Managing Affective-learning THrough Intelligent atoms and Smart InteractionS

**D1.1 - MaTHiSiS Exploitation Plan M12**

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<th>Description</th>
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<tr>
<td>ACS</td>
<td>Autism Spectrum Case</td>
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<tr>
<td>API</td>
<td>Application Programming Interface</td>
</tr>
<tr>
<td>xAPI</td>
<td>Experience Application Programming Interface</td>
</tr>
<tr>
<td>CAGR</td>
<td>Compound Annual Growth Rate</td>
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<tr>
<td>CFR</td>
<td>Charter of Fundamental Rights</td>
</tr>
<tr>
<td>CGDLC</td>
<td>Career Guidance Distance Learning Case</td>
</tr>
<tr>
<td>CLS</td>
<td>Cloud-based Learner’s Space</td>
</tr>
<tr>
<td>DOW</td>
<td>Description of Work</td>
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<tr>
<td>DSS</td>
<td>Decision Support System</td>
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<td>EP</td>
<td>Exploitation Plan</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<tr>
<td>GPL</td>
<td>General Public License</td>
</tr>
<tr>
<td>HCI</td>
<td>Human-Computer Interfaces</td>
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<tr>
<td>HTML</td>
<td>Hypertext Markup Language</td>
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<tr>
<td>ICT</td>
<td>Information Communication Technologies</td>
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<tr>
<td>ITC</td>
<td>Industrial Training Case</td>
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<tr>
<td>MEC</td>
<td>Mainstream Education Case</td>
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<tr>
<td>MOOC</td>
<td>Massive Open Online Course</td>
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<tr>
<td>LMS</td>
<td>Learning Management System</td>
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<tr>
<td>PESTLE</td>
<td>Political, Economical, Societal, Technical, Legal, Environmental analysis</td>
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<tr>
<td>PMLDC</td>
<td>Profound and Multiple Learning Disabilities Case</td>
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<tr>
<td>SCORM</td>
<td>Sharable Content Object Reference Model</td>
</tr>
<tr>
<td>SLA</td>
<td>Smart Learning Atom</td>
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<tr>
<td>SME</td>
<td>Small Medium Enterprise</td>
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<tr>
<td>STEM</td>
<td>Science, technology, engineering and mathematics</td>
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<td>SWOT</td>
<td>Strength, Weaknesses, Opportunities, Threats</td>
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<tr>
<td>Abbreviation / acronym</td>
<td>Description</td>
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<tr>
<td>TFEU</td>
<td>The Treaty on the Functioning of the European Union</td>
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<td>3D</td>
<td>Three-dimensional</td>
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Table 1: Definitions, Acronyms and Abbreviations
Project Description

One of the core objectives of the MaTHiSiS project is to enter the learning environments and make use of computing devices within learning spaces in a more interactive way, which will provide a product-system to be used in formal, non-formal and informal education. An ecosystem that will assist learners/tutors/caregivers for both regular learners and learners with special needs will be introduced and validated in 5 use cases: Autism Spectrum Case (ACS), Profound and Multiple Learning Disabilities Case (PMLDC), Mainstream Education Case (MEC), Industrial Training Case (ITC) and Career Guidance Distance Learning Case (CGDLC).

The MaTHiSiS product-system consists of an integrated platform, along with a set of re-usable learning components (educational material, digital educational artefacts etc.), which will respond to the needs of a future educational framework, and provide capabilities for: i) adaptive learning, ii) automatic feedback, iii) automatic assessment of learner’s progress and behavioural state, iv) affective learning and v) game-based learning.

Within MaTHiSiS an innovative structural tool of learning graphs is going to be introduced to guide the learner though the process of learning in the given scenario. To reach a learning objective, the learner will have to “follow the path” of the learning graphs, built up by Smart Learning Atoms, which are specific learning elements that carry defined learning materials.

To ensure barrier-free integration in the market, MaTHiSiS will make use of a range of interaction devices, such as specialized robots, mobile devices and whiteboards. The consortium will ensure easy-to-use solutions with e.g. specialized graphical editor-like tool, allowing to easily create educational materials as well as the reusability within both mainstream education and vocational training setups.

Objectives of the project

A Cloud-based Learner’s Space (CLS) will be developed to provide storage and interaction system for adaptation/personalization in learning, profiles storage, interaction, data acquisition and analysis as well as content creation on the fly. This is a core component of the MaTHiSiS system which includes 4 crucial subsystems that create an innovative smart learning ecosystem: i) the experience engine, a graph-based interactive storytelling engine, that generates interactive content that is later sent to a device of the tutor’s/learner’s choice; ii) the learning graph engine, responsible for adaptation of the Learning Graph based on learner’s behaviour and interaction; iii) the Decision Support System (DSS) providing and collecting learning analytics and controlling synchronous and asynchronous interaction between devices, and iv) Profile Repository to store collected data and learning graphs for learners profile. To ensure constant educational flow and augmented learner engagement, the emotion recognition and the context aware the cognitive/behavioural status extraction tools are going to be introduced within the system addressed by the Sensorial component.

By the end of the project, MaTHiSiS will introduce a marketable innovation, aimed to the re-usability of educational and training content and fostering the interactivity between technology and learners/tutors/caregivers.
Executive Summary

This deliverable is the first approach to the exploitation and sustainability of the MaTHiSiS results. Some of this report contents must be updated along the project’s lifespan considering the evolution of the different MaTHiSiS exploitable assets identified during this year.

The deliverable provides an overview on the market development that shall be taken into account for planning MaTHiSiS exploitation. The document introduces the problem statement which is being rectified by the MaTHiSiS platform to help create the mission and a baseline for the exploitation of the platform.

The e-learning and LMS market has been on the rise for the past several years and is expected to see the same trend in the future. The global e-learning market has been annually growing with an average of 7.9% with Asia leading this growth followed by Eastern Europe with 17.3% and 16.9% respectively. The LMS market has outperformed all the estimations for the past few years and has doubled in two years with an estimate CAGR of 22.8%.

From the SWOT analysis the deliverable captures the fact that the progress in areas of educational sciences and HCI stimulate a positive background for the exploitation of the platform. Specific strengths of the MaTHiSiS solution include a strong SME involvement in all activities of the platform development, access to a large number of users and continuous involvement of other stakeholders to better address the needs of the market. The weaknesses identified include a strong competition in Europe and abroad as well as a lack of a scientifically grounded proof of interplay among the components. There are huge opportunities for the exploitation of the platform due to the growing need of smart and adaptive educational environments, increasing market for educational systems as well as the lower cost for a number of the stakeholders involved in the usage of MaTHiSiS results. The threats included the barriers to adoption such as legacy systems and resource constrains. Bureaucratic procedures are also identified as a threat for the exploitation along with rapid change in technology and markets.

Results of PESTLE analysis determined that politically, there is a significant interest in the technology innovation in educational sector and new political reforms has given a rise to integration of such platforms in the education sectors of various countries. Economically, there is fundamental change in the market due to various political and social factors. The cost rise of education in some countries and decline in others develop a gap which plays a vital role in choosing alternative online education systems by learners. The workplace attitude towards e-learning is changing as digital natives join the decision making processes. Technologically, there has been significant advancement which has had great impact on the usability and availability of the e-learning and the educational technologies. Technologies such Cloud-based learning, Gamification, SaaS authoring tools, Notification systems, Tin Can API, 3D Virtual work training, AI virtual coaches and Robotic patients have been a boosting factor for e-learning platforms. E-learning provides an alternative to paper based learning as well as eliminates physical training spaces which put a great impact environmentally. There is a significant decrease in commuting needs by the learners which again has a positive impact on the environment.

Porter’s five forces analysis revealed that due to technological barriers, the entry threat of new competitors is not significant, although particular attention will be paid to monitor which projects/companies/products provide similar capabilities. MaTHiSiS suppliers are the content developers therefore the supplier power is quite low. There are two types of users for MaTHiSiS investors and the end users. Although the investors will have high power, the customer power of the end users will be quite low. The threat of substitution is quite low as well due to the entry barriers.

Apart from the exploitation of the platform as a whole, individual components such as Creation Tools, Affect Recognition Software, Sensorial Component, Educational materials, Learning graphs,
Learning Analytics & Visualisation tools, MaTHiSiS mobile applications and Education materials are going to be commercialized where possible. The initial analysis reveals the competitors in regard to each of so far identified components. These will be closely monitored and additional components might be identified in the later stages of the project.

Business Scenarios will be defined upon exploitation of individual components and exploitation of the integrated platform. These can be used by the consortium as a whole, a group of beneficiaries or by individual beneficiaries. A joint exploitation approach will be employed by the consortium for the exploitation of the platform which will be dependent on how the project will evolve and the feedback from the stakeholders to the first prototypes. Additional funding might be required to successfully enter the market and scale. These can be provided by European national funds, Investment funds and venture capital, or Public Private Partnership depending on the groups of partners or individual partner’s requirements. The exploitation

The value proposition of MaTHiSiS is the extraordinary technical solution that is provided to the teachers and learners to enable them to tailor their learning paths. The ability of the platform to adapt to the learner will create a positive impact on the learning curve of the user.

Finally, the initial stakeholder analysis was put in place. The identified groups are Students/Learners, Instructors/Teachers, Family members, Employers, Educational Institutions, Content Providers, Technology Providers, Policy Makers, Governments, Accreditation Bodies. Most of these stakeholders are unique to the country of exploitation (government, accreditation body) or dependant on the end-user (e.g. family member), some of them can already be identified for further engagement (See Appendix). Based on the reasons to engage with a particular stakeholder, Wright and Cairns’ stakeholder framework map was created. Thus stakeholders are identified as HIGH value, MEDIUM value and LOW value based on contribution, legitimacy, willingness, influence and necessity of involvement. As a result, it is identified that learners, teachers, family members will have the highest influence followed by the employers and the educational institutions. Accordingly, tactics are created to engage, communicate and Inform the stakeholders based on their importance. Also channels such as MaTHiSiS communities, social network groups, GitHub repositories, five thematic repositories and project website will be used to reach the stakeholders.

Following the reviewers’ comments resulting from the First Review held on 10/02/2017 on additional improvement of the deliverable, we have stated and analysed the markets we are approaching as per use-case and have added five separate market analyses that can be found in Section 3 – Market Analyses and specifically sub-section 3.1.1 was added and 3.1.2 re-edited to elaborate more on the target segments. Further MaTHiSiS is not limiting the provision of its products and services to some set of countries rather aims to expand worldwide, nevertheless at least for the piloting countries the analysis of the public bodies has been provided in detail covering most of the comments and feedback of the reviewers. Specifically, section 7.2 provides a deeper look at the stakeholder identification per use case and sections 7.3 describes the analysis of the public bodies for all the use cases and countries where success of the exploitation requires engagement with public bodies. Our primary target market is educational market (not mainstream solely) and all the use cases and pilots defined in the contract and in the deliverable, are equally important for future commercialization. The major stakeholders are also mentioned in section 3. Further, addressing the comments, the analysis of public bodies includes the review of those bodies, who are responsible for taking decisions on new curricula, funding, who is responsible for implementation and financial support. The analysis also provides an overview of the German public bodies to show that our market is not limited by the piloting countries only. Finally, within the PESTLE analyses, namely section 3.5.4 explains why we involve robots, their usefulness and the pricing trends and again those who can fund their implementation in schools described in the respective stakeholder analysis section. Going beyond the official review letter, the SWOT analysis (section 3.4) is more trimmed to MaTHiSiS solution addressing both strength and limitations (e.g. affect recognition tools, etc.) and section 5 offers further elaboration on initial plans for further business case development scenarios.
1. Introduction

The goal of this deliverable is to outline the exploitation initiatives to be performed by MaTHiSiS beneficiaries in order to evaluate and further create exploitation opportunities for the MaTHiSiS platform, its modules and services, establishing the most suitable actions to ensure successful sustainability of the MaTHiSiS project beyond its lifetime.

The deliverable consists of 8 chapters that raise important questions to successfully plan the exploitation activities within the MaTHiSiS consortium. Thus, Chapter 1 introduces the goal of this deliverable, problem statement and the mission statement of the consortium, whereas Chapter 2 begins the possible elaboration on the approach to exploit the results. Further joint exploitation possibilities and steps to take will be discussed as part of the T1.2 within WP1. Third Chapter provides an analysis of the e-learning market and the adaptive smart learning systems, gives the overview of the PESTLE factors, SWOT analysis, unique value of the system, its competitors and Porter’s five forces analysis.

Further the deliverable defines the initial exploitable results, elaborating on its competitors, target users, strengths, weaknesses, opportunities and threats in Chapter 5 following the definition of business scenarios in Chapter 6.

The stakeholder analysis in presented in Chapter 7 and the conclusions are derived in Chapter 8.

1.1 Problem Statement

No two learners are alike, and yet our learning resources and teaching approaches are not adapted to the different levels of ability of each of our students. Too often we provide a fixed learning menu for a set of individuals that have a diverse range of talents and learning styles.

Our teaching approaches fall short as a result. We fail to engage each learner in the various ways that can best grasp their interest and provide them with an individual learning experience that really works for them.

Front line teaching professionals are well placed to adapt their teaching to each of their learners because they know all about their needs and abilities – but they can rarely have the time and resources to provide that sort of individualized tuition.

These challenges affect everyone in the classroom, but they have the most marked effect on those who are different from what is perceived to be a ‘typical’ learner. That means learners who have special needs; because of their learning disabilities, their ethnicity or their medical needs for example – will inevitably be those worse affected.

The range of different ways we each need to engage with learning does not however just apply to special needs of each of our learners. A further problem that we increasingly face is that we need to teach in a range of different settings and at different times. We do have a wider range of new technologies at our disposal than ever before to grapple with this array of challenging learning situations – but there are real challenges aligning the right technical tool to the right learner in the specific setting in which they need to learn.

We have new tools that can provide diverse learning experiences for our varied and atypical learners wherever they need to learn. They can learn as individuals on mobile devices or work in teams on new interactive platforms that facilitate the pooling and sharing of ideas. Responsive, interactive learning robots now add to the options that we have at our disposal - but how can busy teachers and trainers make the most of the rich array of learning opportunity that the widening array of technical tools provide?
Technological progress presents new challenges for teaching professionals where every device has a different set of features and a unique type of interface that might be profitably exploited for our learners.

Can we build a system that adapts to every individual’s personal strengths and meets the challenges faced by each learner in a suitable and responsive way?

Can we design learning experiences that work across different platforms and devices and so provide coherent learning pathways in various different settings?

These are the challenges that address with the innovative MaTHiSiS system.

1.2 Mission Statement

The mission of the exploitation plan by the consortium is to analyse and establish a plan to achieve maximum impact from the results of MaTHiSiS and development of executable business models with those results.

It is of crucial importance to understand the routes the consortium can take to exploit the results of the project. For this a better understanding of the market needs is required as well as direct engagement with important stakeholders is needed. The nature of the MaTHiSiS project already takes the above mentioned points into consideration and the most important stakeholders are involved in the project consortium. This definitely helps to better define and shape future products and services. Nevertheless, ensure the commercialization of the results a much broader consultation required, including the developers, content providers, decision makers, governments, etc.

The main goal of MaTHiSiS is to address all the problems mentioned in section 1.1 and in particular striving to provide a personalized learning experience to each learner on the one side, but also to reduce the management of the learning process on the teaching side as well as to provide tools for developers and other stakeholders to better address the needs of the market and to bring innovative solution to Europe.
2. Approach

The current Deliverable is a starting point for the rest of exploitation activities through the MaTHiSiS lifetime. Some of this report contents must be updated along the project’s lifespan considering the evolution of the different MaTHiSiS exploitable assets identified during this year.

The strategy that has been followed is described below:

- First approach to the market of MaTHiSiS, identifying which is the gap that this platform is going to cover. For a successful commercial uptake of the project results and developed system after the project, it is necessary to fully understand the market forces acting on and within the system, to develop a new tool in line with the market needs and differentiating from potential competitors.
- Identification of the MaTHiSiS exploitable results and first version of the IPR management of the components of MaTHiSiS. Final decision of the licenses that will be used to release MaTHiSiS components and the integrated system systems will be discussed during the second year of the project.
- Potential business scenarios that will be developed in next versions of the deliverable.
- Initial version of the value proposition which provides the differentiation of MaTHiSiS from the rest of potential competitors: MaTHiSiS provides every type of learner, in every type of setting, on the device they have at their disposal, with a bespoke, individualised learning experience that is adapted to their personal requirements.
- Description of the stakeholder engagement strategy to be conducted

2.1 Exploitation Plan Governance

In the context of the MaTHiSiS Exploitation Plan, governance is defined as a set of processes, procedures and activities established to ensure: (1) timely and efficient execution of the Exploitation Strategy and Plan; (2) continuous review of the Exploitation Strategy and Plan in order to expand and optimise the exploitation of project results; (3) the alignment of project stakeholder to the Exploitation Plan objectives, priorities, responsibilities and progress.

The list of governance processes and procedures include:

- Establishing a framework for controlling and monitoring the Exploitation Plan risks
- Establishing success and quality metrics for Exploitation Plan activities
- Establishing a framework for reviewing progress
- Establishing an effective Communication Plan to ensure partners’ alignment on Exploitation Plan activities progress and priorities
- Defining clear roles and responsibilities for the exploitation team

During the Research Phase a set of governance processes have been put in place and executed to control the efficient planning and execution of the activities during the first eighteen months:

- The goals and objectives have been set and agreed for the Research and Exploitation Strategy Implementation Phases to ensure the project team are aligned.
- The Risk Log was created to register potential risks including the Weakness and Threats identified during the PEST and SWOT research. The risks identified as a result of the PEST and SWOT research have been analysed, categorised and the high level mitigations have been devised for each risk. The risks categorised as non-exploitation risks have been transferred to the Project Coordinator to be managed at the project level, i.e. the team responsible for the risk will execute the mitigation actions and control the risk.
The Exploitation Team Charter has been defined to ensure the roles, responsibilities and expectations are clearly set amongst the project stakeholders for the exploitation activities.

The communication reports on the exploitation activities have been sent to the project team on a one- or two-weekly basis, and the meetings with relevant partners have been organised on per-need bases (see the section Communications Management).

The schedule for short-term activities has been devised to ensure the timely and structured execution of the planned short-term objectives and activities.

During the Exploitation Strategy Implementation Phase, the governance objectives will expand to include:

- Risk monitoring and execution of mitigations to ensure risks are under control.
- Establishing the success metrics and KPI for promotion and marketing to support impact evaluation and strategies adjustment.
- Ensuring the clinical trials feedback is reflected in the Business Models Value Proposition.
- Developing and implementing the tools and methodologies for the market in-field feedback collection, evaluation and implementation in the Business Models and the MathIsIs market-oriented products.
- Identifying the most appropriate and effective IP models and agreements to ensure mutual agreement amongst the partners for the exploitation of project results (commercial and non-commercial).

For the Final Exploitation Phase the governance objectives will be defined during the preceding phase.
3. Market Analysis

3.1 Market Review

Educational technologies are playing an increasingly important role in the way we transmit and acquire knowledge in our highly connected society. What once began as abacuses and blackboards now comprises a myriad of electronic systems and tools designed to help students, teachers, employees and private individuals learn anything anywhere and at any time. Moreover, the number of e-learning technologies has been increasing exponentially since the advent of the internet. Such technologies offer considerable benefits. They can communicate knowledge in interactive, highly customisable ways, especially when compared to traditional classroom settings where often a relatively small number of teachers is responsible for the academic success of large groups of students. They also provide professionally active adults, who otherwise would not have enough time to take classes, with an opportunity to continue their education and thus improve their career prospects. This is especially true for jobs in which change is occurring at a faster pace: If companies and their employees fail to keep this pace they can quickly be outdone by their competitors. Perhaps most importantly, e-learning emancipates education from its physical location. This means that even people in the most remote areas of the world can acquire an education if they are provided with access to e-Learning technologies.

The number of lives e-learning could potentially change for the better is incalculable. In the face of such considerable benefits, it comes as no surprise that the market for E-Learning technologies is growing at an unprecedented rate.

e-Learning

Never before has the market for e-Learning software and devices expanded faster. According to a comprehensive report by Italian e-Learning provider Docebo from the year 2014 [1], the worldwide market for E-Learning was already worth $35.6 billion in 2011. While this number may seem big, it pales in comparison to the $51.5 billion reached in 2016 thanks to an annual growth rate of about 7.9% during the period 2012-2016.

It is to be noted that this 7.9% is a global aggregate. Certain regions will experience more rapid growth. The highest of these will is expected to be found in Asia with an estimated CAGR of 17.3% mainly due to government-funded programs which aim to increase literacy in rural areas. The sheer number of potential e-learning users in such areas makes the Asian market the biggest.

Surprisingly, the second fastest growing regional market will be the Eastern European one with an estimated CAGR of 16.9%, mainly led by Russia. In this region, the already substantial $728.8 million in revenues from the year 2013 were projected to reach a full $1.2 billion by 2016. Driven by public sector investments and a large numbers of young start-ups, the growth of the Eastern European e-learning market surpasses even that of Western Europe and North America.

That being said, Western Europe is still currently the second biggest buyer of e-Learning technologies after North America. In 2013 it boasted $6.8 billion in revenues which grew to an estimated $8.1 billion in 2016 thanks to a CAGR of 5.8%. In Western Europe, E-Learning technologies are notably used in higher education. More recently, small and medium business have begun to incorporate more and more learning technologies in the workplace due to the relatively low cost of implementing them.

Favouring this rapid expansion are factors such as the relatively low costs of implementing E-Learning solutions, the flexibility and effectiveness such systems offer and finally the growing number of internet users across the world [2]. By the year 2019, a total of 51.5% of the world’s population is
expected to have access to the internet\(^1\). Additionally, there is potentially huge return on investment with the use of such technologies in the workplace: As workers become more skilled they occupy higher positions and get higher salaries.

**LMS**

The market for Learning Management Systems is expanding faster and faster. While the most optimistic projections expected it to grow to $1.9 billion by 2013 \([3]\) and then $2.5 billion by 2014 \([4]\), it has outperformed those projections. By the end of 2013, the projected $1.9 billion had already been exceeded reaching $2.55 billion. A recent report by MarketsandMarkets, one of the leading market research firms in the world, values the worth of the global LMS market alone at $4.07 billion for the year 2015 \([5]\). This means that it more than doubled in only two years. Moreover, at an estimated CAGR of a sizeable 22.8%, MarketsandMarkets forecasts that by the year 2020, the global market for LMS applications alone will be worth a substantial $11.34 billion.

When it comes to market size, Europe and North America are expected to be the biggest while the Asia Pacific and Middle East and Africa regions are forecasted to experience the most market traction. More specifically, the European LMS market is currently growing at a CAGR of 21.9%. Valued at $486.4 million in 2014, it will have nearly tripled by 2019, reaching a total worth of $1.3 billion \([6]\).

**Trends**

Cloud technology is changing the way we use and interact with the internet in general. This is no exception when it comes to E-Learning. An increasing amount of E-Learning providers and users are storing their courses and data entirely in the cloud. E-Learning and LMs providers are no exception here.

Smart connected devices are also playing a major role in recent E-Learning developments, as are mobile devices like laptops, smartphones and tablets. This is because mobile technology is being adopted across the world at an unprecedented rate. Indeed the mobile industry, including devices, carriers and apps, has become the fastest growing industry ever recorded \([1]\).

The rise of digital publishing has also already left its mark on E-Learning. An increasing amount of creators all over the world have been self-publishing all kinds of educational content ranging from e-textbooks to courses and videos. However, this is not affecting the E-Learning market in a significant way as of yet.

Another strong trend in E-Learning is adaptive learning. Through adaptive learning, computers can adapt the course material to the students’ needs and present him/her with the customised training course. This also makes it possible to allocate the teachers’, professors’ and educators’ time more efficiently since adaptive learning can make them more aware of the unique needs of each learner.

### 3.1.1 Use-case specific market analysis

Although the potential market for MaTHiSiS exploitation can be much bigger and has the potential to cover many areas of application, for the time being we analyze the market (its size, potential development and state of current offerings) with respect to the use cases and pilots we are having during the project runtime

#### 3.1.1.1 Autism Spectrum

According to the World Health Organization (WHO), one person in 160 has an ASD, which accounts for more than 7.6 million disability-adjusted life years, at the same time representing 0.3% of the global disease burden.\(^2\) Although there is no clear market division of the educational market offering


\(^2\) WHO. Autism spectrum disorders and other developmental disorders. From awareness to building capacity. September 2013
products and services specifically for one or another disability, there are some evidences that schools and other educational organizations serving learners with ASD will continue to enhance learning experience for students and adults with autism. At the same time, there will be a stronger advocacy of the national organizations to support the development of specialized programs for rising number of students within and outside of K-12 educational system. Thus, in America the legislation called Achieving a Better Life Experience Act (ABLE) is designed to allow specific saving accounts for individuals with disabilities to support lifetime needs with up to 100,000 US dollars. A number of Senate Bills (e.g. Senate Bill 850 of the State of Florida) passed as well to provide families with Personalized Learning Scholarship Accounts to be able to customize education of autistic kids that can be spent on private schools, educational therapies or innovative educational services.

In UK, educational programs aimed at learners with ASD are supported by the government. Netley primary school, for example, has a program for children with autism who are able to weave in and out of mainstream classes. The school receives governmental grants of approx. 22,500 British pounds per pupil per year and has 16 personnel for 24 pupils which are much more than the national average (1 for every 17).

Apart from educational benefits, MaTHiSiS strives to reduce the overall economic burden of childhood autism spectrum disorder. Although it is clear that care for children with ASD is associated with the increased health care costs, the total financial burden is even higher when accounted for non-health care costs and in particular school costs. The study of Lavelle et al. concludes that the regression-adjusted school costs for children with ASD were 8610 US dollars higher in comparison to the control group on non-ASD learners. In US only, applying these numbers to the estimated 673000 children aged 3 to 17 years old will result in approximately $6 billion additional school resource utilization annually (based on the data of 2011).

As for European market, it is more complicated to estimate the size of it due to the lack of data and methodological limitations. Some estimates and conclusion of the European Commission state that specific prevalence rate for “classical autism” in the EU is varying between 3,3 to 16,0 per 10.000 of population whereas when all forms of ASD are included, these numbers range between 30 and 63 per 10 000. The study conducted by the Centre for the Economics of Mental Health (CEMH) on direct and indirect costs associated with ASD concluded that the average cost for attending a special residential school is three times higher compared to special day school (30.000 pounds vs. 10.000). Taking the assumption in consideration that 15% of children with ASD attend residential schools, annual average sums up to 13.000 pounds.

