



Result 4

Creation of virtual methodological guide focused on smart textiles entrepreneurship

Activity 4

Creation of the guide

Creation of the Virtual Guide

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1. Context

The objective of the HACKTEX project is to develop the tools necessary for skills enhancement targeted to higher education in relation to innovation in smart textiles. Within this context, the project will create a virtual training program and tools for functional and smart textiles, materials for an industrial smart textile bootcamp training for intensive summer education course, a virtual methodological guide focused on entrepreneurship and a project handbook of good practices. In this context, the aim of Result R4 is the creation of a virtual methodological guide focused on smart textiles entrepreneurship.

Smart textiles are based on innovation and research, but their full development requires the transition toward the market, which is the most important problem currently facing the industry. This transition can be facilitated by entrepreneurship training tailored to the specifics of the smart textiles sector and the virtual methodological guide is such a solution. Entrepreneurship knowledge and skills will help specialists and students to understand the market, giving them the basic tools to develop a business in manufacturing or in R&D for smart textiles. The guide offers students and other external users some helpful tips and industrial challenges that need to be faced in the smart textiles sector, since it compiles the info from the material and the feedback from stakeholders to have a final summary and tips of the entrepreneurs thinking for the researchers.

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2. Creation of the virtual guide

2.1. Collection of feedback from stakeholders

Feedback from stakeholders was obtained through:

- The Need Analysis, which consisted on a survey that was targeted to:
 - Experts/managers from companies manufacturing smart textiles or intending to transition to such applications
 - Relevant experts involved in training and research (universities/research institutes)
 - Students from textile engineering specializations
- The Multiplier Event held by CIAPE

From this feedback, some keywords can be identified (underlined in the following sections) to extract a mind-map of the topics of interest.

2.1.1. Conclusions from the Need Analysis Report

Regarding the survey used for the Need Analysis Report, the results obtained from processing the responses given by the three targeted groups pointed out:

Existing current needs of the smart textiles sector

- Influential factors on the development of smart textile prototypes/products:
 - developing new raw materials/products
 - HR with relevant skills
 - understanding market requirements
 - standardization
- Lack of proper technology to develop smart textiles
- Lack of funding to develop smart textiles
- Stronger links companies and universities

Existing initiatives in the smart textiles sector

Companies and universities are interested in participating mainly in research projects and partnerships with the industry for companies from the sector. Such partnerships are mainly motivated by the need to develop new products/technologies and knowledge.

Perceived weak points in engineering training for the field of smart textiles

Regarding the training on fundamentals for smart textiles, the 5 most relevant topics are:

1. new advanced smart materials/products
2. new advanced smart textiles - raw materials
3. complementary knowledge related to smart textiles (physics, chemistry, electronics, etc.)
4. functionalization methods and processes for smart textiles
5. standards for smart textiles; evaluation of properties/product functionality.

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Although the need for fundamentals and technical skills is observed to collect a higher attention, the following project-related, market-related and transversal skills are also identified as relevant:

- Pro-active understanding of customers and market needs
- Work in a team
- Plan, design and execute research projects/prototypes referring to smart textiles
- Identify, pose and resolve R&D problems
- Capacity to generate new ideas (creativity) for the development of smart textiles

Moreover, non-technical subjects such as legislation and certification are also of interest for the industry.

2.1.2. Conclusions from the Multiplier Event

From the Multiplier Event, the following issues related to the development of the Smart Textile market and connected training needs arise:

- Selection of the best materials according to the purpose
- Design aspects linked with sustainability issues
- Wearable: best processes and methodologies to integrate/embed electronic components into textiles in order to guarantee comfort and practicality
- New triboelectric accumulators
- How to manage the data flow (data protection; data management)
- How to combine sustainable aspects with the need to add new components/treatments and so add complexity to the textile
- Aspects related to washing/maintenance and resistance/durability
- Disposal issues
- Waste management and reuse of materials/components
- Be aware of the legislative aspects
- Integrate electronic competences
- Entrepreneurial aspects
- How to rethink the working cycles/processes
- New business models
- Stimulate innovations
- Create interdisciplinary working teams
- How to get products accessible to the wider public
- Make know these products to the wider public-communication aspects
- Knowledge transfer universities/enterprises
- Better link among the sector's main actors

2.2. Analysis of the feedback

The keywords collected can be classified into technical aspects (to be covered in the materials of the MOOC) and entrepreneurial aspects (to be covered in the materials of the Virtual Guide). Moreover, they can be grouped considering their thematic framework:

