Co-funded by the Erasmus+ Programme of the European Union

Building Skills 4.0 through University and Enterprise Collaboration

SHYFTE 4.0

WP2: Implementation of Shyfte Framework for Training and Learning

D2.5: Skills 4.0 Training and Learning Center of Excellence

vs:3.0.0

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The objective of this deliverable is to define the protocol of operation and internal articulation of the Learning Center of Excellence, define the center's laboratory operation, define the diffusion and dissemination system and the internal evaluation system of the center's operation.

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Further Information

http://www.shyfte.eu/

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1. Executive Summary

The objectives of this deliverable are to define the global architecture of the Learning Centers and the main models and concepts used to define it.

The deliverable D2.5 also describes the protocol of operation and internal articulation of the Learning Center and defines the Learning Center's operations and their internal evaluation system.

2. Shyfte Service-Oriented Architecture

A design paradigm can be seen as a governing approach to design a logical solution; composed of a set of complementary rules or principles that collectively define an approach represented by the SOA paradigm [2]. Service orientation represents its design paradigm, that applies to distributed solution logic. Shyfte architecture follows the SOA paradigm].

Design characteristics should have attention to:

- Technological constraints used to build/or host the units of logical solution.
- Technological or systems constraints that reside alongside the deployed units of solution.
- Requirements constraints and priorities of the project delivering.

The center of excellence main service is the upskill service that promotes teaching learning offering customized training. It considers the gap analysis, regarding SMEs information and trainee/student level of expertise in a specific domain.

Shyfte SOA architecture (Figure 1) is composed by the following layers: presentation layer, business process layer, application layer, and data layer.

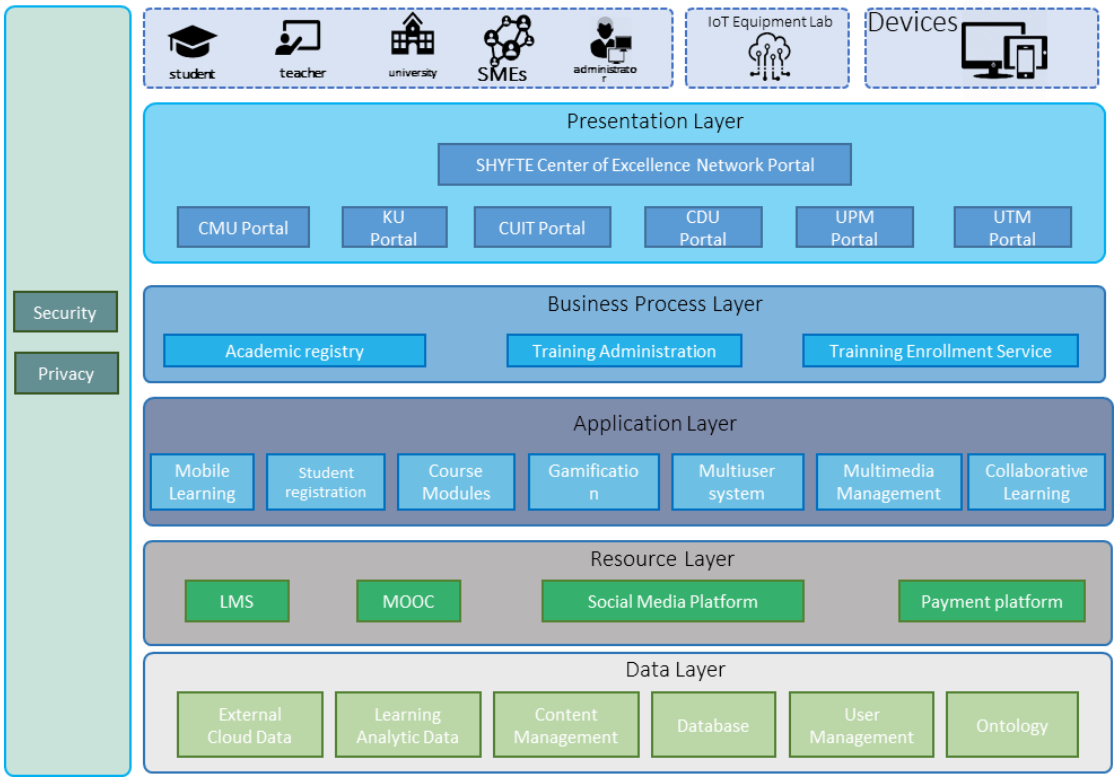

Figure 1 – Shyfte SOA architecture.

- *Presentation Layer* - It is the point of entry to interactive consumers and services from external sources (e.g., other systems, other SOAs, cloud service consumers, human users, etc.).
- *Business Process Layer* – represents the layer process for representation and composition, providing aggregating loosely-coupled services. Whose processes are aligned with business goals. Data flow and control flow mediate the interactions among services and business processes. Services and business processes coordination in order to fill customer requirements. Includes information changes between participants, resources and processes in order to achieve the business goal. Allow to change faster to market condition changes. Responsible for orchestration.
- *Application Layer* – This layer bridges business and technology. It is characterized by: flexibility, and technology "independence", i.e. managing the dependency between and implementation technology. The main responsibility of this layer is to implement the service contract, support interactions for the execution of the service functionality, with the business layer, perform syntactic data validation.
- *Resource Layer* - this layer has connection with business layer and database. Concerning the access of the data logic, internally the resource layer has connection between business layer and database. Externally, it is linked to external or enterprise applications. Other sources, all into all such as domain or integration.
- *Data Layer* – Data layer refers physical resources for computing, storage, and network connectivity in the internet, and its applications and databases. Additionally, it uses information for data integration services, reliability on data on read and update.
- *Security and Privacy Layers* – spans security infrastructure learnings. The Security layer is responsible for system safety against attacks, both internally and externally. It might include mechanisms for electronic signature to authenticate the identity, and data encryption, and mechanisms for cloud security.

Shyfte SOA follows a federated architecture (Figure 2), proposing an infrastructure that enables to call services between heterogeneous services. It includes data transformation, dealing with security and reliability, service management, monitoring, and logging. That Federated SOA is

operated through Service engines, specifically: Engine Skills analysis, engine students training, maturity model engine, and training services, that organizes services in a specific order.

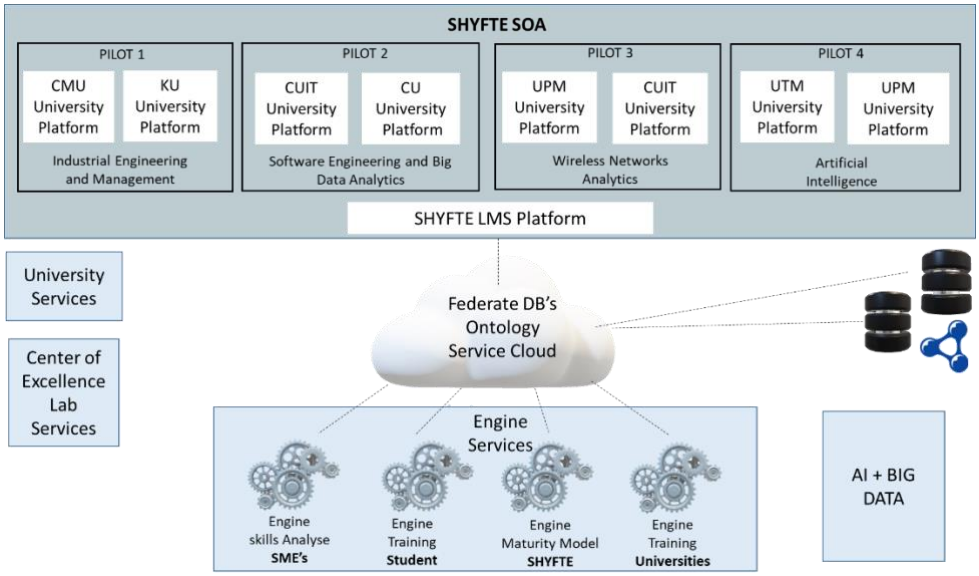

Figure 2 – Federated SOA.