Over the past 30 years, the number of children with ASD has rapidly increased (partially due to different methodology and diagnostics criteria) but the numbers above show that it is a substantial market with growing demand which MaTHiSiS can address in the nearest future. For the sake of successful exploitation the following stakeholders for this specific case study will be considered:

<table>
<thead>
<tr>
<th>Country</th>
<th>Organisation/institution</th>
<th>Main activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>Instituto de Salud Carlos</td>
<td>ASD</td>
</tr>
</tbody>
</table>

---

### Table 2. ASD stakeholders

<table>
<thead>
<tr>
<th>Country</th>
<th>Stakeholder</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>England</td>
<td>National Autistic Society (NAS)</td>
<td>Registered charity, provides education and care for people with ASD</td>
</tr>
<tr>
<td></td>
<td>Local Authority Educational Department</td>
<td>In charge of deciding on educational plans for children with ASD</td>
</tr>
<tr>
<td>France</td>
<td>“Maison Départementale des personnes handicapées”</td>
<td>Educational plan decision body</td>
</tr>
<tr>
<td></td>
<td>Autisme (autisme.france.free.fr)</td>
<td>National parents association</td>
</tr>
<tr>
<td></td>
<td>Sésame (<a href="http://www.sesameautisme.com">www.sesameautisme.com</a>)</td>
<td>National parents association</td>
</tr>
<tr>
<td></td>
<td>Pro Aide Autisme (<a href="http://www.proaidautisme.org">www.proaidautisme.org</a>)</td>
<td>National parents association</td>
</tr>
<tr>
<td>Italy</td>
<td>Public Health Autism Centre</td>
<td>Public authority</td>
</tr>
<tr>
<td></td>
<td>Centre for Diagnosis, Treatment and Research of Autism, ULSS 20</td>
<td>Diagnosis, treatment and research for ASD</td>
</tr>
<tr>
<td>Scotland</td>
<td>Scottish Society for Autism (SSA)</td>
<td>Registered charity for people with ASD and families</td>
</tr>
</tbody>
</table>

### 3.1.1.2 Profound and Multiple Learning Disabilities

The market analysis showed that there exists a small number of specific learning and e-learning offers that target a group of people with learning disabilities. This finding was also confirmed by the study of MMB-Institute back in 2011⁷, nevertheless this specific niche hasn’t developed much since then. The study shows the reasons behind really low offers in learning solutions for people with disabilities based on an ad hoc survey performed among 42 companies offering e-Learning products and services to find the reason of such a market gap in the supply. Even a limited number of offerings for these specific cases are largely subsidized projects and therefore often have only a limited life. Only a small number of offers can be considered as a full commercial product which can be used beyond a single institution or a specific target group.

The majority (29 out of 42 companies) cites as the main reason for the supply deficit is a too small size target group (see Fig. 3). The lack of public funding and the low interest of the personnel responsible are also mentioned as the main reasons. After all, half of the respondents also use self-criticism: lack of knowledge on the part of the e-learning service providers is also given by them as a reason for the low supply of e-learning products for people with learning disabilities.

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Indeed, looking specifically at the PMLD market, major difficulties arise when trying to understand the size of it as no centralized data for population with PMLD was ever created both on European and national levels. The observations mostly do not have a year on year information; the numbers are not accurate enough and provide different figures depending on the source and in most cases are simply estimations based on the data in hand. To have an impression about the size of the market, we had a look at UK population. According to the Public Health England report\(^8\) over 1 million citizens had a learning disability, of which about 225,000 children and more than 900,000 adults. The data on children with special education needs presents some insights about the number of children with a primary SEN within state funded schools over a period from 2009 to 2013. The data reveals that even though the overall trend of percentage of children with primary SEN associated with learning disabilities goes down, at the same time the numbers for PMLD cases specifically has risen by 3.8% (see Figure 2):

It is worth to mention that according to the research conducted by Emerson et al. from Centre for Disability Research (CeDR), only a third of the citizens with learning disability are undertaking some form of education or training and less than 15% specifically among those who are suffering from PMLD. At the same time, same report states that it is more unlikely to be employed with PMLD in comparison to other learning disabilities and nearly no one with PMLD had a paid employment for the time of the research conduction (or at least within the focus group). Further observation reveals that even though the overall spending of authorities on the support of the citizens with learning disabilities has risen, nevertheless the funding of professional support, equipment provision and adaptations have drastically decreased, whilst direct payments has increased in some cases by 80-150%.

One can argue that this specific market should be carefully rethought and disrupted. Given that the governments are willing to increase the overall public spending there is a need to pay more attention to the personal development and education of the PMLD learner, providing a chance to be fully

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**Figure 2. Number of children with primary SEN associated with learning disabilities (2009-2013)**

<table>
<thead>
<tr>
<th>Type of SEN</th>
<th>School Action Plus</th>
<th>%</th>
<th>Statement</th>
<th>%</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2009 to 2010</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MLD</td>
<td>130,620</td>
<td>96.8%</td>
<td>41,030</td>
<td>54.8%</td>
<td>171,850</td>
<td>81.8%</td>
</tr>
<tr>
<td>SLD</td>
<td>3,620</td>
<td>2.7%</td>
<td>25,230</td>
<td>33.7%</td>
<td>28,850</td>
<td>13.7%</td>
</tr>
<tr>
<td>PMLD</td>
<td>720</td>
<td>0.5%</td>
<td>8,680</td>
<td>11.8%</td>
<td>9,400</td>
<td>4.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>134,960</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>74,340</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>209,900</strong></td>
<td><strong>100.0%</strong></td>
</tr>
<tr>
<td><strong>2010 to 2011</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MLD</td>
<td>124,105</td>
<td>96.9%</td>
<td>36,645</td>
<td>51.0%</td>
<td>160,750</td>
<td>80.4%</td>
</tr>
<tr>
<td>SLD</td>
<td>3,225</td>
<td>2.5%</td>
<td>26,045</td>
<td>36.3%</td>
<td>29,270</td>
<td>14.6%</td>
</tr>
<tr>
<td>PMLD</td>
<td>795</td>
<td>0.6%</td>
<td>9,100</td>
<td>12.7%</td>
<td>9,895</td>
<td>5.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>128,125</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>71,790</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>199,115</strong></td>
<td><strong>100.0%</strong></td>
</tr>
<tr>
<td><strong>2011 to 2012</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MLD</td>
<td>114,805</td>
<td>96.8%</td>
<td>34,715</td>
<td>48.9%</td>
<td>149,520</td>
<td>78.8%</td>
</tr>
<tr>
<td>SLD</td>
<td>3,055</td>
<td>2.6%</td>
<td>26,880</td>
<td>37.8%</td>
<td>29,935</td>
<td>15.8%</td>
</tr>
<tr>
<td>PMLD</td>
<td>795</td>
<td>0.7%</td>
<td>9,460</td>
<td>13.3%</td>
<td>10,255</td>
<td>5.4%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>118,655</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>71,055</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>189,710</strong></td>
<td><strong>100.0%</strong></td>
</tr>
<tr>
<td><strong>2012 to 2013</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MLD</td>
<td>104,900</td>
<td>96.6%</td>
<td>33,455</td>
<td>47.3%</td>
<td>138,355</td>
<td>77.2%</td>
</tr>
<tr>
<td>SLD</td>
<td>2,900</td>
<td>2.7%</td>
<td>27,540</td>
<td>38.9%</td>
<td>30,440</td>
<td>17.0%</td>
</tr>
<tr>
<td>PMLD</td>
<td>805</td>
<td>0.7%</td>
<td>9,715</td>
<td>13.7%</td>
<td>10,525</td>
<td>5.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>108,605</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>70,710</strong></td>
<td><strong>100.0%</strong></td>
<td><strong>179,320</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

%Change 2009 to 2010 – 2012 to 2013 (compound annual growth rate)

<table>
<thead>
<tr>
<th>Type of SEN</th>
<th>% Change 2009 to 2010</th>
<th>% Change 2012 to 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>MLD</td>
<td>-7.0%</td>
<td>-6.6%</td>
</tr>
<tr>
<td>SLD</td>
<td>-7.1%</td>
<td>+3.0%</td>
</tr>
<tr>
<td>PMLD</td>
<td>+3.8%</td>
<td>+3.8%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>-7.0%</strong></td>
<td><strong>-1.9%</strong></td>
</tr>
</tbody>
</table>

*Percentage of children with primary SEN associated with learning disabilities*
involved in the market economy and develop socially. Assuming certain support from stakeholders, policy makers and engagement of the end-users themselves, there is a great potential for MaTHiSiS to serve as a facilitator of the future market change.

3.1.1.3 Mainstream Education

The growth of the ICT market and its penetration in all aspects of our modern life has driven us to the concept of “knowledge-based society” in which the generation and usage of new knowledge are of crucial importance in creation of wealth. Technology will further continue to bring incremental transformation to our daily activities and education approaches are not an exception. Nowadays we observe a much greater use of tablets, smartphones and other portable devices in classrooms, especially in middle, upper and higher education.

Nevertheless, it is argued that a rapid development of ICT helped to greatly increase the means of delivery of content through a number of channels like internet and smart devices, but there still exists the lack of understanding about the ways to use such innovations to rapidly improve development skills of the learner within mainstream education. Schools do not use the full potential of the widely available resources for a number of possible reasons (lack of ICT competence, lack of finances to acquire needed infrastructure, etc.). Nevertheless formal education is under increasing pressure to adapt to all the technological innovation.

There have been large investments (both private and public) in ICT in education over the past decade. Over 5.5% of education revenues are nowadays invested in technology and more than $64,15 billion were spent globally in 2010 on education IT. With the development of the technology and the emergence of new approaches towards mainstream education, technical implementation within schools is progressing but with different pace among different EU member states. An initiative launched by the European Commission Opening Up Education, aimed at boosting innovation and digital skills in schools revealed some of the information about the European market. For example, more than 90% of primary and secondary schools in Latvia, Lithuania and the Czech Republic are provided with the Internet access, whereas only 45% have access in Greece and Croatia. At the same time the EU average ratio of computers available for education is 5 to 1.

Nevertheless, thanks to the technology there is a great potential for schools to adapt to the market changes faster and the companies that provide adaptive learning technologies receive a lot of attention from a number of stakeholders (educators, public authorities, investors), and European market has a really important role here. Europe has some of the most innovative educational technology startups but lack the ability to scale up and compete with US based competitors. According to Benjamin Vedrenne-Cloquet, co-Founder & CEO of the Edxus Group, the funding levels in US are 10 times higher than in Europe.

The mainstream education market is experiencing a path of disruption that is the rise of schemes of the connected devices and Bring Your Own Device (BYOD). As reported by techradar, the school environment is changing at several levels through the penetration of smart phones and tablets. These devices are much cheaper than PCs and as some schools are failing to provide such infrastructure and trying to cut the costs, the benefits of such schemes are very appealing. On the other note, BYOD is of great importance due to a very high level of engagement of children with smartphones.

Another trend in the mainstream educational market is the application of robots in the program. The techadvocate research group placed robotics among those who will bring the innovation within mainstream education to a new level, considering that the robotics industry is anticipated to double.

and become a $135 billion market by 2019\(^1\). Robotics use in K-12 is growing finding its application in STEM classes and programming and encouraging critical thinking and problem-solving.

All that being said, a clear statement can be made, that apart from technological and pedagogical innovations, that MaTHiSiS is bringing on the table of the mainstream education, one might state that the platform is ready to propose a tailored solution to the wide range on schools – those who already have suitable infrastructure, computers, IWBs, etc., those who try to reduce spending of the school budgets and practice the BYOD approaches as well as to the mainstream schools who already hold a pulse on innovation and introduce robots in their teaching and learning practices.

3.1.1.4 Industrial Training

Backed by the challenges in the job market and bringing up the need of training to close certain skill gaps, a rising number of companies increase their expenditure on training and other external products and services related to industrial and corporate training. For example, in US spending on industrial training has risen by 11.7% in one year and over the course of 5 years the market grew from $52.8 billion to $61.8 billion. The potential of investing in training activities of employees is also observable in Europe. It was estimated that large European companies, alike the US ones invest more than 2-3% of the gained revenues in employees training activities. It is worth to understand the size of the market MaTHiSiS is aiming at.

The overall spending on the training services was showing a modest annual increase of 2.5% reaching more than $306.9 billion in 2013\(^1\). Although Europe is still lagging behind the U.S. market, it is estimated that the European market is responsible for around 30% of the global industrial training market. Nevertheless, European market tries to catch up that is for example in UK, almost 90% of British companies provides industrial training to their employees (although spending less than EU average) as quoted by the Activia Training, a UK corporate training provider, analyzing the Eurostat data\(^1\). In fact according to Eurostat survey, the majority of companies already provide training or have allocated specific budget to introduce it in the nearest future, especially within bigger companies with more than 250 employees:

\(^{11}\) http://www.thetechdevocate.org/3-technologies-making-their-way-to-mainstream-education/
\(^{12}\) Trainingindustry.com
\(^{13}\) https://www.activia.co.uk/interactive/corporate-training-bridging-the-gap
With respect to the needs of the end-users, and specifically the employees, a study made by Cegos Group\textsuperscript{14} evaluating 2,355 employees and 485 HR directors as well as training managers from UK, France, Germany and Spain identified that the majority of employees want to experience a more technology-driven learning approaches preferring e-learning and blended learning and the satisfaction level of such approaches was close to 90\% whereas 82\% of participants stated that the experience may be even more effective if self-assessment techniques are provided.

Within the mature markets, large companies might be the ones to engage with to exploit the results of the MaTHiSiS despite a much longer and complex buying cycle. The consortium believes that such companies or big corporations might be the early adaptors due to higher interest and budgets allocated for such solutions and the possibility to cover the courses/flow that will be already available within the system by the end of the project.

3.1.1.5 Career Guidance Distance Learning

Career guidance is aiming to help the learner to identify their own ambitions, abilities and qualifications and understand what drives the labor market and the education system. It guides the user towards better decisions about planning and making their decisions on working and learning paths. Nowadays there is a wide range of approaches for the introduction of career guidance such as printed and electronic information, group discussions or personal consultancy in schools, phone, online etc. The target group is quite wide ranging from public employment services, enterprises, schools and tertiary institutions, private guidance services as well as community groups. The survey made by the OECD and then adapted by the European Commission through the European Center for

\textsuperscript{14} Jeremy Blain, Cegos Group 2009, Current learning trends in Europe and the United States. Addressing the challenges of the economic downturn and the development needs of toda’s learners.
the development of Vocational Training and the European Training Foundation review a number of career guidance national policies that provide a variety of services such as personal and educational counselling, general education information, teaching and job placement, etc.

For exploitation purposes we may distinguish between different phases of career guidance: i) career guidance in schools; ii) career guidance in tertiary education; iii) guidance for adults (lifelong education). The latter is considered to be one of the most underdeveloped markets and primarily used by unemployed population, those seeking the employment and receiving public employment services.

The career guidance in schools with a wide variation of implementation is sometimes included in school curriculum. Sometimes such courses are integrated in some specific subject (Czech Republic); in other countries it is an optional (not mandatory) element within the curriculum (e.g. Ireland, Luxembourg). The OECD report provided the results of a broad survey on students in academic and vocational programs who receive individual career guidance:

![Figure 4. Percentage of upper secondary students in academic and vocational programmes who receive individual career counselling](image)

The situation with the tertiary education and access of career guidance for adults is not as straightforward. Due to the nature of guidance (e.g. preparing learners for more specific activities beyond the traditional professions) and more open and competitive environment makes standard approaches less tailored to the actual needs of the learner. That is why many institutions are actively looking for possibilities to expand career guidance services. For example in Spain, the Navarra Private University introduces a web-based self-evaluation tool together with employment skills training activities. In Ireland, The Trinity College offers guidance assistance through ICT-based tools. To estimate an approximate submarket of potential career guidance learners one can look at the unemployed inactive population who are in education or training. We exclude from this set population who do not seek employment due to such reasons as awaiting recall to the previous job, cannot work due to illness or disability, looking after children or incapacitated adults or other family and personal responsibilities, retired, etc.
Figure 5. Unemployed inactive population who are in education or training

Thus we can observe a change towards the provision of such services for youth. Further looking at the youth population in the age group between 15 and 24 who are neither in employment nor in education and training, a rough estimate about those who use the services provided by the public employment authorities (although we note the fact that not everyone takes advantage of such services for various reasons).

Figure 6. Use of public services for career guidance

Nevertheless access for adults is much more limited. And we state so, because we believe that the career guidance market is not limited to unemployed only (these services are usually provided by
the public employment services), rather than demanded by a much greater share of population – those who are seeking for a long-term career development and planning, persons who wish to change career, improve future employment prospects etc.

Provision of career guidance faces a number of financial difficulties. Due to dominant provision through public services, it is mainly the responsibility of the public body to provide the funding. Some countries like the Netherlands and the UK tried to stimulate the creation of private markets by limiting public financial support to earlier free services putting such burdens on adult learner who is seeking for career guidance. The OECD Education Policy Analysis states that such policy failed to show its effectiveness as individuals are not willing to pay for career guidance at rates capable of developing and sustaining the market. Grubb\textsuperscript{15} discusses the reasons of why it is hard to introduce career guidance via private markets:

- Not clear specification of supply and demand;
- The market is highly volatile;
- Often incorporated within other services (e.g. education, job placement);
- Hard to predict the benefits and hard to measure.

That being said, public authorities and governments play a key role in the better formation of the supply and demand and the introduction of new, innovative ways to address the needs of the population. Further success of MaTHiSiS exploitation strongly relies on the involvement of the stakeholders. Specifically for career guidance, the consortium does realize the importance of career guidance specialists (psychologists, teachers, labor-market administration), schools, public employment services, higher education, professional association of career guidance practitioners and policy makers.

3.1.2 Target markets and segments

Given high segmentation of the market and different approaches that we are trying to adopt keeping in consideration specific markets MaTHiSiS is targeting at, a closer look at certain aspects of the end-users have been conducted (age, income level, location, educational level, developers’ and LMS providers trends, etc.). Thus, the results show that the MaTHiSiS platform will not be age-dependent and one of the unique propositions among the others is that MaTHiSiS will involve learners with learning disabilities and their family members. As the analysis of the market for Autism and PMLD sectors has shown, due to the lack of data it is quite hard to estimate the exact number of potential users and even harder to differentiate them by age. As an example, some data covered in the white paper of European Intellectual Disability Research Network show that a number of children and young people in Germany who experience certain learning and intellectual disability lies at approx. 160,000\textsuperscript{16}. At the same time the percentage of adults with learning disabilities who live independently and use non-residential services has not been recorded in any federal statistics yet. The following graph, extracted from the Eurostat data, shows the level of education of people with learning disabilities by age:


This brings us to the analysis of learners by the education level. As we can see, the level of education among learners with disabilities varies a lot depending on the country, but the overall goal of MaTHiSiS is to target learners from any educational background or any level of education. Since MaTHiSiS is being designed for use by anyone with or without a learning disability, all levels of educational material will be present or can be added to the platform and the user will be able to choose whatever they feel comfortable with or the system will adapt to their needs. This explains the reason of choosing those specific use-cases described in the previous section for MaTHiSiS pilots, indicating that the platform is suitable for any age, any initial level of education, previous background and knowledge.

Nevertheless it is important to mention here another target group who MaTHiSiS is designed for – the teachers. The education level of tutor that will be targeted can be variable from teaching formal or informal education. Although there will be a focus on tutors who have some background with the technology since it will be easier for them to create learning graphs and extract required information, the design of MaTHiSiS strongly relies on feedback from the end-users to ensure that the end result is going to be easy to understand and use so that even the tutor who is not a tech savvy could grasp the idea on the go.

Further, looking at the career guidance market, another target group for MaTHiSiS are unemployed citizens, those seeking for employment possibilities or undergoing further career development. Looking specifically at unemployed citizens, Eurostat provides some insights that as many as 20.448 million men and women in Europe were unemployed as of October 2016. The overall trend shows that the number of unemployed is going down compared to 2015 but to a different degree among EU member. At the same time youth unemployment is still, more than double, than unemployment rates for all ages. The European economic downturn severely hit the young. The EU-28 youth unemployment rate was systematically higher than in the euro area between 2000 and mid-2007\(^{17}\). Starting from 2008 until the third quarter 2010 these two rates were very close. The European Commission concludes that one of the reason for such high rates of unemployment is the lack of

decent education in Europe. Currently nearly 30% of 20-64 year-old population of Europe is unemployed. Although, as noticed in the chart below, the percentage of unemployment has been decreasing over the past 3-4 years and is expected to decrease significantly till 2020 to 25% (according to the EU target).

Figure 8. Employment rate for ages 20-64

And to help reach this target, more innovative solutions around education, career guidance and training have to be offered and this is the niche that MaTHiSiS will try to take. High long-term unemployment rates considered to have a rather negative impact on people’s purchasing power. But it is not always the case. Taking an assumption (but not setting as a goal) that the end-user (unemployed) would have to bear the costs of using MaTHiSiS, we still believe that unemployment won’t severely affect the purchasing power of unemployed and should the proper business model arise, a direct B2C engagement is feasible. As mentioned by the RegioReserach data, Spain’s 25% unemployment rate in 2012 was the highest in the EU and the third highest in Europe, yet the country’s purchasing power level of around 12,600 euros is still above the European average and the case of Greece is similar – unemployment stood at approx. 24% in 2012 with an average per capita purchasing power of 10,350 euros per year [8]. Therefore it is a fair assumption that unemployment would not severely affect the purchasing power of unemployed people and thus would be a target market for MATHiSiS exploitation.

Further, analysing the target end-users by their location from the learners perspective showed that the platform’s target learners will be unaffected by their location as it is one of the strengths of the online learning. Any learner from any location can access any learning material of the platform depending on the hardware they have at their disposal at the moment.

Since tutors can also access the platform using the internet, location will not be a differentiation for the tutors as well.

Analysing the target markets by the income level is a much complicated task due to the fact that the markets MaTHiSiS is trying to cover is quite different, with various stakeholders and therefore different income levels. The MaTHiSiS end product will be appropriately priced after extensive market research and determining cost of running the platform. This will allow us to give access to the majority of the public at a sustainable cost. At the initial stage we do not foresee that learners themselves are going to be paying for MaTHiSiS products or services. It is believed that on one hand MaTHiSiS will rely on the direct contracts with corporations that would like to provide industrial training to their employees and on the other hand involve public authorities and foundations to ensure the adaption of MaTHiSiS in public educational institutions, public employment centres, etc.
so that the latter would not have to bare such costs on their own therefore providing free access to learner regardless of the income level. For specific details and analysis of such public bodies, see the stakeholder analysis section.

The number of developers has been increasing drastically over the course of the past decade and expected to grow further in the nearest future. Eastern Europe is among the regions with highest share of developers within the population followed by Russia, India and China with 37.6% citizens involved in Information technology which includes e-Learning. Looking specifically at this target market segment, e-Learning content developers employ a SaaS model and here the mobile learning play a huge role during the decision process of launching learning management systems. Industrial companies and corporation want to get the full benefit of accessing training resources on any device, at any time, from any place. It’s estimated that the mobile learning industry alone will grow to over $37 billion by 2020\textsuperscript{18}. The LMS market was estimated to worth more than $2.55 billion in 2013 with a CAGR of approximately 25.2%. Specifically, the LMS market is predicted to worth more than $7 billion in 2018. The following statistics\textsuperscript{10} determine the trend in the market and the forecast of the reachability of the MaTHiSiS platform:

- 44% of companies intent to purchase online learning tools and systems;
- 41% of companies intent to purchase Learning Management Systems (LMSs);
- 37% of companies intent to purchase authoring tools/systems;
- 33% of companies intent to purchase classroom tools and systems;
- 29% of companies intent to purchase content development products and services;
- 27% of companies intent to purchase courseware design and presentation tools and software;
- 18% of companies intent to purchase audio and web conferencing products and systems.

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3.1.3 Societal expectations

The societal expectation from the final product of the MaTHiSiS project are the following:

1. It will bring equality in terms of education provided between the people with learning disabilities and people without these;
2. This will elevate the employment rate of the disabled people and hence increasing the employment rate in general;
3. Due to the better education provided to the people with learning disabilities, it would bring more insights into how to improve upon the MaTHiSiS project and overall improve the level of education provided to them.

3.2 Value Chain

MaTHiSiS, and any adaptive smart learning environment, provide a paradigm shift in terms of how education is perceived and delivered. The MaTHiSiS solution has the potential to fundamentally transform the approaches different stakeholders take towards learning in a new economy in which knowledge is of high value and market changes are rapid and undeniable.

The value chain analysis captures the major activities that take place in an organization and reference them to the analysis of the competitive strengths of the business [9]. Therefore, the value chain of MaTHiSiS examines all the internal processes within the ecosystem to better understand the internal activities and the overall organizational infrastructure. The value delivery system of the e-learning is quite complex and the value chain of such affects and is affected by many other stakeholders, as defined by Porter [10].

Figure 10. e-learning value system and market map

Therefore the value chain framework of MaTHiSiS incorporates a set of various activities and stakeholders in a value system (as depicted in Figure 4) acknowledging that the activities within the
ecosystem are interdependent. Thus, the value chain analysis highlights that increasing costs in one value activity might result in an overall cost reduction of the whole proposition.

The structure of MaTHiSiS can be seen as two distinct activities: the primary activities and the support activities, as partially adapted from the analysis of the internal value chain of the online learning institution [11]. Here, primary activities are those that capture main activities that are creating and delivering the product or service, whereas the support activities support the primary ones to efficiently and effectively assist the core activities.

<table>
<thead>
<tr>
<th>Organizational Infrastructure:</th>
<th>finance, planning, general management, quality control.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Resource Management:</td>
<td>can constitute of recruiting and the development of the workforce</td>
</tr>
<tr>
<td>Technology Development:</td>
<td>information management processing and the potential protection of knowledge</td>
</tr>
<tr>
<td>Procurement:</td>
<td>acquisition of additional resources</td>
</tr>
</tbody>
</table>

| Inbound Logistic               | consist of such activities as course development, curriculum planning, identification of a set of PAs needed for the course, learning objectives, SLAs, LMS, etc. |
| Operations                     | captures the process of course development, which might consist of SLA creation, writing/importing, multimedia creation, editing, etc |
| Outbound Logistic              | packaging and storage of LMs, delivery of the material to the learner |
| Delivery collaboration and marketing | unique value definition, marketing activities. Definition of the branding strategy. |
| Service                        | overall support from both: technical and academic partners |

Figure 11. MaTHiSiS value chain

3.3 Competition Analysis

An initial analysis of MaTHiSiS competitors that can offer a learner process proposing new utilities and taking into consideration new technological developments is required to be able to fully realize the potential of the future MaTHiSiS platform. To consider certain products and services as competitors, an adaptive e-learning system has at least to support the following processes:

- Representation of the (educational) content;
- Provide an instructional strategy, have a user model;
- Offer a mechanism for assessing the learner’s progress (manually or automatically);
• Be able to adapt using the user model.