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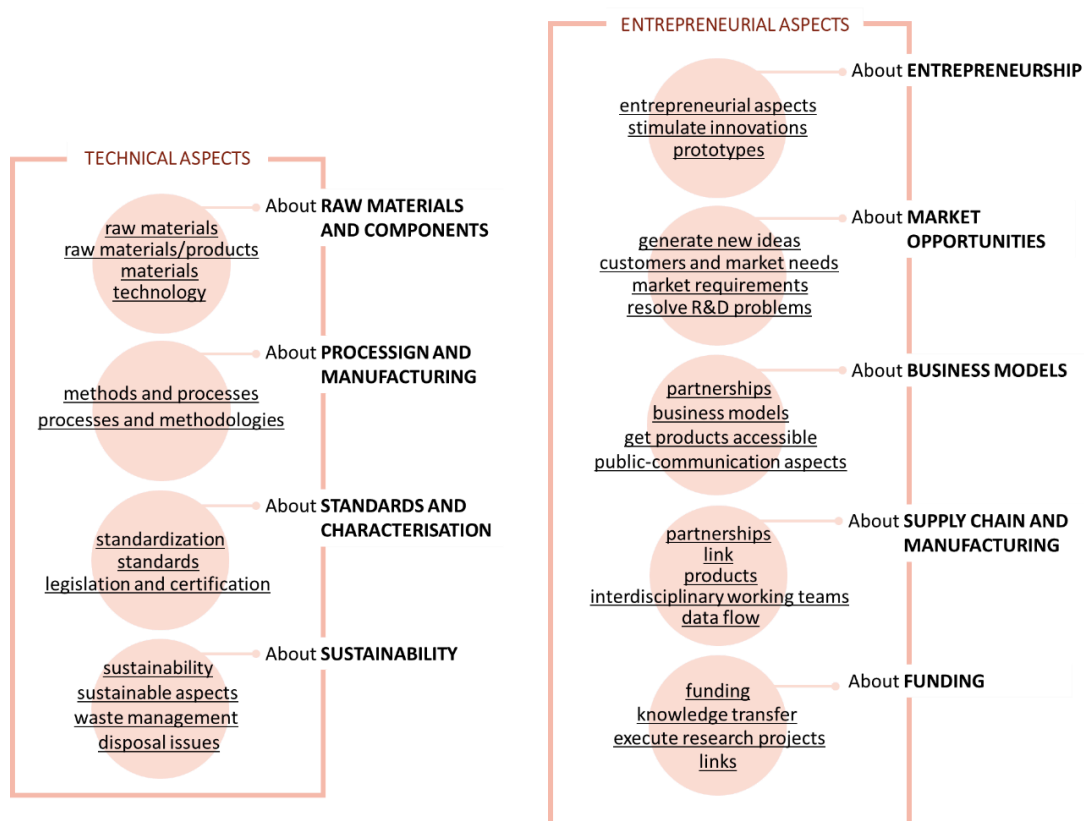


Figure 1. Technical aspects to be covered in the materials of the MOOC (left); and entrepreneurial aspects to be covered in the materials of the Virtual Guide (right).

2.3. Conceptualisation of the Virtual Guide

Taking into account this information, the Virtual Guide is redefined to work as a navigation tool, in order to guide the students and external users throughout all the virtual content created both for the MOOC and the Virtual Guide on Entrepreneurship.

Therefore, the relationship between the topics of interest identified from the feedback and all the virtual materials created is established and organised in the Virtual Guide.

2.3.1. Topics

Regarding the *technical aspects*, the following needs for specific knowledge are identified:

1. About raw materials and components for smart textiles
2. About processing and manufacturing smart textiles
3. About standards and characterisation
4. About sustainability and other related issues

Regarding the *entrepreneurial aspects*, the following key needs for guidance are identified:

1. About entrepreneurship in the smart textiles sector, in general
2. About identifying market opportunities
3. About business model development

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4. About supply chain and manufacturing
5. About funding and financial management

2.3.2. Available materials

MOOC on Smart Textiles

LU1. Introduction to smart textiles

This unit introduces the learner to the MOOC and the sector of smart textiles. It provides the definition of the term of smart textiles and its evolution in time and technologies. It analyses the term materials, technological characteristics and functions and stipulates the importance of smart textiles as a new area for the development of the sector for textiles by integration of innovation in IT, new sustainable materials and processes with the conventional textile know-how.

