €43k. After deducting fixed operating expenses, a core EBITDA of €48k remained, resulting in a positive core EBITDA margin of 29%. Thus, 3DWAYS was able to cover its fixed and variable costs with its revenue, which shows that the company is operationally profitable. However, when also deducting the D&A of €75k and financial losses of €6k, respectively, a negative core EBT of €33k remains. Due to the planned shift to an assetless operating model and the almost complete depreciation of existing fixed assets, such D&A expenses are no longer expected. Therefore, *ceteris paribus*, both core EBT and net profit are expected to be positive in the future (3DWAYS 2024d).

However, it must be noted that despite being operationally profitable, 3DWAYS overall has relatively high financial leverage (high debt-to-equity ratio) and rather low cash reserves (€19k) in combination with a negative EBT of €33k in 2023 (3DWAYS 2024d). Hence, budget considerations must be carefully decided when internationalizing.

1.4.4 The assetless model

As 3DWAYS is transitioning to an assetless business model, the following three KPIs have been analyzed to further assess how efficient the company is in using its assets, *(i) core asset turnover*, *(ii) tangible fixed asset turnover* and *(iii) Return on Invested Capital* (ROIC), the formulas and explanations of which can be found in *Appendix F*. These metrics were calculated from 2019 to 2023 and can be seen in *Figure 10*.

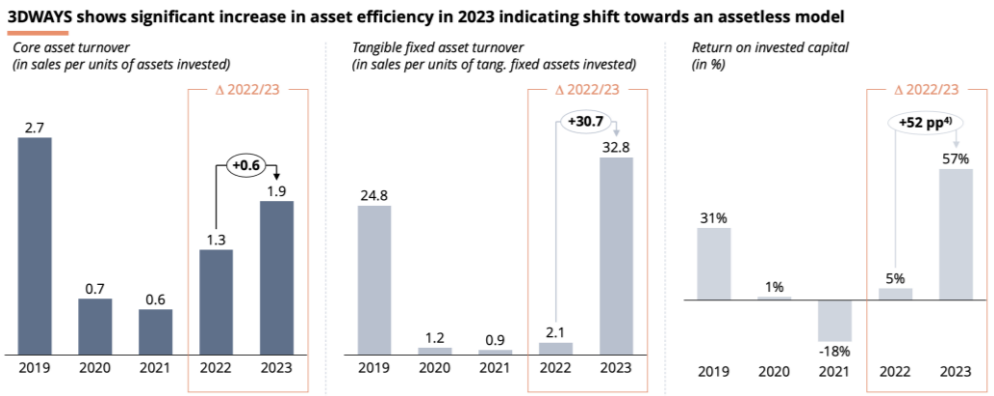

Figure 10: Assetless model for 3DWAYS (based on: 3DWAYS 2024c)

In 2023, 3DWAYS' tangible fixed assets were almost fully depreciated, significantly reducing

the company's balance sheet. As a result, the company experienced notable increases in core asset turnover, tangible fixed asset turnover, and ROIC from 2022 to 2023. These improvements reflect a shift toward an assetless model, indicating that 3DWAYS is utilizing its asset base more efficiently to generate sales than in previous years. Due to 3DWAYS' focus on assetless manufacturing, all three metrics are expected to increase in the future (3DWAYS 2024d).

As 3DWAYS plans to pursue an assetless business model, it is crucial to evaluate its potential advantages and disadvantages, which can significantly shape the company's strategic direction. Key benefits include reduced capital requirements, as companies adopting this model avoid significant upfront investment in physical assets such as plant or machinery, freeing up resources for other operational needs. Additionally, an assetless model is highly scalable and flexible, allowing companies to respond quickly to market fluctuations and shifts in demand without being constrained by asset-heavy infrastructure. Finally, it supports a focus on core competencies, enabling companies to allocate resources to innovation, customer engagement, and strategic activities by outsourcing non-core operations (Management Study Guide n.d.).

