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# Enabling Collaboration with Enterprise Architecture and Interoperability: Digivisio 2030 Programme in Finland

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**Abstract**

Digivisio 2030 is a joint programme of higher education institutions (HEI) in Finland with an objective of creating a national digital service platform. The platform will enable compatibility of digital services, provide guidance based on digital pedagogy and curricular data as well as learner's data, and make the data available for individuals and society.

Interoperability and adhering to standards are important principles of the common enterprise architecture of Digivisio guiding the development of the digital service platform. Integrations should be consistently implemented to ensure the interoperability of information systems, improve data quality, expedite processes, and reduce manual labor. Technology solutions must adhere to the selected standards, support interoperability, increase the ability to manage systems, enhance user satisfaction, promote information security and privacy, while also being justified from an overall economic perspective.

International standards cannot be taken "as is" to make the basis of the operational model concerning students and their study rights. National legislation in the field of higher education varies between countries, and this field is usually quite strictly regulated. Thus, interoperability support on the international level is a balancing act where there is a need to find a common denominator and enough flexibility to allow extensions for local or future needs.

The presentation suggests that a common integration architecture in Finland built with a mapping to selected international standards will enable national integrations with international systems such as the Europass platform. The same issues that need to be solved on the national level will have to be solved on the European level as well. The changes need to be implemented on multiple levels, including legislation, processes and operational models, as well as the technical and infrastructure levels.

# 1 Overview of Digivisio's goals

Involving all Finnish higher education institutions, Digivisio 2030 is a joint programme whose aim is to create a future for learning that benefits the HEIs, learners and our society as a whole. The purpose of the program is to enable learner-centric, flexible learning paths and make higher education accessible for different learners. Digivisio 2030 is a part of national policy programme to digitalise continuous learning in Finland (Ministry of Education and Culture of Finland, 2021).

The objective of Digivisio 2030 is to create, as mutual and stakeholder cooperation:

1. A national digital service platform that
    a) enables the compatibility of digital services between HEIs,
    b) provides a “My Data” service for the learner and integrates the accumulation of the learner’s competence before and after the higher education in the learning and career path, and
    c) improves the compatibility of the actors' IT services and lowers the threshold for utilizing national solutions.

2. Guidance based on digital pedagogics, the learner’s path and shared data, which
    a) supports studies and student well-being regardless of time and place and in an accessible way,
    b) introduces AI solutions to aid the guidance, and
    c) places the learner's benefit at the centre of development.

3. Support for change management for HEIs, so that we can
    a) introduce the national digital service platform,
    b) digitize student administration processes and admission to higher education,
    c) support the evolution of HEIs into open communities managed by information, and
    d) make data available for individuals and the society.

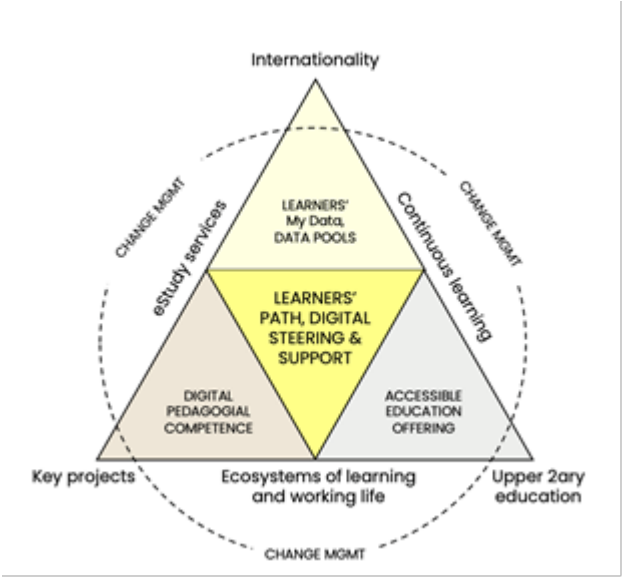


**Figure 1: Digivisio 2030 framework**

With the implementation of Digivisio 2030, Finland will have an open and recognised learning ecosystem in 2030, with quality, diversity, flexibility, efficiency and relevance to different life situations and needs, delivering ever better learning outcomes. The learning ecosystem will also provide a platform for research, artistic work and innovation for the broad benefit of individuals, society and working life. In order to make this ecosystem to happen, change needs to be driven on multiple levels: legislation, processes and operating models of collaboration between the HEIs and the technical and infrastructure levels. Enterprise architecture and interoperability are the key tools.