LU2. Raw materials and components for functional and smart textiles

To develop smart textiles, it is necessary first of all to know which raw materials can provide such functionality and interactive behaviour. Therefore, this unit focuses on the main products available to impart to textiles passive functionality (conductive fibres and inks/pastes, optical fibres, PCMs) and active functionality (chromo-active, energy harvesting or shape memory materials), and also on other electronic elements (sensors and actuators) that can be used for developing e-textiles.

LU3. Technologies for functional and smart textiles

This unit describes technologies and processes for the production of smart textiles. It focuses on technologies for production of 2D and 3D smart textiles, the development of advanced functional and smart materials by novel, resource-effective processes such as digital printing including inkjet printing, 3D printing and chromojet, spray technology as well as application of enzymes. It also focuses on joining and integrating technologies for smart textiles production.

LU4. Standards and characterization of functional and smart textiles

Standardisation is one of the major problems for smart textiles. The lack of standards in the sector creates problems in evaluating their processability and performance. This unit discusses the standards required to evaluate the different levels of performance of smart textiles and their functionalities – textile properties, as well as properties related to the field of application (like electrical, chemical, physical, etc.).

LU5. Issues related to the sustainability of functional and smart textiles

The unit analyses the issues related to the sustainability of functional and smart textiles. The unit highlights the importance of sustainable smart textiles as a market requirement and analyses the methods for assessing the sustainability of products and production methods (Life Cycle Analysis, footprints, ecolabelling). The relevant certification schemes and the implications they may have on the smart textiles industry are also presented.

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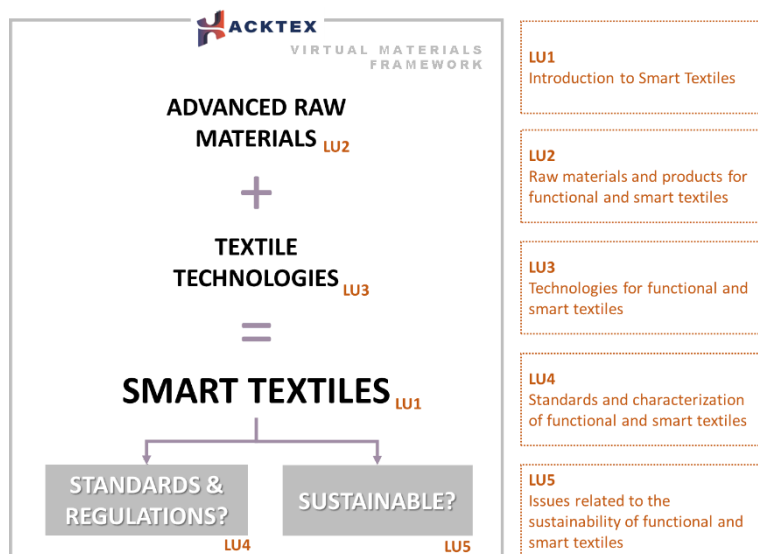


Figure 2. Scheme of the contents of the Virtual Materials developed for the MOOC.

Database

This database features companies operating in the smart textile industry across various EU countries. It provides a comprehensive overview of smart textile producers, component manufacturers, suppliers, and more. Detailed insights into each company's specialization, product range, technology usage, and other key aspects are readily available. Whether you're an investor, job seeker, or simply intrigued by the European smart textile landscape, this database is an invaluable resource for discovering companies actively engaged in the smart textile industry



Figure 3. Product categories available in the database.

Entrepreneurship materials

Unit 1. Introduction to the smart textiles market

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This unit provides an overview of the situation and main trends and players in the smart textiles market, discussing specific supply chains, relevant manufacturing companies, and industries using smart textiles. The lessons also focus on examples of smart textiles niche markets, giving the learner a wide overview on the several economic sectors where smart textile products might have an important impact in terms of technology and innovative applications.

Unit 2: From ideas to opportunities

There is a lot of research done in the field of smart textiles, but few ideas make the transition towards the market. In this context, this unit covers topics referring to various tools to understand and recognize unmet needs and market opportunities, as well as methods and techniques used to develop and validate business ideas.

Unit 3: Developing a business model

The users gain the ability to understand better the requirements and patterns of behaviour of potential consumers and develop a value proposition explicitly geared toward these clients. In addition to this, the unit discusses the activities and resources required to build the business, as well as the marketing that is most suitable to be used to commercialize the items that the company produces.