The majority of such systems although propose limited functionality and offer a limited number of components of the learning process. Although some systems have the resemblance of MaTHiSiS functionality which are going to be presented further.

<table>
<thead>
<tr>
<th>Product/Service name</th>
<th>Description</th>
<th>Functionality</th>
<th>Teaching/Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITES [11]</td>
<td>Conceptual map model for developing ITS</td>
<td>Web-based system constructing test sheets and learning paths depending on individual learning status</td>
<td>Primary school – Natural Science</td>
</tr>
<tr>
<td>Logiocando [12]</td>
<td>Intelligent Tutoring Hypermedia System</td>
<td>Includes a tutorial component and uses an expert system that adapts the content to the learners capabilities</td>
<td>Primary school – Logic</td>
</tr>
<tr>
<td>IAELS [13]</td>
<td>Adaptive e-learning system</td>
<td>Includes intelligent agents providing personalized learning paths based on a priori algorithms</td>
<td>University – C language</td>
</tr>
<tr>
<td>Kavcic [14]</td>
<td>Adaptive Hypermedia Education System</td>
<td>Personalizes instructional sequence using user model and linguistic rules</td>
<td>University - Java</td>
</tr>
<tr>
<td>SIETTE [15]</td>
<td>Self-Assessment Tests</td>
<td>Provides adaptive tests according to learner’s current knowledge. Provides hints and feedback based on cognitive diagnosis</td>
<td>University – AI&amp;KE</td>
</tr>
<tr>
<td>HELP [16]</td>
<td>Hypermedia-based English learning system</td>
<td>Provides adaptive feedback and corrective instructions via adaptive hyperlinks according to the confidence scores of the learner. Confidence scores are assigned by the system based on the alternative answers of the student.</td>
<td>University – English</td>
</tr>
<tr>
<td>PEL-IRT [17]</td>
<td>Personalized e-learning system using IRT</td>
<td>Applies the max. likelihood estimation based on the difficulty and perception questionnaire therefore estimating initial ability of the learner. The difficulty level of the material is the dynamically adjusted based on the learner’s feedback</td>
<td>University – Neural Network</td>
</tr>
<tr>
<td>TANGOW [18]</td>
<td>Adaptive Hypermedia</td>
<td>Creation of adaptive courses, adapting the amount of learning content and the difficulty level of the test, both with respect to the learners knowledge</td>
<td>Secondary school – Mathematics</td>
</tr>
</tbody>
</table>
learning the course is adapted based on these sources.

| ALFanet [20] | Adaptive e-learning platform, multiple adaptive scenarios | Course designers are able to choose the desired adaptation. Combines machine learning and user modelling for adaptive learning with multiple scenarios (adaptive contents, adaptive self-assessments, dynamic recommendations). The system is using a number of various personalization sources like previous knowledge, learning progress, interest in the course etc. | University – Different courses |

Table 3. MaTHiSiS system competitors’ analysis

A study of the existing solutions that possibly offer similar functionalities as MaTHiSiS shows the rapid development of the market as well as healthy competition. The above mentioned competitors have already proven their effectiveness in terms of academic achievement of the learners as well as their users’ satisfaction. Although these examples show the overall success in the application of such solution, there are still certain pitfalls that the MaTHiSiS solution will try to resolve.

Thus all the above mentioned examples require a lot of time investments with little automatic parameterization requiring a lot of manual and sometimes intensive design and codification tasks. This in turn was the reason of a quite slow adaptation of the adaptive learning system in the teaching and learning communities. Therefore the major goal here is to integrate as many phases of the learning process into a single e-learning context. Other aspects that MaTHiSiS will address in comparison to the competitors is the learners mobility in ubiquitous environments while in many cases the information within the competitor solutions is provided for a single instance of a course. Many stakeholders, including end-users have stated the limitations of such solutions [21] [22], including:

- More extensive logs covering more activities of the students (here the example can be taken from MaTHiSiS approach – learning materialization through quizzes, videos, games, etc.);
- Collecting and storing the data over a wider time-window and a much wider set of activities, as well as from different e-learning systems (MaTHiSiS will collect the data from several PAs);
- Automatic classification of the content based on the learners’ interactions.

3.4 SWOT Analysis

To discover crucial internal and external factors that influence MaTHiSiS success, a thorough strategic planning for the sake of objective assessment has to be performed to better understand the current state of development and respectively adjust future goals. One of the top tools in strategic planning, SWOT analysis, is introduced in this section to identify major environmental relationships that originate internally (strengths and weaknesses) and externally (opportunities and threats).

The MaTHiSiS proposed business strategy aims to ensure a strong market position for ICT in Education. All project activities and resources are guided by this goal.

The innovations to be delivered by MaTHiSiS require analysis of complex trade-offs including technical (e.g. hardware constraints, algorithmic constraints, etc.), operational (e.g. costs, quality of service, in-field constraints, etc.) and socio-economic (e.g. ethical operation, legal compliance, business models for sustainability, cross-jurisdictional, etc.) aspects in relation to key stakeholders.

A SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis for the MaTHiSiS proposition is given below:
3.4.1 Strengths

The initial analysis of strengths of the MaTHiSiS platform stated in the DoW was defined in the following bullet points.

- Strong progress in the areas of educational sciences and HCI;
- Innovative service delivery model using three agent platforms;
- Clear vision for design & architecture;
- Innovative approach for integrating sensor and messaging, access to large networks of users throughout Europe (PE, AV, NOCQGV, JCY, FMD, RIX, LCS) and a validation and testing within a number of pilots in real-life conditions;
- Strong SME participation in business development and design.

MaTHiSiS actually goes beyond those defined above. An access to a various set of resources of any traditional learning course gives the possibility to participants learn location independent, leaving them the freedom to determine their own time for studying. The ability to being accountable for own knowledge and self-discipline are among the advantages of online-enabled learning. One of the major strengths of MaTHiSiS is the ability to take into consideration the impact of emotional and cognitive aspects of the learner. It is now commonly agreed that emotions within the users of all age groups and background have a compelling impact on learners behaviour and therefore applies to any use-case within the MaTHiSiS project. The motivation of the user comes through several internal and external emotional triggers, which can block the learning process (in case of negative emotions) or otherwise stimulate to a more engaged learning process. But these particular aspects were often neglected by most of the commercial systems. MaTHiSiS will be able to benefit from a number of tools that using cameras and microphones will record verbal and nonverbal behaviour of the learner to understand their emotions and adapt the content appropriately.

Further, the introduction of the concept of the Learning Graph and Learning Atom that on one hand sets an easy to understand concept for the tutor or the administrator of the course, and on the other hand will help the learner to fill any gaps in their comprehension of the course to the smallest peace of knowledge.

The asynchronous nature of MaTHiSiS solution gives the opportunity to the learner to research and compose their knowledge with more thought. Unlike face-to-face learning, one of the major strengths is time and space for MaTHiSiS learner to interact and react to the learning activity or the problem to be solved.

Furthermore, there is no particular preconceived idea that is based on visual clues, thus learners familiarize about each other from the inside out. Assuming less involvement of the traditional teaching methods where teacher presenting in the front of the class, the learning experience using MaTHiSiS aims to offer a more student-centred approach, resulting in learners being more engaged and active contributors to the learning process and taking over more responsibilities for learning.

Teachers become more creative with their teaching as old paradigms are challenged.

One of the most crucial educational and technological strengths and innovations that is coming from the MaTHiSiS proposition and the adaptive learning in general is the ability to immediately change the learning process and instructions based on a learner’s initial and consecutive knowledge. As a learner interacts with the learning material and MaTHiSiS platform as whole, the technology will be able to pick up the affective state, state of the acquiring knowledge or skill or instances which
learners are struggling with and adapt the content in real-time. In such a way, learning is optimized as the adaptive learning program is able to alter its approach on an individual level to ensure that learners are accomplishing all the relevant concepts prior to moving on to more difficult material.

Many K-12 students today are ‘digital natives,’ meaning the technologies that are so commonplace today have always been a part of their lives [26]. It is considered that such learners are particularly tech savvy, and it is believed that they can become more engaged in the learning process, should there be a chance to spend part of traditional class time with adaptive learning programs or in general ICT.

Looking at the MaTHiSiS solution adaption for blended learning purposes, the introduction of adaptive learning will also help to free up time for teachers to provide students individual additional face to face instruction. Not only MaTHiSiS adaptive learning software will adjust the pace and presentation means of the learning material, one of the major strengths of the solution is the constant monitoring and analyses of learners’ responses, providing teachers access to really helpful and valuable data. The latter offers to the teachers insights whether learners are truly grasping the new concepts, and whether individuals in their classrooms could benefit from one-on-one instruction [27].

Looking at further strengths of MaTHiSiS, we can point out the ability to reduce the likelihood of cognitive overload. Not only can educational institutions and companies, providing corporate training, create custom courses that are most efficient and less time-consuming, but more effective as well, in particular through the introduction of learning materials broken down into smaller modules. In such a way, learners are not overwhelmed with a large number of information rather the material is carefully picked in a way to be easily absorbed and retained.

The aim of the MaTHiSiS solution is to be easily maintained and updated over time. Institutions that require quick and regularly update of the learning materials will be able to include new products or new policies to the platform, as well as to make various adjustments to the course with ease and even introduce new platform agents or multimedia elements that create added value to the platform and additional benefits to the teacher and learner.

3.4.2 Weaknesses

The initial potential weaknesses findings were the following:

- Not thorough proofs, up to date, of a scientifically grounded interplay among the MaTHiSiS components;
- Growing market with a significant percentage unaware of the MaTHiSiS offerings;
- Competition from Europe and abroad.

Nevertheless, MaTHiSiS can be affected by other factors that can result in additional weakness of the system. The common view on education and personal development mentions that one can develop properly in relatively small groups only. Within the school environment, learners acquire important social and communication skills, how to make friends and be patient, as well as understand the initial concepts of competition. Competition between several learners considered to be very encouraging and bring a lot of benefits to the table. The use of online (distant) learning believed to have lack of f2f human interaction, which to some extend applies to MaTHiSiS as well.

Looking at MaTHiSiS as a whole and specific innovative tools it makes use of, one can consider the weaknesses of the emotion recognition systems. To train the system (classifier) a rather big database of emotional expressions is required which is quite time consuming process with recording and annotation procedures. The system won’t be able to ensure that all the spontaneous emotions are
recorded and certain weaknesses of such systems are the occlusion, lighting conditions and constantly changing position of the subject. As for the speech recognition, reverberation and background noise can result in inaccurate outcomes of the analysis.

One crucial weakness of adaptive online learning system is the learner’s isolation. There are some important questions that arise when thinking about learners experience, such as whether they will miss the ability to discuss the problem with peers, or ask for help from teachers. Even here, MaTHiSiS tries to counteract such weaknesses and potential for isolation, by introducing multiplayer solutions and introduction of robotics which to some extent can play a role of social actor during the learning process.

While MaTHiSiS does strive to provide courses to a wider population living in distant, diverse places, the consortium still realizes a potential weakness arising from the accessibility issue. To be able to interact with the system, learner would require access to a computer (or other hardware such as smartphones, robots, IWB) and an internet connection. It would also be beneficial to be computer literate to navigate the system and learning materials (in this regard consortium will aim to develop the most easy to use and understandable user interfaces to reduce such risk) and the same time teachers should be able to create and attach documents or even work with authoring tools.

3.4.3 Opportunities
A number of various opportunities have been identified during the proposal writing of the MaTHiSiS project:

- Growing need of smart and adaptive educational environments [EC SMART-Nr 2010/0039];
- Increasing market for educational ecosystems;
- Lower cost for learners involved in the usage of MaTHiSiS results;
- Maturing of the technologies enabling the concept of MaTHiSiS;
- Usage of innovative technologies (learning graphs, SLAs) that boost MaTHiSiS added value;
- Reduction in risk to independent software developers (including mobile) wanting to develop products for similar applications.

MaTHiSiS platform already aims at the provision of the education to learners with disabilities (ASD and PMLD) but has the opportunity to broaden its spectrum to other functional disabilities, since many of them are simply not able to participate in the learning process and/or visit schools. More opportunities and chances of MaTHiSiS can be reflected in the following:

- Ultimate lowering of infrastructure costs and its diffusion;
- Though increasing introduction of ICT in education and population literacy with computers stimulates faster development of the market, therefore greater market opportunities for MaTHiSiS;
- New teaching methods though introduction of new PA’s within the platform via the old and new media panel;
- Offer new opportunities for teaching staff through grasping new technologies, diversifying career paths, experimentation and research;
- Lifelong learning policy development could be widened to new target stakeholder groups and become an opportunity for personal development, innovation within the entire socio-economic group such as touristic and artistic, historical and others.
MaTHiSiS will encourage the provision of the lifelong learning. With educational institutions starting to provide their courses available on a free basis through online lectures (like the coursera platform), one has the opportunity to learn on their own pace and from any location. The major opportunity for MaTHiSiS here is to become a facilitator of such courses, whereas we do understand that for this a separate business model will have to be thought through.

Reporting and management are other big possibilities for MaTHiSiS. From the one hand expanding to another markets (outside of educational domain) and from the other actually enhancing the services that will already be provided within the commercial product. These might include the customization and adjustment of the desired data on the student’s performance etc.

### 3.4.4 Threats

There are a number of threats that were identified before the project start. The consortium realizes that additional threats might be identified along the project runtime:

- Barriers to adoption due to legacy systems and resource constrains;
- Complex bureaucratic procedures;
- Existing market players with established channels to educational sector;
- Changes in technology and markets;
- Loss of competitive advantage due to the adoption of new technologies by competitive products;
- The uneven (asymmetrical) availability of ICT infrastructures and tools, including connectivity, across Member States;
- The absence of open interoperability standards
- The issue of unclear business models for education and training institutions, in particular European universities that are lagging behind emerging phenomena like Massive Open Online Courses [Opening up Education].

MaTHiSiS will stimulate and support the educational institutions and other organizations offering learning in their attempt to transform into functional connected learning communities. In such a way the possibility to strengthen the smart education market will arise at the same time stimulating the provision of the mechanisms that enhance innovation in European industry and therefore foster its competitiveness and market penetration. One of the major threats that can be imposed on MaTHiSiS successful exploitation is the cost. Among those are the technical infrastructure, licenses costs and the fact that the IT support is limited within educational organisations.

MaTHiSiS will strive to contribute to the reduction of such costs through the delivery of reusable components and materials. It is foreseen that such components will be easy-to-use and will capitalize on already existing and mature technologies to ease the requirement for resources provisioning.

As it has been already mentioned, learners must have access to the basic infrastructure and an internet connection. In some cases, depending on the application of the system, its environment and specific requirements of the end-user towards learning material, some machines (whiteboards or even robots) with minimum specification as imposed by the MaTHiSiS system supplier will be required. Same applies to the services with a relatively higher internet bandwidth to transfer the learning materials in a timely way.

Material incompatibility impose another threat as some learning materials designed for one particular operating system will not function on another (Apple Macintosh vs. Windows PC, iOS vs. Android).

Taking career guidance or lifelong learning use cases into consideration, motivation of the end users might pose additional threat on the adoption of MaTHiSiS. Some concerns state that employees or population outside of K-12 have to be extremely motivated to take advantage of the online training.
Some of those were traditionally educated in schools and nowadays might refuse to be part of the adaptive learning revolution, either due to lack of belief in the opportunities and progresses of such adaptive internet enabled learning systems.

The report of tellright group identified that while the excitement and enthusiasm for online programs that has been generated recently, it is important to recognize that some subjects should not be taught online because the electronic medium in its current state of development does not permit the best method on instruction, while hands-on subjects such as public speaking, surgery, dental hygiene, and sports where physical movement and practice contribute to the achievement of the learning objectives shall still be taught in a traditional way and adaptive learning systems shall not be a tool cut the corners and save some costs for some institutions. [28]

3.5 PESTLE Analysis

To get a clear picture of macro-environmental factors that affect MaTHiSiS at current stage of the development and in the future, a PESTLE analysis in terms of political, economic, social, technological and legal factors has been performed.

3.5.1 Political

Adaptive learning systems and any e-learning system appears to be an area of significant political interest. Many policy makers and governments acknowledge that technology both in short and long terms will eventually bring significant cost savings, improved learner performance, and provide the prominent actors of the educational market a stimulus for further innovation. In fact, more and more governments are investing in the development and implementation of eLearning across EU member countries and beyond, and nowadays with a special attention to countries where public education and access to it has been presenting a problem.

New political reforms, e-Learning policy documents and perspectives (Learning in the Information Society: Action Plan for a European Education Initiative (1996), the eLearning Action Plan (2001), the eLearning Programme (2003) and the Lifelong Learning Programme (2006)) have boosted an integration of ICT in the education sector. More and more discussion on a governmental level arise on the role of technology in providing education to larger number of audiences. Thus, the EU policy to support national action aimed to support skills deficits in workforce, technological developments and global competition were introduced through the Education and training 2020 framework [29]

3.5.2 Economical

The economics of the adaptive learning systems, online learning and training markets are experiencing rapid and fundamental changes which are driven by political views, worldwide competition and socio-economic changes amongst learners, teachers, companies, society as a whole. While it is impossible to differentiate the economic and political imperatives posed on education, the downward pressure on funding for skills provision is well known. This is backed by the need for many EU economies, competing in a globalized world, to tackle skills deficits and economic productivity.

Significant budget cuts in a number of EU countries are just one of the many aspects of rapid transition of education and training markets. At the same time, while education budgets are suffering from substantial cuts by the governments, work-place skills and industrial career guidance training is shifting towards a period of an increasing demand. This trend is observable both domestically and internationally. Indeed, as reported in Section 3.1 the global market for education and training is showing a strong growth, and in some countries, for example UK government desires to even export educational services. At the same time it is recognized that innovation in learning technology and implementation of ICT in education will play an important part in the nearest future.
Evaluating the latest trends in education, not surprisingly e-learning became the only sector within the training market that has demonstrated steady growth since 2008 [30]. Large corporations applied e-learning approaches in their employees’ education to cut costs during the global economic crises and it seems that it is unlikely that any of them would consider coming back to traditional classroom training. Studies and experience have shown conclusively that e-learning has saved companies money and time. Learners have come to accept, and in most cases embrace, the flexibility it has offered [30].

Some views state that online learning will further show stable growth due to the rise in the costs of higher education (and already high costs for education for kids with disabilities) in certain countries. At the same time we can observe the opposite in other EU countries, where the costs for higher education are steadily decreasing. Such a gap between the cost of similar education will in the future contribute to the decision making process of the learner while deciding to pursue higher education.

By strengthening distance learning, MaTHiSiS contributes to the economic situation of e-learning. Connecting many different institutions, teachers and students, providing a central content source, may result in reduction of costs.

Numerous reports, research literature provided by the OECD, show that improved educational outcomes are strongly linked to the economic growth. Nevertheless, a country’s wealth and spending on education alone is not a guarantee for better educational outcomes [31].

Achieving a workforce that is proficient in the use of technologies is seen as fundamental for meeting the labour demands of the new economy, and a way of increasing the productivity of that workforce.

Weak, stagnant economy has worsened already complex financial issues in higher education. To name a few: growth in textbook and college tuition costs, as a result an increasing student debt, lower retention and graduation rates. Due to these reasons, more and more learners in higher education increasingly desire their institutions to make other alternatives available: less expensive learning material, an affordable education or flexible delivery. It is believed that the introduction of solutions like MaTHiSiS has a potential to slow down or even sometimes reduce the cost of education.

The consortium acknowledges the fact, that although adaptive internet enabled learning systems can enhance economic outcomes on both micro and macro levels through a number of methods, it is...
nevertheless quite difficult to quantify the benefits. One reason for this is that there exists a significant time lag between the learning process and its effects on the student’s employment or the society at large. [32] A vast diversity of approaches on how ICT is introduced in schools also makes it hard to evaluate the real outcomes of technology introduction across Europe and has to be evaluated at a point of time for a single school. Technology is nowadays used in different ways to deliver lectures, track learner’s progress, perform assessments, as a presentation facilitator or to deliver educational games, etc. It is clear, that each of these methods pose different costs on schools and benefits for the learner. What’s more is that each of the mentioned methods requires different efforts to integrate them into a single learning/teaching process. And usually the process of integration is a far more challenging aspect when considering the adaption of ICT in education and its costs.

All that being said, e-learning serves as one of the key components within a much larger picture, reflecting a challenge of educating the next generation of workers for a new, knowledge-centred economy. [32] Once future graduates are well prepared for globalized market economy, the positive effect on the national and EU economy will be far more apparent after the market provided them the employment opportunities.

3.5.3 Societal

“The changing nature of how learners learn, the rise of social learning and the impact of mobile devices, cannot be ignored. These are portents of change, and learning will continue to change in directions that are difficult to predict.” [30]

Our environment, whether it is our home, workplace and the traditional classroom at school are all becoming more and more connected into one educational space. The development of technologies and services like serious gaming (gamification), simulation-led learning, augmented and virtual reality are gaining its importance in our daily life and education. Several researches indicate that serious games will have an impact on 50% of organisations in areas such as innovation, education and business processes. [33]

More and more developers within the adaptive smart education domains and educationalists are increasingly paying attention to consumer usage patterns with their everyday devices to further apply extracted knowledge on human behaviour into learning. Since the mobile learning has revolutionized the way we learn and perceive information with the vast adaption of mobile devices, as well as social learning emerged from social media, it is now time for immersive learning to emerge from the video games entertainment sectors. It is projected that in the nearest future, we will experience a strong growth in demand for learning products that are much more immersive to the end-user and offerings of on-demand video and episodic learning content will grow. Therefore, MaTHiSiS will aim to meet such demand, addressing the learning on demand lifestyle of the modern society used to multi-tasking through a number of complementary media sources.

At the same time, we can observe a drastic change of the society attitude towards online learning and that is believed to have even more drastic changes in the coming years. The overall attitude and perception of learners towards education and training will be reshaped as digital natives will be joining the decision making processes on different levels of the society.

3.5.4 Technological

With the introduction of technology into the education and training market without any doubt, the provision of such services becomes more interesting and creative. There are some apparent evidences that the development of e-learning and educational technologies do add value, reduce costs of provision and help to improve learner’s experience.

Nevertheless, according to the industry observers and investors opinion, the education technology market is under innovated at present. [30] And with the pace the market is developing at the
moment, it is more than hard to predict for sure which technologies will be adapted more widely and which will fade away.

The supply for a number of legacy contents induced by the development of HTML5, as well as a strong demand for Apps (mobile applications) as learning experiences, are some of the examples of the market emergence dictated by the end-users demand. The development of serious games and ‘gamification’ solutions have long been predicted to be the next trend in education provision and it indeed has seen a growing interest within the industry since the beginning of 2014. Mobile devices, supported with Bring Your Own Device policies and a vast number of Cloud services, considered to be the major disrupters of the market over the past few years. One of the prominent success examples of recent years has been the introduction of online video courses which will strengthen its position on the market even more as they meet the requirement of provision anywhere and anytime and are supported by all kinds of devices.

Connecting all the different tools included in the MaTHiSiS project will be a technological challenge. MaTHiSiS tries to connect content, authoring and communication resulting in an overall engine for all learners needs.

Nowadays, almost every learner has easy access to digital media facilitator such as smartphones, tablets, laptops, PCs and internet connection. The development of e-learning on one hand is the result of the technology breakthroughs but on the other hand it has provided a boost to already existing solutions:

- **Cloud-based learning** is introduced on two distinct levels: school and corporate levels. To obtain a certain course content it is no longer needed to go through download and installation process of materials as providers are now able to offer to the learner a cloud-stored individual learning modules. Sometimes they go even further providing a full e-learning course either for free or one can purchase, download and use them on demand. At the same time, growing demand for more affordable and business tailored training will be offered through cloud-based technology, which will consolidate corporate training processes and design more suitable solutions for smaller businesses.

- **Gamification** has been introduced a while ago in different domains of application, but will certainly evolve even further. Gamification considered as being a driver of technological innovation that helps to develop learner’s skills, behaviors and problem solving. It brings benefits to different types of end-users either by improving employees performance, enrich the learning experience and customer engagement, while bringing on board personal development of the learner. Here, MaTHiSiS will gamify certain learning activities by proposing a number of Learning Materials in the form of mini-games.

- **SaaS authoring tools**: SaaS is a software licensing and delivery model centrally hosted in a cloud, offering to the end-user easily downloadable software or content, virtual updates. Such on-demand software brought to the industry massive savings in costs and time and a number of other benefits. As mentioned in Section 3.4, it is expected that more than 45% of all software will be SaaS based by the year 2023.

- **Notification systems in LMS**: Such notification systems have become one of the most important features of distributed mobile and ubiquitous learning systems. Mainly they are introduced in the instances where instructions and information to the course are required, to simply raise awareness or draw the attention of the learner to a specific event. Nowadays it is widely used to provide information on the go during the learning process related to the learner’s material.

- **Tin Can API, aka xAPI**: the Experience API is one of the most widely discussed e-learning software specification that enables the collection, communication and further analysis of data about a range of learning experiences a learner is going through. xAPI is considered
to be a logic step forward from the previous standard SCORM and overcomes a number of limitations that the latter one had.

