

Using enterprise architecture and capability models in higher education: case studies from the EUNIS community

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Abstract

There are important lessons to be learnt from actual implementations of enterprise architecture and capability models in higher education. In this paper we draw on three different case studies from France, Finland, and Spain respectively, showcasing both commonalities and important differences. The examples showcase use cases as well as the organisations and processes behind the developments

We argue that one important contribution from these European examples is an understanding of the national differences that need to be accommodated in a standard such as the recently introduced higher education reference model (HERM). One aspect that also becomes obvious from a European perspective is the need for translations—and how language use is closely connected to local variations in the Higher Education models.

1 Background

Enterprise Architecture (EA) is a high level, strategic technique designed to help senior managers achieve business and organisational change.

A reference architecture, described using an EA approach, is the overall blueprint for an organisation. A capability model summarises the most essential operational components.

Together these components give a holistic view of an organisation allowing stakeholders from different parts of the organisation to plan and deliver major change projects using a common understanding of use cases and priorities.

EUNIS EA SIG has been working with international partners UCISA (UK) and CAUDIT (Australia and New Zealand) to translate and localise their higher education specific models.

You should read our introductory paper “Higher education institution capability model: helping business and IT leaders speak the same language” to find out more about these approaches generally and their use in higher education.

This paper looks at the experiences of early adopters of these techniques within the EUNIS community. We consider examples from Finland, France and Spain. Some of the early adopters have been working with the common models and some have undertaken their own developments. We look at the lessons learned from each of these experiences and how this can feed into future work

2 France

France has had an active EA community within higher education for a number of years.

EA activity was initially stimulated by the French government's Digital Directorate which has promoted an EA approach in Public Administration since 2012 by publishing a framework called “Cadre commun d'Urbanisation du SI de l'Etat” (Framework for a common IS government EA approach). This framework is part of a set of other frameworks dealing with issues such as interoperability, data repositories, security, accessibility etc.

At the same time, the French Ministry of higher education led an initiative to apply part of this to teaching, learning and research¹ (Comité d'orientation numérique (CODORNUM), 2018). Within the higher education Enterprise Architecture community, the group is led by a public mutualisation agency (Amue*) and a professional association (Csiesr†).

This group, called the "urba-ESR group", brings together more than 100 representatives from universities, schools and research organisations. The group is not only aimed at enterprise architects (who are in fact very few in the group and in the French ESR community [[‡]]) but to anyone interested in the subject of enterprise architecture and its implementation within their institution.

The group's objective is to foster the EA initiative within the French Higher Education community. This is done through the publication of outreach documents or works on specific subjects such as the evaluation of maturity in terms of urbanisation within the Higher Education community, data modelling, benchmarking of enterprise architecture tools etc.

One of the main activities of the group was to implement the higher education part of the business capacity model proposed by the Framework for a common IS government EA approach (see below)

* <https://www.amue.fr/>

† <https://www.csiesr.eu/>

‡ A survey conducted in 2020 by the group showed that only 18% of the respondents have an enterprise architect

2.1 National model

The French government's Digital Directorate EA framework is based on an Informational System description according to a 5-layers model, and provides a set of rules and recommendations to help public administrations implement an EA approach, whatever the domain (culture, education, higher education, agriculture, budget, defence, military, foreign affairs, justice etc.)

Part of this framework is dedicated to the description of a French BCM called POS (Plan d'Occupation des Sols). This model maps the French Public Services in a classified way. This model is based more on functions or activities than on capabilities. Its aim is to propose a classification and a vocabulary for activities shared by all members of the French public administration.

The different kind of activities are grouped within three main domains: "Steering", "Core business" and "Support". Those areas are complemented by "Shared data" that gathers the data that are shared within the organization as people, organizations, facilities or classifications.

The last one is the "Exchange area", that spots the organizations interactions with the outside (users, stakeholders, partners, ...) but also the means to achieve those exchanges like "identity and access".

A task force from the "urbaESR group", composed of a dozen organisations (universities, research organisations and engineering school) and led by Amue and Strasbourg University, tried to use the common model for enabling capabilities as far as possible. They did however need to add higher education specific activities in the core business area. Activities added included: Teaching and Learning; Research and Cultural Conservation (i.e. libraries, archives and museum collections management).