Unit 4. Important issues for entrepreneurship

This unit covers other aspects important for the success of an entrepreneurial endeavour, such as the process of designing a business pitch in order to find potential funding, tools to ensure business sustainability and how to choose the most suitable exit strategy. It aims to develop abilities to create, lead and coordinate R&D projects in the textile and fashion sector. It also aims to convey tools and methods to take advantage of entrepreneurial thinking.

2.4. Organisation of the tips

Connecting the key needs with the available materials, the Virtual Guide is organised through 19 tips covering the key points (chapters) presented in Table 1.

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Table 1. Virtual Guide organisation.

Chapter	Tip topic
1. Introduction to Smart Textiles Entrepreneurship	1.1. Definition of smart textiles and their applications 1.2. Overview of the growing market and opportunities in smart textiles 1.3. Benefits and challenges of starting a smart textiles venture
2. Identifying Market Opportunities	2.1. Analysing industries and sectors where smart textiles can make an impact (sports, healthcare, fashion, etc.) 2.2. Assessing consumer needs and identifying potential use cases 2.3. Exploring emerging applications and untapped markets 2.4. Generating new, feasible ideas to exploit opportunities
3. Business Model Development	3.1. Defining your value proposition and target customers 3.2. Identifying distribution channels suitable for smart textile products 3.3. Developing marketing strategies to reach your target audience 3.4. Establishing partnerships with retailers, e-commerce platforms, or distributors 3.5. Identifying revenue streams (product sales, licensing, service contracts, etc.). 3.6. Creating a pricing strategy and assessing production costs
4. Supply Chain and Manufacturing	4.1. Sourcing materials and components for smart textiles production 4.2. Establishing partnerships with suppliers and manufacturers 4.3. Ensuring quality control and scalability in production
5. Funding and Financial Management	5.1. Assessing funding options (grants, investors, crowdfunding, etc.) 5.2. Utilizing resources and tools specific to smart textiles development 5.3. Resources and Support for Smart Textiles Entrepreneurs

However, this organisation has been reformulated to take a more user-friendly approach. The resulting Virtual Guide (to be uploaded on the project's website with all the connections to the links required) is presented in the next section.

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3. The Virtual Guide

CHAPTER 1: Smart Textiles... What are they?

An introduction to smart textiles and their market

Entrepreneurship on the smart textiles field requires a clear knowledge about what smart textiles are, to start with.

TIP 1

Do you need to revise or clarify the **definition of smart textiles and their applications**?

In the *Hacktex MOOC* you will find the definition of the term of smart textiles and its evolution in time and technologies and the importance of smart textiles as a new area for the development of the textile sector.

Moreover, if you want to check their definition from an entrepreneurial point of view, in the material *Introduction to the smart textiles market* you will find their definition and characteristics, main trends, and possible limitations.

Currently, there is a growing interest on the market about smart textile solutions. The integration of certain features into textile products or the proximity of textiles to the body for monitoring vital constants, among other reasons, have boosted the research, development and commercialisation of smart textiles.

TIP 2

Do you want to have an **overview of the growing market and opportunities in smart textiles definition of smart textiles and their applications**?

The materials *Introduction to the smart textiles market 2* and *Introduction to the smart textiles market 3* explore the smart textiles market by providing examples of products and/or prototypes potentially to be merchandised in the fields of healthcare, personal protection, sports, automotive, aerospace, home, agriculture and architecture, among others.

However, behind the opportunities and the potential benefits of this growing market, there are also some challenges to take into account before starting a venture on smart textiles.

TIP 3

Do you want to analyse the **benefits and challenges when starting a smart textiles venture**?

In the material *From ideas to opportunities* you can find a SWOT analysis of the advanced and smart textile industry, with the strengths, weaknesses, opportunities, and threats for the businesses in the market. You can also learn what the intellectual property right issues are and how to take them into account.

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CHAPTER 2: Starting a venture on smart textiles

Identifying Market Opportunities

Once taken the decision on taking a venture on smart textiles, it might be difficult to know how to start. A good approach is to analyse first which are the potential sectors for smart textiles. Knowing in which industries and sectors a smart-textile based solution can make an impact can help finding niche applications and focussing the target (potential customers) to better address the efforts of the venture.

TIP 4

Do you want to analyse the **industries and sectors (sports, healthcare, fashion, etc.) where smart textiles can make an impact?**

The material *Introduction to the smart textiles market 2* explores the smart textiles market by providing examples of products and/or prototypes in several fields.

Exploring the market can make the difference. By assessing customer needs and identifying potential use cases it is possible to elaborate a clear framework in which the venture will be positioned.