Shyfte SOA might be implemented through the use of a main LMS platform represented the Shyfte Centers of Excellence. Federation it is known to allows the integration of different components in a flexible way, that allows to integrate or combine existing teaching learning materials of the universities with those developed specifically for the Centers of Excellence. Additionally, it is a step forward to allows the life continuity of the Centers, located at Lisbon, replicable in France. That is responsible to maintain all the platform.

Each Pilot responsible should the platform at the level of each pilot, maintaining its identity aligned with the rules of the country, due to the federation characteristic of the architecture. The databases are distributed, at different locations. It means that there are local databases; and databases at the top level of the architecture, that should be synchronized.

2.1 HiSkill-TPACK Conceptual Methodological Framework

The Shyfte information system's maturity model is the core of the e-learning platform of the project since it is a multidimensional model that supports customized training for Shyfte centres of excellence in four Industry domains. In Information Systems (IS), it belongs to the class of maturity models [149][150] for education. E-learning systems, which inherit from IS Maturity Models, are defined resorting to a variety of dimensions determined for different levels of maturity, i.e., novice, ready, expert, and advanced, as represented in Figure 3. Those progressive steps are based on the levels of training to be delivered through the computational system. Other planes might be conceptualized, for instance, those dedicated to skills, knowledge, competence, jobs, grouping concepts and features.

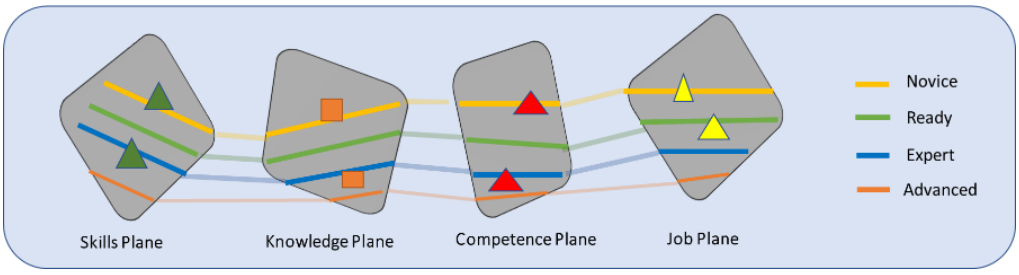

Figure 3 – Information System Maturity Paths.

Thus, one might say that the IS inner maturity model might be represented by several virtual plans (Figure 3) connected by virtual paths, as represented in the figure: a) the skills plane, in which are represented the KPI skills in the meta-skills, hard skills and soft-skills model [1] [2]; b) the knowledge plane, in which are projected the knowledge KPI; c) the competence plane, in which are represented the competencies for the courses KPI; d) the job plane, which is linked to the previously mentioned entities of the model.

Previously mentioned concepts that are represented in each plan are enclosed in the system questionnaires; and consequently, in the system ontology, which has a representation of the whole semantics of the system. Levels are connected through a roadmap training path. Each of those maturity levels, i.e. novice, ready, expert, advanced are represented in multi-dimensional, interconnected variables that are relevant for the quantification and qualification of gap analysis. For instance, the skills plane, the competence plan, and the job plane, as represented in Figure 4.

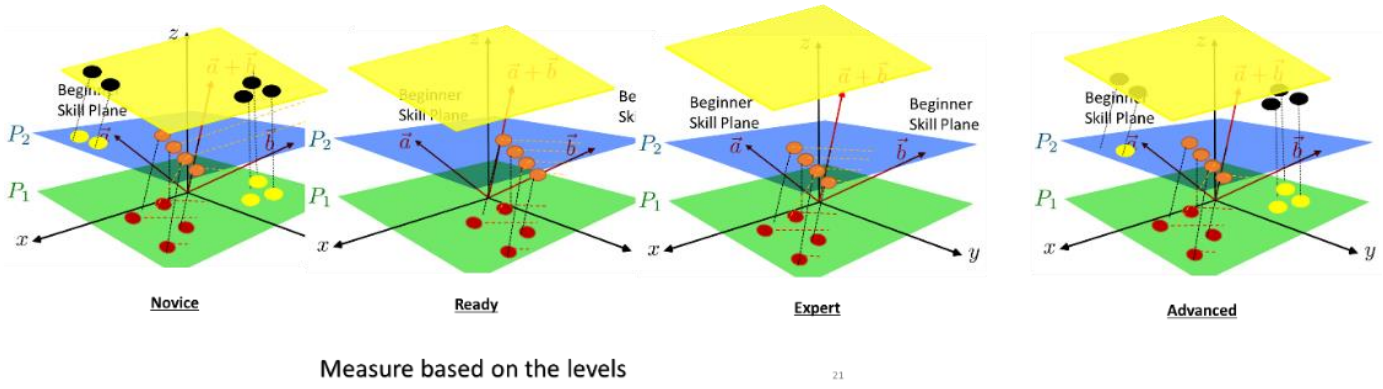

Figure 4 – Roadmap path through IS Maturity Levels.

In the system, the student/trainee position is composed based on data representation, constructed with information mainly extracted from questionnaires, that might be seen as a "student matrix" or map. It is computed to position the trainee/student in the course based on her/his skills, competencies, and knowledge maturity path, as can be seen graphically in next Figure 5.

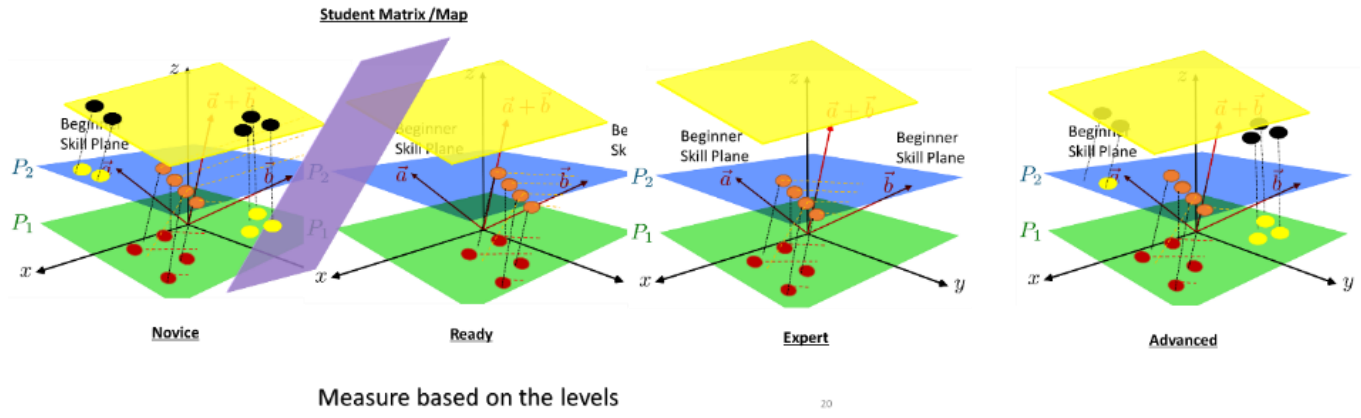

Figure 5 – Student position, after assessment, concerning maturity path, and reference levels of maturity: novice, ready, expert, advanced.

Furthermore, the Shyfte information system maturity model, as a multidimensional model created by several virtual plans, allows the representation of several entities. Going deeper, as can be seen in Figure 6, there is a correlation and connection between student and inner features, and to course modules, described in terms of KPIs that represent each plan. The next figure represents a student/trainee entity in an appropriate course once its position in the system is known.