After several years work, the group is ready to propose a BCM (or Business Activity Model) suitable for any Higher Education French institution.

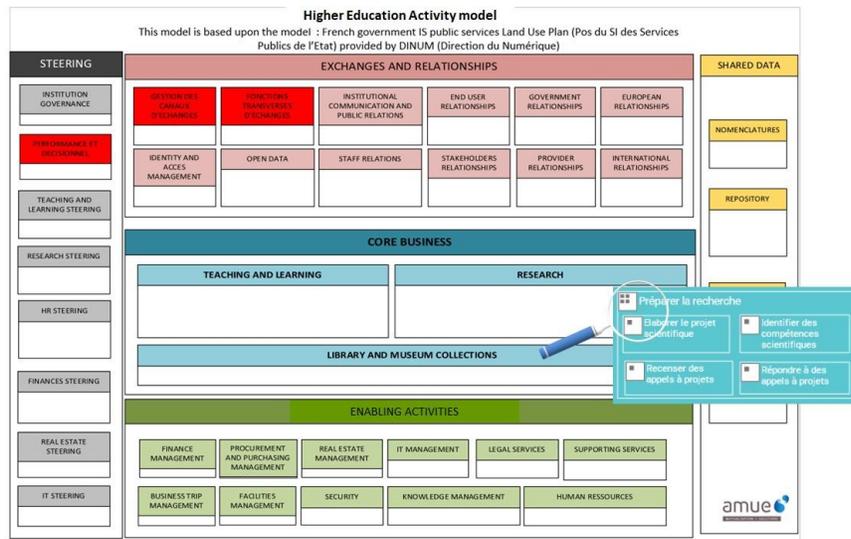


Figure 1: Plan d'Occupation des Sols (French Business Activity model)

The beta version has already been used for some years, mainly by Amue, and it is hoped that the tool soon can be used by all higher education organisations. One of the expected benefits is that within

an organisation it will allow communication between governance, information systems and other staff through the use of a common vocabulary and classification.

Some practical use cases of this local BCM are described in the next chapter.

2.2 Using the French BCM (POS) to prefigure IS interoperability

Based on the French BCM model (POS), Amue have produced a series of views focused on particular business areas (finance, human resources, Learning and Teaching, etc.). These views, powered by HOPEX(MEGA) tool, are extracts of the full model that show only the domain activities plus the activities that interact directly with it. Each view is completed by an excel file giving a precise description of each element represented.

This level of representation, which is not very IT-oriented, facilitates interactions with the stakeholders and allows them to describe in a literal way the information they exchange with each other and for what purpose.

All this information is then used to build a functional map (using Microsoft Visio) showing the interactions between the different functional activities and the business objects exchanged, using the same vocabulary as the model (POS).

Not all these interactions will be automated within the IS, and some will only be automated on the “to-be” IS, but this use case has made it possible to offer all the stakeholders a shared vision of the functional exchanges of one domain with the others.

This communication tool can be further enriched to show, when they exist, the applications that cover the functional activities and thus reinforce the “IS point of view” of the map.

Amue also used the French BCM (POS) to quantify the Information System functional coverage and detect functional architecture weaknesses.

For this IT-oriented objective, the complete model or an extract (as described above) can be used, depending on the objective to be achieved.

These views, powered by HOPEX (MEGA) tool, link applications and functional activities and display the features of the application.

Associating an application with its functional area reveals the strengths and weaknesses of the functional coverage by IT in a very visual way.

It is easy to see at a glance the application coverage of a given functional area, which highlights the areas that are correctly covered and those on which the application effort should be focused.

On the other, in some cases, one functional area is associated with more than one application, which may reveal duplicate functionalities.

This view is not a real working tool for the enterprise architect (because it is not technical enough) but is useful for communication with the CIO and/or staff, when it comes to identifying areas for IS improvement.

2.3 What are the next steps for the EA French working group?

After years of working in a small group it is important that the group gets peer validation of this work. Presentations of the model will be organised for this purpose but also to promote the model within the Higher Education IS community. The group is also considering which governance system would be best to consider feedback or requests for changes to the model from users. Finally, support from

Ministry of Higher Education, Research and Innovation is sought in order to increase the legitimacy of the model.