TIP 5

Do you want to **assess consumer needs and identify potential use cases?**

The material *From ideas to opportunities 2* explains about considering the end-user perspectives (such as needs, preferences, values, experiences) and using the “empathy map” as a tool to develop a successful and marketable product.

Moreover, the materials of *Developing a business model 2* provides a structured approach on the process of understanding various customer segments, crafting and delivering a relevant value proposition for each segment.

In this sense, revising emerging applications and untapped markets can help to found the niche target for the venture. Having a niche (unexplored) market helps reducing competitors and locating potential customers.

TIP 6

Do you want to **explore emerging applications and untapped markets?**

The material *From ideas to opportunities* shows how to recognise and stay updated with the opportunities offered by the rapidly evolving advanced textile industry. They also provide an analysis of the latest research trends and application developments in the advanced and smart textile market.

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Anyhow, to exploit the opportunities it is necessary to generate new and feasible ideas. Otherwise, the market might not accept the proposal, which puts in risk the venture.

TIP 7

Do you need help **generating new, feasible ideas to exploit opportunities?**

The materials of *From ideas to opportunities 2* cover key aspects of effectively applying the idea generation process (problem and constraint definition, working group setting up, using the ACER's Creative Thinking Framework). They also introduce different tools and techniques able to stimulate creativity and examples of their application to the smart textile sector.

CHAPTER 3: From idea to product concept

Business Model Development

The definition of a new product is a complex process that requires certain steps to go from the idea to the commercial product. This process can be described as a double diamond (Figure 1), in which there are phases of research and development that imply expanding the project, and phases of definition and decision making that start from these expanded points to achieve clear and specific proposals.

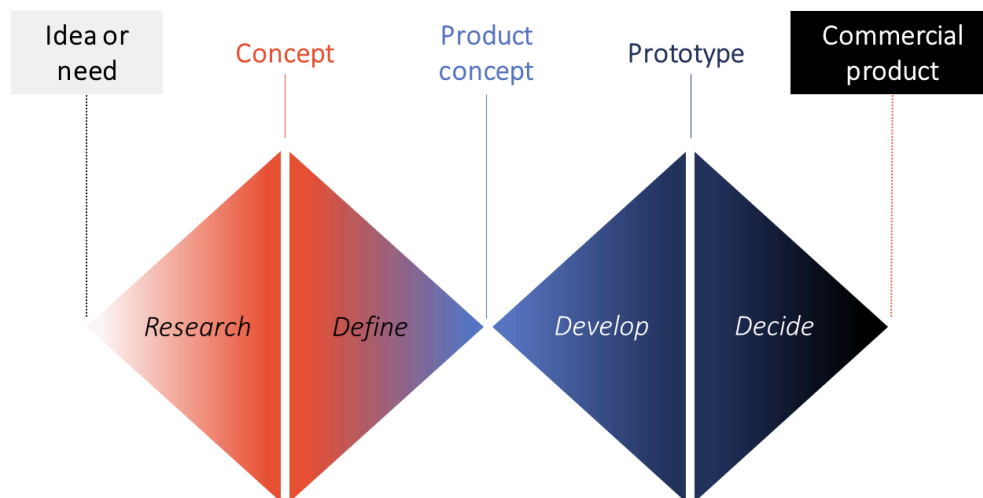


Figure 4. Double diamond for product development.

In the case of starting a new venture, the product (or service) needs a first diamond to go from the idea or need to the product concept. At this point, it is necessary (or highly recommendable) to develop the business model and verify whether the product concept has a potential market for it, in order to validate it. This means a lot points to be revised, such as:

- defining the value proposition
- identifying potential distribution channels
- establishing partnerships
- assessing production costs

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- developing marketing strategies
- identifying revenue streams

Defining the value proposition

TIP 8

Do you need help **defining your value proposition and target customers?**

The material *Developing a business model 2* covers the key elements of the Business Model Canvas, presenting the customer types and customer segmentation strategies and ways to craft the value proposition to cater to different customer segments.

Identifying potential distribution channels

TIP 9

Do you need to know how to **identify distribution channels suitable for smart textile products?**

The material *Developing a business model 2* defines and describes the different types of channels, presenting the factors to consider when choosing channels to reach and sell to different customer segments.

Establishing partnerships

TIP 10

Do you need help **establishing partnerships with retailers, e-commerce platforms, or distributors?**

The material *Developing a business model 3* presents the main types of key partners in the smart textiles market and the strategies to find, select, and build long-term partnerships.