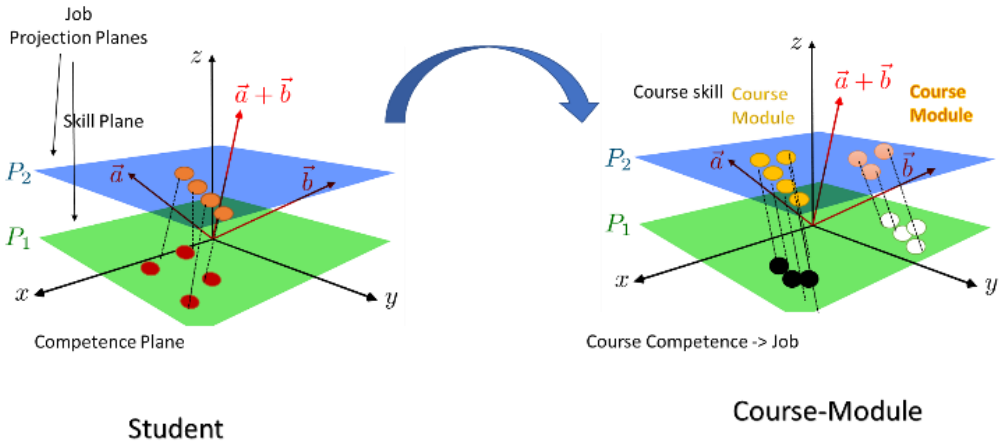

Figure 6 – Maturity job-oriented mappings, and correspondent skills and competencies correlated to courses and modules for generic domain.

Previously mentioned dimensions are enclosed in the maturity map of the training. Every course and related objects or entities are referenced internally by a structure that allows the navigation within training levels through a roadmap training path. Although the information might be organized hierarchically in different dimensions (Figure 3, 4, 5 and 6), it can be projected in one organized maturity map (Figure 7). This map can be organized in the system as a dataset with several entries.

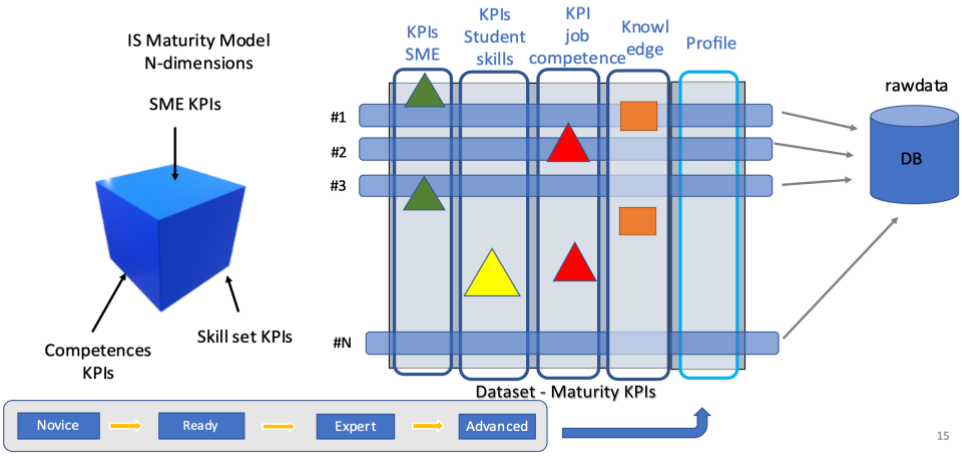

Figure 7 – Shyfte IS Maturity Model Dataset.

2.2 Features and Services

There were identified 4 distinct features of this application: Competences and Curricula (CRUD), Questionnaires, Skills Gap Analysis and Training Program. Therefore, for each feature, there are associated one or more services with the responsibility of fetching/saving data as well as implementing the required business logic. The Figure 8 shows the features that have been considered for this application and all the related services for each feature:

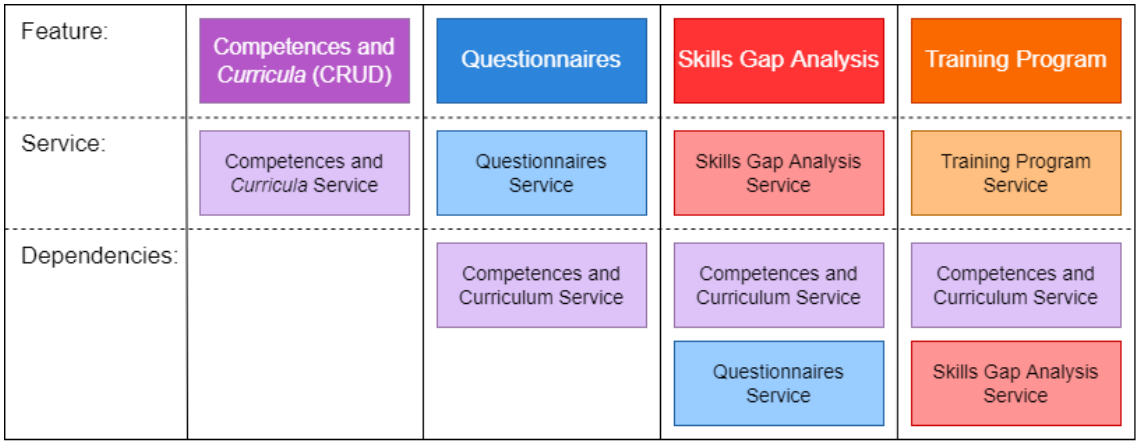

Figure 8 – Application's Features and Services.

As can be seen in the schema, some services will be used across several modules, so they are named as dependencies. For example, concerning the Skills Gap Analysis feature, besides its own service (Skills Gap Analysis Service), it additionally needs the Questionnaires Service — since this is the service responsible by providing the result set obtained from questionnaire — and the Competences and Curricula Service — the one responsible to provide the set of competences and skills required for the job that the user is applying to.

After specifying the main features of the application and subsequently all the needed services, therefore it is the time to propose a conceptual architecture.

2.3 Conceptual Architecture

The diagram in the figure below (Figure 3) shows a conceptual architecture for the application. This diagram aims to show how the different features and services are related with each other.

This conceptual architectural design in the Figure 9 has been based on the design mentioned in [19]. In fact, there are slight differences between the two architectural diagrams. The main difference lies in the services that will be used to provide the functionalities to generate the questionnaires, perform a skills gap analysis and generate a training program.

In this new design, there is a new feature called “Competences and Curricula”. This feature is associated to the service that is identified in this schema as “Competences and Curricula Service”. This service will basically be the one that will be responsible to process the data regarding Job competences and curricula which is a terminology that comprises all the data regarding knowledge domains, skills sets and modules (the HEIs courses). This service will provide the functionality knew as CRUD over this data.

The “Questionnaires Service” which is associated with the feature with the same name, “Questionnaires”, is a service that communicates with the “Competences and Curricula Service” service to fetch the necessary data to generate the questionnaires (competences and skills) that will be presented to the user. The result of the “Skills Questionnaire” will be used as input to the “Skills Gap Analysis Service” which will perform the skills gap analysis.

Finally, there is presented the “Training Program Service” which is responsible for generating a custom training program considering the result of the skills gap analysis. This service as well as the “Questionnaires” and “Skills Gap Analysis” services are shown, in this design, connecting to the “Competences and Curricula” service and the reason is because this is the source of the data which the services will get and process, in order to per-form the skills gap analysis and generate a training program.