However, the assetless model is not without its challenges. A notable drawback is the dependency on external partners, which can expose companies to risks such as supply chain disruptions or inconsistent service quality due to limited control over third-party operations. Furthermore, this reliance may lead to higher long-term costs, as ongoing payments to external providers could surpass the expenses associated with owning and managing assets internally. Finally, there is a loss of operational control, as outsourcing critical functions can limit a company's ability to maintain quality standards, respond to issues promptly, or ensure alignment with its strategic objectives (Management Study Guide n.d.).

In summary, the assetless model offers reduced capital requirements and operational agility but comes with trade-offs such as partner dependency, long-term costs, and reduced control.

1.5 Client analysis

This subsection examines three key projects 3DWAYS has undertaken in the past to provide tangible examples of its service offering. Additionally, it will analyze the current state of client concentration and extract patterns that can guide the internationalization strategy.

1.5.1 Key projects

Since its foundation in 2016, 3DWAYS has played a crucial role in helping clients with various problems – from prototyping new products to optimizing supply chains and significantly reducing their cost structure. In this subchapter, three distinct projects of 3DWAYS are highlighted, each with its own set of objectives, challenges, and outcomes.

One project involved a brain-controlled helmet developed for Nereos[8], where the main challenge was that the existing Electroencephalogram (EEG) headsets were uncomfortable, difficult to position, and impractical due to their bulky and visually unappealing design. The objective was to create a user-friendly, comfortable, and easy-to-clean headset that could fit a wide range of head sizes while remaining durable. 3DWAYS delivered a supply chain strategy including the best manufacturers for all the helmet parts, improving the helmet with better comfort, sensor alignment, and an adjustable fit. As a result, Nereos achieved a valuation of €6 million after the product's launch (3DWAYS 2024c).

Another project was focused on smart traffic lights for GRUPO ETRA[9], which faced profitability issues when selling traffic lights through public tenders. The objective was to optimize their supply chain by engaging manufacturers specializing in traffic light components and reverse-engineering existing designs. 3DWAYS helped streamline their supply chain, reducing costs through automation and minimizing supply chain challenges. This transformed

[8] Nereos enhances mental performance and well-being through neurofeedback training, utilizing EEG headsets and adaptive software to help individuals achieve optimal cognitive states

[9] Grupo ETRA provides advanced tech solutions in mobility, lighting, energy, security, and communications

the traffic lights business into a profitable venture, and the manufacturers involved received new projects, boosting their overall efficiency (3DWAYS 2024c).

The third project, "Simple Spacer" for Metropolitano de Lisboa, focused on a cost optimization strategy. The client previously faced high costs, exceeding €21k, when purchasing spacers from local suppliers. The project aimed to explore more affordable sourcing options, including international suppliers, and to analyze potential cost savings. By outsourcing, 3DWAYS achieved an 81% cost reduction, enabling the client to offer the product at a significantly lower and more competitive price of €4k (3DWAYS 2024c).

1.5.2 Quantitative client analysis

As shown in *Figure 11*, 3DWAYS' client base was highly concentrated with just 22% of its clients contributing 88% of the company's total revenue in 2023 (3DWAYS 2024e).

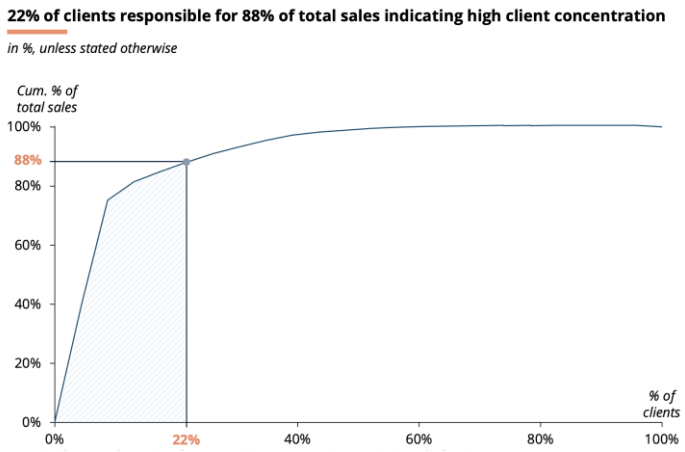

Figure 11: Client concentration 2023 (based on: 3DWAYS 2024e)

Among these clients, the top five play a significant role in driving the company's sales, making up 88% of total revenue, see *Figure 12*. On average, one client brought in €3,922 in revenue between 2018 to 2023 (3DWAYS 2024d, 2024e, 2024f).