## 1.1 Continuous and Flexible Learning Tray

The target state of Digivisio 2030 will be developed gradually, using agile development methods in both functional and technical development. There will be several technical releases that are co-created and piloted with pilot HEIs. Every HEI can apply to become a pilot, and the General Assembly of Digivisio 2030 decides which institutions are chosen. All HEIs can observe the pilots, and the key findings as well as the learnings of the pilots will be shared via a change program that aims to support the change management and deployment of the services in all HEIs.

The first implementation of the Digivisio programme is the Continuous and Flexible Learning Tray. The aim of the new digital service is to combine the continuous learning offering of Finnish HEIs so that learners can access it easily and effortlessly in one place.

In the new service, learners can view and compare the HEIs' education offering that does not lead to a degree, find education offering that meets their situation, schedule and competence needs, and select a Finnish HEI whose offering they value highly and trust to be of a good quality as a partner in continuous learning.

The new service enables HEIs to achieve a wider and more diverse learner base, make their operation more efficient by utilising the data collected by the service, and develop a more versatile offering that can respond to the different motivations and interests of continuous learners.

The continuous and flexible learning tray combines several technical solutions that build the basis for the digital service platform. The platform will later be expanded to multiple uses of data and applications.

- The educational offering service enables the presentation of the offering of different HEIs in a similar way, thus making it easier for the leaner to compare different offerings and choose the most suitable for the learner's personal situation.
- The identity management service enables authentication via the learner's user-centric identity and provides a single identity for the learner which is used across the HEIs. This also makes it possible to simplify and improve the efficiency of administrative processes between HEIs.
- The My Data service gathers the learning-related data of the learner in one place and enables a personalised service experience and transactions by tapping into the learner's existing knowledge and supplementing it in the process.
- The guidance services form the tray's recommendation engine to promote the alignment of supply and demand.
- The joint application and registration services improve the learner's progress up to the registration, the payment and the attachment to an institution, that is, the implementation of conversions.
- The data platform collects the data required by the Continuous and Flexible Learning Tray from source systems and returns updated information to them. Data stored on the platform could also be used by other actors and software in later stages.

The first technical release will take place during the spring 2023.

# 2 Interoperability at the heart of Digivisio's enterprise architecture

Digivisio 2030 is the first development programme in the Finnish higher education sector that brings together all HEIs, aiming at both functional and qualitative change in the development of educational offerings and new digital solutions common to all institutions.

With Digivisio, shared information and common platforms will enable rapid and cost-effective development of services, while interoperable data models between HEIs will allow solutions to be used by all learners, wherever and whenever they need them. In order to achieve this goal, the HEIs must jointly agree on significant changes to such matters as how teaching is offered, how the learner can select study modules, and how the architecture of the underlying information systems is built.

The enterprise architecture of Digivisio serves as the basis for all development and has been worked on in a smaller group formed by experts from the HEIs, but at the same time actively involving all HEIs and key stakeholders. Both national and international reference architectures are used in the architectural work and the modeling has been done using general standards (TOGAF, Archimate3, BPMN etc.). To combine the enterprise architecture work and agile development Digivisio applies methods of SAFe framework, which are focused on balancing intentional and emergent needs and requirements during the development process (Scaled Agile, Inc., 2023).

The enterprise architecture is built on the basis of the work previously done by the higher education sector, complementing it in terms of the services produced in the programme. These services are positioned as an integral part of the existing business, data and information system architecture of not only the HEIs but also of the national level more broadly.

Therefore, at the heart of the enterprise architecture of the Digivisio programme are interoperability and the programme's service promises. The role of the architecture is to support the implementation of the Digivisio strategy. The solutions implemented on the basis of the architecture must be interoperable and form a comprehensible whole for the education sector. The architecture shall take into account the identified linked architectures and be semantically interoperable with the identified connected architectures. The digital solutions will use existing standards and will be developed taking into account and exploiting common national solutions.

The enterprise architecture of Digivisio aims, as a first step, to address the national barriers on the learner's path. To ensure that the learner pathway runs smoothly internationally, information systems and approaches must also be compatible on the EU level.

## 2.1 Benefits of interoperability and use of standards

The common architecture principles of the Digivisio 2030 programme include several interoperability principles. The benefits of interoperability are described from the perspectives of service quality, manageability, and costs. Because the HEIs in Finland have gained experience in collaborating on the development of many shared services over the past 20 years, the significance and benefits of interoperability work are easy to recognize and share.