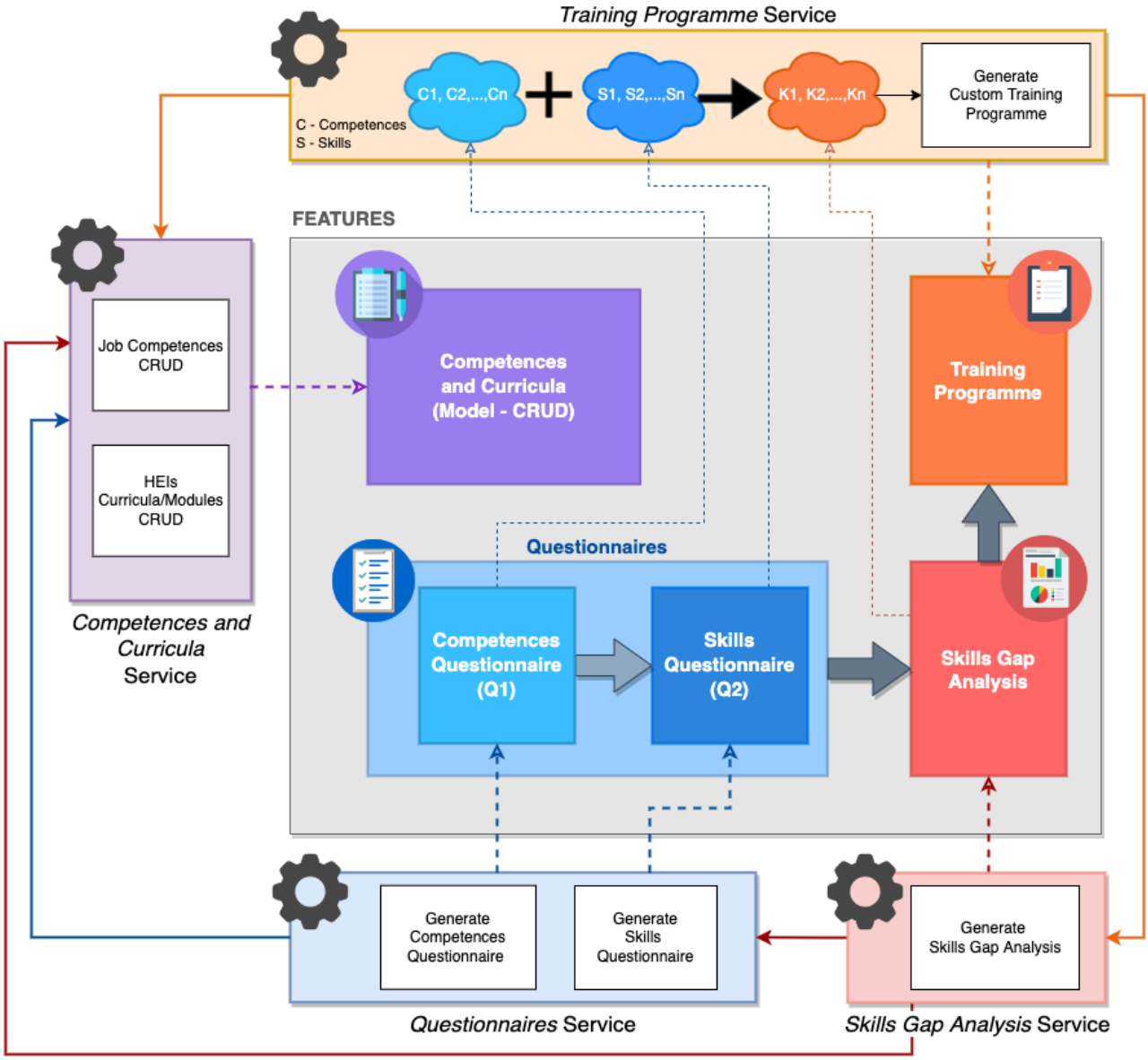

Figure 9 – Conceptual architecture.

3. Prototype Implementation and Validation

Having well defined how should the designed software work, in order to accomplish what is purposed in the research question of this study (chapter 1) and, having presented an architectural concept design as a possible design which can be followed to find out a solution for this problem, it is time to implement and validate that solution. This way, with this goal in mind, a project called Shyfte 4.0 appeared as the ideal project where the designed software could be introduced on, in order to validate it.

Notice that concepts as questionnaires, skill gap analysis or training programs, de-scribed in the conceptual solution introduced in the chapter 3, will be re-introduced and presented a technical solution for them in this chapter.

3.1 Shyfte 4.0 Project

The Shyfte 4.0 [20] is a project, co-funded by the Erasmus+ Program of the European Union. With the 4th wave of the industrial revolution, new jobs and employee roles will be created, and the SHYFT project comes up, aiming to build a collaboration between HEIs and industrial SMEs and adopting state-of-art technologies to improve the working environments and re-skill the human working resources in technologies in the Industry 4.0 domain.

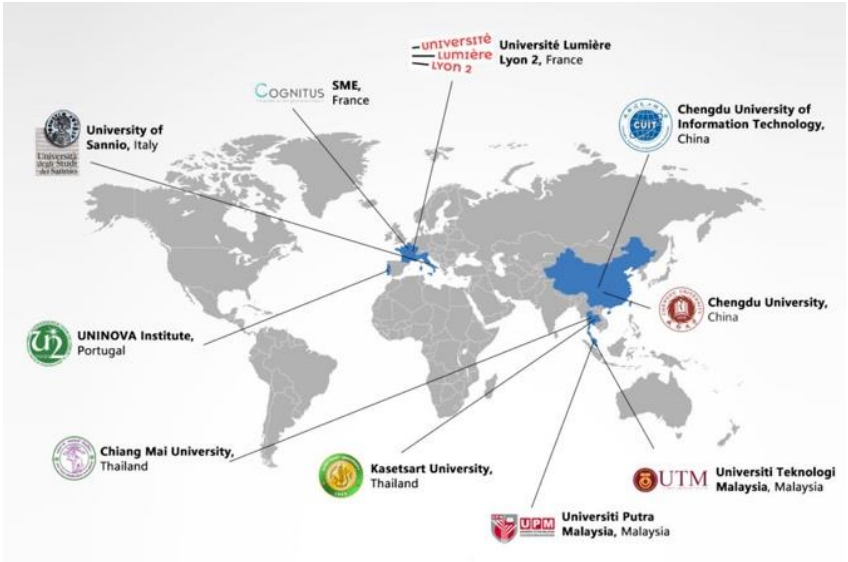

Figure 10 – Shyfte 4.0 partners

3.1.1 Project Specification

For this project four pilots have been established in three Asian countries (China, Malaysia and Thailand). The pilots are the following:

- Pilot 1: Industrial engineering and management.
- Pilot 2: Software Engineering and Big Data Analytics.
- Pilot 3: Wireless networks analytics.
- Pilot 4: Artificial Intelligence.

Each one of these pilots are related to one specific domain. Therefore, for each do-main, — with the collaboration of the HEIs — a so-called Learning Framework has been specified.
Regarding the collaboration with SME industry, different types of jobs in Industry 4.0 were specified. Each one of these jobs belongs to one of the four mentioned domains. The Learning Framework Domain as well as the Job will be explained with more detail and shown some examples further below. Additionally, there will also be presented what is called as SME Framework. It specifies what a company needs to progress from a certain proficiency level to a more advanced one in one Industry 4.0 domain.

Aiming to provide a solution for what was specified, in the Shyfte project, a solution was proposed, which comprises the implementation of web portal which will have two distinct user paths: “individuals” path and “SMEs representatives” path. So, basically, this portal will be used by two different types of users. The “individuals” referred to the ones that by their own initiative decide to upskill their competences in a certain field in some Industry 4.0 domain. Concerning the “SME representative”, it refers to a user that is representative of a SME and, knowing what the company needs, has the possibility of registering an employee to enroll a customized training program. A more detailed explanation of these two paths will be further described.

3.1.2 Learning Framework

So, as said before, an important concept in this project is the Domain and, as shown before, there are four different domains. Now, a Domain is divided in some groups which are called Skill Sets, and a Skill Set can be seen as a stack or agglomeration of Modules (HEIs courses), and it is important to notice that a module can be part of one or more skill sets.

Finally, we have three different maturity levels in which the modules are grouped on: Beginner, Intermediate and Expert.

Following in the next points, there will be presented an example for each type of Domain (which also shows Skill Sets) and a Module.