3 Finland

Finland has a national EA SIG [§](founded 2008) and active EA practitioners in many universities. The leaders of EUNIS EA SIG are based in Aalto University (Patrik Maltusch) and the University of Helsinki (Esa Suominen).

3.1 Initial start of joint efforts

The joint information management development project RAKETTI (Supporting Structural Development) was launched in autumn 2008. The RAKETTI steering group's letter of appointment (June 4, 2008) stated that the realization of the goals for the Structural Development of Higher Education Institutions requires higher cooperation between the Ministry of Education, higher education institutions and information management.

3.2 Enterprise architecture specific result from the joint efforts

The joint effort program brought the community together and enabled to share knowledge about interoperability and the enterprise architecture methodology. Below are some outcomes and tangible results that we even today 14 years later still can refer to:

1. Kartturi ^{**} - The Methodology Guide for the Enterprise Architecture of Higher Education Institutions is an overall architecture model adapted to the university field. The aim is to support and guide the development of the structures and operations of higher education institutions to achieve the goals set in the strategy. (Korkeakoulujen KA-Pilotti & KA-SIG & CSC - Tieteen tietotekniikan keskus, 2013)
2. The reference architecture for university support and teaching support services and administration describes how the processes, services, main data, actors and roles in the area work together in the university field.
3. The operational architecture of research and research administration describes the strategic goals of the research administration area of higher education institutions and the functions and processes that support them.

3.3 National system survey

In Finland a yearly survey of higher education sector systems and licences is conducted and covers 99% of all Higher Education Institutions. It contains more than 3000 unique information system and software items.

The report is a manual activity performed by each organization and then compiled centrally by the national Licence-SIG. The survey has been developed based on feedback from the whole sector and in the last two years it has been extended with enterprise architecture artifacts. The most recent addition is the mapping of pre-defined system services and adapting to a Capability model structure. The mapping has been done towards the UCISA model. This mapping is visualised in a PowerBI model extracting the various systems and mapping them into a canvas like view.

[§] <https://tt.eduuni.fi/sites/kity/SitePages/Home.aspx> - Login site to EA-SIG

^{**} <https://www.finna.fi/Record/3amk.82461/Versions?lng=en-gb>

There are some weak points in the manual collection of data. These challenges relate mainly to semantics because each organisation is free to describe its system landscape in a different way. One successful initiative has been to provide preassigned categorization on previous years answers and then apply them to the next year's survey. Additionally, the structure mimics the reference architecture for services published in 2016 by the national EA-SIG in Finland, which also has been preliminary mapped to the Capability model.

With the collected data the national EA-SIG has been able to build a canvas that is interactive and can display 3 levels of architecture state: current state, target state and implementation phase. It also allows a flexible comparison using any attribute of the survey in any combination with a fixed structure.



Figure 2: Drill down of Current state viewpoint (Education) - UCISA 2.0 Capability model

3.4 Use in Aalto University

Aalto University ^{††} was established in 2010 through a merger of three universities. From the beginning, enterprise architecture was identified as a useful approach to support the fusion and merging of functions. Having proven its value, the methodology of modelling went on to have, and still has, a key role in driving digital transformation at the university.

Aalto University has an in-house capability model that has been used since 2013. Its origins lie in insights provided through using the TOGAF ^{†††} reference architecture.

The University had ambitious transformation plans and there was a business need to make visible the change impact of each of the planned projects. More than 10 projects (+5M€) were running simultaneously, introducing change to existing operations and building new capabilities at the same time.

Back in 2013, the term capabilities weren't yet in use, instead they were semantically understood more as services or processes. What was clear was that the scale of these planned projects posed a serious resource challenge (+200% resource allocation) and a high risk of failure of mission-critical development actions.

The University needed a standardised way to describe, and especially visualize, the operational landscape and project impact in order to minimize overlapping change requests.

Documenting the landscape (as-is) and change (to-be) using an architecture repository increased understanding and highlighted the need for a relational schema to ensure analysis of change could take place systematically across projects and functions.

This work resulted in an Operational Development Model with a set of capabilities (25) describing operations in the simplest way. These capabilities describe the core activities supporting digitalization at this university.