Glooma as top client brought in 40% of total revenue in 2023

#	Client	€k	%
1	Glooma, Lda	79	40%
2	ISQ	71	36%
3	Ebreathie – Breathing Solutions	12	6%
4	Companhia Carris de Ferro de Lisboa	7	3%
5	Metropolitano de Lisboa, E.P.E	6	3%
			Σ 88%

Figure 12: Top 5 clients in 2023 (based on: 3DWAYS 2024e)

Notably, Glooma, Lda alone accounted for 40% of the total sales, while ISQ contributed 36%, together representing a substantial portion of 3DWAYS' revenue. The other three key clients, Ebreathie – Breathing Solutions, Companhia Carris de Ferro de Lisboa, and Metropolitano de Lisboa, E.P.E, generated smaller shares but still contributed to the overall picture of concentrated revenue streams (3DWAYS 2024e).

The concentration of sales among such a small group of clients indicates a high dependency on a few key relationships, which could pose risks if any of these clients were to reduce their spending or terminate contracts with 3DWAYS. This risk is particularly evident with Glooma, which by itself represents almost half of the company's sales. On the other hand, it can also be argued that potentially higher acquisition costs for these customers are justified as they are the largest contributors to 3DWAYS' overall revenue.

When analyzing the company size in *Figure 13*, 3DWAYS works with a mix of small, medium, and large businesses. The largest portion of clients are small companies, followed by large companies, while only two clients fall into the medium-sized category (3DWAYS 2024e). Thus, the mix of small and large companies shows that 3DWAYS serves a wide variety of businesses. This diversity could bring both challenges and opportunities, as the needs and expectations of each type of client may vary significantly.

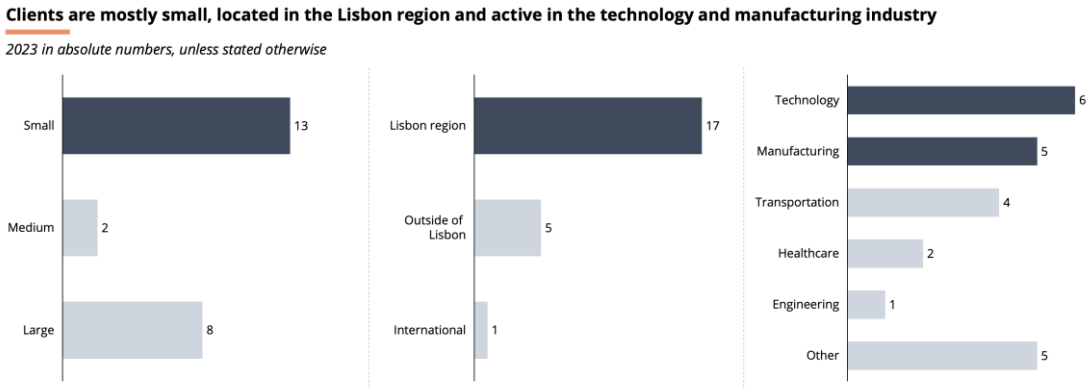

Figure 13: Clients categorized by size, location and industry (based on: 3DWAYS 2024e)

There are also notable patterns within these top customers. Glooma and Ebreathie are in the healthcare sector, while Companhia Carris de Ferro de Lisboa and Metropolitano de Lisboa are in the transport sector (3DWAYS 2024e). This suggests that 3DWAYS has established a strong presence in both sectors, which may provide strategic opportunities for future growth.

Almost 75% of 3DWAYS' clients are based in Lisbon, with only five outside Lisbon, and one international client (3DWAYS 2024e). This indicates a strong geographical concentration in Lisbon, making the company reliant on this specific regional market.