- **Robots**: educational robots become more and more used and emerged as a subset of educational technology that is nowadays finds more and more application in higher education (for simulation purposes) and primary education to facilitate learning and improve performance, creativity, social interaction of students with and without disabilities

Since the use of robotics is one integral part of MaTHiSiS and a clear added value to the platform, this technological factor is analyzed with much more detail. Over the past years, robotics development and implementation has been on the rise and became an integral part of our society. The overview of Mubin et. al [31] indicates a wide range of applicability of robots in education from language learning to science and technology education taking a role of tutor, peer or as a tool. The use of robots in no way can be overestimated as already in 2008 the number of service robots has outnumbered the industrial ones [32]. Moreover, studies show that learners who were taught with the help of the educational robot had better results on post-learning examination and in general were much more engaged in the learning process in comparison to audiotapes and traditional books [33]. Robots not only contribute to the advanced technology development, they also provide a rather tangible and physical representation of learning outcomes. [31]

The benefits of using robots in education has become undeniable and a number of researches, publication and literature reviews show positive affect of using robots on skill development. Thus the influence on children’s behavior and development was presented in Lai Poh Emily Toh, et al. publication [34]. The major finding are presented in Table 4:
<table>
<thead>
<tr>
<th>Papers</th>
<th>Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barker &amp; Ansorge, 2007</td>
<td>Results showed increase mean scores from pre-to post-test, indicating that robotics was effective at teaching youth about science, engineering, &amp; technology concepts.</td>
</tr>
<tr>
<td>Williams et al., 2007</td>
<td>Study shows a significant difference on acquiring physics knowledge but not for science inquiry skills</td>
</tr>
<tr>
<td>Barak, 2009</td>
<td>Study reveals that students often come up with inventive solutions to problem when learning with robots.</td>
</tr>
<tr>
<td>Highfield, 2010</td>
<td>The result significantly showed that children engaged in multiple mathematical processes; they demonstrated perseverance, motivation &amp; responsiveness.</td>
</tr>
<tr>
<td>Whittier &amp; Robinson, 2007</td>
<td>The results showed that all students obtained significant gains in their conceptual understanding. There is an increase of mean pre-test from 26.9% to post-test 42.3%.</td>
</tr>
<tr>
<td>Kazakoffet al., 2013</td>
<td>Results indicated that the sequencing ability of pre-kindergarten and kindergarten students increases when participating in an intensive robotics and programming curriculum.</td>
</tr>
<tr>
<td>Slangen et al., 2011</td>
<td>Robots helped challenge pupils to manipulate, reason, predict, hypothesize, analyze and test.</td>
</tr>
<tr>
<td>Chang et al., 2010</td>
<td>Results indicate that robots could create interactive and engaging learning experience for students.</td>
</tr>
<tr>
<td>Young et al., 2010</td>
<td>Quantitative results showed that 95% have positive attitude towards tangible learning companions/robots. They become more active in practicing conversation.</td>
</tr>
</tbody>
</table>

Table 4. Articles that reported on skills development using robots

Going beyond the literature review it is worth having a look at the examples of robot application in EU. There is a lot of development happening around this field and the University of Birmingham Autism Centre for Education and Research (Acer) in collaboration with Topcliffe Primary School strongly contribute to the research on how robots are applied to improve children’s social interaction and communication skills. Moreover, the Nottingham Trent University (also partner within MaTHiSiS consortium) investigates the potential of robotics-based education with a focus on learners with wide range of disabilities and the results show that humanoid robot significantly increased the engagement of learners compared to traditional classroom learning. And this interest in the application is closely observed and anticipated, even collaborated with a large number of
stakeholders, including institutions in Bulgaria, Italy and the Krakow Branch of the National Society for Autism in Poland.

For some, the costs of robots might be of a concern. But the overall trends on the market, the pace of development and the comparison of advantages and benefits that robots bring on the table bring a lot of optimism and assurance that we are just at the very beginning of wider adoptions of robots in education. And the fact that MaTHiSiS offers such robots as a platform agent gives an added value, competitive advantage and serves as the innovation powertrain on the market.

In addition to all the above said, the consortium believes that considering the timeline and possible commercial launch of the system by the end of the project runtime, the prices on robots will continue to decrease. The outtakes from the Telegraph interview\(^\text{19}\) mention:

\begin{quote}
“When we first invested in this technology, the robots were £8-10,000,” says David Brown, “but they are now being released for £4,000, so it’s starting to become much more affordable.”
\end{quote}

\begin{quote}
“Keeping cost in mind is also a factor that David Stewart – as head teacher – is aware of. Yet he says that, even in the last 18 months, he has seen prices come down, making this technology a lot more affordable – something which he hopes will play a part in promoting widespread use once the research is complete.”
\end{quote}

In any case these costs were never meant to fall on the shoulders of the end users. The possibilities to cover such costs and who funds such implementation are described within the stakeholder analysis of this deliverable and sometime high interest towards the use of robots and good deeds of the companies, such robots would not cost a penny of public money.\(^{20}\)

\subsection*{3.5.5 Legal}

In the PESTLE analysis at hand, one must distinguish between the political initiatives that, at EU level, promote the adoption of e-learning, and the legal factors which encompass the legislative frameworks, the binding norms, the principles, and the sources that affect the MaTHiSiS product and services, at the current stage of development and in the future.

From a political point of view, the European Union has competence to support, coordinate or supplement actions of the member states in the field of education, vocational training, youth and sport (art. 6 TFEU). In line with article 165 TFEU, the EU has adopted a “strategic framework for European cooperation in education and training up to 2020.”\(^{23}\) This strategy, which builds on the earlier education and training 2010 (ET 2010) initiative, sets out 4 strategic objectives and six priorities. The objectives that resonate with the MaTHiSiS project goals, include 1) raising the levels of basic skills such as literacy and numeracy, 2) making mathematics, science and technology more attractive, 3) strengthening linguistic abilities, the development of job-specific skills irrespective of personal, social or economic circumstances, and 4) digital competence. One of the priorities that interests MaTHiSiS closely is “open and innovative education and training, including fully embracing the digital era.” Another policy hook for e-learning is the “EU agenda to improve competences and learning for the 21st century”\(^{24}\). Of particular interest to MaTHiSiS, the agenda mentions the need to develop a comprehensive approach to competences, encompassing curricula, learning materials, teacher training, personalised learning and assessment techniques. Empathically, the 2016 “Resolution of the Council on promoting socioeconomic development and inclusiveness in the EU through education”\(^{25}\) boasts the role of education and training in achieving sustainable economic recovery and in reducing disparities in the EU. In December 2016, the European Commission\(^{26}\) argued that “education systems need to be modernised and the quality of education continuously...

\(^{19}\)http://www.telegraph.co.uk/education/educationnews/10923190/Welcome-to-Nao-your-robot-teacher.html

\(^{20}\) “The robots have been donated by French manufacturers, Aldebaran. They cost about £15,000 each”. From the interview of BBC News with Dr. Karen Guldberg. Retrieved on 23.03.2017 from http://www.bbc.com/news/education-20252593
improved. Globalisation and technological change open up new possibilities, for education and for work.” Interestingly for MaTHiSiS, the communication pointed out that “only a quarter of the school children in Europe are taught by digitally confident teachers.” To reap the benefits of these trends, “education and training systems need to respond better to these changing realities,” the Commission concludes.

As anticipated, the “legal” factors affecting MaTHiSiS can be identified in posited legal norms and legislative frameworks. In the context of the European Union, in particular, e-learning products and services must abide by the legal norms that are sourced in European Union law and in the law of the member states.

In primis, it should be borne in mind article 14 of the EU Charter of Fundamental Rights, ‘Everyone has the right to education and to have access to vocational and continuing training.’ This article should be read under the light of human right to education recognized in the 1989 Convention on the Human rights of the Child, which states in article 29, comma 1, that “the education of the child shall be directed to:(a) The development of the child’s personality, talents and mental and physical abilities to their fullest potential.” Furthermore, EU countries are bound by the Convention of the Rights of Persons with disabilities (CRDP). Art.9 of the CRDP put states parties under the obligation to “take appropriate measures to (g) promote access for persons with learning disabilities to new information and communications technologies and systems.”

In addition to the implications derived from human rights law, a key legal factor that interests e-learning systems such as MaTHiSiS is the EU legal framework on personal data protection. Education technologies, in fact, entail the processing of sensitive personal information and therefore create risks of excessive interference with learners and teachers’ private informational sphere.

The Charter of Fundamental Rights of the European Union (CFR) protects the right to privacy in its art. 7 and the right to data protection in its art. 8. [27] Art. 8 CFR enshrines the right to the protection of personal data, stating that “everyone has the right to the protection of personal data concerning him or her.” In addition to article 8, the centerpiece legislation in the field of data protection is EU Directive 95/46/EC on the protection of individuals with regard to the processing of personal data and on the free movement of such data, referred to as the Data Protection Directive [28], and, as its successor, the Regulation 2016/679 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, commonly known as the General Data Protection Regulation. [29]

The European Union data protection framework becomes applicable in MaTHiSiS when the data subjects (e.g. the students) become identifiable. Personal data should be processed, according to article 7 of Directive 95/46, based on consent obtained from the data subjects, which is given freely, without undue pressure. The consent is freely given if the data subject is able to exercise a real choice and there is no risk of deception, intimidation, coercion or significant negative consequences if he/she does not consent.”21

In any case, pursuant to article 6 of Directive 95/46/EC, data used in e-learning must remain adequate, up to date, relevant and not excessive for the purposes for which it is collected. Irrelevant data must not be collected and if it has been collected it must be discarded. Moreover, e-learning tools and programs like MaTHiSiS must guarantee that the data subjects have their prerogatives, covered by article 12 Directive 95/46, respected, such as the right to receive some information

whenever data is collected, to access the data, to have data corrected, and to object to certain types of processing.

As far as children are concerned, a child is regarded as data subject for data protection law. This means that they enjoy full rights as regards to the general rules on the legitimacy (consent) and the fair processing of personal data, information to be given as a data subject, etc. The Working Party 29 in its Opinion 2/2009 on the protection of children’s personal data, which is also referred as “General Guidelines and special case for schools”, emphasised the need to focus on children as a special category. A child should be entitled to special and adequate legal rules, which at the same time would protect a child’s vulnerability and ensure a child’s right to development. In relation to providing the consent, it is illusory to expect that a child understands the implications of a “one button click”; e-learning tools should thus provide additional tailored information requirements for children for the processing of their personal data or to communicate privacy notices.

3.5.6 Environmental

No need in physical training spaces and classes would result in a smaller or at all no facilities required for training, therefore contributing to the reduction of the energy, heating and power usage.

MaTHiSiS will contribute to lowering the environmental impact through the provision of an alternative to the already established paper-based learning and testing activities therefore introducing an effective way for educational institutions and companies to significantly reduce their carbon impact on the environment.

Back in 2005, a study led by the Open University has concluded that the provision of a distance learning courses requires almost 90 percent less energy and produces 85 percent fewer CO2 emissions per student in comparison to the conventional campus-based university courses. [40] The introduction of distance online learning reduces the need for classrooms and therefore the accompanying costs to maintain such facilities. In addition to that there are a number of benefits through the contribution of the end-user - learner. As the provision of internet enabled courses takes place via internet, learners do not need to travel daily to their schools, universities etc. The diminishing need of dial commuting, leads to a significant reduction of CO2 emission and air pollutants. Especially learners in metropolitan areas, experiencing heavy traffic throughout the day, prolonging their time in vehicles and other means of transportation impact the environment even more. Last but not least, the more such vehicle is used the more “wear and tear” it will suffer leading to a more frequent auto parts replacements ultimately leading to more pollutants ending up in landfills.

3.6 Porter’s five forces analysis

The Michael Porter’s five forces model [33] is commonly used for the analysis of forces which can represent potential threats for the company/product under consideration, and should normally impact on its exploitation/business strategy. The set of five forces is next introduced:

1. Entry threat

This is the threat that new competitors might enter on the market on which the product/company under scrutiny already exert their activities. This threat is determined by at least two factors:

- The barriers to entry: the barriers to entry may be of different natures, like for instance the level of financial investment required, technological barriers, joint ventures already developed between different actors present on the market, etc.

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• The interest to enter the market: similarly opportunities assessment may stem from elements of different natures like the size of the present or potential market, the number, the size, and the products quality of potential competitors already present, or who might enter, etc.

2. Suppliers power

The suppliers power depends amongst other factors on the quality and price of the products and services, the number of suppliers, the number of potential clients for their products, the substitutability of these products as well as different ratios like the one between the purchasing under consideration and the total production cost, or the one between the purchasing under consideration and the total revenue of the supplier, etc.

3. Customers power

Similar factors to the ones seen here above in the case of the suppliers, have to be taken into consideration: the breakdown of the total revenue of the firm between its different clients, the number of such clients, etc.

4. Substitution threat

The substitution threat is the threat that the products proposed on the market by the firm under consideration can be replaced by alternative products at a competing price, and offering a quality level that is superior or equal to the one of the product proposed by the firm.

5. Competitors rivalry

Competitors’ rivalry is probably the most obvious force driving the market’s evolution. Such rivalry may be derived from what Porter calls generic strategies, in fact three:

a. Global Cost dominance: the idea is here to squeeze as much as possible the production cost whatever the segment considered;
b. Differentiation: the strategy is here to propose higher quality products whatever the segment being considered;
c. Focused differentiation: just like the previous one, this strategy is based on quality, but focuses a specific segment rather than applying to the whole market.

3.6.1 Entry threat

In the case of MaTHiSiS considering its IA capabilities for adaptation/personalization considering the affective/intent state of learners, the support for ubiquitous learning and stealth monitoring based on LA, new competitors will have some technological barriers in particular due to the combination of disruptive technologies (facial expression detection, affect tools for image/video/3d/speech or the detection of affective/intend states, multimodal learning analytics, combination of multiple interaction devices and their synchronous/asynchronous communication). Possible competitors can successfully provide solutions based on any of those technologies but it is quite unlikely they will address the combination of all of them. Thus, as part of the exploitation strategy particular attention should be paid to monitor which projects/companies/products provide similar capabilities.

3.6.2 Suppliers power

MaTHiSiS suppliers are mainly content providers of learning materials and games, their power will depend on the quality and whether the product or service provided by that supplier is generic or specific, and of course on the existing competition and their prices.

The cases in which the product or service provided by the supplier have low competition, MaTHiSiS will need to buy its product at the market price, where this price is in fact largely determined by the supplier. Thus, such fact will have consequences on the production cost but not on the competitiveness of MaTHiSiS.
3.6.3 Customer Power

Two types of buyers should be initially considered:

a) investors

Investors (including prescribers, key accounts, commissioners, and public authorities) will have a strong buyer’s power given the fact that they are at the origin of the development through their financial support of the project.

b) end users

The individual buyer’s power can be determined taking into account the market’s demands that need to be satisfied after analysing them through usual segmentation techniques.

Higher power will have specific customer, which is generally a company or an institution who request the provision of tailored products.

Once the MaTHiSiS Business models will be completed, and its different revenue streams will be defined, the power of MaTHiSiS customers can more precisely determined.

3.6.4 Bargaining power of suppliers

The threat of MaTHiSiS platform being replaced by alternative products is closely related to the previous analysed Entry threat, thus as part of the exploitation strategy and in particular when defining MaTHiSiS Business models special attention will be dedicated to analyse alternative products, their quality and prices to try to minimize this potential threat.

3.6.5 Competitors rivalry

In the case of MaTHiSiS, it seems feasible to follow a focused differentiation strategy, which will be based on the provision of a quality platform which special focus on the segments determined in section Targeted Segments.
4. Initial identification of the MaTHiSiS Exploitable Results

4.1 Exploitable Results: MaTHiSiS platform and individual components

Beyond the overall MaTHiSiS integrated platform, the project is generating a number of results with exploitation potential as presented in the following section. As the project will progress the list will be refined to add more products, should those be identified.

<table>
<thead>
<tr>
<th>Products / Technical Components</th>
<th>Owner(s)</th>
<th>Licensing terms</th>
<th>Exploitation plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>MaTHiSiS Integrated Platform</td>
<td>All partners developing components</td>
<td>To be defined</td>
<td>To be defined in the following versions of the current deliverable</td>
</tr>
<tr>
<td>Creation Tools</td>
<td>DXT</td>
<td>Commercial</td>
<td>The technical results developed by DXT in the frame of the MaTHiSiS project will be integrated in DXT’s INSCAPE product line. INSCAPE is a flagship product of the company for the authoring of interactive experiences.</td>
</tr>
<tr>
<td>(Educational Material Creation Tool + Learning Games Programming Tool)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Affect Recognition Software</td>
<td>NCSR</td>
<td>Open Source</td>
<td>The research group CIL of NCSR will make the audio affect recognition software publicly available for research use.</td>
</tr>
<tr>
<td>Sensorial Component</td>
<td>CERTH</td>
<td>Commercial</td>
<td>The research group of CERTH will study the possibility of integrating the component in the solutions / products of its spin-off company d-Cube.</td>
</tr>
<tr>
<td>Educational materials, learning graphs</td>
<td>FMD</td>
<td>Open source</td>
<td>The materials developed by FMD in the frame of the MaTHiSiS project will shared with partners and end users.</td>
</tr>
<tr>
<td>Educational Materials on Self Advocacy for learners with Intellectual Disabilities (ID), including Profound &amp; Multiple ID</td>
<td>RIX/UEL</td>
<td>Open Source</td>
<td>RIX Media will incorporate the learning materials into open and proprietary online training Courses. Materials will be shared with partners and end users and published for general use that benefits the end-users with ID.</td>
</tr>
<tr>
<td>Testbed game-based learning platform</td>
<td>UM</td>
<td>Commercial/Open source (indicate</td>
<td>This application has been used in MaTHiSiS context as a data acquisition</td>
</tr>
</tbody>
</table>
Learning Analytics & Visualisation Tool

ATOS
Open source (Apache and GNU GPL licenses)

The Learning Analytics visualization tool developed by ATOS will be further exploited/reused in future research and development projects and will be also included as part of the Innovation management and Technology transfer actions of the User Experience Research line to other ATOS divisions with interests in TEL; User Experience

MaTHiSiS Mobile app

OTEA/NG
Commercial

OTEA/NG will explore the possibility of establishing an alliance with the rest of the MaTHiSiS technical partners towards offering MaTHiSiS system (together with the mobile layer implementation code developed by OTEA) commercially.

Educational materials, Re-usable content (Smart Learning Atoms, Learning Graphs)

EOPPEP
Open source (indicate license)

The materials developed by EOPPEP in the frame of the MaTHiSiS project will be shared with partners, stakeholders and end users.

Table 5. MaTHiSiS Exploitable Results

Last but not least, the knowledge resulting from the project will be reused for exploitation, future projects or research. The knowledge gained during the project will be exploited by all the partners and that this will be specified in the individual exploitation plans of the partners that will be included in the following versions of this deliverable. Specific elaboration on the exploitable results of each partner are also going to be part of the T1.2 of the DoW.

4.1.1 Creation Tools

The leader of the innovation and software development is DXT.

4.1.1.1 Description

The MaTHiSiS Creation Tools (namely Education Material Creation Tool and the Learning Games Programming Tool) tightly integrates a set of visual editors enabling non-programmers to create and assemble educational experiences and publish it on the MaTHiSiS platform.

They enable the creation of Learning Graphs and Smart Learning Atoms and Learning Actions and their materialization with the support of multiple devices. Learning Materials can be imported from existing multi-source, multi-format content.

4.1.1.2 Owners

This result is owned by DXT.

4.1.1.3 Targeted Sectors and Users

The targeted sectors for this result are vocational training and education even though it has also significant potential in the field of culture and tourism, with educational dimension.
The targeted users are people with no-programming skills but with expertise in pedagogy, education, and some skills in multimedia. The typical user is comfortable with tools like PowerPoint and is familiar with the notions of non-linear storytelling if she/he needs to create Learning Action materializations with the tool. The typical users has access to a collection of digital assets, including existing learning material, that she/he can import and exploit in the tool.

These tools come with an experiencing engine allowing the execution of the materialization of the created learning experiences.

4.1.1.4 Competition Analysis

Although there are a large number of applications created especially for the creation of interactive experiences, for edutainment applications, few include full-fledged authoring tools that empower the tutors themselves to author and modify the experience. In the table below, we have focused on authoring tools that have one or more of the following characteristics:

- Includes a powerful visual editor (linked to but not dependant on a scripting system);
- Based on rich media environments including for instance, 3D or AR components;
- Includes geo-located content;
- Works on popular mobile devices;
- Supports multiple devices exploitable in the same experience.

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Articy</td>
<td>Designed to help game and level designers test non-linear stories and dialogs. Features an intuitive visual editor that displays assets along with the design. Can also export to XML. However, it is not connected to any game editor, and so does not “do anything” by itself. <a href="http://www.nevigo.de/?id=13">http://www.nevigo.de/?id=13</a>. See also Rabil Jr., R. (2012). An Evaluation of Software Tools for Interactive Storytelling (p. 71).</td>
<td>Visualizes branching stories and dialog.</td>
<td>Not connected to any engine or working system.</td>
</tr>
<tr>
<td>Thinking Worlds</td>
<td>Within a 3D environment, can place objects and characters, and dictate their behaviour through a visual sequence and interaction editor. <a href="http://www.thinkingworlds.com">http://www.thinkingworlds.com</a></td>
<td>Quick to create single-player serious games in 3D.</td>
<td>No link to mobile devices.</td>
</tr>
<tr>
<td>3DVia studio²⁴</td>
<td>Dassault System’s game authoring tool mainly for web games based on scripting like its predecessor Virtools. An extension for authoring Virtual Reality content is also available.</td>
<td>Collaborative edition.</td>
<td>Complex to use. Server driven experience. Uncertain future</td>
</tr>
</tbody>
</table>

Table 6. Authoring tools

4.1.1.5 SWOT Analysis

**Strengths**

- Based on visual programming principles that makes it accessible to non-programmer.

**Weaknesses**

- Some high level concepts of MaTHiSiS exposed in this tool may be not immediate to grasp for the new users who may be more comfortable with a

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²⁴[http://www.3dvia.com/studio/](http://www.3dvia.com/studio/)

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Layered architecture enabling lay people to access top level and gradually reach more complex levels when getting more experienced.

- Considers the experience as taking place in a mixed reality environment blending digital and real world.

- Supports multiple devices, potentially including IoTs as sensors or effectors exploitable in the learning experience.

- Enables the easy adaptation to the learner’s skills and capabilities/disabilities.

- Comes with an experience engine allowing the execution of the materialization of the learning experiences.

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>- An unprecedented tool with significant potential impact in the fields of vocational training and education, especially for the new train of on-the-job training.</td>
<td>- The education market may not have the financial resources to acquire such a tool and train its personnel.</td>
</tr>
<tr>
<td>- No real competition on the market. There exist some game development tools without the pedagogic dimension. No competitive product identified offering both educational and learning material/game authoring in a consistent, and non-programmer compatible way.</td>
<td>- Developing such a tool is extremely ambitious for a project like MaTHiSiS. If not well aligned with DXT’s INSCAPE roadmap, there is a risk that the result will be too far from product at the end of the project. Authoring tools are some of the most expensive pieces of software to develop.</td>
</tr>
<tr>
<td>- Can benefit from the commercial network and efforts related to the exploitation of the INSCAPE product line.</td>
<td></td>
</tr>
</tbody>
</table>

Table 7. SWOT Analysis - Creation Tools

4.1.2 Sensorial Component

The leader of the innovation and software development is CERTH.

4.1.2.1 Description

The Sensorial Component is the main affect/intent capturer and analyser and it encapsulates all necessary algorithms to recognize the affective state of a learner (namely, RGB HD cameras and Kinect depth sensors). CERTH’s primary objective focuses on Face Tracking, Gaze Estimation and Skeleton Analysis, in the wild. In general, the outcome of this component is the Emotional and Affective State of the Learner and the feature extraction from each modality separately.
D1.1 – MaTHiSiS Exploitation Plan M12

The most important task of the SC is to automatically extract information concerning the learner’s cognitive and/or physical state to support Decision Making related to the overall affective state of the learner.

4.1.2.2 Owners

This result is owned by CERTH. Within the sensorial component there are discrete IP rights for speech and mobile device-based emotion recognition from inertial sensors that belong to NSCR and UM respectively.

4.1.2.3 Targeted Sectors and Users

The targeted sectors for this result are any disruptive technology vendor dealing with the gamification of traditional processes where the affective state of the user is a mean to personalise, adapt and improve the User Experience. Some indicative domains that could make use of such a state-of-the-art component are vocational training and education, gaming industries and proximity and/or online marketing carriers, taking under consideration the response to advertising messages.

4.1.2.4 Competition Analysis

Given that the Sensorial Component applies to diverse market segments, a competition analysis is out of scope. The real challenge is to deliver an out-of-the-box solutions being able to detect user’s emotional and affective state from a multi-sensor IoT network, in the wild and feed an external decision maker with high-quality adjustable features. Nevertheless, these features are of high interest for the developing market of affect based applications and no commercial products are yet developed to establish a proper competition analysis.

4.1.2.5 SWOT Analysis

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Face Tracking in the wild</td>
<td>- Difficulties in deploying in multi-class environments</td>
</tr>
<tr>
<td>- Skeleton Analysis in the wild</td>
<td>- The setup and calibration of the sensors are time-consuming and complex operations</td>
</tr>
<tr>
<td>- Gaze Estimation in the wild</td>
<td>- Limitations when operating in the wild, depending on the environmental “noise”</td>
</tr>
<tr>
<td>- Emotional and Affective State Recognition from Face and Skeleton</td>
<td>- Data sampling depending on external components (i.e. Interaction with different sensors)</td>
</tr>
<tr>
<td>- Affective State Recognition (Engagement – No Engagement) from Gaze</td>
<td></td>
</tr>
<tr>
<td>- Combined computer vision and deep learning algorithms</td>
<td></td>
</tr>
<tr>
<td>Targeted Feature Extraction</td>
<td></td>
</tr>
</tbody>
</table>
Opportunities
- Deliver an out-of-the-box “sensing” component to diverse markets
- Exploitation through CERTH’s spin-off company named d-Cube and specifically in the Immersive Places and Immersive Exercising and Immersive Industries solutions.

Threats
- Exploitation strategy should focus on targeted markets
- Difficulty from software vendors in the integration of the components to their products
- Difficulty to integrate diverse components from different partners within the consortium in order to deliver a holistic solution, from sensing to affective state recognition and to interaction adaptation and personalisation.
- People may feel unease when their affect is monitored thus slow adoption of such technologies may be a crucial threat.

Table 8. SWOT Analysis - Sensorial Component

4.1.3 Affect Recognition Software (Audio)

4.1.3.1 Description
The affect recognition software from audio data is used to analyse speech segments and classify them accordingly, based on the emotional state of the speaker. It will incorporate both linguistic (i.e., spoken words) and non-linguistic (i.e., vocal features) cues, to create a description of a vocal segment into a feature space and then, to classify it to one of a set of predefined emotions, using an appropriate pre-trained model.

4.1.3.2 Owners
The result is owned by NCSR. Within this software third party open source libraries have been used.

4.1.3.3 Targeted Sectors and Users
The target users are the educational institutions, media organizations as well as third party developers who might make use of affect recognition software from audio data.

4.1.3.4 Potential users of this software are researchers in the fields of audio signal processing and analysis. Competition Analysis

The competition analysis presented herein is only in terms of the developed low-level audio feature extraction library. A competition analysis of the affect recognition software is out of scope, since to the best of our knowledge there does not exist any similar tool or library.