Assessing production costs

TIP 11

Do you want to learn about **creating a pricing strategy and assessing production costs?**

The material *Developing a business model 3* defines and explains the main elements of the cost structure for a smart textiles business.

Developing marketing strategies

TIP 12

Do you need help for **developing marketing strategies to reach your target audience?**

The material *Important issues for entrepreneurship* revises the theoretical basis of strategy.

The material *Developing a business model* presents the aspects regarding problem identification and understanding the market and the customers in order to create products and services to better meet the needs and requirements. Besides, *Developing a business model 2* presents the steps to build long-lasting customer relationships.

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*Identifying revenue streams***TIP 13**

Do you want to learn about **identifying revenue streams (product sales, licensing, service contracts, etc.)**?

The material *Developing a business model 3* defines and explains the main revenue streams for smart textiles companies.

CHAPTER 4: From product concept to commercial product**Supply Chain and Manufacturing**

Once having a validated product concept, the moment of developing the details to reach a prototype arrives. This means having a clear idea of the materials and processes available to develop such a solution.

TIP 14

Do you need **sourcing materials and components for smart textiles production**?

In *Raw materials and components for functional and smart textiles* of the HACKTEX MOOC, you can find information about products to impart passive and active functionalities to textiles, and electronic components for e-textiles. Moreover, in the unit *Technologies for functional and smart textiles* of the HACKTEX MOOC you will find information about technologies for production of 2D and 3D smart textiles, and for integration and joining in smart textiles production.

However, do not forget about sustainability when developing your project. The unit *Issues related to the sustainability of functional and smart textiles* of the HACKTEX MOOC analyses the issues that are related to the sustainability of the functional and smart textiles.

Besides, in the *HACKTEX Database* you will find a wide range of companies all over Europe that are active in different fields of smart textiles.

Besides sourcing the materials, components and technologies to be used in the development, it is necessary to establish partnerships with suppliers and manufacturers. This step might come prior to the development of the prototype, but it is always necessary prior to the definition of the commercial solution.

TIP 15

Do you need to **establish partnerships with suppliers and manufacturers**?

To start, you have a list of producers and suppliers for materials and components available in the *HACKTEX Database*.

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Another key point for the manufacturing and launching of a commercial product is ensuring the quality control and scalability in production, since it is a key step to pass from a prototype to a commercial product.

TIP 16

Do you want to learn about **ensuring quality control and scalability in production**?

The *Standards and characterization of functional and smart textiles* unit of the HACKTEX MOOC, you can find details about the standards required to evaluate the textile properties and performance/functionalities of the smart textiles. The unit introduces important testing protocols for different areas of use in the fields of smart textiles, and also explains quality parameters and protocols, as well as scalability, of both product and production processes.

CHAPTER 5: Economical and partnership needs of start-ups**Funding and Financial Management**

One of the most difficult points of starting a new venture on smart textiles can be obtaining the funding for starting, developing or launching the project. First of all, it is necessary to understand how to evaluate the different funding options to meet the financial needs.

TIP 17

Do you want to **assess funding options such as grants, investors or crowdfunding**?

The materials of *From ideas to opportunities 3* show how to assess the funding needs for a business based on smart textiles, finding the right balance in the financial structure, and how to evaluate the different funding options available to diversity the sources in accordance with the established financial strategy.

Some resources and tools are specific for the development of smart textiles. In this sense, a relevant funding source for business based on smart textiles is the European Union. However, it is needed to know the implications of applying for such a funding.

TIP 18

Do you want to **use resources and tools specific to smart textiles development**?

In the materials of *From ideas to opportunities 3* explain the European Union's main funding options, their objectives and their accessing and financial rules, to promote and sustain the smart textile business development.

However, the needs of start-ups are not only the search for funding. Other challenges these might face is the lack of support for the establishing of their projects or the lack of certain knowledge. However, there are other resources and supports for entrepreneurs of the smart textiles field. So, it is important to know about incubators, accelerators, entrepreneurship programs, industry associations and communities for knowledge sharing.

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TIP 19

Do you want to know more about the **resources and support for smart textiles entrepreneurs**?

In the materials of *From ideas to opportunities 3* you will find information about accessing incubators, accelerators, and entrepreneurship programs; joining industry associations and communities for knowledge sharing to sustain business operations and expansion; and maximizing the chances of success as a smart textile.

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ERASMUS +

KA2 – Cooperation for innovation and the exchange of good practice

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