From an internationalization perspective, this concentration offers both opportunities and challenges. On the one hand, securing just a few large clients or projects in new markets could have a significant impact on achieving growth targets. However, this also highlights the importance of diversifying the client base to reduce reliance on a handful of major customers, which would help mitigate risks associated with client turnover or reduced demand. As *Figure 13* suggests, 3DWAYS' clients are primarily concentrated in the technology and manufacturing sectors. The transportation sector follows closely with four clients, while the healthcare and engineering sectors are only represented by a few clients. The residual "Other" category accounts for five additional clients coming from various industries such as education, hospitality, and others. This data shows that nearly half of 3DWAYS' clients are active in technology and manufacturing.

1.6 Synthesis

The Inside-Out analysis provided a holistic picture of 3DWAYS' current set-up, which must be properly understood before conducting the outside-in analysis.

The analysis showed that 3DWAYS has a strong business model, serving European companies and start-ups by identifying optimal manufacturing options, securing competitive prices and meeting sustainability targets. 3DWAYS primarily uses a pay-per-order pricing model, earning a 10% supplier commission, although it occasionally covers costs upfront when suppliers resist. Despite having three customer acquisition channels, 3DWAYS often faces trust barriers when approaching customers directly, a challenge that must be addressed during the expansion.

As 3DWAYS has recently decided to discontinue its prototyping service and focus more on its manufacturing service, it can use this momentum to move from an asset-light model to a completely assetless model. While going assetless frees up resources and promotes operational agility, 3DWAYS must also be aware that it increases dependency on partners and reduces control – factors that must be considered when expanding into new territories. Although 3DWAYS is still fixed-cost-heavy, its core EBITDA margin of 29% shows that the company is operationally profitable. Due to the shift toward an assetless model and the fixed assets being nearly fully depreciated, its negative core EBT is expected to be positive in the future.

3DWAYS has demonstrated its ability to help customers optimize their supply chains, improve their profitability and develop new products. However, 3DWAYS' customer portfolio is highly concentrated, with a few key customers accounting for almost 90% of total revenues in 2023. To handle the risks, a good balance between small, medium and large key accounts must be found during internationalization which will be obeyed in the targeting process.

To fully understand 3DWAYS' current position and develop a comprehensive internationalization plan, further analysis of megatrends shaping its business environment, relevant markets and market segments is required before selecting the target niche markets.

2. CONCLUSION – GROUP PART

This thesis raised two guiding questions – *"Where to play?"* and *"How to win?"* – in the context of 3DWAYS' ambition to expand into the European sustainable manufacturing market. Through a structured analysis presented in five project phases, a comprehensive internationalization strategy has been developed. This has been achieved by, first, properly segmenting the sustainable manufacturing market, second, targeting the most promising market niches through ranking models and in-depth niche market analyses, and third, by choosing a suitable entry mode combined with a positioning and marketing strategy that differentiates 3DWAYS from its direct competitors and raises awareness among potential customers in the target markets.

The inside-out analysis highlighted 3DWAYS' core strengths in helping startups and large companies identify optimal manufacturing solutions, secure competitive prices, and achieve sustainability goals. Transitioning to an assetless model enhances flexibility and efficiency but increases reliance on partners. With a 29% EBITDA margin, the company demonstrates profitability, however still financially constrained due to high financial leverage and slim cash reserves. Furthermore, its concentrated customer base underscores the need for diversification. Additional challenges are the trust barrier faced by clients and the inflexible 10% commission.

The outside-in analysis identified favorable macroeconomic conditions for international expansion into the sustainable manufacturing market, with strong growth in Europe in industries such as healthcare, electronics, and consumer goods aligning with 3DWAYS' expertise. However, challenges like geopolitical risks and stricter regulations require proactive management. The outside-in analysis was concluded with the segmentation of the sustainable manufacturing market using three segmentation criteria, *(i)* country, *(ii)* industry vertical and *(iii)* company size and complexity.

The targeting process identified the most attractive market niches by leveraging qualitative and

quantitative attractiveness scoring models for industries, countries, and a combination of them. This resulted in targeting the medical technology and smart home niche in both Germany and the UK with a focus on large corporates and SMEs/startups with complex supply chains.