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yaafe</td>
<td>A Python library for audio feature extraction and basic audio I/O (<a href="http://yaafe.sourceforge.net/">http://yaafe.sourceforge.net/</a>)</td>
<td>-</td>
<td>Basic feature extraction</td>
</tr>
<tr>
<td>Essentia</td>
<td>Open-source C++ library for audio analysis and music information retrieval. (<a href="http://essentia.upf.edu/">http://essentia.upf.edu/</a>)</td>
<td>Fast performance</td>
<td>Provides basic classification</td>
</tr>
</tbody>
</table>
### Table 9. Competition Analysis – Affect Recognition Software

<table>
<thead>
<tr>
<th><strong>Strengths</strong></th>
<th><strong>Weaknesses</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Extraction of emotions in the wild from audio features</td>
<td>Heavily relies on appropriate model creation</td>
</tr>
<tr>
<td>Supports domains where users are not able to produce words</td>
<td>Public training sets are rare and focus on other domains</td>
</tr>
<tr>
<td>Language-independent model</td>
<td>Limited performance in noisy environments (“in the wild”)</td>
</tr>
<tr>
<td>Calibration is not required</td>
<td>Relies on available hardware (e.g., microphones used)</td>
</tr>
<tr>
<td>Easy integration in other projects</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Opportunities</strong></th>
<th><strong>Threats</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Deliver a multi-platform solution which may run on cheap hardware</td>
<td>The expected results heavily rely on the data that would be gathered within the data gathering process (pre-pilot): errors in annotation, biased users</td>
</tr>
<tr>
<td>MaTHiSiS’ use case may provide excellent research opportunities for conference/journal publications and dissemination in general</td>
<td></td>
</tr>
<tr>
<td>Fusion with other modalities may provide state-of-the-art results</td>
<td></td>
</tr>
</tbody>
</table>

### Table 10. SWOT Analysis - Affect Recognition Software

#### 4.1.4 Testbed learning game

The leader of the innovation and software development is University of Maastricht

#### 4.1.4.1 Description

The University of Maastricht testbed learning game platform is an implementation of a serious game based on Q&A (question and answer) applications, which was developed for data collection purposes, by UM. This platform includes some generic courses (namely, mathematics, geography, history and sports). All of them contain several questions belonging to 9 levels of difficulty. Furthermore, this application allows the addition of new courses and questions through a user-friendly interface. The platform enables the definition of questions based on three different types: true or false, multiple choice (3 possible answers) and free response questions.

The flow of the game consists of the completion of the tests that the platform presents while the interactions (such as scores obtained, time required to answer, etc.) and the face reactions are stored. The data acquired has been used to implement different mechanisms for adaptation of the learning content based on face emotion analysis and/or interactions and performance.
4.1.4.2 Owners

This result is owned by UM.

4.1.4.3 Targeted Sectors and Users

The main targeted sector of this application is the research community but also vocational training and education could use this platform due to the possibility of including new courses and questions easily.

In the context of researchers concerned with learning methods improvement, this application offers opportunities to acquire useful data related to cognitive learner responses while interacting with the learning content, performance and video recordings. This platform can be used as a testbed for this kind of experiments.

In connection with vocational training and education, the platform can be easily used by a tutor with no programming skills due to the fact that the application includes a user-friendly interface that allows the addition of new learning content (i.e. new courses and/or questions). A tutor can divide his/her courses in up to 9 levels and the progression and performance will be stored.

4.1.4.4 Competition Analysis

Given the fact that the platform has been developed by the University of Maastricht for research purposes, its application is dedicated to emotion recognition and can assist the research community in collecting related data. In particular, the scope of the software is to link levels of difficulty in test sessions, facial expressivity and user responses to affective states, deriving from the theory of flow.

To the knowledge of the researchers in UM, a similar game has not been made available publicly by the research community (free entry of Q&A by the teacher/user, face recording, affect-related annotations, different levels of difficulty); moreover, as the application is offered for research purposes, a competition analysis would not be applicable, in the typical market sense, since different solutions have been proposed by the research community for answering different (although related) research questions. However, below, one can find similar products that have been introduced by the research community for focused purposes:

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protus [30]:</td>
<td>Tutoring system developed for teaching Java programming language. The main scope of &quot;Protus&quot; is to recommend the best possible material for the e-learners based on their background and skills.</td>
<td>Easily identified learning style</td>
<td>Specifically made for an application</td>
</tr>
<tr>
<td>EduRank [31]:</td>
<td>A system for personalizing educational content for learners, which combines collaborative filtering and social choice theory.</td>
<td>Similar students are identified automatically</td>
<td>Not focused on the affective component</td>
</tr>
</tbody>
</table>

Table 11. Competition Analysis - Testbed Learning Game

4.1.4.5 SWOT Analysis
Strengths
- Based on user-friendly interfaces, the platform is accessible to user with no-programming skills
- Based on user-friendly interface to include courses and questions, the platform can be enhanced by non-programmers (tutor with no programming skills)
- Face-based analysis
- Tracking of interactions
- Use of user skill level

Weaknesses
- Currently limited to laptop/PC environments, in order for the facial component to be able to deliver results
- Limited type of Q&A sessions (free text entry, multiple choice, Yes&No answers)
- To change the environment (fonts, colours, etc.), one needs to adjust the code

Opportunities
- Exploitation of the product to different sectors, with minor changes needed
- Easy deployment of new sessions, beyond the default ones
- A good tool for specialists to cross-check user performance and emotions through videos

Threats
- Users may feel uncomfortable knowing their facial responses are monitored/stored
- Currently only supported by stationery devices, whereas the trend is towards mobile ones
- Does not (currently) support collaborative settings

Table 12. SWOT Analysis - Testbed Learning Game

4.1.5 Learning Analytics & Visualisation Tool

4.1.5.1 Description
The Learning Analytics and Visualisation tool will allow Tutors/Learners to monitor the progress of a learning experience according to their specific needs. In the case of Tutor, he/she will be able check the progress of his/her learners and time spent on the different learning actions defined according to the lesson design and also will get some real-time information to be able to modify certain details of the learning experience to ensure that learners will be able to attain the specified learning goals. In the case of learners, it will allow them to visualize their activity streams including their performance and affective states.

4.1.5.2 Owners
The leader of the innovation and software development is ATOS.

4.1.5.3 Targeted Sectors and Users
The targeted sectors for this result are training and education even though it has also significant potential in all fields of where an educational/training process will occur.

The targeted users are tutors/teachers and learners with no-programming skills willing to know about the current status and progress of a learning experience.
4.1.5.4 Competition Analysis
Learning Analytics and Visualization tool incorporates affective aspects based on the data gathered from parameterized and dynamic deployment of sensing and actuating devices to show learners’ levels of engagement in addition to the overview of their performance during the different learning experiences supported by MaTHiSiS platform.

At the moment of conducting this analysis, Learning Analytics dashboards available only focus on showing some aspects of the learners’ performance and engagement but only from the interaction perspective, no affective aspects are considered.

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMMA dashboard</td>
<td>EMMA dashboard provides different visualizations for MOOC providers and students of the MOOCs based on the data stored in learning record store. The focus of the EMMA learning analytics dashboard will be to support awareness and sense-making of the learning activities in online settings. Students’ dashboards enable to raise students’ consciousness of their learning activities by providing overview of the progress or social structures in the course context. Instructors’ dashboard provides feedback to course designers about the activities during the course.</td>
<td>Visualization of MOOC Learning Analytics Social Network Analysis</td>
<td>Custom design dashboard, only usable within the EMMA platform. No affective state representation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOCO- Analyst</td>
<td>LOCO-Analyist is an educational tool aimed at providing teachers with feedback on the relevant aspects of the learning process taking place in a web-based learning environment, and thus helps them improve the content and the structure of their web-based courses.</td>
<td>Interoperability of contents and their visualizations based on IMS CP(^\text{25}). Tracking information embedded in the course design Social Network analysis based on chats interactions Use of Semantic Web technology</td>
<td>Visualization of interactions are reduced to statistical analysis of the time spend, average time of revisiting, average scores No affective state representation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analyse</td>
<td>ANALYSE is a learning analytics tool developed for Open edX(^\text{26}). It transforms low level data into useful indicators about the learning process (scores, overall and daily time dedicated to the different activities, progress on different activities and overall progress)</td>
<td>Detailed visualization of learning indicators. Open Source tool, easy to reuse for new implementations.</td>
<td>Only applicable for MOOC environments. No affective state representation</td>
</tr>
</tbody>
</table>

\(^\text{25}\) https://www.imsglobal.org/content/packaging/index.html
\(^\text{26}\) https://open.edx.org/

Table 13. Competition Analysis - Learning Analysis and Visualisation Tool
4.1.5.5 SWOT Analysis

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Detailed overview of the learning progress monitored through a combination of sensor and interaction tracking of learning actions</td>
<td>• Strong dependence of the reliability of the sensorial components and processing of their information for the determination of the learning affective states.</td>
</tr>
<tr>
<td>• Inclusion of the affective state of learners during the different learning activities</td>
<td></td>
</tr>
<tr>
<td>• The information presented in the dashboards is also related to the generation of recommendations for improving the learning process as well as for enhancing the personalized support offered to participants by the platform</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Provision of LA analytics dashboards for the support of training deployments in any knowledge domain</td>
<td>• Appearance of new tools with similar functionalities to monitor and show learning performance and affective state of participants in a learning process.</td>
</tr>
<tr>
<td>• Further exploitation through the Technology transfer activities of ATOS</td>
<td>• Personal data privacy regulations might negatively impact on the broad adoption of monitoring individual’s activities and their visualization to help improving their learning performance.</td>
</tr>
</tbody>
</table>

Table 14. SWOT Analysis - Learning Analytics and Visualisation Tools

4.2 IPR Management

IPR Management is a critical process to ensure that proprietary assets are properly monetized in case a third party is interested in leveraging on it to either develop new products/services or improve existing ones. IPR involves high complexity due to the need of valuing the asset. However it is a must to assure that a “creator” gets a return (monetary or credit / recognition) in transferring its technological asset.

The IPR management of MaTHiSiS started from the initial phase of the project. D7.1 [35] initiated it by collecting the main software components identified during the architecture definition, the responsible partner, the technologies and software libraries used with their respective licenses. An initial analysis performed, shown that certain components will be provided publicly as open source while some other will be maintained as proprietary.

A further analysis will be done in year 2 to identify if a single license scheme can be applied to the integrated platform. It will be documented and delivered in the exploitation deliverable due at the end of Y2.
5. Definition of Business Scenarios

There would be two potential business scenarios for MaTHiSiS exploitation:

1. Exploitation of the Individual components;
2. Exploitation of the Integrated platform.

These business scenarios will be further researched and defined in the year 2 of the project. They could be exploited in the following scenarios:

- Exploitation and use of MaTHiSiS exploitable assets by the consortium as a whole;
- Exploitation and use of MaTHiSiS exploitable assets by a group of beneficiaries;
- Exploitation and use of MaTHiSiS exploitable assets by individual beneficiary.

Given the current status of the project as identified assets are not fully developed or are being tested in the pilots, we could not complete their full description, quality and qualitative assessments. Therefore, we postponed the full definition of those scenarios for next year and we focused on the preparation of the initial versions of the MaTHiSiS value proposition and SWOT. It must be noted that descriptions of the identified assets will probably evolve during Y2, thus an update of the current MaTHiSiS value proposition and SWOT will be made as well. In the next year emphasis will be given on preparing individual exploitation and sustainability plans and trying to synthesize them into a common Exploitation Agreement.

Considering the number of parties involved in the development of the product and differences in their interest, approaches to the market, licensing and IP measures, applicability of various business models etc., a really careful consideration on different possibilities has to be taken. Since the project is still in development, new components with their respectful licensing emerge within the system, the consortium strongly believes that the time for such discussions and decisions has yet to come. Nevertheless, at this point of time, we are able to propose several scenarios that might be later considered by the consortium. According to the business models and distribution channels a probable collaboration between consortium partners can arise in a form of a spin-off company. Creating a spin-off company on the one hand helps to stand out in terms of clear product portfolio or services that future company aims to offer but at the same time require to perform a number of crucial but sometime time-consuming and costly activities towards the definition of possible future infrastructure, legal procedures and management. In addition it would also require the consideration of additional investments in labor, software and capital. In order to ensure a sustainable exploitation plan, it will be crucial to form a legally binding partnership between partners of the consortium to be able to exploit the results after the lifetime of the project. Therefore, a number of legal structures that are going to be validated during the second year of the project can be proposed.

The initial objective of defining such a strategy is not targeted to conclusively deciding the legal structure of MaTHiSiS project, but instead provides an initial synopsis to validate how it can function in the future and shouldn’t limit the results of the project’s outcomes by any means. Three major structures that are identified at this stage which might be applied to the project:

- New Legal Entity
- Supply Chain
- Joint Venture

Considering a new legal entity, the consortium will need to define what foreground can be passed and which of the MaTHiSiS beneficiaries will be willing to do that with respect to individual exploitation strategies. These actions will be a subject to reconsideration of the IPR agreement. One of the possibilities will be to pass the IPR of a respective beneficiary to the future entity in return for
a licensing fee or company’s shares. In these cases, future shareholders expects gaining profits as a result of company’s trading agreements and operations on the market.

Future steps for the exploitation of MaTHiSiS will include the validation of this approach and in particular addressing the issues of legal base (where the entity is going to be funded), legal basis (type of the entity, based on the legal procedures of the respective country), ownership and administration (definition of who and how will operate the company and how many shares each partner will hold). The following step of the exploitation plan would be to investigate each partner’s interests and potential as an active participant in the future entity or as a shareholder.

The concept of supply chain will be introduced if there is no apparent supreme structure originated during or after the end of the timespan of the MaTHiSiS project. Supply chain captures certain relationships between groups of partners who showed their interest in delivering a product or a service using the IP of one of the partner. In this case no particular agreement would be needed to reflect the relationships between partners but rather stimulates bilateral agreements between the parties.

To illustrate the concept of a supply chain we envision that a beneficiary within MaTHiSiS, who has expertise in the development and supply of any of the MaTHiSiS’s modules, acts as customer for another partner coming from the MaTHiSiS consortium. If there is an interest and a viable business between a chain of partners, a commercial contract will be considered.

A joint venture is defined as “a form of business association between two or more independent organisations (joint ventures) to undertake a common project or to achieve a certain goal.” On high level it is described as an agreement between partners, where specific contribution of each partner is defined. Such contribution arises in form of financial investment, assets, skills, etc. It is crucial to note that benefits, risks and responsibilities are also shared between the parties of the venture. Through the process of validation of such concept, the partners might need to consider the responsibilities (e.g. finance, resource management) and in the form of a possible joint venture agreement. The main investigation will define partners’ rights and their direct obligations to the MaTHiSiS venture, definition of the management board, addressing the decision making process, framework for resolving disputes, sharing benefits and losses, etc.

When considering any of the concept or business model, it is clear that MaTHiSiS might require additional funds to ensure successful entry to the market and scaling. In addition to that, some initial funds might be required to build up a basic infrastructure, cover personnel and marketing costs, etc. Therefore, we see three possible funding sources:

- Funding, that can be provided by European or national funds to support start-ups;
- Investment funds and venture capital;
- Public Private Partnership.

Apart from that, specific funds might be available on national levels within programs that support business development and innovation provided to either private or public entities.

To better determine the most suitable exploitation model and protect the IP of the consortium and individual partners, the consortium will consider taking advantage of the following services:

- The Innovation Relay Centres (http://www.innovationrelay.net), a network of more than 70 centres involving more than 240 organisations in 33 countries which provide assistance on marketing innovation, help venture capitalists find new technologies to exploit, and help companies source innovative solutions to satisfy a technological need.
- The Cordis Marketplace service (http://www.cordis.europa.eu/marketplace), an online service where you can find RTD results and search for innovative business opportunities on emerging technologies.
- Gate2Growth (http://www.gate2growth.com), which offers in particular a database of experts and service providers - ranging from incubators to patent lawyers, to accountants.

A joint venture is defined as “a form of business association between two or more independent organisations (joint ventures) to undertake a common project or to achieve a certain goal.” On high level it is described as an agreement between partners, where specific contribution of each partner is defined. Such contribution arises in form of financial investment, assets, skills, etc. It is crucial to note that benefits, risks and responsibilities are also shared between the parties of the venture. Through the process of validation of such concept, the partners might need to consider the responsibilities (e.g. finance, resource management) and in the form of a possible joint venture agreement. The main investigation will define partners’ rights and their direct obligations to the MaTHiSiS venture, definition of the management board, addressing the decision making process, framework for resolving disputes, sharing benefits and losses, etc.

When considering any of the concept or business model, it is clear that MaTHiSiS might require additional funds to ensure successful entry to the market and scaling. In addition to that, some initial funds might be required to build up a basic infrastructure, cover personnel and marketing costs, etc. Therefore, we see three possible funding sources:

- Funding, that can be provided by European or national funds to support start-ups;
- Investment funds and venture capital;
- Public Private Partnership.

Apart from that, specific funds might be available on national levels within programs that support business development and innovation provided to either private or public entities.

To better determine the most suitable exploitation model and protect the IP of the consortium and individual partners, the consortium will consider taking advantage of the following services:

- The Innovation Relay Centres (http://www.innovationrelay.net), a network of more than 70 centres involving more than 240 organisations in 33 countries which provide assistance on marketing innovation, help venture capitalists find new technologies to exploit, and help companies source innovative solutions to satisfy a technological need.
- The Cordis Marketplace service (http://www.cordis.europa.eu/marketplace), an online service where you can find RTD results and search for innovative business opportunities on emerging technologies.
- Gate2Growth (http://www.gate2growth.com), which offers in particular a database of experts and service providers - ranging from incubators to patent lawyers, to accountants.
and training providers in every European country. The ProTon network (http://www.protoneurope.org), a European association of technology transfer professionals.

- The IPR Helpdesk (http://www.ipr-helpdesk.org), which assists potential and current participant in the EC research Framework Programmes on intellectual property rights issues arising in this context; they also publish a number of general-purpose papers on specific IPR issues;

- The European Patent Office (http://www.european-patent-office.org), which grants European patents and offers additional services, e.g. training seminars and patent information products (CD-ROMs, on-line Espacenet database, etc.);

- The World Intellectual Property Organisation (WIPO – http://www.wipo.int), whose website also contains specific information for SMEs; it should also be noted that WIPO runs a mediation and arbitration facility (http://arbiter.wipo.int);

- National Patent Offices (http://www.european-patent-office.org/onlinelinks/a/aa), which grant national patents and often provide additional services to local users; The OECD – see in particular their Guidelines for the licensing of genetic inventions (http://www.oecd.org/sti/biotechnology/licensing).
6. Value Proposition

"MaTHiSiS platform provides every type of learner, in every type of setting, on the device they have at their disposal, with a bespoke, individualized learning experience that is adapted to their personal requirements"

MaTHiSiS provides an extraordinary technical solution that enables the teachers that best know the learners to tailor the ways in which they are taught; to provide the precise learning and training materials that each individual needs to access; adapted to the specific environment in which the learning has to occur; and on the technical device that really suits the learners themselves and their unique personal circumstances.

The MaTHiSiS system is a state-of-the-art responsive learning system designed to provide each individual learner, the setting in which they are learning and the technology they have at their disposal. The MaTHiSiS system does this and then goes further! The system can even monitor how the learner is feeling today, how they react to their learning experience and then adjust what is provided in a way that responds to the individual’s mood and behaviour to make the learning experience work in the best way possible - for the individual – here and now!

MaTHiSiS proposes a new model of learning and training that embraces the new tools that we have at our disposal and exploits them to provide a uniquely inclusive and responsive experience.

Our personal mobile devices are individualized, why not do the same with our learning pathways? Why not set my teaching or training course to match and exploit my learning strengths - and really grapple with my learning weaknesses? Why not provide me, the individual learner, with a learning journey that I can navigate with appropriate prompts, reminders, new skills and learning challenges that match precisely to what I need to my own circumstances?

In the process, the MaTHiSiS system provides a uniquely accessible and inclusive quality of e-learning experience. The MaTHiSiS platform and the customised content that it delivers provides every type of learner, in every type of setting, on the device they have at their disposal, with a bespoke, individualised learning experience that is adapted to their personal requirements.

The majority of existing online learning systems are not really fit for this purpose. They are poorly adapted to work across different devices that are at the disposal of today’s teachers and trainers. They have not been designed with the full range of different learner needs, learning environments and teaching tools that educators encounter in mind. MaTHiSiS tackles these problems directly with a uniquely responsive and individual learning system.

Further than that, the MaTHiSiS system is highly flexible in the sense that it can be applied across many educational scenarios and use cases such as mainstream educations (for learners with and without disabilities), industrial and/or corporate training, career guidance and even go beyond the educational domain which are going to be evaluated during the course of the development.
7. MaTHiSiS Stakeholders

7.1 Model for Stakeholder engagement

Engaging stakeholders is the developmental exercise needed to enhance mutual understanding of sustainability and push the limits of cognitive, moral and emotional development [32]. There are various ways and levels of engaging stakeholders and stakeholder engagement can mean different things in different contexts [33]. Also, the quality of engagement is largely subject to the number of stakeholders participating in the process.

The engagement vision in the context of exploitation is defined in the project and tends to draw and sustain the attention of (a) stakeholders and (b) the general public to MaTHiSiS results:

(a) Involving the stakeholders is a challenging mission as it will contribute to the sustainability potential of the project. MaTHiSiS will provide an educational ecosystem-as-a-product which will attract a variety of tools and module developers as well as content providers who will be actively involved in MaTHiSiS outcomes. MaTHiSiS will employ the communication channels identified to invite decision makers to participate in testing and will disseminate the results of the tests to showcase its operational reliability (Pilots in Industrial Training and Career Guidance). Early adopters can push towards the full adoption of the platform as an advantageous learning solution.

(b) Introducing new methods for the general public to face the learning procedure can be really challenging; and especially sustaining the user interest in the long run. The way to succeed in this is to provide the end user with the capability to actively participate in the procedure. MaTHiSiS will enable the general public to become a real part of the ecosystem and actively participate in building the educational content. This will be technically covered by the activities of Task 2.1 (stakeholders documents-end users) and Pilots in Education, as well as the workshops organized by the project.

A stakeholder taxonomy part was developed, identifying individual stakeholders that represent all the stakeholder groups in the taxonomy. The list contains groups important for the project goals.

The originator of stakeholder theory, R.E. Freeman [10] has defined a four-step process to identify, classify, prioritise and integrate stakeholders. Step one involves identification of all possible stakeholders. Step two is devoted to understanding the needs and interests of the stakeholders and classifying them into meaningful groups based on their stake and influence. Steps three and four concern integrating, communicating and acting with stakeholders.

Identifying stakeholders → Classifying stakeholders → Prioritising stakeholders → Integration plan for stakeholder engagement

Figure 13. Stakeholder Identification Process

Stakeholder theory suggests that if we think about and analyse the relationship between an enterprise and the groups and individuals who can affect or are affected by it, then we have a better chance to deal with problems. There will be limits to how successful such an approach can be, but by
using stakeholder theory you can test these limits by creating as much value as possible for all stakeholders.

Identification of key stakeholders for the MaTHiSiS defines the successful future exploitation of the project. For this sake, the definition and evaluation of MaTHiSiS stakeholder groups have to be made. Strategic management provides a number of definition for a “stakeholder”. As defined by Eden et al., stakeholders are “people or small groups with the power to respond to, negotiate with, and change the strategic future of the organization [9] “. At the same time, a broader definition addressing individuals, who the project will have an impact to and do not have any direct influence on the implementation of the platform have also to be considered and taken into account. Therefore, Edward Freeman argues that a stakeholder is “any group or individual who can affect or is affected by the achievement of the organization’s objectives” [10].

MaTHiSiS strongly relies on stakeholder engagement to pursue successful uptake of the market, the relevance of innovation, its usefulness to the society and in general to maintain the integrity and credibility of MaTHiSiS outcomes.

A group of decision-making within the consortium needs to clearly define and articulate at what stages of project’s development cycle there will be a need to involve external stakeholders and how the results of this work will be included in this process. Any engagement with stakeholders must begin with an appropriate and realistic level of details. This engagement will be projected to a wider board of external stakeholders that MaTHiSiS consortium will engage with as part of WP10 activities.

Partners of the consortium applied several approaches towards identification of stakeholders including creation of an initial database of relevant stakeholders. Initially, the working group has mapped several key actors who might have the most interest in the MaTHiSiS project, including those who come outside of the eLearning sector but could nevertheless affect or be affected by the project outcomes.

A systematic technique has been applied throughout the iterative process of analysis within this chapter. At the first stage a generic list of stakeholders, with the use of snowballing sampling was created.

### 7.2 Identification of stakeholders

A key task for successful engagement is identifying individual stakeholders, creating a taxonomy of stakeholders and analysing their stakeholder motivations. This task will form the basis of engaging stakeholders through interviews, focus groups, workshops and other means throughout the project and will ensure that the consortium’s analyses, findings and recommendations are based on realistic stakeholder contexts, interests and drivers. This requires engaging stakeholders to identify, assess and balance their “stake or interest”.

The major stakeholder groups have been identified depending on the use case and the market they are active in. Thus, as presented in Table X, the following groups were identified:

<table>
<thead>
<tr>
<th>Segments/Actors</th>
<th>Autism</th>
<th>PMLD</th>
<th>Mainstream Education</th>
<th>Industrial Training</th>
<th>Career Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learners</td>
<td>Individuals with disabilities of the autism spectrum</td>
<td>Individuals with PMLD</td>
<td>Primary education students</td>
<td>Industrial Workers, Industrial Executives</td>
<td>Unemployed individuals</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Secondary education students</td>
<td>CPD Learners</td>
<td>Long-term unemployed individuals</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Secondary</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Tutors / Caregivers</th>
<th>Developers (companies or freelancers)</th>
<th>Market Actors (different actors of the Education value chain)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teachers, Tutors</td>
<td>LMS Developers</td>
<td>LMS providers</td>
</tr>
<tr>
<td>Phycologists</td>
<td>Developers of related affective</td>
<td>Industries</td>
</tr>
<tr>
<td>Assistant personnel for learners with special needs</td>
<td>detection, gaming, personalization and adaptation systems</td>
<td>Educational Content Providers</td>
</tr>
<tr>
<td>Parents</td>
<td>Developers of related affective</td>
<td>Promoters and investors</td>
</tr>
<tr>
<td></td>
<td>detection, gaming, personalization and adaptation systems</td>
<td>Potential Buyers (Companies interested in providing affective and</td>
</tr>
<tr>
<td></td>
<td>education students</td>
<td>(Companies interested in providing affective and public long-life training centres) and investors</td>
</tr>
<tr>
<td></td>
<td>Undergraduate university students</td>
<td>Educational Content Providers</td>
</tr>
<tr>
<td></td>
<td>Postgraduate university students</td>
<td>Promoters and investors</td>
</tr>
<tr>
<td></td>
<td>Long term career development (employed)</td>
<td>Potential Buyers (Companies interested in providing affective and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Companies interested in providing affective and public long-life training centres) and investors</td>
</tr>
</tbody>
</table>
The consortium does realize that MaTHiSiS affects and can be affected by a vast number of stakeholders as they are aggregated from different markets and different actors. Therefore each stakeholder should be treated individually and communication with them should be carefully thought through. Nevertheless for the sake of simplicity of representation some of the stakeholder groups can be divided into sub-groups. The different groups and sub-groups, and reasons for communicating with them are summarized in Table below.