3.1.2.1 Learning Framework Domain

In the diagram below (Figure 11) is shown an example of a Domain, in this case the one for Artificial Intelligence field:

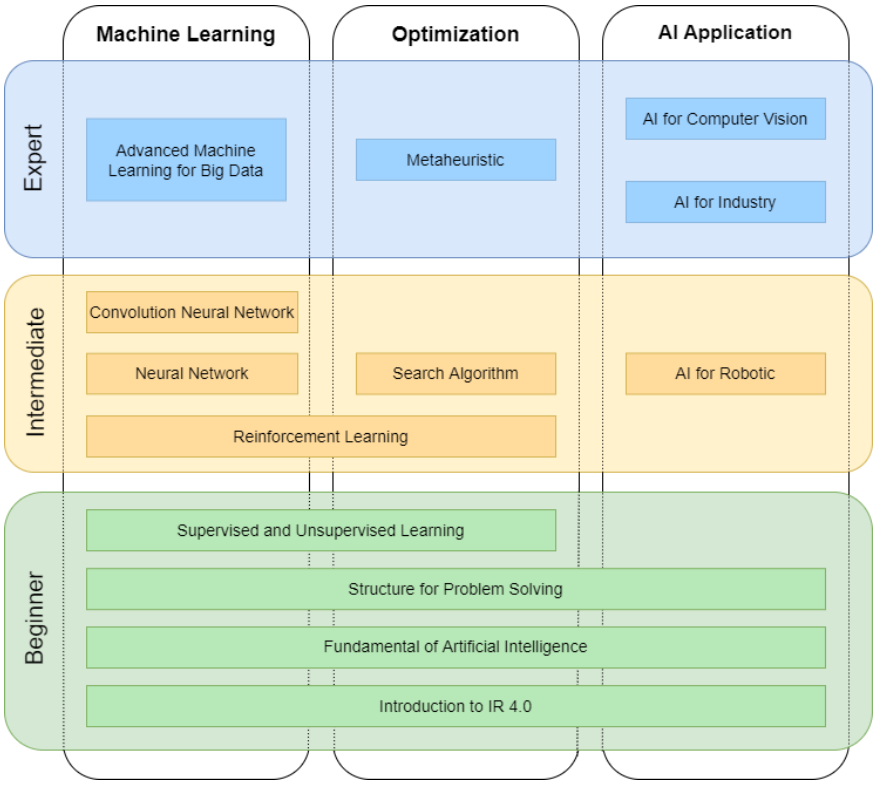

Figure 11 – Artificial Intelligence domain.

As can be seen in the Figure 5, this domain consists in three main skill sets: Machine Learning, Optimization and AI Application. It also shows the modules required for each maturity level (Beginner, Intermediate and Expert) as well as the Skill Set (one or more) where they belong to. For example, in the case of the Beginner level, the module "Introduction to IR 4.0" is shared across all the three Skill Sets of this Domain.

In fact, this domain is part of a main domain called “Artificial Intelligence and Robotics” and this is the reason for referring this domain as a sub-domain below in the next points. However, it is important to note that a not all domains have sub-domains.

3.1.2.2 Module

Now, in case of a Module, an example could be the “Neural Network Computing” module, which its data is presented in the Table 1.

The information contained in the Table 1 describes the module and an important field of this table is the “prerequisites” field. In this case, there are two prerequisites for the “Neural Network Computing” module: “Basic programming” and “Engineering mathematics”. Both prerequisites should be viewed as required modules that should be done before of attending the “Neural Network Computing” module.

Table 1 – Neural Network Computing module.

Domain	Artificial Intelligence and Robotics			
Sub-Domain	Artificial Intelligence			
Skill Level	Intermediate			
Skill Set	Artificial Intelligence	Neural Networks	Computing	
Module Title	Neural Network Computing			
Module Acronym	NNC			
Module Description	This module introduces Neural Networks fundamentals as well as intermediate level implementation. This module gives the students appropriate knowledge and skills to develop, design and analyse effectively NN techniques for practical problems with some degree of accuracy.			
Meta Skills	To be an Artificial Neural Network applicator.			
Module Outcomes	Students will be able to use Artificial Neural Network to solve real problem.		Student will be able to prepare a proper database to be used for ANN module.	
Keywords	Neural Network		Computing	
Target Group	Bachelor students	Master students	PhD students	Industry workers
Target Group Level	3rd year B. Eng. onward	1st year M. Eng. onward	1st year PhD	Entry level and manager
Prerequisites	Basic programming		Engineering mathematics	
Soft Skills	Team working	Problem solving	Ability to work with data	Presentation
Assessment Methods	Assignment	Project presentation	Assessment rubric for teamwork	
Available Period	Every first semester			
Class requirements	Computer		Internet	
Payment Description	One-time payment			
Payment Value	500			

Apply Instructions	Go to university and apply
Certification Info	Professional Certificate
Education Institution	University of Science and Technology
Version	1,0

Additionally, a module has also as related information, what is called the "Teaching Plan" (Table 2).

Table 2 – Neural Network Computing module - Teaching Plan.

Module's Teaching Plan				
Total Duration (hrs)		12		
#	**Topic / Hard Skill**	**Delivery Method**	**Teaching Material**	**Duration (hrs)**
1	Define fundamentals of artificial intelligence and neural network	Lecture	Videos	1
		Simulation		
2	Define machine vision process	Team working group	Flow process mapping software	1
		Case study	Data set	
		Real life examples		
3	Differentiate supervised and unsupervised Neural Network	Team working group	Flow process mapping software	2
		Project assignment	Data set	
4	Simulate supervised Neural Networks and display results	Team working group	TensorFlow (cloud platform)	4
		Hands-on programming	Data set MNIST	
			Simulation software	
5	Simulate unsupervised Neural Networks and display results	Team working group	TensorFlow (cloud platform)	4
		Hands-on programming	Data set MNIST	
			Simulation software	

Now, for each topic in the module's teaching plan, there is a group of questions (in most of cases only one) which have the purpose of assessing the knowledge of the trainee in such topic. The Table 3 shows one pre-assessment question for the first topic of the module:

Table 3 – Neural Network Computing module - Pre-Assessment questions of topic 1.

#	Topic / Hard Skill	Pre-Assessment Questions	
1	Define fundamentals of artificial intelligence and neural network	**Question**	What is back propagation in Neural Network?
		Options	A) It is another name given for supervised Neural Network. B) It is the transmission of error back through the network to adjust the inputs. C) It is the transmission of error back through the network to allow weights to be adjusted so that the network can learn. D) It is another name given for unsupervised Neural Network.
		Answer	C
		Weight	10%

Hence, there will be a pre-assessment question, not only for the first topic, but also for the remain topics — in this case there will be at least 5 questions on this module (one for each topic). Each group of pre-assessment questions — there is a group of questions for each topic — will have a weight value associated to it and therefore, the sum of the weights must total 100%. Moreover, each question inside that group of questions has also a weight to differentiate the importance of each question regarding the topic pre-assessment.

Now, it should be noted that existence of these module's pre-assessment questions is crucial in the Shyfte project since these questions will be the ones used to generate the pre-assessment questionnaire (or skills questionnaire). This pre-assessment has the purpose of being the input of the process which will recognize the trainees' knowledge gaps and recommend an appropriate training program to enhance the current expertise through skill development: re-skilling or up-skilling.

Finally, it is important also to note that not all these questions will be used in the final pre-assessment questionnaire, since it depends on the questionnaire generator algorithm, which will be further explained.

3.1.3 Job

An example of a Job is the "Robotic Engineer" job. The Table 4 shows the data that specifies this job:

Table 4 – Robotic Engineer job.