The go-to-market strategy centers on building credibility through partnerships, leveraging networks for client acquisition, and adopting tailored entry modes and marketing tactics to meet the specific needs of each market. These steps, paired with a refined positioning strategy, are designed to overcome trust barriers, ensure alignment with the overall business strategy, and differentiate 3DWAYS from competitors. Moreover, a robust risk management framework addresses the dependencies of the assetless model.

Finally, financial projections highlighted the attractiveness of the proposed strategy, forecasting profitability from year one, with robustness being tested using scenario and sensitivity analysis.

While the strategy and methodology are believed to be robust, this thesis also shows some limitations. Firstly, the chosen approach relied primarily on secondary data, limiting the precision of insights. Conducting primary research, such as interviews with potential clients and suppliers, would enhance the depth of the analysis. Additionally, the financial decision-making process for funding the expansion was not covered, leaving a critical aspect of strategic planning for future action. Finally, the implementation and monitoring phases were beyond the scope of this work, necessitating further efforts to validate and refine the proposed roadmap.

In conclusion, the strategy provides clear answers to *"Where to play?"* and *"How to win?"*. By targeting specific niches in Germany and the UK, leveraging its assetless model, and implementing a structured roadmap, 3DWAYS is well-positioned for sustainable growth. With further validation and execution, 3DWAYS can successfully tackle these niches and strengthen its position as a reliable partner in sustainable manufacturing and supply chain solutions.

3. BIBLIOGRAPHY – GROUP PART

3DWAYS. 2024a. “3DWAYS Website.” 2024. https://www.3dways.eu/.

———. 2024b. “Conscious Manufacturing [Internal Document].” Notion. 2024.

———. 2024c. Deep-Dive sessions with client.

———. 2024d. “Financial Statements [Internal Document].”

———. 2024e. “List of Clients 2019-2024 [Internal Document].”

———. 2024f. “List of Sales 2022-2024 [Internal Document].”

———. 2024g. “Mission, Vision, Values [Internal Document].” Notion. 2024.

Eisenmann, T.R. 2012. “Business Model Analysis for Entrepreneurs.” 2012, April. http://www.hbs.edu/faculty/research/publications/Pages/default.aspx?contentType=Working%20Papers.

iSQ. 2024. “iSQ Website.” 2024. https://www.isq.pt/.

Management Study Guide. n.d. “What Is Asset Light Business Model, Its Advantages and Disadvantages.” n.d. https://www.managementstudyguide.com/asset-light-business-model.htm.