The essential principles that are directly linked with integrations:

**The integrations are implemented consistently**. Integrations should be consistently implemented, and overlapping integrations should be avoided. System-to-system integrations are primarily done through an integration hub or service bus. Consistently implemented integrations that utilize integration hubs or service buses ensure interoperability of information systems and enable the sharing of data between systems. The integrations connect systems, thereby improving data quality, expediting processes, and reducing manual labour.

**The technology solutions are interoperable and compatible**. The software and hardware must adhere to selected standards and be fundamentally aligned with the choices made in the education sector. The standards support interoperability, increase the ability to manage systems, enhance user satisfaction, promote information security and privacy, and enable support from multiple vendors while also being justified from an overall economic perspective. Interoperability standards and industry standards are followed unless there is a compelling reason to apply a deviating solution. We promote the interoperability and compatibility of data, applications, and technology.

The HEIs have a will to adhere to the standards. The non-trivial question of what standards are selected is discussed in the next section.

## 2.2 Background for the selected standards

As the work on interoperability did not start with the Digivisio 2030 programme, it is important to value the work previously done by Finnish HEIs. There have been several steps in history that have advanced the semantic uniformity of educational data. The Bologna Process and the aims of the Bologna Declaration directed the development of credit system and curriculum data (Ministerial Conference in Bologna, 1999). The implementation of these requirements initiated a national cooperation with the Finnish HEIs resulting in common specifications (titled *M-määritykset*) and XML-binding documents in the years 2004–2010 to ensure interoperability with the ECTS system.

The next important effort was to develop abilities to enable the use of the national data warehouse service for education (VIRTA) that was launched in the spring 2014. The data contents and the use of

the data resources of the VIRTA register are regulated by legislation, and all HEIs under the governance of the Ministry of Education and Culture use the VIRTA register to store a copy of a part of their student register. Related to this work, the HEIs produced a common data model (XDW), which was applied to the VIRTA integrations and other services (CSC - IT Center for Science, 2014).

The data needed in application systems was specified in a more uniform format when the Finnish national Studyinfo service was developed and launched by the Finnish National Agency for Education to cover the study programme information of all education providers in secondary and tertiary education. In this work, the international Metadata for Learning Opportunities (MLO) standard was used as a basis for data modelling and the development of APIs (European Committee for Standardization, 2008).

In the years 2017–2020, the Finnish HEIs developed the Cross-Institutional Study Service as a centralised and standardised service for transferring information on study provision, enrollment and completed studies between the HEIs to support national student mobility. In this work, the previous standards and specifications were used and extended into more detailed level to specify common APIs in the JSON format. The integrations from the HEIs' student information systems to the Cross-Institutional Study Service are currently in deployment phase.

The Ministry of Education and Culture has organized a working group to maintain the common vocabulary OKSA in Finland for the whole educational sector since 2010 (Ministry of Education and Culture of Finland, 2021). These definitions and terms in OKSA are used by default, if they are applicable.

As these specifications are largely used by the current student information systems with existing integrations to common services, it has been a natural choice to rely on them in the current selection of standards. As this historical development is rooted in the ECTS work, there is an interest to map the national data model of the HEIs to the international standards as well. A more detailed analysis concerning the MLO standard for learning opportunities has already been made, and the mapping in the level of data fields has been done in the Digivisio 2030 programme with the representatives of the Finnish National Agency for Education. The aim is to transfer the data needed by all relevant services for applicants by using the common integration platform produced by the Digivisio 2030 programme.

# 3 Development of the common data model

Developing a common integration architecture that will be realized in APIs and deployed into production in many services operating together is a multi-faceted task. One can distinguish several points of view that need to be addressed when the common data model is designed and deployed.

- **Data requirements driven by organizational priorities**. What kind of data is needed to support the target processes? Is the data already available in the master systems? When is the data created in the processes?
- **The understanding of the data by the interest groups**. What user groups does the data concern in the services and user interfaces? How to present the data to the users in such a way that the understanding and the need of the data can be validated properly? Do we understand the practices of the users to support the creation of the needed data without extra work on their behalf? If there are new areas of data, do we have methods to test the draft version of data model in practice to validate presumptions?
- **Coherence and uniformity of data.** Is there an existing definition for the needed data in the used standards and specifications? If the existing specifications need to be extended, are the extension-possibilities built in the models?

- **Policies of the stakeholders.** If the target process needs development for both the systems of the HEIs and common services to cover the new data needs, there is a need to discuss about the roadmaps of the HEIs systems and how the new functionalities can be adopted in the organizational practices of the HEIs after the technological development is ready.