Domain	Artificial Intelligence and Robotics
Sub-Domain	Artificial Intelligence
Job Title	Robotic Engineer
Job description	Plan, program, and control robots including the use of motor controls, vision, learning, planning and cooperative behavior.
Competences Set	**Modules / Skill Set**
Able to plan, program and control robots.	Metaheuristic Optimization
	Neural Network Computing
	Search Algorithm
	AI for Computer vision
	Reinforcement Learning
	Supervised/Unsupervised Learning
Able to use motor controls, vision, learning, planning and cooperative behavior to program and control the robots.	Convolution Neural Network
	Neural Network Computing
	AI for Computer vision

	Supervised/Unsupervised Learning
	Intro to AI Application
	Fundamental of AI
	Introduction to IR 4.0

As shown in the Table 4, considering the Shyfte's learning framework model, this job belongs to the “Artificial Intelligence” sub-domain which, in turn, belongs to the “Artificial Intelligence and Robotics” domain. It is also possible to see that there are some specific competences required for who is applying for this job. Such competences can be achieved by successfully concluding some specific modules.

3.1.4 SME Framework

The SME Framework can be seen as a matrix that describes what is required in each Concept of Domain and level of proficiency in a specific Industry 4.0 domain.
There are specified four different levels of “readiness”: novice, ready, proficient, and advanced. The following Table 5 shows part of the specified SME Concept of Domain x Proficiency level matrix for AI Domain. In this case, to simplify, it shows only two of “concepts” of the AI domain.

Table 5 – Excerpt of SME Concept of Domain x Proficiency level matrix for AI Domain.

Concept of Domain	Novice [1]	Ready [2]	Proficient [3]	Advanced [4]
Machine Learning (ML) Platforms	Companies don't use ML in their business.	Companies have adopted ML into their day to-day functions.	Companies have ML Infrastructure in place and disrupt business models.	Companies use ML pervasively. Companies rely on AI to achieve business growth.
AI-optimized Hardware	Companies don't use AI-optimized hardware in their operation.	Companies have used AI-optimized hardware into their day to-day operation.	Companies have fully used AI-optimized hardware in their operation.	Companies have fully used AI-optimized hardware pervasively in their operation to achieve business growth.

Now, to move a company further from a lower level to higher one of some Concept of Domain, it is required that its employees obtain certain skills/knowledge and that could be achieved through a training program which comprises specific modules or skill sets. Therefore, it can be seen as a Skills Gap analysis The Table 6 shows an example, in this case, for the Machine Learning concept of AI Domain.

Table 6– Required modules to improve level for the Machine Learning concept of AI Domain.

Concept of Domain	Novice [1] → Ready [2]	Ready [2] → Proficient [3]	Proficient [3] → Advanced [4]
Machine Learning Platforms			

3.2 Designing a Prototype

After explaining the Shyfte project — which is the base project where the prototype for validating the research question will be applied on — and showed the type of data to work with — particularly, the Learning Framework and Job — a technical solution for the prototype can now be presented.

The first step will be the definition of both user paths, “individuals” and “SME” path, via flow chats diagrams. Secondly, the definition of the database model through an entity relationship diagram (ERD) and then, we will dive into the service layer and propose an algorithm for each service that need be implemented (questionnaires, skill gap analysis and training program) via pseudocode. Finally, the final architecture will be presented.

3.2.1 “Individual” User Path

The flowchart diagram in the Figure 12 shows the “path” of what is called an “individual” user, who is a user that, on his own initiative, wants to evaluate his skills and enroll a training program.

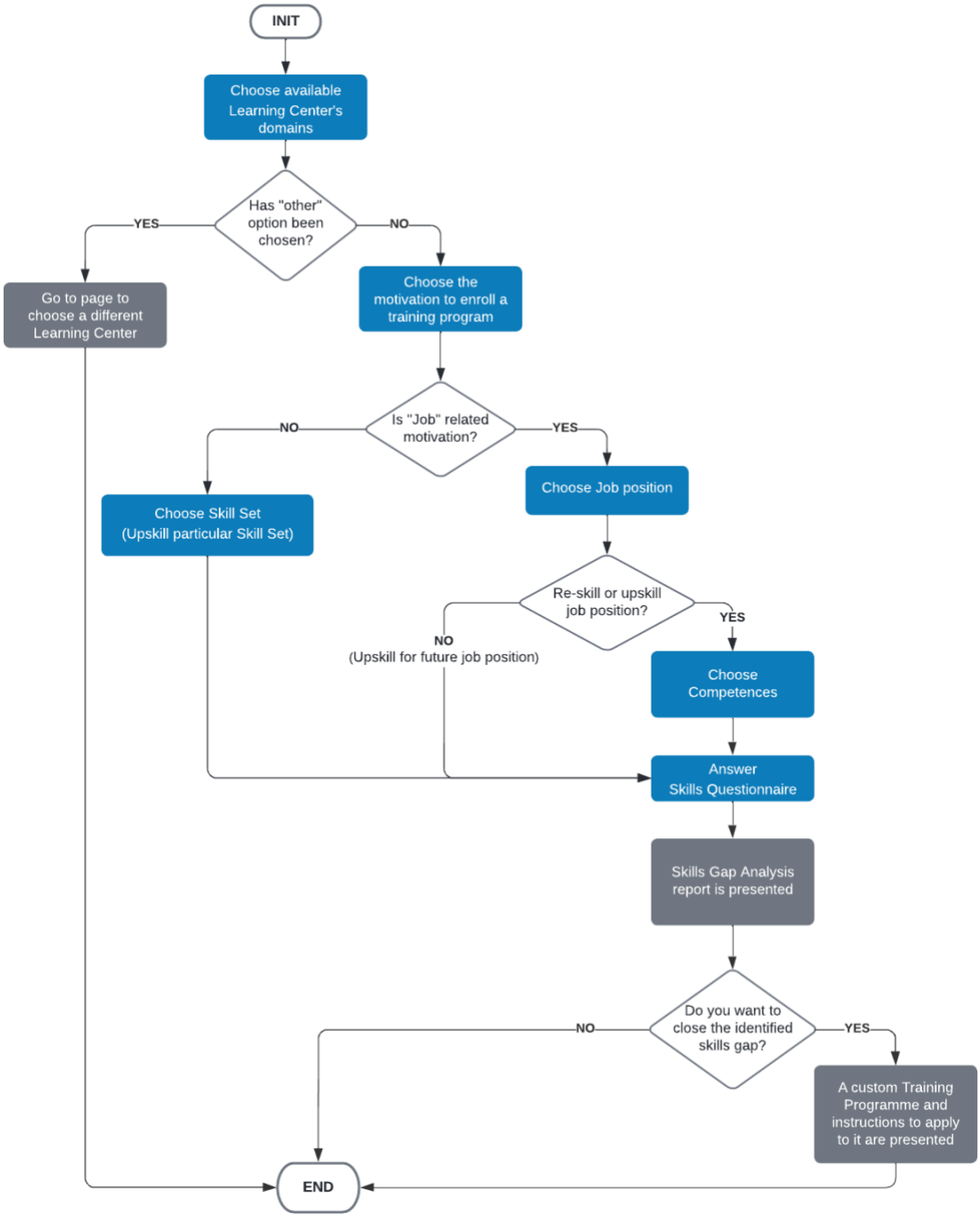

Figure 12 – Individuals path flow chart.

In the first step, the user will be asked to choose the learning domain (e.g., Artificial Intelligence) that he is interested on. In case that chosen domain belongs to a different Learning Center of the one that the user has signed on, the user will be redirected to that Learning Center. In the next step, the user will be asked to indicate his motivation to enroll a training program. It will allow to choose between these 3 different options:

- Re-skill or upskill current job position.
- Upskill for future job position.
- Upskill some skill sets of the domain.

When the user chooses one of the two first options, the system will take in consideration all the required competences for the job (e.g., Robotic Engineer) and the modules (or even the skill sets) related to each competence. The first one is for a user that wants to re-skill one or more competences of his current job. The second one is for a user that wants to upskill his knowledge in all the competences regarding some job position that he pretends to apply to. Lastly, there is a third option for a user that wants to gain or improve skills in a specific Skill Set of the Domain (e.g., Machine Learning).