4. APPENDIX – GROUP PART

Appendix Overview

Appendix Figures

Appendix Equations

Appendix A. Table of contents

Appendix B. Table of figures

Appendix C. List of Abbreviations

AI ..... *Artificial Intelligence*

COGS ..... *Cost Of Goods Sold*

D&A ..... *Depreciation and Amortization*

GTM ..... *Go-To-Market*

RfP ..... *Requests for Proposals*

ROIC ..... *Return on Invested Capital*

SC ..... *Supply Chain*

SCM ..... *Supply Chain Management*

WTP ..... *Willingness-to-Pay*

Appendix D. Manufacturing blueprint

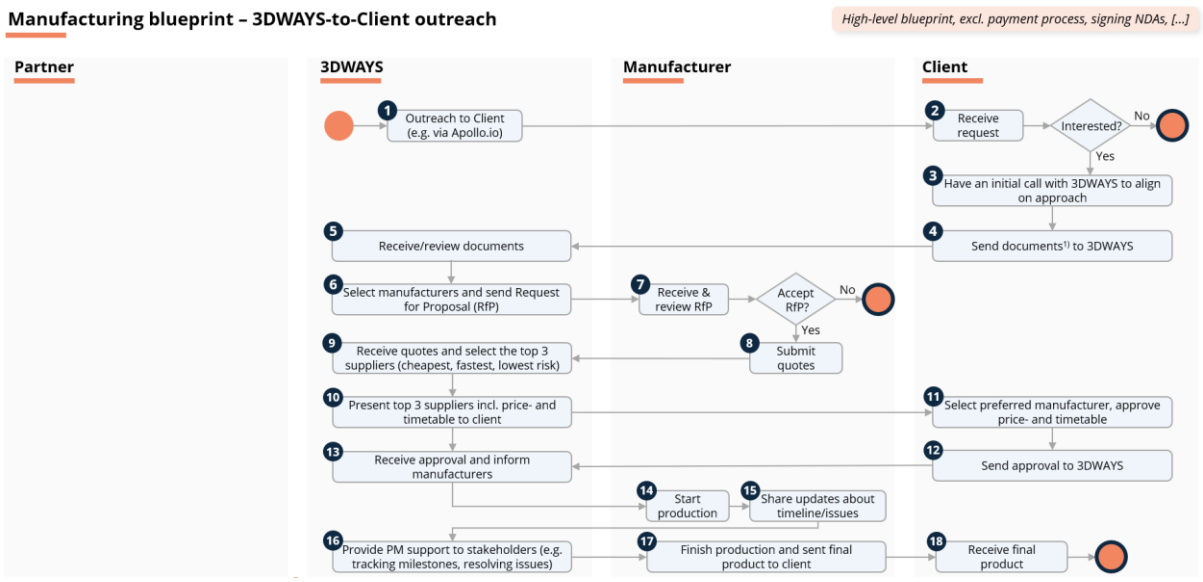

Figure A-1: Example of manufacturing blueprint[10] - 3DWAYS-to-Client outreach (based on: 3DWAYS 2024b)

[10] This blueprint provides a high-level overview and is intended for general guidance only. It may not encompass all specific steps or details involved, such as the signing of NDAs, payment processes etc.

Appendix E. Reformulated financial statements

Reformulated income statement (in €)

Core Operations in €	2018	2019	2020	2021	2022	2023
Sales and Services Rendered	182,183	137,121	274,790	133,427	163,524	162,422
(-) Cost of Goods Sold and Materials Consumed (COGS)	(33,806)	(16,824)	(76,846)	(28,984)	(32,760)	-
(-) External Supplies and Services	(59,946)	(36,389)	(123,895)	(78,328)	(66,117)	(71,701)
(-) Personnel Expenses	(85,317)	(68,160)	(68,396)	(67,841)	(58,231)	(42,869)
Core EBITDA	**3,113**	**15,748**	**5,653**	**(41,726)**	**6,415**	**47,853**
(-) Depreciation and Amortization	(13,162)	(15,316)	(91,418)	(73,971)	(75,183)	(74,701)
Core EBIT = EBT	**(10,049)**	**432**	**(85,764)**	**(115,697)**	**(68,768)**	**(26,848)**
Non-Core Operations in €	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
(+) Other Income	493	4,649	78,884	73,015	66,324	0
(-) Other Expenses	(10,170)	(1,457)	(8,745)	(5,990)	(1,047)	(8,339)
Non core EBITDA=EBIT	**(9,677)**	**3,192**	**70,140**	**67,025**	**65,278**	**(8,339)**
(+/-) Net Financial Gains/Losses	(1,318)	(1,268)	(3,675)	(2,955)	(3,576)	(5,898)
Non core EBT	**(10,995)**	**1,924**	**66,464**	**64,070**	**61,702**	**(14,237)**
Financing Operations in €	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
(+) Operating Subsidies	31,508	-	-	4,676	336	10,688
(+) Work for the Entity's Own Account	-	-	21,000	47,800	8,000	-
Non core EBITDA=EBIT=EBT	**31,508**	**0**	**21,000**	**52,476**	**8,336**	**10,688**
TOTAL EBT	**10,463**	**2,356**	**1,700**	**849**	**1,270**	**(30,398)**
Check	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*

Reformulated balance sheet (in €)

