



Knowledge & Technology Transfer of Emerging Materials &
Technologies through a Design-Driven Approach

3.3 Training contents and exercises about entrepreneurship related to EM&Ts

Author: P1 – Polimi – Politecnico di Milano, Design Department

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EXECUTIVE SUMMARY

This document reports task 3.2 Setting up of Entrepreneurship methods for each EM&Ts and task 3.3 Training contents and exercises about entrepreneurship related to EM&Ts.

In task 3.2, Polimi set up the entrepreneurship teaching methods on the basis of the results of D2.3 (Survey to companies about topics related to EM&Ts) and considering the current gap between Academia and Business Practice related to EM&Ts arisen during the transnational workshop [D3.5]. The task took place between M13 and M16, led by Polimi, and involving IDC and BCD.

In task 3.3, Polimi was responsible for the creation of a training module related to entrepreneurship skills for EM&Ts and addressed to students. This module and its contents can be used to prepare students for the mobility [D5.2] and related workshops [D5.3]. The task took place between M16 and M19, led by Polimi, and involving IDC and BCD.

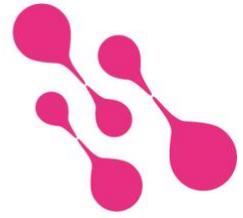
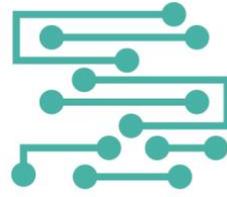
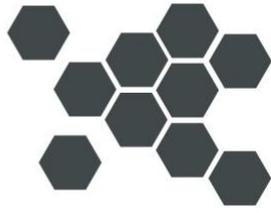
tasks are part of Work package 3, aiming to define a Unique Design Teaching method for the 4 EM&Ts areas. Mainly based on the result of the discussion of the first transnational workshop [2.5], this phase aims at creating the contents of the unique design teaching method for students with a mixed background (design & engineering) in the field of EM&Ts. The Workpackage built and integrated the related teaching methods to boost: entrepreneurial skills addressed to the Business needs related to EM&Ts; knowledge and technology transfers from academia and research centres to industry.

According to the Project Description, Deliverable 3.3 consists of An Academic Syllabus for Each EM&T containing:

- Objectives
- The applied method (i.e. theoretical lectures, hands-on sessions, brainstorming, creative session, collaboration with company, team building etc.)
- References

This is the result of existing method developed by the Department of Design of the Politecnico di Milano but tailored on the EM&Ts by including the output generated by the surveys among companies [T2.3]

This document positions the training contents and describes the methodology for the setup of the training contents. In particular, the template used for the Syllabus design is reported. The resulting Academic Syllabus is presented. Conclusions describe future implications of the task in the scope of the project and as a legacy after the completion of the project. The Syllabus template and the Academic Syllabus is attached as annexes to the document.



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1 INTRODUCTION

Herewith described tasks 3.3 and 3.4 are based on the formulation of entrepreneurship teaching methods and the creation of a training module related to entrepreneurial skills for Emerging Materials and Technologies (EM&Ts) and addressed to design & engineering students. The tasks are informed by previous tasks and related results. In particular, they are informed by T2.3 Survey to Companies about EM&Ts related topics and T3.1 specific teaching methods for each EM&Ts area, which resulted in four academic syllabuses, in combination with the existing methods developed by the Department of Design of the Politecnico di Milano. The latter are tailored on the EM&Ts,

Tasks 3.3 and 3.4 results in Deliverable 3.3, consisting of an Academic Syllabus for Each EM&T containing: Objectives; The applied methods (i.e. theoretical lectures, hands-on sessions, brainstorming, creative session, collaboration with company, team building etc.); References; other relevant information for the setup of the teaching activity.

This document positions the training contents and describes the methodology for the setup of the training contents. In particular, the template used for the Syllabus design is reported. The resulting Academic Syllabus is presented. Conclusions describe future implications of the task in the scope of the project and as a legacy after the completion of the project. The Syllabus template and the Academic Syllabus is attached as annexes to the document.