The defined capabilities are not equal in scope e.g. study life-cycle is much larger than printing. It was challenging to achieve the right balance of capabilities when new to working with the concepts and pressed for time. In effect, one part of the organisation was trying to describe another unit's use of resources.

^{††} <https://www.aalto.fi>

^{†††} <https://pubs.opengroup.org/architecture/togaf9-doc/arch/>

Regardless of these limitations, and liberty to broadly define what a capability is, it was possible to “glue” strategic mission, portfolios and programs, processes, roadmaps and systems into one “big relational picture” enabling a holistic view from any angle of operations. The learning from using capabilities helped the University create compelling transformation roadmaps that link strategic goals all the way down to system functionality.

To address these challenges demands a model that is more business focused than the original model which is oriented towards IT operations. Using established semantics and descriptive definitions shared across an industry is more likely to find acceptance and adoption with leadership. Therefore, the next logical step is to update and upgrade the in-house capability model to a global business capability model.

There have already been efforts to align this work towards the HERM model capabilities and we are expecting to get results already before end of 2022. As we have already a working model the transformation is more in the detail validation of single capabilities rather than validating the new model.

3.5 Use in University of Helsinki

University of Helsinki was established in 1640. It is the oldest and largest university in Finland with the widest range of disciplines available. Over 31 000 students were enrolled in the degree programs of the university spread across 11 faculties.

Enterprise architecture work began in the early 2010s. At the heart of the work is to support digitalization from the current state towards to target state. An earlier viewpoint to architecture has often been an organization unit's perspective. For example, information system maps were visualized according to the organization unit that owns the systems. This perspective has been too narrow, because there is an increasing need to see the overall situation/picture not limited to organization silos. Since 2020 the enterprise architecture work has been implemented using the capability model as a structure and the architecture descriptions and the organization viewpoint alongside. First the UCISA Capability Model was implemented, but currently the HERM Business Capability Model is under implementation.

The focus in enterprise architecture work has been on the current state descriptions, mainly due to the Act on Information Management in Public Administration that requires public organizations to describe its information management model. The Information Management Model of the University of Helsinki is a description of processes, information pools and information systems. It describes the dependencies between these elements and will be used as a tool for impact analysis when changes are planned in the organization. The Information Management Model also documents the people responsible for each process, information pool and information system.

The advantages of using the capability model as a fundamental structure of the model can already be seen. For example, multiple risk management processes, information and information systems are modelled as part of the Risk Management capability. The responsibilities of these elements belong to different organizational units within the University of Helsinki. Earlier these elements would have been scattered over multiple models per organizational unit. Now the capability brings these elements together to give a better overview of crucial parts that are needed to implement this capability.

3.6 Other simple use cases: Data Balance Sheet - EA Landscape

Aalto University (FI) is using a self-composed capability model. This mapping is visualised in a PowerBI model that composes a report of the current EA landscape that is used to support an

organisation's information and knowledge management ^{§§}by describing the state of its data processing and data management practices.

3.7 What are the next steps for the EA Finnish working group?

A few possible next steps have been identified:

- Finnish translation of the HERM BC model and HERM Data reference model
- Based on Finnish translation of the HERM BC model, HE Institutes might publish Data Management map. Map can be published similar way in different institutions or in same map.
- Adapting HERM BC model to national HE institutions Digivisio 2030 -project to bring common language to the project. Work in progress.
- Adapting HERM BC model to national surveys like EA-SIG Maturity survey and System survey.

4 Spain

In 2017 the Sectoral Committee on Information and Communication Technologies of the Conference of Rectors of Spanish universities (CRUE), set up an enterprise architecture subgroup to start work on enterprise architecture for the Spanish university system.

Prior to this, awareness of EA was very low in Spanish universities so initial activities involved awareness raising and disseminating information.

The Spanish group decided from the outset that achieving business benefit was more important than achieving technical mapping.

The most important benefits were identified as being:

- Comprehensive framework for business, performance, applications, data, integration, technology, security and governance.
- to provide a comprehensive view of the university to all stakeholders
- Enables the development of systems that are interoperable and scalable
- Provides a performance framework to measure drive performance based on indicators
- Ensures departmental and interdepartmental relationships are effectively identified
- Structured way to categorize and prioritize university unit services for effective automation
- Framework to develop and deploy applications from different units in a standardized way

^{§§} <https://www.aalto.fi/fi/informaatiojajanki>

- Facilitates the optimized use of Information and Communication Technologies by the university, reducing the cost of IT and business operations by identifying opportunities for reuse.