in € million	2018	2019	2020	2021	2022	2023
Core Operations						
(+) Operating cash	133	366	404	716	953	370
(+) Tangible Fixed Assets	10,420	5,528	228,467	154,495	79,312	4,953
(+) Intangible Assets	25,479	15,055	21,000	68,800	77,824	77,483
(+) Inventories	0	0	0	0	-	4,797
(+) Clients	3,332	70,490	69,615	14,576	2,120	16,508
(+) State and Other Public Entities	713	1,506	616	76	-	2,698
(+) Subscribed and Unpaid Capital	4,779	0	0	0	4,950	-
(+) Accruals and Deferrals	0	4,092	5,317	443	715	738
(+) Other Current Assets	3,888	3,379	232,830	32,007	27,985	40,208
(-) Suppliers	(7,220)	(9,539)	(3,858)	(200)	(31,105)	(24,643)
(-) State and Other Public Entities	(12,202)	(19,283)	(2,157)	(4,752)	(7,616)	(2,137)
(-) Other Payables	0	(11,000)	(13,056)	(5,721)	(5,894)	(5,113)
(-) Other Current Liabilities	(19,650)	(10,504)	0	0	0	0
(-) Other Payables	(4,474)	0	(152,567)	(28,237)	(26,023)	(32,095)
Core operations Invested Capital	**5,198**	**50,090**	**386,612**	**232,203**	**123,222**	**83,766**
Non-Core Operations						
(+) Excess Cash	6,533	17,949	19,809	35,064	46,717	18,124
(+) Financial Investments	263	1,177	1,364	1,531	940	961
Non Core operations Invested Capital	**6,797**	**19,126**	**21,174**	**36,596**	**47,657**	**19,085**
Financial Activities						
(-) Loans Obtained	(2,391)	(58,025)	(238,471)	(167,111)	(135,246)	(98,312)
Net Financials	**(2,391)**	**(58,025)**	**(238,471)**	**(167,111)**	**(135,246)**	**(98,312)**
TOTAL	**9,604**	**11,192**	**169,315**	**101,687**	**35,633**	**4,539**
EQUITY	**9,604**	**11,192**	**169,315**	**101,687**	**35,633**	**4,539**
Check	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*	*TRUE*

Figure A-2: Reformulated financial statements

Appendix F. Formulas and explanations

$$Core\ asset\ turnover = \frac{Sales}{Core\ invested\ capital}$$

Equation A-1: Core asset turnover formula

Asset turnover measures how efficiently a company uses its assets to generate revenue, calculated by dividing revenue by average asset value. A high ratio indicates efficient operations. (Schmidt 2024). However, to illustrate how effectively 3DWAYS is generating sales from its core invested capital[11] instead of total assets, the core asset turnover was used as a metric. To compute the invested capital, the total core liabilities[12] were deducted from 3DWAYS' total core assets[13].

$$Tang.\ fixed\ asset\ turnover\ = \frac{Sales}{Tangible\ fixed\ assets}$$

Equation A-2: Tangible fixed asset turnover formula

Tangible fixed asset turnover evaluates how effectively a company uses its tangible fixed assets to generate sales. Fixed (non-current) assets are physical, long-term assets (e.g., properties, plants and equipment such as machinery, furniture and vehicles) a business uses to produce income. By dividing sales by these fixed tangible assets, it can be assessed how efficiently a firm generates revenue from those tangible fixed assets (Corporate Finance Institute 2024a).

$$Return\ on\ invested\ capital = \frac{Core\ EBITDA}{Core\ invested\ capital}$$

Equation A-3: ROIC formula

ROIC measures a company's efficiency in generating returns on its invested capital (Corporate Finance Institute 2024b). It was calculated by using core EBITDA as EBITDA is used as an appropriate proxy for profitability throughout the project. In practice, the ROIC allows investors

[11] Capital specifically invested for its core activities
[12] Account payables, current liabilities, etc.
[13] Cash, tangible & intangible assets, inventories, etc.

and management to assess the return generated on each Euro invested in the business. A higher ROIC typically indicates more effective use of capital, suggesting the company is generating value for shareholders (Corporate Finance Institute 2024b).

$$Score = \sum_{i=1}^{n} (Criteria_i * Weight_i)$$

Equation A-4: Scoring formula

$$\sigma = (\frac{Variable - Min.\ Value}{Range}) * 99 + 1$$

Equation A-5: Data standardization for values with positively correlated impact

$$\sigma = (\frac{Max.\ Value - Variable}{Range}) * 99 + 1$$

Equation A-6: Data standardization for values with negatively correlated impact

$$CAGR = (\frac{Size\ 2029_{projected}}{Size\ 2023_{actual}})^{\frac{1}{6}} - 1$$

Equation A-7: Computation of CAGR