1.1 RELEVANCE OF ENTREPRENEURIAL SKILLS IN RELATION TO DESIGN & EM&TS

Every entrepreneurial success story is providing to the business attention new business model and case study for the management students. Off late, entrepreneurship has become one of the most popular subjects being pursued by college students who plan to become their own boss in the future. Lots of mature companies as matter of fact fail because of their lacking in understanding emerging opportunities and shocking events – as new technologies, startups, disruptive business models. This is the reason why entrepreneurship and intrapreneurship cultures – the form of entrepreneurship conducted in existing companies (the so called “*incumbents*”) - are spreading out into business communities and managerial agendas. While managers operate according to the principles of “resource allocation” and results controlling in existing markets (i.e. Causation principles), entrepreneurs, contrarily, operate to attract and steer resources catching new opportunities for new market creation (i.e. Effectuation principles) (Sarasvathy, 2001). From the early 2000s, the digital revolution jointly with the creation of large logistic networks and the improvement of the financial security empowered the possibility to become an entrepreneur or enabled companies in easily igniting the creation of new business units. If being an entrepreneur become easier, on the other hand, designers seem to be very close to the “entrepreneurial mindset” for their way to frame opportunities, their attitude to grasp changes in socio-cultural models, their proposition capabilities to forge an idea from scratch. This is why the paradigm of entrepreneurship, the movement of the lean startups and the Design Thinking approach are converging in a whole set of common constructs and tools (Gurusamy et al., 2016; Glen et al., 2014; Mootee, 2013) paving the avenue for the emergence of the new figure of the “designer-entrepreneur” (Colombo et al., 2017).

Therefore, the integration of a training module on entrepreneurial skills is required in the EM&Ts design education pathway. It is beneficial for students engaged in learning about EM&Ts to be introduced to the principles of entrepreneurial behavioural traits, the logics and models related to the creation of new startups, and the customer development concept. To this extent, it is fundamental to strengthen the *soft* and *hard* skills related to the entrepreneurship realm (Smith et. Al, 2007) and transferring the main concepts that distinguish the business management from the

strategic entrepreneurship. Students undertaking this challenge need to be helped to adopt an entrepreneurial mindset when looking at new opportunities for business, thinking about new products and services and envisaging the change in mature markets (McGrath and MacMillan, 2000). As a result, they may learn the importance of resource orchestration and be taught to organize entrepreneurial thinking and acting by using the business model canvas and the lean launchpad methodology. To do so they may need to draft over a very short period of time the business model of a new venture. Moreover, the training module needs to contextualize some “entrepreneurial learnings” digging some concepts and tools in different industrial settings.

1.2 THE SYLLABUS AS A PEDAGOGICAL TOOL

The tool used to formalize the training contents is one of the Academic Syllabus. A syllabus is a pedagogic tool, a teaching device, playing the crucial role of facilitating learning, providing a blueprint, a framework (Afros & Schryer, 2009). It is a tool for teachers to think systematically and coherently about what and how to teach, and a communication tool to provide relevant information to students, e.g., contents, structure, learning objectives, evaluation methods (Doolittle & Siudzinski, 2010). Syllabuses are the foundations that courses are built on: the resulting course can be considered the product of the syllabus applied, including both the blueprint as well as the materials to be learned/taught, together with guidance to the practitioner in terms of approach and implementation (Slattery & Carlson, 2005; Parkes, & Harris, 2002).

2 METHODOLOGY

2.1 IDENTIFICATION OF RELEVANT SECTORS

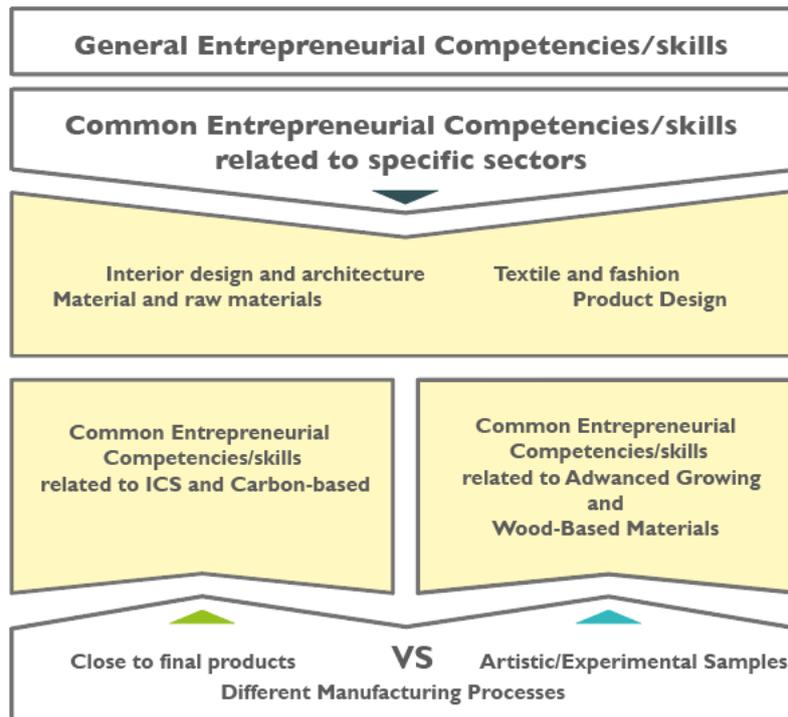
The syllabus of the training contents is expected to be divided into two modules. While the first module is on foundations and general contents (i.e., causation and effectuation, finding opportunity activity, igniting phase, Design Thinking, Lean Startup, customer development process, and more), the second module is focused on business ecosystems and venturing in specific industrial sectors. Therefore, in the definition of the training contents, it was necessary to identify the most relevant industrial sectors for each EM&Ts. This is because training contents need to report case studies, tools and methods that are very peculiar in each industrial sector. As an example, the consumer electronics sector uses entrepreneurial competences and models that differ from the ones of the clothing sector. The same distinction can be applied to end-users and manufacturers.