After a motivation has been chosen and consequently (if it is the case) also chosen competences, there will be prompted what is called as Skills Questionnaire. The result of this questionnaire will be processed, and this is what is known as Skills Gap Analysis. Therefore, a report with the result of the analysis will then be presented to the user and the system will ask if the user wants to close the identified skills gap. If the user accepts the challenge, a custom Training Programme will be generated and presented to the user, as well as the instructions to apply to it.

3.2.2 SME User Path

The other user path is called “SME path” and refers to the steps that a SME user (representative of a SME) takes when interacting with the system.

This SME path has considerable differences when comparing with the “individuals” path. In this case, the user is a representative of a SME and knows the current state of the company in some concepts in Industry 4.0 domain. That user also knows what is the target level that the company aims to achieve.

So, in the first step, the user will choose the Domain where the company fits in, secondly will choose the desired Concepts of Domain and the target level. Therefore, the system will present the enterprise’s gap analysis and a custom training program. That training program consists of the identified modules to close the gap and could be assigned by the SME representative to one or more employees or even to himself. The flowchart diagram (Figure 13) shows the SME path.

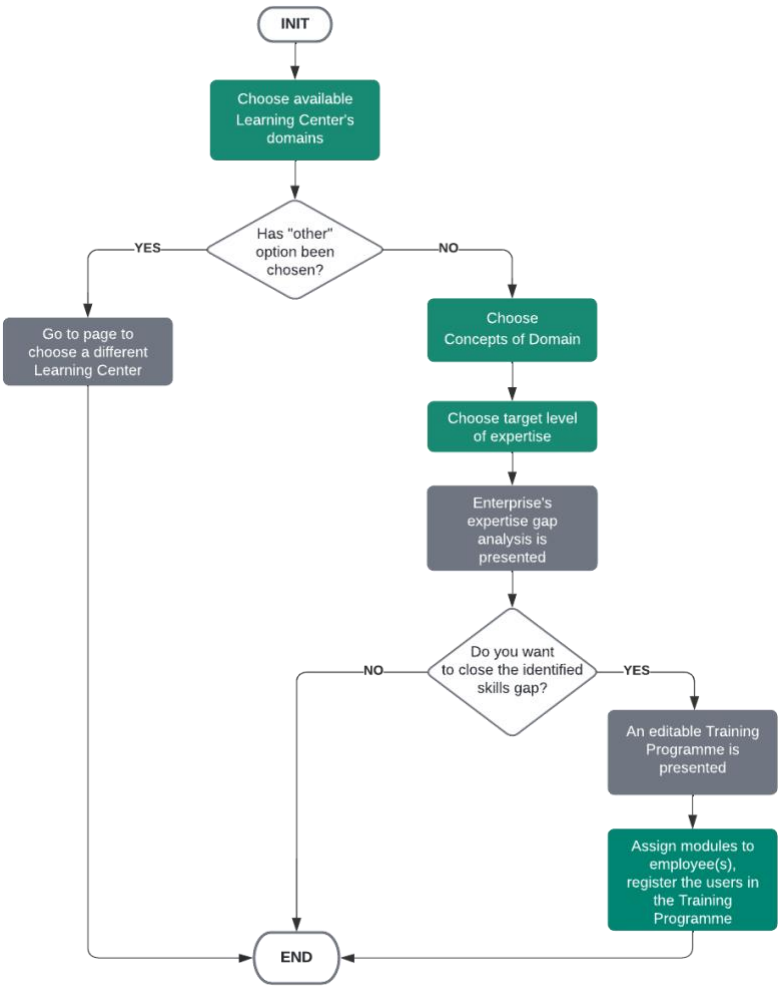

Figure 13 – SME path flow chart.

3.2.3 Database Model

At this stage, considering the type of data that we have and how it is organized, the approach chosen was to use a relational database and, hence, modelling the database by using an Entity-Relationship Diagram (EAR).

With this diagram, the main concepts presented before (e.g., Domain, Skill Set, Module, Job, etc.) — as well as other concepts that are, in certain way, disguised in form of table columns — will be the entities of this model. Then, relationships between these entities could be drawn.

The ERD is presented below divided in two parts only for simplify the presentation. The Figure 14 shows the main part of this diagram and Figure 15 shows the part of this diagram that relates to the SME table.

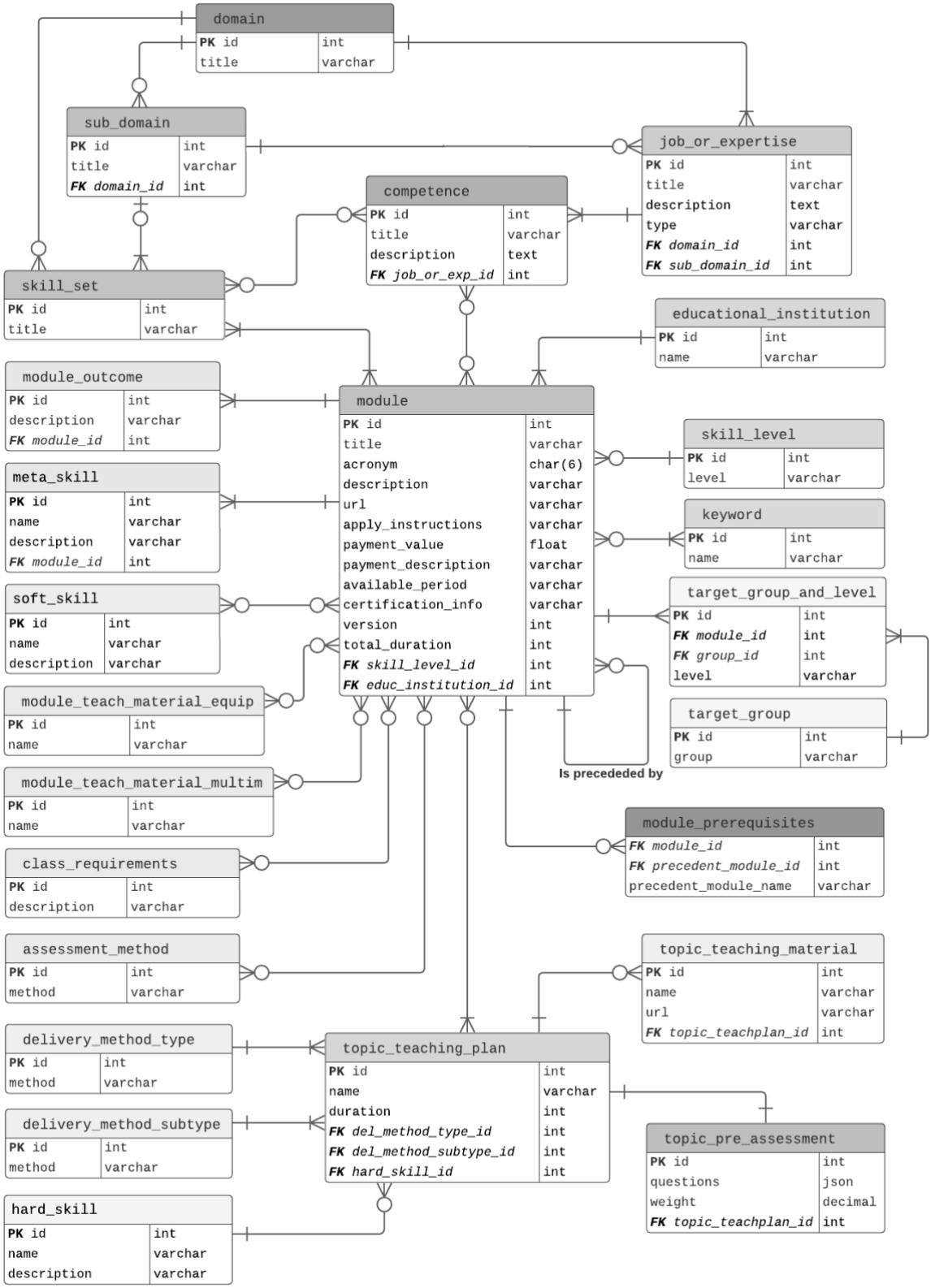

Figure 14 – Main Shyfte 4.0 ERD.