<table>
<thead>
<tr>
<th>Stakeholder affiliation &amp; group</th>
<th>Why we want to reach stakeholders</th>
</tr>
</thead>
</table>
| **1 Students/Learners (SH1)** | - To raise awareness of the possibilities for using MaTHiSiS products  
- To raise the awareness and understanding with regards to MaTHiSiS products and how it can be used to support education.  
- Enable learners to participate in dialogue around MaTHiSiS product  
- To ensure learners participation in the pilots developed by MaTHiSiS  
- To support discussion on usability |
| **2 Tutor (SH2)** | - To raise awareness of the possibilities for using MaTHiSiS products  
- To raise the awareness and understanding with regards to MaTHiSiS products and how it can be used to support education.  
- To encourage the public to lobby their leaders in support of the MaTHiSiS products deployment. |
| 3 Caregiver/Family members (SH3) | - Enable teachers/instructors to participate in dialogue around MaTHiSiS products  
- To develop and implement pilots developed by MaTHiSiS  
- To support discussion on usability  
- To encourage civil society to lobby policy-makers to consider the recommendations made by the MaTHiSiS consortium.  
- Serve as a support and encouragement body for the learner  
- To raise awareness of the possibilities for using MaTHiSiS products  
- To raise the awareness and understanding with regards to MaTHiSiS products and how it can be used to support education. |
| 4 Employers (SH4) | - To raise awareness of the possibilities for using MaTHiSiS products  
- Potential direct Buyer of the MaTHiSiS product/service  
- To raise the awareness and understanding with regards to MaTHiSiS products and how it can be used to support education.  
- Enable educators to participate in dialogue around MaTHiSiS products  
- To encourage implement pilots developed by MaTHiSiS  
- To support discussion on usability |
| 5 Educational Institutions (SH5)  
- Schools  
- Universities  
- Research institutions | - To encourage academic organisations and researchers to conduct further research in regards to the issues of concern raised by the project, especially in relation to their own research practices  
- The adaption of MaTHiSiS within AS, PLMD and Mainstream strongly relies on the readiness of these stakeholders to adopt the solution  
- Engage in dialogue about how research funding policies can be adapted to foster deployment of MaTHiSiS products  
- Encourage schools to adopt MaTHiSiS products  
- Engage with policy issues addressed by project and possible methods of implementation  
- Provide feedback on/insight into current barriers to MaTHiSiS products  
- Act as advocates for MaTHiSiS products deployment at institutional level (policy) and end-user level (practice)  
- To encourage schools to raise the awareness of their members in regards to MaTHiSiS products. |
| 6 Developers (SH6) | - To raise awareness of the possibilities for using MaTHiSiS products  
- These actors are particularly influential and have |
Table 15. Stakeholders

*Time and location independent system which will be able to function in multi-learner, cloud-enabled environments combining the use of robots, mobile devices and interactive whiteboards, being customizable for users based upon their needs and learning profile.

The MaTHiSiS consortium has jointly worked towards identifying relevant stakeholders in each of the identified key categories. Partners are compiling a list of contacts and networks and this will be maintained on an on-going basis. In doing this, the consortium will act appropriately to protect personal data and the data rights of the stakeholders. (*Stakeholders must be informed of the use of their data and offered an opt-out mechanism every time an e-mail is sent, as well as at the end of the project.*)
Stakeholders Analysis

An understanding of stakeholder interest, motivations and drivers is essential for effective dissemination and prioritisation. Understanding stakeholder motivations will enable the consortium to effectively engage, communicate with and promote future dialogue between different stakeholders. Indeed, the combination of the stakeholders’ relevance to MaTHiSiS and motivations will help the consortium define targeted communication strategies for different groups of stakeholders. Stakeholders are often varied and heterogeneous, with different levels of interest or power. As such, Wright and Cairns present the following graphical representation of stakeholder interest and power [34]:

![Wright and Cairns' stakeholder framework](image)

Figure 14. Wright and Cairns’ stakeholder framework

Stakeholder Mapping

Stakeholder mapping is a collaborative process of research, debate, and discussion that draws from multiple perspectives to determine a key list of stakeholders across the entire stakeholder spectrum. Mapping can be broken down into four phases:

1. **Identifying**: listing relevant groups, organizations, and people
2. **Analysing**: understanding stakeholder perspectives and relevance
3. **Mapping**: visualizing relationships to objectives and other stakeholders
4. **Prioritizing**: ranking stakeholder relevance and identifying issues
The process of stakeholder mapping is as important as the result, and the quality of the process depends heavily on the knowledge of the people participating. Identifying, Analysing, Mapping, Prioritizing.

Identifying

The final list of stakeholders will depend on the project business, its impacts, and current engagement objectives. This list will change depending on environment changes and stakeholders themselves if they make certain decisions or change their opinions.

Analysing

It is useful to do further analysis of the stakeholders identified to better understand their relevance and the perspective they offer, to understand their relationship to the issue(s) and each other, and to prioritize based on their relative usefulness for this engagement.

Values: MEDIUM, LOW, HIGH

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Expertise</th>
<th>Contribution</th>
<th>Legitimacy</th>
<th>Willingness to engage</th>
<th>Influence</th>
<th>Necessity of involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Students/Learners</td>
<td>LOW</td>
<td>LOW</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>2 Tutor</td>
<td>HIGH</td>
<td>HIGH</td>
<td>MEDIUM</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>3 Caregivers/Family members</td>
<td>LOW</td>
<td>LOW</td>
<td>MEDIUM</td>
<td>LOW</td>
<td>LOW</td>
<td>LOW</td>
</tr>
<tr>
<td>4 Employers</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
<td>HIGH</td>
<td>MEDIUM</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>5 Educational Institutions</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>6 Developers</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
<td>HIGH</td>
<td>LOW</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>7 Market Actors</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>8 Policy Makers</td>
<td>MEDIUM</td>
<td>HIGH</td>
<td>MEDIUM</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
</tbody>
</table>

Table 16. Stakeholder Mapping

Mapping stakeholders helps to further determine which stakeholders are most useful to engage with and see where stakeholders stand when evaluated by the same key criteria and compared to each other. It helps visualize interplay of issues and relationships created in the criteria chart above. Table 15 presents several dimensions of stakeholder importance to the project including their expertise that can be broken down into contribution to the project development decisions and whether this contributions can be made accountable (in other words, whether a stakeholder has an expert knowledge that can have a drastic impact on the decisions of the consortium) that are provided in the legitimacy column. Further column, willingness to engage, elaborates on the
estimation of a certain stakeholder disposition to be engaged in the decision making process, which can come up in form of stating the desired functionality of the MaTHiSiS platform or the way it should be exploited or even posing some restrictions on it (e.g. by the government). Finally the column **necessity of involvement** indicates whether the consortium shall engage with this particular stakeholder based on the previous indicators to best address their interests and power on the outcome of the project.

![Stakeholder Map](image)

**Figure 15. Stakeholder Map**

### 7.3 Analysis of public bodies

Carefully planning the exploitation activities it is always worth giving a thought about the geography of business. Definitely, the ultimate goal of MaTHiSiS is to enter as many markets as possible and on the global scale, nevertheless all the businesses have to start somewhere. Given the importance of the policy makers within the educational domain as those are mainly responsible for implementation of innovative solutions and its integration in education system we have analysed policy makers and public bodies in order to answer two major questions:

- Who is responsible for implementation?
- How is it then financed?

In the following section we first assume the countries where the pilots are run are the primary target countries as it will be easier to reach potential customers as well as to engage with valuable stakeholders through the organizations and institutions that have piloted MaTHiSiS solution. During the runtime of the project and by its end we strongly believe that MaTHiSiS will have quite enough attention and visibility specifically in the piloting countries. In addition to that, Germany has been added to the list of the analyzed countries as Nurogames GmbH, one of SMEs participating in the project has strong liaison activities with a number of customers within educational sector and has been developing educational software for German market for quite some time.

#### 7.3.1 Germany

Education in general, and in particular primary and secondary school education in Germany is regulated on the level of each Federal State independently according to the Federalism Reform of 2006. Consequently, all the possible initiatives related to the implementation of eLearning in schools in Germany are the responsibility of the each of the 16 State Ministries of Education. With regard to
the directive on school development in the area of new media, this means that strategies and action plans can be developed at federal level, but ultimately, every ministry of education decides to what extent e-learning and the acquisition of new media competency among teachers and pupils on the local level will be implemented/adopted.

The development of new innovative technologies that support personalized, adaptive, distant learning in German schools is supported by the introduction of curricula and a series of support measures for faster adaption and a number of initiatives. The very first initiatives were launched in the late 1990s. Through the support of innovative solutions more than 1.1 billion euros were invested in various eLearning projects across a number of Federal States. The results and a central portal for discussion and evaluation of such actions are actively discussed in the research community, industry and policy makers (e.g. on the Internet platform www.bildungsserver.de).

7.3.1.1 Who funds the implementation in schools

Due to the mentioned delegation of competencies that lies on federal governments in regard to the education policies, a consideration about the initiatives and programs that support the introduction of ICT enhanced learning in Germany shall be aimed accordingly on a local levels, whereby enterprises (industrial partners) are also involved and influence greatly the adaptation processes.

In many cases, initiatives for further development of e-learning have emerged at an early stage and a large part of the measures have been designed on a public-private partnership bases.

As an example since June 2003, the State Ministry for Schools and Continuing Education of North Rheine Westphalia has been closely collaborating with over 25 private donors in the "Partner für Schule NRW" (Partner for Schools NRW) campaign. The initiative sees itself as an intermediary between the schools and the economy. Companies were invited to actively participate in the region development and contribute with their social responsibility in education, while schools take advantage above all from financial benefits. One of the prominent examples is the project "The virtual classroom" that promotes learning with notebooks in the Unna education campus. The project is being implemented as part of the initiative "unit.21.schule" as a joint project of the city, municipal business enterprises and the company Fujitsu Siemens Computer.

Further the state government of NRW together with NRW.Bank supports a number of initiatives that are aimed towards improving the innovation capacity of the region in regard to the education. Thus, the state of NRW bears all the costs for provision of LOGINEO NRW for schools on permanent basis. The cost for the use of the system falls under the responsibility of municipal jurisdiction. As the results show, for successful exploitation of MaTHiSiS in Germany (within the mainstream education), an engagement with local foundations has to be made. Such foundations working in the educational domains for the different Federal states are provided below:

<table>
<thead>
<tr>
<th>Name of the foundation</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hochschulnetzwerk</td>
<td>Bader-Württemberg</td>
</tr>
<tr>
<td>Digitalisierung der Lehre</td>
<td></td>
</tr>
<tr>
<td>Baden-Württemberg</td>
<td>Bader-Württemberg</td>
</tr>
<tr>
<td>Virtuelle Hochschule Bayern</td>
<td>Bavaria</td>
</tr>
<tr>
<td>E-Learning Brandenburg – eBB</td>
<td>Brandenburg</td>
</tr>
<tr>
<td>Multimedia Kontor Hamburg</td>
<td>City of Hamburg</td>
</tr>
</tbody>
</table>

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27 http://www.unit21.de/campus/ueber-den-campus/
28 http://www.logineo.nrw.de/LOGINEO/Startseite/index.html
7.3.1.2 Who funds the implementation of e-learning in higher education

The higher education follows the same approach as the mainstream education but in addition to that has strong established initiatives that fund the development of e-learning solutions and supported by the industry as the latter see much faster return on investment (ROI) when supporting higher education innovation. In March 2014 an initiative "Hochschulforum Digitization" (Higher education digitalization forum) was launched. Within this initiative, around seventy experts are working in six thematic groups on new business models, technologies, internationalization & marketing strategies, change management and organization development, innovation in learning and pilot scenarios, curriculum design and quality development and governance and policies. The Hochschulforum is a joint initiative of the Donors Association of Germany, Center for Higher Education (CHE) and the HRK German Rector’s Conference. It is sponsored by the Federal Ministry of Education and Research.

Many universities support initiatives with their own funds. For example Free university of Berlin introduced its own Fue-Learning program the focus of which lies on the development of new teaching and learning cultures, while at the same time providing sustained teaching, collaborative learning, use of blended learning and interdisciplinary approaches with up to 25,000 Euro. More universities are listed in the Annex of D1.1.

Associations/Foundations

Foundations in Germany usually pursue a charitable purpose related to a certain social issue such as the promotion/funding of research and teaching. There are a number of foundations in Germany to differentiate: private, political party related, trade union, ecclesiastical etc. In addition to foundations, companies or individual entrepreneurs who do not have their own foundations are also active as founders, for example through the endowed professorship. A prominent example is the Hasso-Plattner-Institut (HPI) which is completely privately funded by founder Professor Hasso Plattner, co-founder and chairman of the SAP software group. The list of potential foundations MaTHiSiS consortium shall consider engaging with is:

<table>
<thead>
<tr>
<th>Name</th>
<th>Database Link</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stifterverband der deutschen Wissenschaft</td>
<td><a href="https://www.stifterverband.org/">https://www.stifterverband.org/</a></td>
<td></td>
</tr>
</tbody>
</table>

---

29 http://www.cedis.fu-berlin.de/e-learning/foerderprogramm/index.html
31 http://www.stiftungsprofessuren.de/
7.3.2 Italy

The overall responsibility for education in Italy rests with two bodies: the Ministry of Public Instruction for preschool, primary, and secondary education and the Ministry for Universities and Scientific Research. There are close links between these two ministries and the Finance Ministry regarding budget matters and the Labor and Social Security Ministry for connecting schooling with the world of work. Educational reform continues in Italy with its main focus on the role of the ministries regarding policy, budget, curriculum, pedagogy, and administration or distribution of responsibilities.

The Ministry of Education, University and Research (MIUR) is responsible for general administration at a national level. School education is organised at a decentralised level by the MIUR through the Regional School Offices (Uffici Scolastici Regionali, USR), which operate at provincial level in Local Offices. There are no decentralized offices of the MIUR at municipal level, nor are there any decentralized offices of the MIUR for higher education. Furthermore, the MIUR has several bodies and agencies operating at national level with representative, consultative, monitoring and evaluative functions for schools and for universities and institutes of Higher Education in Art and Music (AFAM).

The Minister is in charge of determining policy with the help of a deputy minister, undersecretaries and with the direct collaboration offices including the Minister’s Cabinet, which co-ordinates the activities of the special advisers’ offices, the legislative office, the administrative office of the Ministry, the technical office and the press office. The MIUR is organized into three Departments. The ‘Department for the Education and Training System’ is responsible for the general organization of the school system, for defining educational and training objectives and the legal and economic status of school staff. The ‘Department for the Planning and Management of Human, Financial and Capital Resources’ is responsible for financial policy, procurement, administrative human resources in schools, and managing information systems. The ‘Department for Higher Education and Research’ is responsible for higher education, specifically the guidance, general regulation and funding of universities; monitoring and evaluating universities and institutes of Higher Education in Art and Music (AFAM); student status; implementation of EU and international legislation; support, planning and coordination of research activities at national, international and EU level.

The Regional School Office (Ufficio Scolastico Regionale, USR) is a branch of the Ministry of Education, University and Research (MIUR). Usually, it is divided into Local Offices, depending on its duties and local requirements. The USR oversees observance of general provisions for education and minimum performance requirements, the effectiveness of training actions and observance of standards. The Local Offices, which operate at provincial level, are an internal division of the Regional School Office and have no autonomy. Local Offices support and advise schools on administrative and accounting procedures and the planning and innovation of the educational offer. They monitor implementation of provisions on school buildings and safety and deal with the integration of immigrant and special needs pupils, the promotion of student participation in schools and, in collaboration with municipalities, they monitor compliance with compulsory schooling. They also carry out any activities that are delegated to them by the head of the Regional School Office.

The Ministry of Education, University and Research (MIUR) has several bodies and agencies operating at national level: The National Education Council (Consiglio Nazionale della Pubblica Istruzione), an advisory body which assists the Minister with the planning and supervision of education policy, the
National Institute for the Evaluation of the Education System (Istituto nazionale per la valutazione del sistema di istruzione, INVALSI) and the National Institute of Documentation, Innovation and Educational Research (Istituto Nazionale di Documentazione, Innovazione e Ricerca Educativa - INDIRE). For three-year vocational training courses, the Institute for the Development of Professional Training for Workers (Istituto per lo sviluppo della formazione professionale dei lavoratori, ISFOL) is the reference body for research and monitoring, policy and guidance to the Regions. At higher education level, the National University Council (Consiglio Universitario Nazionale, CUN) and the National Council for Higher Education in the Arts and Music (Consiglio nazionale per l’Alta formazione artistica e musicale, CNAM), for universities and AFAM systems respectively, are each charged with formulating opinions and proposals on issues of general interest and, in particular, planning, approving university teaching regulations and the appointment of professors and researchers. The National Council of University Students (Consiglio Nazionale degli Studenti Universitari - CNSU) is the student representative body at national level, with a consultation and recommendation role for issues of general interest to the university sector. Quality assurance is guaranteed through the National Agency for the Evaluation of the University and Research System (Agenzia nazionale per la valutazione del sistema universitario e della ricerca – Anvur), a public body under the jurisdiction of the Ministry of Education, University and Research. Finally, the Conference of Rectors of Italian Universities (Conferenza dei Rettori delle Università italiane - CRUI) gives its opinion on the three-year plan drafted by the Ministry on the objectives for the university system and the allocation of financial resources. It also makes recommendations in areas aimed at optimizing the management of teaching and scientific regulations.

The Regions have a joint legislative role along with the State on issues related to education. Conversely, they are solely responsible for the planning, management and provision of vocational education and training through recognized institutions. Through the State/Regions Conference, the Regions work closely with the Ministry of Education and the Ministry of Labour, which define the minimum national standards for the education system and the vocational education and training system. Education and training issues within the jurisdiction of the Regions are handled by specific education offices (Assessorati).

Local administration includes Provinces(1) and municipalities (Comuni), which have responsibilities in different areas and at different levels of the education system. Provinces are assigned specific functions for upper secondary education only. Municipalities, often representing small residential communities and restricted areas, are distributed throughout Italy and have their own or regionally or provincially delegated responsibilities for functions and services relating to pre-primary, primary and lower secondary schools. Provinces and municipalities carry out their specific education-related functions through dedicated educational offices (Assessorati).

Schools at pre-primary, primary and secondary level have teaching, organizational and research autonomy. Schools were granted autonomy and legal status in 2000. Since the 1995/1996 school year, it has been possible to set up what are known as comprehensive institutes. These are groupings of primary schools, lower secondary schools and pre-primary schools managed by a single school manager. The Ministry of Education (MIUR) lays down a general framework for school autonomy to ensure uniformity within the Italian education system. In fact, the Ministry of Education sets the general objectives of the educational process, the ‘specific learning objectives’ for pupils’ skills, the subjects on the minimum national curriculum and the annual number of teaching hours dedicated to them, the total annual compulsory timetable for curricula, standards for the quality of education services, general criteria for pupil assessment, general criteria for the organization of adult education study paths. Each school draws up its own Educational Offer (1) The organization of the State at provincial level has been recently revised. Thus, responsibilities of provinces in education may change in the future. 12 Plan (Piano dell’offerta formativa, POF) which is the basic document setting out the cultural and planning identity of the school. It must be consistent with the general and educational objectives of the various kinds of study and specialisms set at national level and, at the same time, it must reflect cultural, social and economic requirements at local level. The POF is drawn
up by the Teachers’ Council (Collegio dei docenti) on the basis of general objectives defined by the District/School Council and taking into account the proposals and advice of parents organizations and associations and, at upper secondary level only, students associations. The POF must be approved by the District/School Council and given to students and their parents on enrolment. Schools are administered and managed by the different bodies described below.

The school manager is the legal representative of the institution and is responsible for its overall management, the management of financial and material resources and the quality of the service provided. Outside of the functions of the school’s committees and boards, the school manager acts autonomously in his duties of direction, co-ordination, and deployment of human resources, in order to organize school activities efficiently and effectively. He or she also promotes the actions needed to safeguard the quality of the educational process and ensure the collaboration of cultural, professional, social and economic resources in the community. In carrying out his/her management and administrative duties, the school manager can delegate specific tasks to teachers. He or she is also assisted by the Director of General and Administrative Services.

The administrative manager of schools which have been granted autonomy is called the Director of General and Administrative Services (Direttore dei servizi generali e amministrativi - DSGA). The Director of General and Administrative Services (DSGA) has operational autonomy within the general instructions of the school manager and the assigned objectives, to supervise the administrative and general services of the school and co-ordinates the relevant staff. He or she arranges the issue of those certificates that do not require discretionary assessment, formulates projects and proposals for improving the services under his or her responsibility and gathers information and arranges the conclusion of contracts, agreements and conventions. He or she is automatically a member of the Executive Board and the District/School Council.

The District Council (in Districts at primary school level) and the School Council (in comprehensive institutes and in secondary schools) are made up of elected representatives of teaching and non-teaching staff, parents and, in upper secondary schools, students. The school manager is an ex officio member. The Chairman is elected from among parent representatives. The Councils make decisions on the organization of school activities, with due observance of the functions of the Teachers’ Council. They provide the latter with the general frame for drawing up the school’s educational offer plan (POF) and approve the POF itself.

The Teachers’ Council (Collegio dei docenti) is made up of the permanent and temporary teachers from each District or institute. It is chaired by the school manager. It formulates the educational offer plan (POF) in accordance with the general management and administration guidelines issued by the District/School Council, taking into account the proposals and opinions of parents’ associations and organizations and students associations (at upper secondary level only). The Teachers’ Council also makes decisions on teaching methods and periodically evaluates the general development of teaching to verify its effectiveness in line with the planned objectives and proposes, wherever necessary, appropriate measures to improve educational activities. The Council selects textbooks, after consulting the Inter-class Council (Consiglio di interclasse) and the Class Council, as well as teaching materials within the financial limits laid down by the District/School Council. Finally, it submits proposals to the School Manager on the organisation of class groups, the teaching timetable and the allocation of teachers to individual classes.

The Inter-section Council in pre-primary schools and the Inter-class Council in primary schools consist of teachers from all classes or sections from every school in the school district and one parent elected for each class or section. The Class Council at lower secondary level is made up of all the teachers of that class, four parent representatives, elected by and from among the parents of all the pupils in the class, and the school manager who chairs the Council meetings or delegates this task to one of the class teachers. Two student representatives and two parent representatives also serve on the Council in upper secondary schools. When meeting in the presence of parents and, if allowed, students, these Councils are 14 charged with facilitating relations among all stakeholders in the school community. They also submit proposals on education and teaching activities to the Teachers’
Council. In teachers-only meetings of the Councils, they also plan activities and carry out the periodic and final pupil assessments.

From September 2015, the former Evaluation Committee has been substituted by a newly made Committee: beforehand the Teachers’ board elected four teachers, every year. Now the members will be 6: 2 teachers appointed by the Teachers’ Board and one by the School Council, 2 parents (or one parent and one student in high schools) chosen by the school Council and an external member appointed by the Director of the Regional School Board (a teacher or a Headmaster or a technical director). The school Headmaster will chair the Committee. The new Committee will be called upon a new role, the most important: indicate to the Headmaster the criteria to assign a ‘merit’ bonus’ for teachers. It is one of the most controversial points in the Reform. The Committee has a difficult job and the Assembly needs to think twice and ponder the decisions about the people to appoint.

7.3.2.1 Who funds the implementation of e-learning in schools

The tendency to integrate ICT in special education is even in preliminary stage in curriculum and teacher education programs. Within the system, there are new program and courses to capture ICT competence and literacy for special education field. The awareness of necessity on ICT integration in special education become current system issue and problem which need to be investigated and planned in detail through strategic planning and management. The most challenge of using ICT in education, significantly in special education is the digital resources. Using digital resources and educational infrastructure within the system are still limited for special education upon documents. As regards the critical analysis on digital and interactive learning environments, applications and competences are not satisfactory. Although literature points out positive correlation between success and using digital resources in special education, there is no evidence on practice within this system.

Major reforms have taken place within the Italian school system to meet the needs of global education in the European Community and find educational compatibility within member nations. The Italian Government adopted reform of the national education and training system in July 2015 (called La buona scuola). This reform foresees changes in several aspects of education and training provision management and of the curricula. The new law reinforces the school-work relationship and improving of digital skills.

The reform also places particular emphasis on digital skills. The Ministry of Education will adopt a national Plan for digital school. Education in the digital age must be viewed above all as a cultural initiative. It begins with a new concept of school: an open space for learning — more than just a physical place, a springboard that enables students to develop skills for life. In this vision, technology is empowering, habitual, ordinary and ready to serve the school, primarily in activities aimed at training and learning, but also in administration, spreading to — and in fact bringing together — all school settings: classrooms, common spaces, laboratories, private and informal spaces. It is an organic plan for innovation in Italian schools, with cohesive programs and actions organized into five main areas: tools, skills, content, staff training and supporting measures. For each of these, we have defined “critical” but achievable objectives linked to specific actions that will enable us to improve the school system as a whole.

The first set of objectives of the Italian plan is to introduce ICT as part of the daily tools of classroom activities, in order to bring schools closer to society and to enhance the Italian population’s ICT skills and digital literacy (Schietroma, 2011). In terms of student outcomes, the plan is expected to impact directly on student engagement and ICT skills. At a different level, the plan is also seen as a catalyst for innovation in education and specifically for the renewal of teaching practices (this pedagogical change is sometimes framed as the move from teacher-centered to learner-centered instruction). By creating a technology shock in the school system, the government expects to change the teaching culture, encouraging more personalized educational paths and promoting more active learning, without interfering in any direct way with the constitutional “freedom of teaching” principle. In the
end, this is expected to result in a more effective and equal education system, with improved learning outcomes for all students (Schietroma, 2011; Eurypedia, 2012).

General government expenditure on education, both as a proportion of GDP (4.1% in 2013) and as a proportion of total general government expenditure (8.0% in 2013), is among the lowest in the EU. This applies in particular to expenditure on tertiary education, which is the lowest in the EU at only 0.4% of GDP and 0.7% of total general government expenditure in 2013.1. On a positive note, the 2015 Stability Law reduced the cuts to public funding for higher education envisaged in previous legislation. It also created a specific fund to finance the ongoing reform of the school system, into which EUR 1 billion will be invested in 2015 and EUR 3 billion from 2016. In 2015, the share of performance-related funding rose to 20% of total funding13 and the National Reform Programme confirmed the government’s intention to gradually increase this to 30% (Ministero dell’Economia e delle Finanze 2015, p.85).