With the support of P6 BCD Barcelona Centre de Disseny and P8 IDC Industrial Development Centre West Sweden AB, P1 Polimi Design Department Politecnico di Milano identified the main relevant industrial sectors. The sectors were identified clustering data obtain from T2.3 Survey to companies. The most relevant industrial sectors for each EM&Ts they are listed as follows:

- **ICS Materials, wearable-based:** Architecture/Construction, Fashion, Furniture, Consumer Electronics
- **Advanced Growing:** Fashion, Furniture
- **Nanomaterials:** Automotive Industry, Fashion, Furniture, Consumer Electronics
- **Experimental Wood-based:** Architecture/Construction, Fashion, Furniture, Consumer Electronics
- Among them, there is a 1:1 ratio between end-users and manufacturers.

We considered the option to couple EM&Ts areas (Nanomaterials combined with ICS Materials, Advanced Growing with Experimental Wood-based) according to their common elements in terms of

materials properties, manufacturing processes, and technological readiness level and nature of the final outcome, as described in the following tentative scheme.



However, in approaching the specificity of entrepreneurial skills, the biggest distinctions emerged to be related to the industrial sectors, instead of the four EM&Ts. For this reason, in the second module, specific skills and models and presented according to industrial sectors (transversal to EM&Ts), instead of the four EM&Ts. The individual sectors are identified as follows:

- Architecture/Construction
- Automotive Industry
- Consumer electronics
- Fashion
- Furniture
- Packaging

2.2 SYLLABUS TEMPLATE AND WRITING OF THE SYLLABUS

To obtain a coherent design for the syllabus, Polimi used a template [Annex 3.3.2], as described below. The same template was used for the syllabuses resulting from T3.1 Setting up of the specific teaching methods for each EM&Ts area. The structure of the template has been designed and shaped based on the format used into Academic teaching environment by taking into consideration the Descriptors of Learning Outcomes for Higher Education Qualification (Gudeva, et al., 2012), to have a universal, normed, and comprehensive document as a legacy of the project after its execution.

The template is divided into different sections:

- 1) Rationale: to explain the reason for the existence of the course and how it relates to the rest of the field or area's curriculum.

- 2) Course Aims and Outcomes: divided into aims, learning objectives, and outcomes. Emphasis is put on thinking from the students' perspective and how the course can contribute to them professionally. In this section, the modules, specific learning objectives for each module, and related outcomes (describing substance and form) are presented.
- 3) Format: to outline detailly and clearly the multiple formats used in the course, i.e., lecture & hands-on sessions, lab and discussion, group learning projects, and/or presentations.
- 4) Course requirements: to present the tasks and assignments aligned with the specified learning outcomes. Requirements include the description of class attendance and participation policy, course readings (required texts and background readings), assignments for each module.
- 5) Grading procedures: to explain how the grade is made of in each module, using percentage.
- 6) Tentative Course Schedule: a table listing lectures/modules, topics, methods/tools, and assignments.
- 7) References.

3 RESULT: THE SYLLABUS

Using the provided template, POLIMI provided a syllabus aimed at describing teaching methods and exercises related to entrepreneurial skills in relation to EM&Ts for design & engineering students. In this section, a concise and consistent overview of the syllabus is provided by reporting, editing, and summing up the original text of the syllabus. All the relevant information on contents, methods, and formats of the courses are reported. Their original and extensive version, is attached as an annex to the document [Annex 3.3.3]

The syllabus outlines the tentative course '**Crafting the entrepreneurial mindset - Strategies and tools to create new venture models.**' This course (6 credits - ECTS) aims to:

- a) teach the principles of entrepreneurial behavioural traits, the logics and models related to the creation of new startups, and the customer development concept.
- b) strengthen the *soft* and *hard* skills related to the entrepreneurship realm and transferring the main concepts that distinguish the business management from the strategic entrepreneurship.
- c) facilitate students in adopting an entrepreneurial mindset when looking at new opportunities for business, thinking about new products and services and envisaging the change in mature markets.
- d) teaching the importance of resource orchestration and to organize entrepreneurial thinking and acting by using the business model canvas and the lean launchpad methodology.
- e) facilitate students to draft over a very short period of time the business model of a new venture.
- f) contextualize some "entrepreneurial learnings" digging some concepts and tools in different industrial settings.