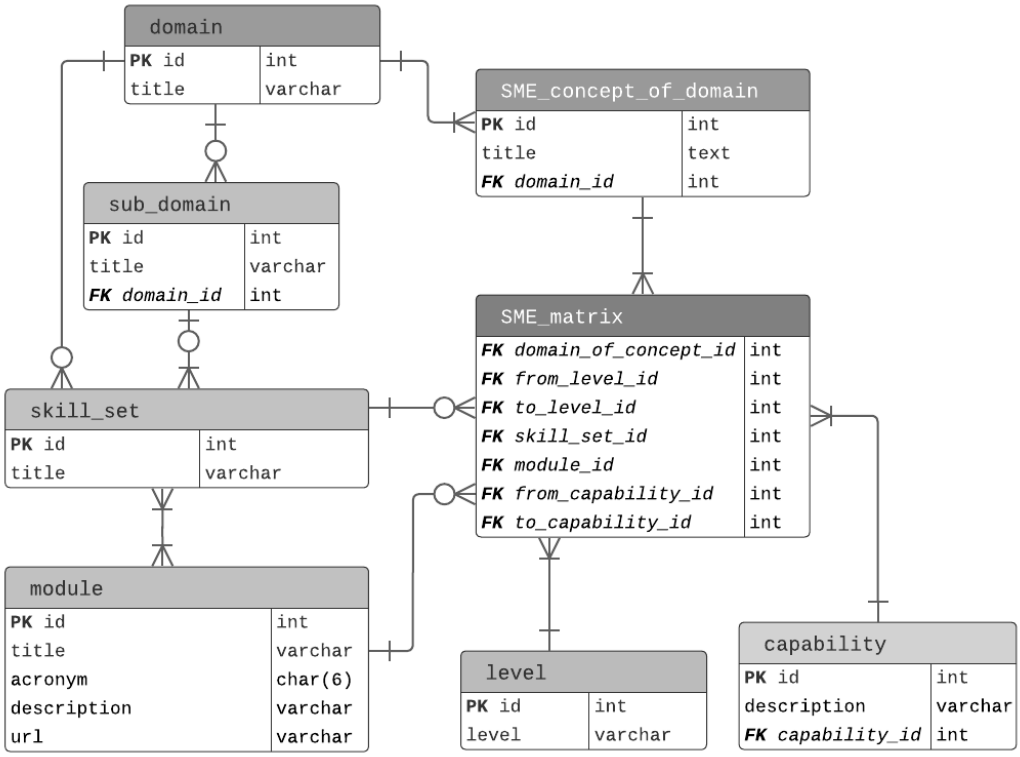

Figure 15 – SME part of Shyfte 4.0 ERD.

Notice that some fields of the Module entity have been removed just to simplify the schema. Now, having the Shyfte concepts and a database model well defined, it's time to dive into the service layer. These services will be the ones with the intelligence to work with the data stored in the database and provide the functionalities, more specifically, the generation of the Skills Questionnaire, the Skill Gap Analysis and the generation of the Training Programme.

3.2.4 Service layer

In this, will be presented in detail, the characteristics of the main services to be implemented according to the chosen architecture. Since the architecture follow a Micro-services Pattern, the services are called as Microservices and are exposed by REST API Interfaces.

3.2.5 Final Architecture

When thinking about which architecture the application would be based on, one of the biggest concerns was to guarantee some specific requirements such as modularity and interoperability. In order to ensure the mentioned requirements, the adopted architecture will follow the Microservices/API Gateway pattern with microservices exposed by REST inter-faces.

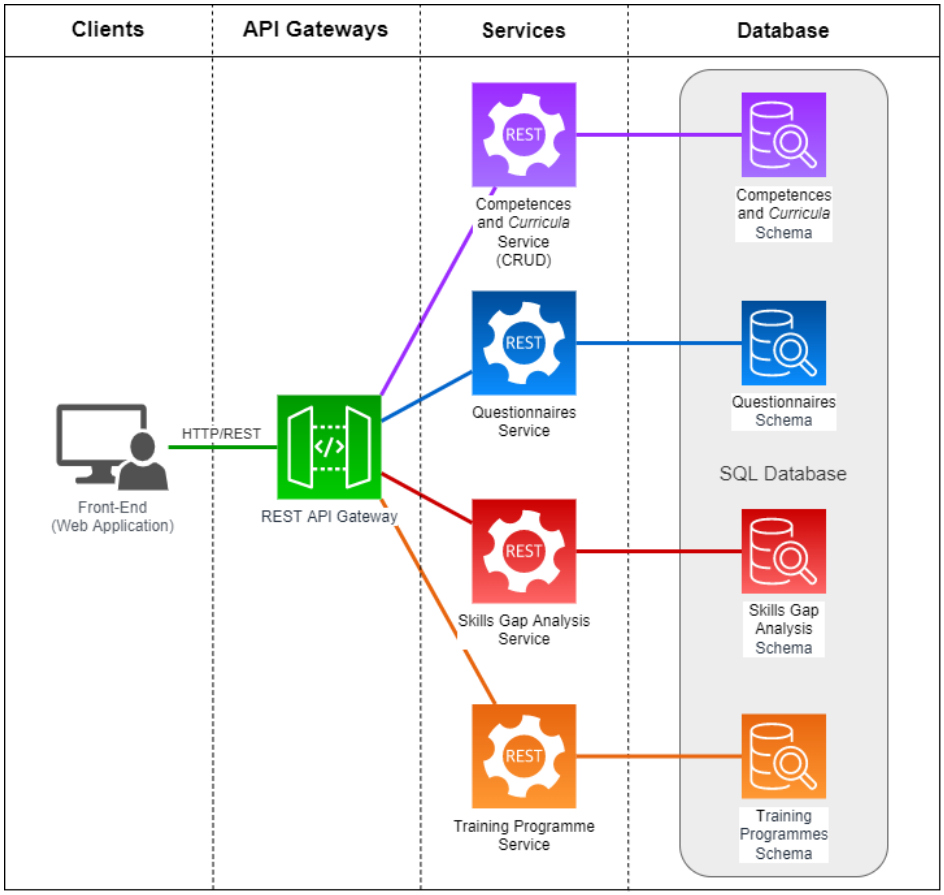

Figure 16 – Learning Center Architecture.

4. Conclusion

The Learning Center to develop is a set of university contents about technology and aims to give the right knowledge to individuals and organizations. It isn't just a place with some data gathered about courses of a university with no extra piece of information to help the user. It is designed to generate the right path for a user to take towards it specific goal.

The way it should work is that it lets the users answer questions about their purpose and what they want to achieve. The users can specify what kind of domain they are interested in and after that what kind of goal they are really searching for. Doesn't matter if it is a specific job, or a competence of a job, or even just a particular skill set they need.

The literature review showed that there is still a lack of studies in the development of methodologies and frameworks that considers sensitive topics centred on the student, such as the sensing of student emotions and attention. Furthermore, the literature evidenced a tendency to combine theories in order to fill gaps and add new knowledge to the theoretical frameworks or models.

Considering various technological educational environments, ranging from presential learning to completely electronic learning, it seems crucial and valuable to consider frameworks or models for technological integration. In the literature, more emphasis is given to TPACK and its derivatives.

The proposed Shyfte Learning Center architecture follows a design paradigm can be seen as a governing approach to design a logical solution; composed of a set of complementary rules or principles that collectively define an approach represented by the Services Oriented Application.

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