The initial funding for the national plan was decided with the budget law for 2007 (Legge del 27 dicembre 2006 n. 296, art. 1 c. 633). The budget law set apart EUR 30 million for each of the three following years (2007, 2008, 2009) “to equip schools of all level and type with technological innovations to support teaching and learning activities”. This budget has since been extended and complemented with regional funds. For the four school years 2007-2011, the centrally funded actions within the National Plan for Digital Schools amount to a budget of about EUR 120 million in total, or about EUR 30 million per year. This represents less than 0.1% of the yearly budget of the Ministry of Education for pre-primary, primary, lower- and upper-secondary education (EUR 42 billion for 2011: Ragioneria Generale dello Stato, www.rgs.mef.gov.it). The detail of this investment is given in Table 1. Investments funded with resources administered and raised by schools directly from families, private non-profit organisations or local governments are not included.

<table>
<thead>
<tr>
<th>Allocation of centrally administered funds for the National Plan for Digital Schools (2007-2011, euros)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase of Hardware equipment</td>
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<tr>
<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Purchase of digital contents (not incl. Editoria Digitale)</td>
</tr>
<tr>
<td>Overheads: administration and communication activities</td>
</tr>
<tr>
<td>Formal training, tutoring and coaching of teachers</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

Private Foundations, IT companies, banking foundations pursue a charitable purpose related to a certain social issue such as research and teaching, education and social inclusion, and act as founders based on call for projects or long term relationships with nonprofit organizations working in the field of social inclusion and education development in relation to ICT. Some of them provide support to cause related projects aligned with their business interests based in Italy and Europe, including cash donations or grants, in-kind gifts, sponsorships, cause-related marketing, and probing services.

7.3.3 Lithuania

According the Law of the Republic of Lithuania on Education, the Ministry of Education and Science implements the national system of formal and non-formal education which secures social attitudes in favor of education and creates conditions for lifelong learning in a changing democratic society.

The Ministry of Education and Science formulates and executes the national policy in the areas of education, science and studies, drafts strategic education plans, annual programs, submits proposals...
and resolutions to the Government, organizes matura examinations, approves the general content of teaching, training and studies under the framework of formal education, etc.

The County Manager’s Administration implements the national education policy in the county, approves strategic education plans for the county, supervises the activity of subordinate education providers, etc.

Municipalities execute the national education policy in the municipality, approve strategic education plans for the municipality as well as the general plan for restructuring of the school network, form the network of pre-schools, pre-primary schools, primary, basic and secondary schools, ensure the environment necessary to provide compulsory education to children, etc.

The school founders ensures the execution of the national education policy, as well as the execution within the school of relevant laws and other legislation providing for school activities, etc.

What concerns education of learners with special educational needs it is organized in accordance with the procedure laid down by the Minister of Education and Science, the Minister of Health, the Minister of Social Security and Labour.

There are two groups of higher education and research institutions in Lithuania: higher education institutions (universities and colleges) and research institutes. State budget appropriations for each state university and state higher education and research institution is allocated under a separate line (detailed information about funding is provided in Law on Higher Education and Research of the Republic of Lithuania [here](#)).

Career/vocational guidance is provided in general education schools, vocational training and other educational institutions, vocational guidance centers and other institutions in accordance with the procedure laid down by the Minister of Education and Science together with the Minister of Social Security and Labour, and in higher education schools – in accordance with the procedure laid down by these schools.

### 7.3.3.1 Who funds the implementation in schools

Education is financed in the form of allocations from the State budget and municipal budgets as well as other financial means. Programs of formal education offered at State-funded, municipal and non-State funded schools, except for higher education institutions, and programs of non-formal education of children are financed out of the State and municipal budgets via the student’s basket, which is a principle of allocating financial means per learner. Expenses of private schools are covered by their stakeholders (detailed information about funding is provided in Law of Education of the Republic of Lithuania [here](#)).

The National Digital Coalition of Lithuania (more information about this coalition is provided here [http://www.skaitmeninekoalicija.lt/en/](http://www.skaitmeninekoalicija.lt/en/)) actively contributes to the implementation of the Information Society Development Programme 2014–2020 Digital Agenda for Lithuania. Institutions, companies and organizations agreed to form the National Digital Coalition for the Promotion of Digital Skills for Jobs in Lithuania have a mission to increase employment and to achieve a more effective use of digital potential and cooperate in implementing information society development programme 2014–2020 Digital Agenda for Lithuania. One of its main goals is to attract more young people to ICT education and choose ICT as a career option.

According the data of Implementation of the Digital Agenda for Europe ([http://daeimplementation.eu/](http://daeimplementation.eu/)), Lithuania mainstreams eLearning in national policies:

- There’s the Action Plan on ICT Implementation in Education ([https://www.e-tar.lt/portal/lt/legalAct/e5ee5450e0de11e388bee944977d73d2](https://www.e-tar.lt/portal/lt/legalAct/e5ee5450e0de11e388bee944977d73d2));
- E-learning is presented in national curricula (primary, basic and secondary: e.g. [http://portalas.emokykla.lt/bup/Puslapiai/pradinis_ugdymas_bendras.aspx](http://portalas.emokykla.lt/bup/Puslapiai/pradinis_ugdymas_bendras.aspx));
There is a number of national scale teacher training projects partly funded by European Social Fund.

Associations/Foundations

In Lithuania there’re several certain stakeholder groups (public or private organizations/foundations/bodies) that can contribute in developing such implementation as MATHISIS platform:

<table>
<thead>
<tr>
<th>List of organisations who can contribute</th>
<th>Contact details for each organisation</th>
<th>Relevance to the project</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POLICY MAKERS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>the Ministry of Social Security and Labour</td>
<td><a href="http://www.socmin.lt/">http://www.socmin.lt/</a></td>
<td>Sets the employment policy objectives, allocates funds for the attainment of the objectives and controls the use of the funds.</td>
</tr>
<tr>
<td><strong>POTENTIAL DEFELOPERS or/and PRIVATE SPONSORS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baltic Computer Academy</td>
<td><a href="http://www.bka.lt/en/">http://www.bka.lt/en/</a></td>
<td>Private enterprise. Helps to create and implement innovative IT training programs, helping organizations to optimize investments to staff training.</td>
</tr>
<tr>
<td>Barclays (private company)</td>
<td><a href="https://www.home.barclays/about-barclays/around-the-world/lithuania.html">https://www.home.barclays/about-barclays/around-the-world/lithuania.html</a></td>
<td>Provides technology solutions and a wide range of services.</td>
</tr>
<tr>
<td>JSC „Blue Bridge Baltic“</td>
<td><a href="https://www.bluebridge.lt/en/">https://www.bluebridge.lt/en/</a></td>
<td>Provides comprehensive IT services and solutions to large companies and public organisations (cloud computing, IT managed services and maintenance, data transmission and cybersecurity, servers and data warehouses, and infrastructure management).</td>
</tr>
</tbody>
</table>

7.3.4 France

Launched by the President of the Republic in May 2015 after the national consultation on digital education, the Digital Plan for Education aims to enable teachers and students to take advantage of all the opportunities offered by digital. Its implementation is based on four pillars: training, resources, equipment and innovation. New digital resources and mobile applications will be made available free of charge for teachers and students from Grades 1-3. They will cover five fundamental disciplinary subjects: French, mathematics, science, history-geography and foreign languages. They will allow teachers to complete and enrich their course and the activities they offer to students. They will allow students to have multimedia materials to learn, practice, revising in class and at home.
The opening of Myriaé in 2016, a national online platform for teachers to facilitate the choice of teaching resources, present all digital teaching resources, free or paid, produced by private or public publishers. Myriaé simplify the presentation of resources by having an overview on the supply of existing resources and conducting research by theme, level of education or type of resources (manual, dictionary, exercises, video banks, Images, educational games ...). Sharing and referral features will be integrated, and dedicated access will be provided to families. The ministry will also propose a resource access manager (RBM), which will be both a trusted framework for student and teacher data and a device that will facilitate the use of digital resources.

In order to accelerate the transformation of digital technology into the school, the State proposes to each voluntary Departmental Council a partnership to participate in the deployment of individual mobile digital equipment to pupils and teachers in the institutions in their territory: for each euro invested by the Departmental Council for the mobile individual equipment of students, the State pays one euro. The investment is focused on mobile individual equipment, especially tablets, in order to establish a continuity of uses, in the classroom and at home.

In the territories, the State supports experiments carried out by schools, colleges or high schools, which concern the use of digital tools in teaching practices or education for the digital society as a whole. Constructed with partnerships between research teams, communities and companies, this initiative ("e-FRAN", ie "spaces for training, research and digital animation") will enable the development of new digital uses validated scientifically, which transform the school by digital to the success of all students, in order to deploy them more widely on the territory.

7.3.5 United Kingdom

The education system in the UK is generally divided into four parts. These are Primary, Secondary, Further Education and Higher Education.

In the past, primary and secondary schools were regulated by local authorities or councils. Lately, more schools are being operated by Academy Trusts. These trusts can be groups of schools or individuals. They get money directly from the government, not the local council. They are also responsible for employing staff. As a result of these changes, schools are responsible for all initiatives related to the implementation of e-learning. They then inform local authorities or councils or Academy Trusts about such initiative.

With regards to directives on the use and development of new media in schools; strategies and action plans can be developed at the Government, Local Authority, or Academy Trust levels. Ultimately, each school decides to what extent eLearning and the acquisition of new media competency among teachers and students are implemented or adopted.

The UK government supports the development of new innovative technologies that enable personalized and adaptive learning. This is reflected in strategies and research aimed at encouraging the embedding of eLearning in Schools and Further Education (PricewaterhouseCoopers LLP, 2004 and The Skills Strategy White Paper, 21st Century Skills: Realising our potential, 2003).

7.3.5.1 Who funds the implementation schools

The main source of funding for eLearning in UK schools is the government. They provide funding for learning generally including SEND. For example, during this 2017-2018 school years, the government provided £130 million to support provision for pupils and students with special educational needs and disabilities (SEND), up to the age of 25, and alternative provision for pupils who cannot receive their education in schools. https://www.gov.uk/government/speeches/school-revenue-funding-settlement-for-2017-to-2018. The amount spend by schools on eLearning is left to the local authorities or councils, Academy Trusts or schools to decide.

Other sources of funding include: Trusts or foundations; private companies; government organisations and welfare and educational funds. IBM for example, through its annual IBM

Most of these entities usually pursue a charitable purpose related to certain social or educational related issues. Act Foundation for example, provides specialized wheelchairs, other mobility aids and equipment including medical equipment to assist independent living for students and/or people with learning and other disabilities.

Below are examples of funders i.e., names and business types.

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Act Foundation</td>
<td>Trust</td>
</tr>
<tr>
<td>Bellinger Donnay Trust Grant</td>
<td>Trust</td>
</tr>
<tr>
<td>BBC children in need grant</td>
<td>Company</td>
</tr>
<tr>
<td>IBM</td>
<td>Company</td>
</tr>
<tr>
<td>Accenture</td>
<td>Company</td>
</tr>
<tr>
<td>Oracle</td>
<td>Company</td>
</tr>
<tr>
<td>T-Mobile</td>
<td>Company</td>
</tr>
</tbody>
</table>

### 7.3.5.2 Who funds the implementation in higher education

Many universities support initiatives with their own funds. But, the UK’s 4 higher education funding bodies provide grants to support the research infrastructure and enable institutions to undertake ground-breaking research of their choosing. These funding bodies are:

1. Higher Education Funding Council for England (HEFCE)
2. Higher Education Funding Council for Wales (HEFCW)
3. Scottish Funding Council (SFC)
4. Department for Employment and Learning, Northern Ireland (DELNI)

### 7.3.6 Greece

Career guidance services in Greece are offered by:

- the 79 Centers of Career Guidance and Counselling (KESYPs) of the Ministry of Education, Research and Religious Affairs operating at prefectural level. They offer career guidance services not only to students but also to adults up to 25 years old. Their services include face to face career guidance sessions to support the self-awareness, development of career management skills, information on educational choices and training opportunities, team counseling, career guidance days etc End users of KESYPs include all target groups needing career guidance (students, parents, unemployed people needing career reorientation and counseling etc)
- the 60 Career Guidance Bureaus (Grafeia Symvouleytikis) of Second Chance Schools (Scholeia Defteris Efkairias) are also offering career guidance services to adult students (above 18years old). 8 of them are residing in prisons.
• the 35 Career Services of the Employment and Career Development Structures (DASTA) of the Universities and Higher Technological Institutions of Greece are offering career guidance and counseling to students and graduates supporting their smooth transition to the labor market. Specific services include: team and face to face counseling about job finding techniques, liaison with enterprises, career guidance to start a business, organization of an internship or a job placement at a cooperating company etc.

More specifically its provision can be offered through a public sector and sometimes through private sectors. Both of them are analyzed below:

Employment Sector

The responsible body for offering career guidance services in the employment sector is the Ministry of Labor and in particular the Greek Manpower Organization which directs the Greek Public Employment Services (PES services - about 116 Centers for Promotion to Employment). OAED within the active labor market policies and PES provides a wide range of subsidized programs for employers who offer job positions or professional experience opportunities to unemployed young people. It is offering young people vouchers which can be exchanged for training programs or work or for specialized career guidance and support programs to support transition to the labor market. Moreover, group counseling activities are also provided by OAED to enhance the access of several target groups (including youth) to career guidance and counseling services. Unemployed people can consult the Greek PES to develop an action plan (of potential training and job applications available) based on their competence and previous training, as well as their motivations. OAED is also organizing apprenticeship programs in cooperation with employers.

Private sector

In the private sector the private and municipal Lifelong Learning Centers (Kentra dia Viou Mathisis) licensed by EOPPEP are providing among others career guidance services to support the career development of adult trainees, to improve their self - awareness, to plan their educational path and to take better educational – employment decisions. According to law 4052 career guidance services to adults are also offered by the Private Job Finding Bureaus (Grafeia Evreseos Ergasias) and the Temporary Employment Enterprises (Epixirisis Prosorinis Apasxolisis). They are providing career guidance services to support the career development of all target groups (students, unemployed people etc), to improve their self - awareness, to plan their educational path and to take better educational – employment decisions.

Furthermore career guidance services are offered by other organizations like the General Workers’ Confederation of Greece (GSEE), the army and the church, social services of hospitals, etc.

7.3.6.1 Who is responsible for implementation in Greece

In the career guidance sector EOPPEP will be the main stakeholder that will be responsible for implementation (main decision maker). He will decide whether to make the system available to other public or private career guidance stakeholders (see list above) and the extent to which they can contribute with new educational material, new learning scenarios and learning graphs etc. Certainly the need for this kind of career guidance services, which are providing for i) adaptive learning, ii) automatic feedback, iii) automatic assessment of learner’s progress and behavioral state, iv) affective learning and v) game-based learning are very innovative and can be used by different stakeholders which need to increase the access to career guidance services, while reducing their burden and providing more comprehensive services to all target groups. However, we can’t specify if other decision makers will emerge, e.g. in the cases where EOPPEP will cooperate with other stakeholders (ministries, universities etc) in the implementation of the system.
7.3.6.2 Who pays for introduction/implementation

After the end of the project EOPPEP will investigate whether other career guidance stakeholders should pay for using the system for their target groups. Such a case is the private career guidance services Life Long Learning Centers (Kentra Dia Viou Mathisis – KDVM) licensed by EOPPEP.

Associations/Foundations that fund such a system

EOPPEP will investigate whether sponsorships can be made with stakeholders (ministries, organization etc) that would be interested in funding the system. Such a case is a career guidance stakeholder which wants to fund the system in order to use it for their target groups, either by itself or by cooperation with EOPPEP.

7.3.7 Analysis of public bodies - Spain

The 1978 Spanish Constitution established a model of decentralised State by which educational powers are shared between all levels of government. It is a symmetrical model, where the educational powers exercised by the Autonomous Communities are basically the same.32

The competences in terms of Education are shared between the State General Authority (Ministry of Education, Culture and Sport) and the Autonomous Communities (Regional Ministries or Departments of Education). The State Education Authority provides the general guidelines on education policy and regulates the basic elements or aspects of the system. The ministry of Education is responsible for setting the Core Curricula, establishing the common objectives, contents and evaluation criteria and the education authorities complete these requirements for their respective regions. The Autonomous Education Authorities develop the regulations and have executive and administrative responsibility for managing the education system in their own territory. In addition, schools have pedagogical, organizational and managerial autonomy for their resources which is accompanied by the participation of the education community in the schools organization, government, running and evaluation.

The role of local authorities is focused on educational management through the Education Departments or Municipal Education Institutes. Finally, Educational institutions (schools, nurseries, high schools...) also collaborate thanks to their pedagogic autonomy, by preparing their school development plan, but also by managing their resources and by preparing their organization and running rules.

The education system offers the following studies: pre-primary education, primary education, compulsory secondary education (ESO), “Bachillerato” (non-compulsory secondary education), vocational training, adult education and university education. Also Language, Artistic and Sports Education are provided, which are considered Specialised Education.

<table>
<thead>
<tr>
<th>Names of non-university educational institutions</th>
<th>Type of education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-primary schools</td>
<td>For pre-primary education pupils. They can provide the whole level (0-6 years old) or just the first cycle (0-3 years old)</td>
</tr>
<tr>
<td>Primary schools (CEP)</td>
<td>For primary education pupils</td>
</tr>
<tr>
<td>Pre-primary and primary schools (CEIP)</td>
<td>For pre-primary and primary education pupils</td>
</tr>
<tr>
<td>Secondary schools (IES)</td>
<td>Which can provide compulsory secondary education and/or Bachillerato and/or vocational cycles of vocational training</td>
</tr>
<tr>
<td>Special educational institutions</td>
<td>For students with special education needs which cannot be attended in ordinary institutions</td>
</tr>
<tr>
<td>Adult educational institutions</td>
<td>They provide for adult people</td>
</tr>
</tbody>
</table>

### Names of non-university educational institutions

<table>
<thead>
<tr>
<th>Types of non-university educational institutions</th>
<th>Type of education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult education classrooms</td>
<td>Integrated within primary educational institutions and/or IES, although they can also belong to city councils and local associations. They provide studies for adult people</td>
</tr>
<tr>
<td>Gathered rural schools (CRA)</td>
<td>Group of several schools gathered in a single school working jointly. They are located in rural areas needing this kind of school group due to their socio-demographic characteristics.</td>
</tr>
</tbody>
</table>

**Table 17: Names of non-university educational institutions according to the education provided (Source: Drawn up by Eurydice Spain-REDIE from the regulations in force)**

7.3.7.1 **Who funds the implementation in schools**

In Spain there are public and private educational institutions.

<table>
<thead>
<tr>
<th>Types of non-university educational institutions</th>
<th>Ownership and source of funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public schools</td>
<td>they are owned by the education authority and publicly-funded</td>
</tr>
<tr>
<td>Private schools</td>
<td>they are privately owned and privately-funded</td>
</tr>
<tr>
<td>Publicly-funded private schools</td>
<td>ownership is private but they can be publicly-funded through a regime of agreements</td>
</tr>
</tbody>
</table>

**Table 18. Types of non-university educational institutions according to their ownership and source of funding (Source: Drawn up by Eurydice Spain-REDIE from the regulations in force)**

**Public funds** are provided mainly by the Ministry of Education, Culture and Sport and regional education authorities. Other ministries, as well as other regional and local authorities, also provide economic support, although to a lesser extent.

- **State:** the amounts allocated to education and their distribution among the different educational stages are annually established in the State Budget.
- **Autonomous Communities:** they manage public funds within their territories and decide on the amounts earmarked for education and their distribution among the different types of provision, programmes and services, which is annually established in their budgets. Such funds come from:
  - the taxes they collect and other revenues;
  - State transfers: the amounts established for each Autonomous Community are determined by different parameters, especially population ones.
- **Local governments:** although they do not have the status of education authority, they cooperate with central and regional authorities in developing education policies and, more specifically, in the creation, building and maintenance of facilities for public educational institutions. Their funds come from the collection of taxes and other revenues, as well as from transfers from the State and the relevant Autonomous Community.

On the other hand, the education authorities establish educational agreements in order to provide public funding to educational institutions of private ownership (**publicly-funded private schools**). The beneficiary of this type of funding is the school unit, i.e., group of students being collectively and simultaneously taught by a teacher on an ordinary basis. Several school units may coexist in the same institution, some of them are considered grant-aided while others are completely private.

Finally, **private schools** enjoy autonomy to draw up their own internal regulations, select teachers, in compliance with qualification requirements set up in current legislation, and decide on their economic regime. Their main source of income is the fees charged to families, although they may also receive additional funding through transfers made by private institutions or individuals.
7.3.7.2 Who boosts and funds the ICT implementation in the Spanish education

Innovation is one of the pillars of Spanish Education. It is present though the use of the new Information and Communication technologies (ITC) in schools and universities, from a very early age. The use of ITC improve the quality of education; training children and teens to be competitive in their future jobs and contributing to the professional development of teachers, as well as to a more effective management of the Educational system.

In Spain there are national strategies covering training measures in all areas, and research in the areas of ICT in schools, digital media literacy and e-skills development in line with the European Framework for the Development and Knowledge of Digital Competence in Europe (DigComp) which was updated in June 2016 by the European Framework for Digital Competence of Citizens (DigComp 2.0). Hence, to integrate ITC in the non-university formative stages, the Ministry for Education, Culture and Sport relies on the Instituto Nacional de Tecnologías Educativas y de Formación del Profesorado (INTEF). This organization elaborates and disseminates digital and audiovisual material from all knowledge areas facilitating teachers to integrate ITC tools in their everyday activities.

7.4 Engagement with Stakeholders

The actions in prior steps have all been designed to inform and improve the preparation process. You have defined strategic objectives and prioritized your stakeholders. The intersection of these two key aspects will define the project choice of engagement tactics, which will lead to a format that matches level of ambition.

Depending on the scope of the engagement strategy, using of multiple tactics to address different stakeholder groups simultaneously should be considered.

Tactics and Format

Figure 16. Engagement Tactics and Format

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33 http://marcaespana.es/talento-e-innovaci%C3%B3n/sistema-del-conocimiento/sistema-educativo-espa%C3%B1ol
36 http://educalab.es/intef
Tactics are high-level descriptions of how you approach stakeholders. The spectrum of categories (engage, inform and communicate) will be used in MaTHiSiS project.

**Engage** describes stakeholders with whom engagement is necessary. **Communicate** describes stakeholders with a high willingness to engage or a high level of expertise but who have not yet participated in dialogue with your company. Communicating more with these stakeholders will help their value engagement. **Inform** describes stakeholders who seek information only instead of a conversation.

**Choosing format**
Stakeholders mapping is constantly revisited in order to identify which quadrants stakeholders fall into. The stakeholder list is re-ranked using the engage, communicate, and inform tactics quadrant.

<table>
<thead>
<tr>
<th>Tactics</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engage (high priority)</td>
<td>• presence at tradeshows • scientific publications in peer-review journals • peer-review international conferences and workshops • sessions/workshops co-located at conferences</td>
</tr>
<tr>
<td>Communicate (medium priority)</td>
<td>• events organized for external audiences • newsletters • websites</td>
</tr>
<tr>
<td>Inform (low priority)</td>
<td>• press releases delivered to traditional media • news coverage</td>
</tr>
</tbody>
</table>

**Table 19. Stakeholder Engagement Tactics**

**Note.** Provided formats are chosen according the KPI’S provided in DoA (part B) project application.

**7.5 Channels**
MaTHiSiS is a modular environment that will have a multi-level and multi-target exploitation process. Since MaTHiSiS aims the ICT-in-Education market, special measures are taken towards exploitation of its outcomes for education. Such measures include that outputs are made available to the stakeholders involved in the education so that the MaTHiSiS experience will become replicable and usable by others, and for this purpose they will be promoted through the different educational, professional, and academic networks of which the partners are members.

1] Three active **MaTHiSiS communities:**
- The **Learners’ Network (LN),** consisting of learners that by the end of the project had experimented with or used the MaTHiSiS platform.
- The **Tutors’/Caregivers’ Network (TCN),** consisting of tutors and caregivers that by the end of the project will be skilled in developing novel educational materials and equipped with the necessary tools.
- The **Developers’ Network (DN),** consisting of developers that by the end of the project will be skilled in using the MaTHiSiS Open API Infrastructure and equipped with the necessary development tools.
2) **Social Network Groups/Pages/Accounts** supporting the LN, TCN and DN user communities (respective Facebook groups, LinkedIn groups, Twitter accounts, Instagram accounts). A direct interface of the system with the various SNs will be available.

3) **GitHub Repository** hosting the MaTHiSiS Open API Infrastructure and all development interactions taken place during the lifetime of the project. A direct interface of the project website with the GitHub Repository will be available in the future.

4) **Five Thematic Repositories of Educational Material**, each corresponding to one of the project use cases and thus covering a significant range of application fields from learning disabilities to distant learning.

5) **Project Website**

Moreover, as part of the exploitation activities, project partners will also consult with representatives from users other than the ones involved in the different predefined use cases, which will be contacted in particular within the associations and networks to which the institutions involved in the project belong. In more detail:

- the Affect Intent Capabilities of MaTHiSiS, as a standalone module, will be exploited towards automatic or assisted grading of the learners.

- the Content Delivery system can be further exploited by its integration into different systems already in use at educational institutions since MaTHiSiS will provide an interoperable interfacing with other systems through the use of already defined standards.

- the Educational Content Development part of the MaTHiSiS project will be further used by teachers/tutors to better in the design and preparation of their courses following the MaTHiSiS learning approach presented in Section 1.3.3.

In terms of deployment models, there are foreseen two scenarios:

(a) the components to be exploited are deployed in infrastructure the responsibility of which lies by the customer, i.e. accommodated in the premises of the customer and

(b) the components are hosted in infrastructures provided by (or is available to) the MaTHiSiS project partners, and the functionality is offered as services, exploiting virtualization scenarios.

In order to maximize the benefits and added value to its potential users, MaTHiSiS consortium is considering fair and justifiable, state-of-the-art cost structure and pricing policies. Educational stakeholders, including learners, educational institutes and business (industry and SMEs) providing educational scenarios, currently use a pool of licensing models including the following:

a) **Pay per learner**: a flat fee per learner is charged, with a potential one-time setup fee. The intensity of the usage of the system does not influence the charging volume (indicative price range €0.5–€5 per user per month).

b) **Pay per use**: Pay per use may consider different parameters including the usage and access of courses (per-user-per-course), the accessible platform modules (per-user-per-module) or the educational content items retrieved from the platform materials delivered per course (volume based or item based), or even charging based upon the number of class attendees (indicative cost €0.5 – €10 per user per course).

c) **License fee**: Upfront cost to access the software and the educational content, that is incurred either once in the beginning of the usage or periodically (on a monthly or annual basis). This may be combined with a (periodic or one-off) support fee (indicative cost: €500 –tens of thousands).

d) **Service fee**: The platform is free to use but related services are charged based on upon estimated effort (and month rate) or per task.
8. Conclusion

This deliverable gives a first overview of the market as well as initial statement at certain exploitable technologies apart from the MaTHiSiS platform as a whole. The market development shows that there is a high demand of the eLearning products and services and MaTHiSiS has all the potential to become a strong actor on the market.