4.1 Model and toolkit

The initiative to introduce the practice of Enterprise Architecture in the Spanish university system has its roots in the working group of directors of information and communication technologies (SIN group), which belongs to the Sectoral Commission for Information Technology and Communications (CRUE-TIC) of the Conference of Rectors of Spanish Universities (CRUE).

In a first step, the working group began to work on identifying a definition of business architecture that was simple and understandable by all the actors of the Spanish University System (SUE).

Regarding the practice of Enterprise Architecture itself, it is identified as one of the key elements for universities (in fact, for any organization), for the university system as a whole, as well as for the relationship with key stakeholders, such as the Ministry of Universities or providers of the university system.

From the beginning, a low penetration of this practice in the Spanish university system was detected, and a first clear objective was set, focused on promoting and disseminating the concept of business architecture itself in the Spanish university system as a whole.

4.2 Initial objectives

In order to have a complete toolkit, four initial objectives were identified and defined:

Reference model

The main architecture reference models were analysed (US FEA, Zachman, TOGAF). The working group studied their level of implementation and its use in several countries (Australia, Austria, Belgium, Canada, Denmark, New Zealand, India). As a result, TOGAF reference model was chosen

Modelling language

Having the reference model fixed, the next step was to identify a modelling language able to support the Reference model. Tied to this, the Archimate modelling language was selected for the EA initiative in the SUE

Modelling tool

Closing the 3 first objectives, Archi was chosen as the tool for modelling. It also has the added value, through the GitHub collaboration plug-in, to enable the possibility for universities to work jointly, building and contributing together

Capability model

Having the first 3 objectives accomplished, the working group identified the first outcome for the SUE, to provide the Spanish Higher Education Capability Map.

Two options were taken into account: start from scratch, or to look for other Higher Education capability maps to reuse one. Finally, once the working group evaluated the existing Higher Education capability maps, the working group decided to not reinvent the wheel and to create a new one, adapted to Spain and Spanish universities' environments, but starting from the existing capability maps provided by CAUDIT and UCISA.

The reason to create a new one was due to factors such as the legal nature of universities (publicly or privately funded) or cultural aspects (religious institutions, institutions with clear commercial orientation, etc.), those and other environmental aspects were taken into consideration to take the decision to create a new one.

The Spanish Capability Map v1.0, combines most of the CAUDITv1.0 capabilities, some UCISA v1.0 ones, and adds some provided by the working group.

As a result, the first Spanish capability map was based on the CAUDIT model, incorporating the commercial capabilities of UCISA, and adapting some aspects of the Spanish university system (such as basic terminology).

Communication

Bearing in mind the above, communication was identified as one of the key priorities to ensure the success of the initiative.

Communication must be modelled properly based on the target audience, so one of the first actions undertaken was to prepare some material oriented to university board, university staff, and other material more oriented to technical profiles. For both cases, the objective/goal was joint and unique, to show and demonstrate how the business architecture fits, and can add value with references from each target. Diverse material was delivered, forming an Enterprise Architecture toolkit.

4.3 Enterprise Architecture toolkit

CRUE Higher Education toolkit for University Board

The EA working group elaborated the following communication and dissemination material for university board, to highlight how Enterprise Architecture fits with the University Board

CRUE Higher Education toolkit for IT Directors – EA initiative

The EA working group elaborated the following communication and dissemination material for IT Directors, to highlight what Enterprise Architecture initiative is, and how Enterprise Architecture initiative can help/support several business domains.

CRUE Higher Education toolkit for IT Directors – EA relation with other ICT standards

The EA working group elaborated the following communication and dissemination material for IT Directors, to highlight how Enterprise Architecture and how it fits with other well-known reference standards.

CRUE Higher Education toolkit for IT Directors – ICT' Run & Grow opportunities mapped on the Enterprise Capability Map

The EA working group elaborated the following communication and dissemination material for IT Directors, to highlight how Enterprise Architecture supports the run or enables the grow

4.4 What are the next steps for the EA Spanish working group?

A few actions have been identified as a result of the work done and based on the feedback:

- Review the capability model to be aligned to HERM one.
- Data model: model the Spanish Higher Education data model in order to collaborate defining the Spanish educational Data Space, aligned to EU data space concept.