This course is made up of **2 different main modules** aimed at covering the different expertise needed for the students.

The first module (3 credits - ECTS) is expected to generate the following learning "take away":

- Understanding of the entrepreneur behavioural and psychological traits

- Recognizing of the main differences between management principles and entrepreneurial ones
- Handling the opportunity finding concepts and logics
- Managing the initial process of the idea “igniting”
- Being able to identify funding opportunities related to the type of venturing
- Handling the phases of the customer development process
- Handling the constructs to design a new business model

The module provides the following contents blocks:

- 1) The difference in principles and constructs between causation and effectuation (4 h)
- 2) The finding opportunity activity and the igniting phase (4 h)
- 3) How Design Thinking supports the igniting phase (4 h)
- 4) The concept of Lean Startup: building, acting and testing business hypothesis through MVP (Minimum Viable Product) (4 h)
- 5) The customer development process (4 h)
- 6) How to fund a startup (4 h)

The required attendance is 75% of the total amount of hours provided by the first module. In combination with theoretical lectures, the teaching methods and tools used in the different contents blocks of the first methods are: constructs and principles, Value curve/Blue Ocean Strategic tool, Value Proposition Canvas, Testing of business assumptions and hypothesis, KPI dashboard constructions. They are applied by a mix of readings of articles and books, on site exercises and home assignments. Students’ assessment and grades will be based on questionnaire about main entrepreneurial concepts and principles (20 closed answers questions) and project work about “opportunities finding”, “value proposition canvas”, and “new business model canvas”.

The second module (3 credits – ECTS), instead, focuses the characteristics, structural features and contingencies of different industrial settings and ecosystems in order to include and frame that factors into the “opportunity finding” activity, in designing a novel business model able to change the industry competitive rules, in igniting the new business ideas and attract funding. This module aims to generate the following learning “take away”:

- Being able to build and depict a specific industry ecosystem
- Recognizing gaps and structural hole in a given industry setting
- Understanding how to connect industrial partners around a business idea
- Creating rewards and reciprocity with incumbents in a given industrial setting

The second module provides the following content blocks:

- 1) The business ecosystem: basic concepts, flows, structure (4 h)
- 2) New venturing in automotive sector (4 h)
- 3) New venturing in fashion sector (4 h)
- 4) New venturing in furniture (4 h)
- 5) New venturing in consumer electronics (4 h)

The required attendance is 60% of the total amount of hours provided by the second module. In combination with theoretical lectures and readings, the teaching methods and tools used in the different contents blocks of the first methods are Ecosystem Map and Business case study discussion for each industrial sector: instructors will provide industry specific business case study to articulate discussions. Students’ assessment and grades will be based on exercises about the Ecosystem depicting and the development of a full startup project in a given industrial setting.

By the end of this course, students will be able to manipulate the main constructs of the entrepreneurial phases, finding and framing a business opportunity, designing a incremental/radical innovation in business model, leveraging the tools of customer development.

4 CONCLUSION NEXT STEPS AND OPPORTUNITIES

The contents described in the syllabuses can be gradually tested and implemented in different actions of the projects. They will be provided as supporting contents prior or during the students' mobility [T5.2] and related with Interdisciplinary EMT&s challenges [Task 5.3], i.e., Design challenges based on EM&Ts involving the mobility of students from and to the HEIs involved in the project. The task is based on the organization and execution of four experimental creative workshops, each focusing on one of the four specific EM&Ts areas. The four workshops will involve in total: at least: 20 companies, 80 in-house students, 60 students in mobility, 20 staff/faculty. To do that, text documents, list of readings, lectures, or videos may be prepared to be provided to students.

Finally, the syllabus will last as a legacy of the project after its completion and may be applied in future courses to be added in the HEIs' curricula.

Concluding, one opportunity for the future development of the syllabus is exploiting the potential of a web-based syllabus (Afros & Schryer, 2009), which expands the navigation, communication, and interactivity possibilities (e.g., link to bibliography, digital contents, calendar).

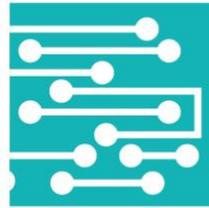
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6 ANNEXES

- 6.1 List of identified relevant industrial sectors (Annex 3.3.1)
- 6.2 Syllabus template (Annex 3.3.2)
- 6.3 'Crafting the entrepreneurial mindset - Strategies and tools to create new venture models' syllabus (Annex 3.3.3)



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