With a broad consultation with stakeholders involved in the project and the external stakeholders, deliverable D1.1 provides a model for engagement with the mentioned actors within the e-learning domain. The initial list of stakeholders of interest is provided in Annex to this deliverable and also feeds the WP10 to establish future continuous communication and consultation. Such consultation will be of high importance to wisely choose future routes for exploitation and adapt the exploitation plan accordingly given that this deliverable is going to be updated every year reflecting the market changes and feedback from various groups of stakeholders.

The work done during these first 12 months for the MaTHiSiS project has marked the starting point for the next exploitation phase of the project. The work to be carried out over the rest of the project’s life will be aimed at the final definition of the different assets, the development of a joint exploitation strategy, as well as the Exploitation and Sustainability Roadmap for MaTHiSiS. Work to be carried out is divided in two parallel tracks that will result in an integrated Sustainability roadmap for MaTHiSiS’s exploitation. On one hand, MaTHiSiS’s exploitation team will work towards a complete characterization of the project results to be used in the commercial approach extending the current Value Proposition, identifying the licensing terms and conducting the cost analysis. On the other hand, the team will work in the definition of the different Business and sustainability plans and the preparation of the individual exploitation and sustainability plans and trying to synthesize them into a common Exploitation Agreement.
9. References


[3] Communication Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions (COM(2016) 0941 final) — Improving and modernising education..


5] Sage Publications.


9]
10. Annexes

List of Stakeholders

<table>
<thead>
<tr>
<th>MOOC Platforms</th>
<th>Content Providers</th>
<th>Technology Providers</th>
<th>Educational Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primarily a community for sharing of educational content and courses on general interest and technology, provided by teachers. An online learning platform that provides course creation tools, as well as ranks (and rewards) instructors using their proprietary Educational Quotient (EQ).</td>
<td>TeachersFirst consists of classroom resources and lesson plans for K-12. Materials are reviewed by teachers and sorted by subject area and grade level.</td>
<td>Currently the most dominant vendor in the education market. Other offerings include Engage for social learning and Collaborate – a virtual classroom. In 2015, they announced a significant cloud-based redevelopment they are calling Learn Ultra or the Ultra Experience.</td>
<td></td>
</tr>
<tr>
<td>Iversity (<a href="http://www.iversity.org/">http://www.iversity.org/</a>)</td>
<td>HotChalk (<a href="http://www.hotchalk.com/">http://www.hotchalk.com/</a>)</td>
<td>BrainX (<a href="http://www.brainx.com/">http://www.brainx.com/</a>)</td>
<td>The e-learning platform Ilias is used by several Universities in Germany, for e.g.</td>
</tr>
<tr>
<td>Based in Berlin and supported by the European Union. It is a free cloud-based (not technically open source) LMS that supports Inter-institutional cooperation (academic networking) and “social reading”. Offering MOOC’s since August 2013.</td>
<td>Includes many turnkey technology solutions to universities, with many of whom they partnered. “The largest online education community in the world, attracting tens of millions of users and serving billions of pages of free education content to consumers around the globe.” They also provide access to many free educational resources for K-12 at <a href="http://lessonplanspage.com/">http://lessonplanspage.com/</a>.</td>
<td>Promises an individual profile for each learner, using a “patented learning technology”. Includes many different courses and libraries, even articles about learning techniques. BrainX also offers a custom course developer. Marketed to both corporations and education.</td>
<td>a. University of Mainz - <a href="https://ilias.uni-mainz.de/">https://ilias.uni-mainz.de/</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>b. University of Hannover - <a href="https://ilias.uni-hannover.de/">https://ilias.uni-hannover.de/</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>d. University of Applied Sciences Fresenius - <a href="https://ilias.hs-fresenius.de/">https://ilias.hs-fresenius.de/</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>e. University of Bayreuth - <a href="https://elearning.uni-bayreuth.de/">https://elearning.uni-bayreuth.de/</a></td>
</tr>
<tr>
<td>EdX (<a href="https://www.edx.org/">https://www.edx.org/</a>)</td>
<td>Ambassador</td>
<td>Education</td>
<td>Solutions</td>
</tr>
</tbody>
</table>
A collaboration between MIT and Harvard, joined by 12 other universities including Berkeley or the University of Stanford. Along with offering online courses, the institutions will use edX to research on how students learn and how technology can transform learning. An good example of a MOOC (Massive Online Open Courses) like Coursera or Udacity. In 2015 they partnered with Microsoft to offer some IT development MOOCs.

<table>
<thead>
<tr>
<th>Institution/Tool</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coursera</td>
<td>(<a href="https://www.coursera.org/">https://www.coursera.org/</a>) Coursera is a venture-backed, for-profit, educational technology company that offers massive open online courses. Collaborates with many highly respected Universities such as Stanford or the John Hopkins University.</td>
</tr>
<tr>
<td>Explain Everything</td>
<td>(<a href="http://explaineverything.com/">http://explaineverything.com/</a>) An interactive whiteboard and screencasting tool. Also offer apps like Final Argument -a mind-mapped, non-linear slide layout presentation tool and Stick Around for making puzzles. Based in Poland and partners with Constructivist Toolkit LLC in New York.</td>
</tr>
<tr>
<td>IT University Online</td>
<td>(<a href="http://ituonline.com/">http://ituonline.com/</a>) IT University Online provides high quality eLearning courses for over 160 certifications to over 350,000 students worldwide. Mainly providing online IT training.</td>
</tr>
<tr>
<td>Edynco</td>
<td>(<a href="http://www.edynco.com">www.edynco.com</a>) Edynco, a company based in Slovenia, is offering an online tool for creating interactive learning maps that can include quizzes, videos and recordings.</td>
</tr>
<tr>
<td>Toronto District School</td>
<td>(<a href="http://www.tdsb.on.ca/default.aspx">http://www.tdsb.on.ca/default.aspx</a>) Offering programs like: e-Credit (18+) Residents who are not currently attending a publicly funded high school and who are 18 years of age or older have the opportunity to complete credits they need for graduation. e-Summer School Summer online program,</td>
</tr>
<tr>
<td>ITIS (Instituto Tecnico Industriale)</td>
<td>(<a href="http://www.majoranabrindisi.it/">http://www.majoranabrindisi.it/</a>) The school is comprised of 110 teachers and 1,300 students. It’s innovation process was initiated by the principal Salvatore Giuliano, who has transformed his institute into an iSchool, with digital books, Skype lessons, and video lessons published on the web.</td>
</tr>
</tbody>
</table>

Focused on higher education institutions, providing a customized bookstore and technology solutions for delivery and management of course materials. Includes course creation and assessment tools. The UK-Based company offers free content for trainers and educators. is offering an eLearning, as well as a moodle-platform:

- https://elearning.frankfurt-university.de/
- https://moodle.frankfurt-university.de/
courses.

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<tbody>
<tr>
<td>Canvas Network offers open, online courses taught by educators everywhere. Powered by the Canvas learning management system, Canvas Network provides a place and platform where teachers, students, and institutions worldwide can connect and chart their own course for personal growth, professional development, and academic inquiry. Canvas Network is developed and supported by Instructure, an education technology company that partners with educators, institutions, and technologists to build open educational resources and break down barriers to learning.</td>
<td>A publisher of educational content, a course delivery Platform or a Learning Management System(LMS) &quot;Well beyond an eBook, a homework solution or digital supplement, a resource centre website&quot; Collaborates with the Harrison College in Indianapolis, USA and Gale, a content provider. Integrates Google Apps for Education.</td>
<td>Joomla is an open source website content management system. Many content creation functions, including quizzes, surveys, editors etc. Contains a performance tracker and ranking functions.</td>
<td></td>
</tr>
</tbody>
</table>

|------------------------------------------------|-----------------------------|----------------------------------|
Khan Academy ([https://www.khanacademy.org/](https://www.khanacademy.org/))

One of the most widely known educational organizations, Khan Academy offers short lectures in the form of videos as well as educational tools and exercises. Their catalogue currently encompasses over 4000 videos. Khan Academy operates as a non-profit organization and offers its courses free of charge.


Advanced Academics is a provider of online education for secondary students, offering innovative online learning solutions, courses, accreditations and a web based curriculum. Partnered with hundreds of districts and schools offering a 24/7 student support environment.

Knewton Adaptive Learning Platform ([http://www.knewton.com](http://www.knewton.com))

A learning infrastructure that “customizes standardized educational content to meet the unique needs of each student.” Offers test preparation courses, learning analytics and content insights. Partnerships with major publishers like Pearson, Cengage or Houghton Mifflin.

Uppsala University ([http://www.uu.se/en/](http://www.uu.se/en/))

One of northern Europe’s highly ranked universities, Uppsala manages online courses that are delivered as audio-visual web lectures through downloadable documents for self-studies. The written examination is performed online at the end of the course.

<table>
<thead>
<tr>
<th>Provider</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Khan Academy (<a href="https://www.khanacademy.org/">https://www.khanacademy.org/</a>)</td>
<td>One of the most widely known educational organization, offers short lectures in the form of videos as well as educational tools and exercises. Their catalogue currently encompasses over 4000 videos. Operates as a non-profit organization and offers its courses free of charge.</td>
</tr>
<tr>
<td>Advanced Academics (<a href="http://www.advancedacademics.com/">http://www.advancedacademics.com/</a>)</td>
<td>Advanced Academics is a provider of online education for secondary students, offering innovative online learning solutions, courses, accreditations and a web based curriculum. Partnered with hundreds of districts and schools offering a 24/7 student support environment.</td>
</tr>
<tr>
<td>Uppsala University (<a href="http://www.uu.se/en/">http://www.uu.se/en/</a>)</td>
<td>One of northern Europe’s highly ranked universities, manages online courses that are delivered as audio-visual web lectures through downloadable documents for self-studies. The written examination is performed online at the end of the course.</td>
</tr>
<tr>
<td><strong>K12</strong> (<a href="http://www.k12.com/">http://www.k12.com/</a>)</td>
<td><strong>DreamBox</strong> (<a href="http://www.dreambox.com/">http://www.dreambox.com/</a>)</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Focused on online education for K8 or K12 students all around the world. Mainly a search engine for connecting the students with the nearest and best schools for them. A for-profit education company that sells online schooling and curriculum to state and local governments.</td>
<td>A mathematics curriculum for young students with Intelligent Adaptive Learning™ that tracks responses and adjusts the learning path to create individualized learning methods. “AssignFocus”, a tool for teachers and educators to create personalized assignments for students, is also included.</td>
</tr>
<tr>
<td>Discovery Education (<a href="http://www.discoveryeducation.com/">http://www.discoveryeducation.com/</a>)</td>
<td>Drillster (<a href="https://www.drillster.com/">https://www.drillster.com/</a>)</td>
</tr>
<tr>
<td>K-12 curriculum and many resources for teachers and students. Includes support for parents.</td>
<td>Drillster presents an adaptive, assessment based learning tool that provides immediate feedback and allows both students and instructors to design drills and tests. Also contains downloadable content and “drills”. Drillster is based in the Netherlands.</td>
</tr>
<tr>
<td><strong>Time 4 Learning</strong> (<a href="http://www.time4learning.com/">http://www.time4learning.com/</a>)</td>
<td><strong>Bonobo Learning Management System</strong> (<a href="http://www.bonobolearning.com/">http://www.bonobolearning.com/</a>)</td>
</tr>
<tr>
<td>Time4Learning is a student-paced online educational tool covering preschool through high school. It is popular as a home-school curriculum, an afterschool alternative to tutoring. Offering content, lessons and programs for all, Elementary, Middle and High School. Also focusing on teaching Kids with special needs.</td>
<td>A learning platform for creating and selling courses. Functions for developing slideshow lessons or quizzes are also included. Simply a trading platform for courses about different topics and contents.</td>
</tr>
<tr>
<td><strong>FuelEducation</strong> (<a href="http://www.getfueled.com/">http://www.getfueled.com/</a>)</td>
<td><strong>Lenovo AirClass</strong> (<a href="https://www.airclass.com/">https://www.airclass.com/</a>)</td>
</tr>
<tr>
<td>Mainly focusing on K12 education, getfueled.com offers a wide range of K12 courses and contents for many different topics. Provides also a special curriculum for</td>
<td>Lenovo provides an interactive virtual classroom software which tracks the students' engagement, monitored by capturing video from their personal webcams and applying emotion-analyzing software. Instructors and student can access documents, photos, video sharing and live chat, and entire classes can be recorded and played back in the</td>
</tr>
<tr>
<td>Language, a Personalized Learning Platform called “Peak” etc.</td>
<td></td>
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<tr>
<td>----------------------------------------------------------</td>
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<tr>
<td>Paradiso LMS (<a href="http://www.paradisosolutions.com/">http://www.paradisosolutions.com/</a>)</td>
<td></td>
</tr>
<tr>
<td>An LMS offered in two versions – one for corporate and one for education. Includes gamification and social learning and easy integration with other software including Microsoft Dynamics and WordPress. Paradiso is a highly customized version of Moodle.</td>
<td></td>
</tr>
<tr>
<td>Eliademy (<a href="https://eliademy.com/">https://eliademy.com/</a>)</td>
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<tr>
<td>Providing a library with 3000+ courses. Includes authoring tools, Learner’s analytics, Grading tools, Tasks and quizzes etc.</td>
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<tr>
<td>Learnkit (<a href="http://www.learnkit.com">www.learnkit.com</a>)</td>
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<tr>
<td>Learnkit exists at the intersection of academia and business. We build certificate programs in partnership with top 20 universities and industry leading organizations. Providing content as well as authoring and presentation tools. Translation and localization of courses to reach international audiences.</td>
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<tr>
<td>*Intuition Rubicon LMS (<a href="http://www.intuition.com">http://www.intuition.com</a>)</td>
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<tr>
<td>A SCORM compliant LMS with assessments. Also offer Intuition advantage – a knowledge management platform, customized learning portals, a library of courses, and custom course building. Based in Dublin, Ireland</td>
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<tr>
<td>*Evolve Learner Manager and Classroom Manager (<a href="http://www.evolveelearning.com/">http://www.evolveelearning.com/</a>)</td>
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<tr>
<td>Included is a Course Authoring and a Management System for e-Learning course LMS and eLearning Vendors development, Swift Presenter for PowerPoint conversion, and a library of compliance courses.</td>
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<tr>
<td>Edtrin (<a href="http://edtrin.com/">http://edtrin.com/</a>)</td>
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<tr>
<td>An adaptive learning platform for LMS and eLearning Vendors, schools, colleges and businesses to deliver and sell video and blended learning.</td>
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<tr>
<td>LearnBoost(<a href="http://www.learnboost.com/">http://www.learnboost.com/</a>)</td>
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<tr>
<td>Free web-based software for K-12 teachers and students. Includes a gradebook, visual editor, a tool for managing lesson plans, and a sharing platform. Integrates gradebooks with Google Apps and offers an interaction with parents.</td>
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<tr>
<td>EI Design (<a href="http://www.eidesign.net/">http://www.eidesign.net/</a>)</td>
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<tr>
<td>EI Design offers a range of innovative learning designed content; some of the techniques they use are gamification, D2L LeaP(<a href="http://www.d2l.com/products/leap/">http://www.d2l.com/products/leap/</a>)</td>
<td></td>
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<tr>
<td>D2L Brightspace LeaP identifies knowledge gaps and automatically recommends content that will help students get up to speed in areas they need to improve. Adapts to the learning process of each student, changing</td>
<td></td>
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<tr>
<td>D2L Brightspace LeaP identifies knowledge gaps and automatically recommends content that will help students get up to speed in areas they need to improve. Adapts to the learning process of each student, changing</td>
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<tr>
<td>France Jean Moulin University Lyon 3 Joseph Fourier University Lille 2 University of Health and Law University Lille 3 Charles-de-Gaulle University of Haute-Alsace</td>
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<tr>
<td>Finland Lappeenranta University of Technology Tampere University of Technology University of Eastern Finland University of Helsinki</td>
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</table>
interactive videos, decision making - branching simulations, story based, scenario based, and guided exploration. They also have a competency lab to research on facets that impact learnability.

<table>
<thead>
<tr>
<th>Blendspace(<a href="https://www.blendspace.com/">https://www.blendspace.com/</a>)</th>
<th>AndorraUniversity of AndorraFYR MacedoniaSouth East European UniversityGeorgiaIlia State University</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blendspace is an online collaborative tool for teachers to build lessons, quiz students and track progress. Focuses on Project-based learning. Combinable with PDFs, PowerPoint, Word, Dropbox, Google Drive, YouTube etc. “Achieve learning goals with fun, interactive lessons”.</td>
<td>AndorraUniversity of AndorraFYR MacedoniaSouth East European UniversityGeorgiaIlia State University</td>
</tr>
<tr>
<td>SweetRush(<a href="http://sweetrush.com">http://sweetrush.com</a>)</td>
<td>GermanyCarl von Ossietzky University of Oldenburg Cologne University of Applied Sciences Deggendorf University of Applied Sciences Dresden University of Technology Hamburg University of Applied Sciences Hochschule Konstanz University of Applied Sciences RWTH Aachen University Saarland University of Applied Sciences University of Bremen University of Goettingen University of Hagen University of Hannover</td>
</tr>
<tr>
<td>Sweetrush is offering a wide range of consultation and content development for training including e-learning, m-learning, games. Includes video, audio and animation editors. Also focusing on health care education.</td>
<td>GermanyCarl von Ossietzky University of Oldenburg Cologne University of Applied Sciences Deggendorf University of Applied Sciences Dresden University of Technology Hamburg University of Applied Sciences Hochschule Konstanz University of Applied Sciences RWTH Aachen University Saarland University of Applied Sciences University of Bremen University of Goettingen University of Hagen University of Hannover</td>
</tr>
<tr>
<td>The CN LMS(<a href="https://www.thecn.com/">https://www.thecn.com/</a>)</td>
<td>HungaryBudapest University of Technology &amp; Economics Corvinus University of Budapest National University of Public Service (NUPS) Öbuda University Semmelweis University Széchenyi István University Szent István University University of Pécs</td>
</tr>
<tr>
<td>A social Learning Management System providing a live broadcasting function, MOOC platforms and many different options such as e-Portfolios, Translator-tools, Polls and Multimedia input. Marketed to education and business.</td>
<td>HungaryBudapest University of Technology &amp; Economics Corvinus University of Budapest National University of Public Service (NUPS) Öbuda University Semmelweis University Széchenyi István University Szent István University University of Pécs</td>
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<tr>
<td>UBC MLOAT(<a href="http://www.learningtools.arts.ubc.ca/mloat.htm">http://www.learningtools.arts.ubc.ca/mloat.htm</a>)</td>
<td>GreeceAgricultural University of Athens Aristotle University of Thessaloniki Democritus University of Thrace University of Thessaly</td>
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<tr>
<td>A free tool that combines video, audio, images and texts into one synchronized learning object. Contains an advanced web based media player on-the-fly that supports the standard multimedia formats.</td>
<td>GreeceAgricultural University of Athens Aristotle University of Thessaloniki Democritus University of Thrace University of Thessaly</td>
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<tr>
<td>woople(<a href="http://woople.com/">http://woople.com/</a>)</td>
<td>IcelandUniversity of IcelandIrelandDublin Institute of Technology NUI Galway</td>
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<tr>
<td>A web-based system that includes a video-oriented authoring tool. Also offers</td>
<td>IcelandUniversity of IcelandIrelandDublin Institute of Technology NUI Galway</td>
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<tr>
<td>University Name</td>
<td>Description</td>
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<tr>
<td>University College Cork University of Limerick</td>
<td>Testing and tracking tools.</td>
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<tr>
<td>Italy Ca' Foscari University of Venice IULM</td>
<td>Geenio(<a href="https://geen.io/">https://geen.io/</a>) A “next generation”, HTML5, cloud-based complete learning cycle learning system that includes authoring and mobile capabilities. Includes analytics and a rating function.</td>
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<td>University of Languages and Communication Milan Technical University Polytechnic</td>
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<td>University of Turin Sapienza</td>
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<td>University of Rome The Catholic University of the Sacred Heart</td>
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<td>The Tuscia University</td>
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<td>University of Bergamo</td>
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<td>University of Bologna</td>
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<td>University of Genoa</td>
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<td>University of Naples -L'orientale</td>
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<td>University of Siena</td>
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<td>University of Trieste</td>
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<td>University of Urbino</td>
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<tr>
<td>Latvia Riga Stradins University Riga Technical University Malta University of Malta</td>
<td>AdrennaLearn(<a href="http://www.adrenna.com/">http://www.adrenna.com/</a>) Described as a social learning platform. Available for K-12, higher education and corporations. Includes authoring and a virtual classroom. Also offers custom course development.</td>
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<tr>
<td>Lithuania Lithuanian University of Educational Sciences Siauliai University Vilnius Gediminas Technical University Vilnius Universit</td>
<td>DELFI LERSUS MMS (<a href="http://www.lersus.de/content/enu/productsolutions/lersus-mms/">http://www.lersus.de/content/enu/productsolutions/lersus-mms/</a>) A basic LMS for eLearning, focusing primarily on authoring tools. Based in Germany but product available in English.</td>
</tr>
<tr>
<td>Lithuania Lithuanian University of Educational Sciences Siauliai University Vilnius Gediminas Technical University Vilnius Universit</td>
<td>SkyPrep(<a href="http://skyprep.com/">http://skyprep.com/</a>) A cloud-based LMS that includes content authoring, assessments, analytics, and e-Commerce. Integrates with Dropbox, Google, LinkedIn, Facebook etc. Based in Toronto.</td>
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<td>Netherlands Delft University of Technology Eindhoven University of Technology</td>
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<td>Free University Amsterdam Norway University of Life Sciences Norwegian</td>
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<tr>
<td>University of Science &amp; Technology University of Bergen University of Nordland</td>
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<tr>
<td>Poland Koszalin University of Technology Poznan University of Economics Poznan</td>
<td>Ed(<a href="http://www.edapp.com">http://www.edapp.com</a>) A mobile LMS with authoring and gamification. Includes rewarding and a large library of templates. Based in Australia.</td>
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<tr>
<td>University of Technology Technical University of Lodz University of Lodz</td>
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<td>University of Warsaw</td>
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<tr>
<td>Portugal Autonomous University of Lisbon ISCTE – Lisbon University Institute</td>
<td>Grasplink Learning Management System(<a href="http://www.grasplink.com/">http://www.grasplink.com/</a>) An online LMS for eLearning. Includes course creation and assessment tools.</td>
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<tr>
<td>Universidade Aberta (Open University</td>
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<tr>
<td>Country</td>
<td>University/Institution</td>
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<tr>
<td>Portugal</td>
<td>University of Aveiro</td>
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<tr>
<td>Romania</td>
<td>Academy of Economic Studies of Bucharest Agora University of Oradea* Babes-Bolyai University</td>
</tr>
<tr>
<td>Russia</td>
<td>Moscow State Linguistic University National Research University Higher School of Economics Peoples’ Friendship University of Russia Southern Federal University</td>
</tr>
<tr>
<td>Slovakia</td>
<td>Academy of the Police Force Comenius University in Bratislava Constantine the Philosopher University</td>
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<td>Serbia</td>
<td>University of Belgrade University of Novi Sad</td>
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<td>Slovenia</td>
<td>University of Maribor University of Nova Gorica</td>
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<td>Spain</td>
<td>Alcalá de Henares University Cádiz University Camilo José Cela University* La Laguna University Lleida University Madrid Open University University of Alicante University of Valencia University of Vic</td>
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<tr>
<td>Sweden</td>
<td>Chalmers University of Technology Karolinska Institute Södertörn University Stockholm School of Economics Stockholm University</td>
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<tr>
<td><strong>Amvonet</strong>(<a href="http://www.amvonet.com/">http://www.amvonet.com/</a>)</td>
<td><strong>Switzerland</strong>&lt;br&gt;ETH Zürich Federal Polytechnic School of Lausanne Graduate Institute of International and Development Studies University of Applied Sciences Western Switzerland University of Bern</td>
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<tr>
<td>An eLearning management, collaboration and authoring suite that includes a virtual classroom with Moodle integration. Marketed to both corporations and education.</td>
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<thead>
<tr>
<th><strong>Enocta Learning Management System</strong>(<a href="http://www.enocta.com/">http://www.enocta.com/</a>)</th>
<th><strong>Turkey</strong>&lt;br&gt;Bahcesehir University Bilkent University Istanbul Bilgi University Istanbul Marmara University Namik Kemal University</th>
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</thead>
<tbody>
<tr>
<td>Includes instructor-led classes, authoring, LCMS, an exam engine, mobile functions, some third party courseware, etc.</td>
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<tr>
<th><strong>Bottom-Line Performance</strong>(<a href="http://www.bottomlineperformance.com">http://www.bottomlineperformance.com</a>)</th>
<th><strong>Ukraine</strong>&lt;br&gt;Borys Grinchenko Kyiv University National Pedagogical Dragomanov University Odessa National Polytechnic University Ternopil Ivan Puluj National Technical University</th>
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<tbody>
<tr>
<td>A lower cost, mobile friendly LMS. Also offer custom development and the Knowledge Guru game engine. Tin Can API enabled.</td>
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<tr>
<th><strong>e-doceo eLearning manager</strong>(<a href="http://www.e-doceo.net">http://www.e-doceo.net</a>)</th>
<th><strong>United Kingdom</strong>&lt;br&gt;Aston University Bournemouth University Cardiff Metropolitan University Glasgow School of Art* University College London University of Exeter University of Plymouth University of Surrey University of Wales Swansea</th>
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<tbody>
<tr>
<td>Based in France. Website available in several languages. Offering an LCMS, eLearning live – a virtual classroom, authoring tools, presentation tools and TvLearn, a live streaming tool.</td>
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<tbody>
<tr>
<td>An SaaS LMS that includes authoring, assessment and eCommerce. Based in the Netherlands.</td>
<td>A web-based LMS offering analytics, adaptive, social, and gamification features. Integrates with other LMSs. Also offer the Evolve authoring tool. Based in the UK.</td>
<td>An SaaS LMS with eCommerce, social networking and course authoring tools. Also providing blended learning and analytics tools.</td>
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</table>