5 Summary and key findings

Capability is a great “thing” that enables to bundle process, system, resources, and information into one manageable entity. It also enforces a broader viewpoint, but at the same time gives explicit relations to what impact it might have to the surrounding when planning development actions.

Organization by default have low maturity to adapt to an EA methodology due to a more process-oriented approach where the semantic is very tied to activities. EA introduces higher level of abstractions which is not identified as “our own language” and Capabilities are facing the same challenge. The use-cases demonstrate in this paper shows that you can start with self-composed capabilities and later introduce other area specific models.

The key is the relational model describing the capability aka meta-model that stays the same despite of the naming of your capabilities to fit the organizational language. With increase of maturity working with capabilities will also lead to better adoption of more standardized models as insight to organizational information or data-literacy rises and creates much needed interoperability for sharing and consuming data.

National level initiatives are crucial to drive the adoption of common models. All displayed use-case demonstrate the value in collaboration on a broad level between the national institutions. All though it required time and dedication for such efforts, senior management and leadership are essential to sponsor these activities. Enterprise architecture discipline alone does not make the change.

Translations are vital for sharing understanding of used terminology. Native semantic is not equal to native translation and the cultural background has to be taken into account. This poses a challenge to the integrity of the original model, do we add or expand definitions.

Last but not least. Stop modelling the models – start filling them with your organizational data and communicate the outcome to validate the current state of your organization. It’s the first step to data driven decision making. Value will come if you stick to facts and solve errors in your data made visible by proven models and methodology.

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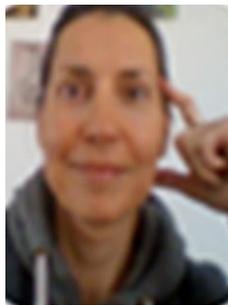
7 Author biographies



Patrik Maltusch is the head of EA architecture team at Aalto University. He is chairing the Finnish EA-SIG, EUNIS EA-SIG and has been one of the lead educators coaching administration staff in the national Higher Education EA program. Early experience, include working as a customer service instructor and further fifteen years as network architect and business owner for infrastructure design in a global Telco company. Patrik is also a distinguished and accredited security professional, risk manager, system auditor and Education Enterprise Architect. As entrepreneur and start-up facilitator he understands what staying practical means for business. For Patrik interoperability is the key to master the ever-growing digitalization needs in a more complex and complicated ecosystem landscape. <https://www.linkedin.com/in/maltusch>



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Valérie Le Strat is a member of EUNIS EA-SIG since 2020. She has been working for Amue as an Enterprise Architect for five years and was previously project manager of the student management systems offered by Amue to its members. As an Enterprise Architect, she promotes the enterprise architecture approach to Amue members as well as internally and co-manages the EA group of French higher education with the Csiesr. She is also a member of the "club urba-EA", a non-profit association that promotes interaction and good practice between enterprise architects in France, whatever their field. Valérie Le Strat holds a PhD in molecular chemistry. [https://www.linkedin.com/in/val%C3%A9rie-le-strat-](https://www.linkedin.com/in/val%C3%A9rie-le-strat-52688117)



Lluís Alfons Ariño Martín is a computer engineer with more than 25 years of experience in IT specialized in the higher education sector. Linked to the Rovira i Virgili University, in his work he fosters a holistic vision of the business, establishing the objective of adding value to the business, aligning IT in the global strategy of the university. Having different recognitions throughout his professional career, he likes to highlight the "IT career award" granted by the ICT Sector Committee of the Conference of Rectors of Spanish Universities (CRUE-TIC), for the recognition that represents the fact of that it comes from colleagues from all Spanish universities. Related to Blockchain, Lluís collaborates with the Blockchain working group of the National Association of Rectors of Spanish Universities (CRUE),

linked to the ICT Committee (CRUE-TIC), in the deployment of the BLUE network (Blockchain Spanish Universities) and he is also a member of the Spanish delegation at the European Blockchain Partnership (EBP) in the Diploma Use Case, on behalf of CRUE, of which he is also convenor

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