The basic architecture for the Digivisio services in relation to other services for the development version 2.0 is described as follows. One key feature is the ability to use the APIs of common integration platform to interact with other systems, according to the needs of the HEIs.

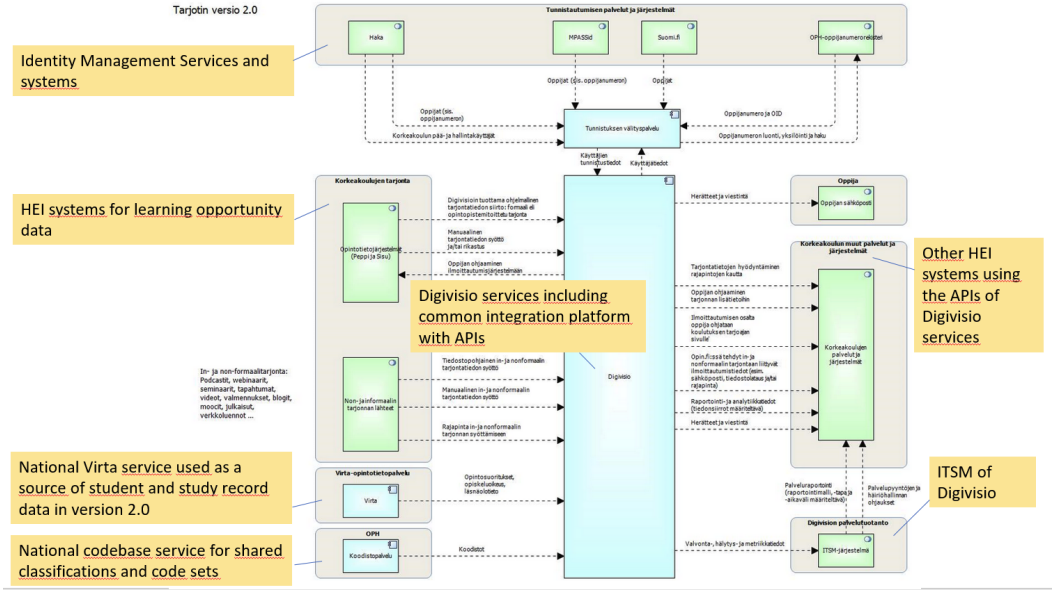


**Figure 2: The Digivisio 2030 system architecture (v. 2.0)**

The work towards a common data model in Digivisio 2030 started with workshops in 2021–2022, where the essential features of previous specifications were collected to detect new requirements and areas that needed modeling. The aim is to combine the earlier models as a coherent whole with a uniform notation and extend the model according to new needs.

When the development of services started, the data modelling was organized as a part of the programme in the following manner:

- An architect group produces graphs and mapping tables, supporting material, real-life examples. The described partial model covers the needs of a certain version and is treated as a draft at this stage. Substantial parts of the model are usually already in standard use. The draft version is discussed with different groups.
    - design & development teams within the programme
    - pilot groups of the HEIs that are organized according to the different versions
    - architects of the main cooperation partners (Sisu, Peppi, Studyinfo)
- Feedback on the proposed solution and data model is gathered from the larger community (HEIs and other stakeholders). The basic forms for this are
    - presentations and discussions of the model explanation of the logic behind the modeling decisions

    - more formal commenting phases for the HEIs and stakeholders
- The planned solution and data model are validated through implementation, testing and piloting.
    - New data is put into test in the implementation and testing of service versions.
    - The semantic validation is done with the HEIs participating in the pilots, and the results are presented for the larger community.
    - There may be changes to the solutions and data model based on experiences, which is normal in iterative development.
- Large-scale adoption of the solution and data model requires the decision to "go live" in the production environment.
    - When the model is deemed valid for the intended purpose according to the empirical evidence the model and the APIs can be used in production.
    - This means that the model becomes more stable and changes to the model and APIs are managed considering the integrated systems (Peppi, Sisu, Studyinfo), and possible requirements to make changes to them as well.

In the work so far, we have detected some new areas where new solutions need to be developed. One important example involves the learning outcome descriptions where basic textual descriptions have become business as usual. The adoption of formal classifications or ontologies to describe learning outcomes, in terms of skills and competences for curricular elements, is still a new phenomenon. At this stage, we have recognized the need to support technically simultaneous use of multiple vocabularies, which is enabled e.g. in the EDCI format for credentials (European Commission 2023). Technically, it is a fairly straight-forward task to create a generic structure to transfer multiple values from several controlled vocabularies as metadata for course units and other elements, but it is a more challenging task to create the supported processes where classification can be done as a part of the curriculum design.

# 4 Possibilities for international cooperation

Experience from earlier work shows that international standards cannot be taken "as is" to make the basis of the operational model concerning students and their study rights. National legislation in the field of higher education varies in different countries, and this field is usually quite strictly regulated, which means that the applied standard usually needs to be extended and/or altered. Also, the changing operational needs of the users should drive the development of the services, and the data model should reflect this development. Support for interoperability is a balancing act where there is a need to find a common denominator and enough flexibility to allow extensions for local or future needs.

Because of the historical development and the impact of the ECTS system, there are good possibilities to map the essential data to international standards. For example, the piloting of the European Digital Credentials Infrastructure (EDCI) model has proven that the required mandatory data can be produced from the student information systems. Another set of standards that are currently examined are the 1EdTech standards.

The development of a common integration architecture in Finland will enable national integrations with international systems such as the Europass platform. It is a realistic goal that in the future, we may have the relevant data for operational purposes on a common integration platform uniformly from all HEIs in Finland. Thus, the mapping from the more complex national data model to a "common

denominator" could be made centrally. This could also be achieved in other countries with centralized or shared solutions. If we can find a relevant set of international standards as a common denominator for the HEIs in Europe, there is a good possibility to avoid separate solutions and duplication of effort and costs.

The European Universities initiative is currently funding 44 alliances with around 340 HEIs in the EU member states, Iceland, Norway, Serbia and Turkey, and the numbers are increasing due to the 2023 Erasmus+ European Universities call (European Commission 2023). There is a real risk that the alliances end up developing network-specific solutions to support their cooperation needs. If we can address these questions within EUNIS and facilitate discussion with the information system architects in European Universities alliances, we could guide the development to the use of standards.

The same issues that need to be solved on the national level will have to be solved on the European level as well. And the changes need to be implemented on the same levels of legislation, processes and operating models, as well as the technical and infrastructure levels.

# 5 References

CSC - IT Center for Science (2014). *Korkeakoulujen tietomalli 2.4*. Retrieved April 14, 2023, from: https://tietomalli.csc.fi/.

European Commission (2023). European universities initiative. Retrieved April 14, 2023, from: https://education.ec.europa.eu/education-levels/higher-education/european-universities-initiative.

European Committee for Standardization (2008). *Metadata for Learning Opportunities (MLO) – Advertising.* Retrieved April 14, 2023, from: https://joinup.ec.europa.eu/collection/european-committee-standardization-cen/solution/metadata-learning-opportunities-mlo-advertising/about.

European Union (2023). *European Digital Credentials for Learning.* Retrieved April 14, 2023, from: https://europa.eu/europass/en/stakeholders/european-digital-credentials.

Ministerial Conference in Bologna (1999). *1999 Bologna Declaration*. Retrieved April 14, 2023, from: http://ehea.info/page-ministerial-declarations-and-communiques.

Ministry of Education and Culture of Finland (2021). *Jatkuvan oppimisen digitalisaatio-ohjelma*. Retrieved April 14, 2023, from: https://okm.fi/digipalvelut-ja-ohjelma.

Ministry of Education and Culture of Finland (2021). *OKSA - Opetus- ja koulutussanasto (2nd ed.) (terminological vocabulary)*. Retrieved April 14, 2023, from: https://sanastot.suomi.fi/en/terminology/72df0ad6-c358-4c09-9b29-83e9722acc91.

Scaled Agile, Inc. (2023). *Agile Architecture*. Retrieved April 14, 2023, from: https://scaledagileframework.com/agile-architecture/.

# 6 Author biographies

**Sami Hautakangas** works as a Senior Specialist in Services for Educational Leadership at Tampere University. In Digivisio 2030, he has a specialist role in the development of information architecture. He has 20+ years of experience in the development of higher education and the digital support for processes. Sami Hautakangas has experience in several national cooperation projects of HEIs in Finland and has participated actively in the development of national specifications promoting interoperability between the HEIs' information systems.

**Hanna Nordlund** works as a Programme Director of Digivisio 2030. She has 10+ years of experience in leading digitalization programmes in education and also in the healthcare and social services sectors. She has also led the development of national digital services in both sectors. Hanna Nordlund also has experience in portfolio and project management and managing organizational change projects as well and managing process development projects in both private and public sector companies. She has worked as a researcher focusing on leadership and innovation management. Hanna Nordlund has a PhD in business administration. In her dissertation, she studied customer understanding in the early phases of innovation process.