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## Abstract

**Purpose** – Corporate universities (CUs) have been experiencing tremendous growth during the past years and can represent a real driving force for structured organizations. The paper aims to define the process of CU design shaped around company strategy. For each step, the authors propose specific roles, activities and methods.

**Design/methodology/approach** – The paper exploits some managerial theories and past research on CUs to draw a two-step framework for their design and development process, then tests (and validating) it through action research and applies its guidelines to two different case studies.

**Findings** – The authors conclude the CU design process can be divided into two steps (development and management), with specific roles assigned to the different activities, and this allocation represents a prerequisite for the CU project success. Moreover, flexibility and potential recycles should be considered when configuring the process.

**Originality/value** – The paper is original in two ways: it proposes a framework for CU design and development (which is unique in its type) and an application of this framework to two real cases, discussing its benefits, criticalities and limitations (thus ensuring generalizability).

**Keywords** Design, Corporate universities, Corporate strategy

**Paper type** Research paper

## 1. Introduction

In a globalized world, where competition between corporations is ever greater and changes occur at a frenetic pace, employees are one of the most valuable assets for any organization, and every successful company needs to build toward become a learning-generation environment by developing its resources and attracting and retaining new talent (Teece *et al.*, 1997). Within a culture of increasing knowledge importance, corporations are beginning to structure their training initiatives in a way that was once the exclusive domain of traditional universities (Brown and Seidner, 2012); in this context, corporate universities (CUs) have been conceived.

With the diffusion of these institutions, different streams of research have been developed on the topic, especially in the form of informative works about how to manage CUs (Dealtry, 2000a, 2001a; Grenzer, 2006; Rhéaume and Gardoni, 2016) or focused exploration of a single component of CUs, such as clusters of people involved (Tuchman, 2009), governance (Dealtry, 2001b), structure (Prince and Stewart, 2002), learning approaches (Fresina, 1997; Rademakers, 2014) and reporting and evaluation (Stumpf, 1998).

Despite these relevant contributions, academics and practitioners still cannot count on a comprehensive overview of how to actually design and develop a CU.

The aim of this paper is to close this gap and to propose a process to design and develop a CU driven by the goal to develop human resources competences to support business and

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strategic goals (Li and Abel, 2011). To explain and explore these aspects in detail, two cases of CU design and implementation are discussed.

## 2. The corporate university system: configuration and linkages with corporate strategy

Among different organizational capabilities, education and skills enhancement represent some of the most powerful tools that firms can exploit to grow (Teece *et al.*, 1997). There are many ways in which people within organizations can learn and grow (Cheetham and Chivers, 2001); among the different forms of corporate training initiatives for human resource development, CUs are viewed as one of the most strategic investments an organization can implement, even though onerous (Meister, 1998; Alagaraja and Li, 2015).

As a source of learning and development for companies, CUs are generally developed to build organization-specific competencies to enhance the ability to meet business needs and performance objectives (Blass, 2005; Rademakers, 2005). Specifically, Allen (2002) defined the next-generation CU as:

> An educational entity that is a strategic tool designed to assist its parent organisation in achieving its mission by conducting activities that cultivate both individual and organisational learning, knowledge and wisdom (Allen, 2002, p. 3).

Cus' academic debate found is flourishing period in the new millennium (Ryan *et al.*, 2015), when scholars and practitioners have argued a lot about the strategic role of CUs in contributing to the organizational (and business) growth of the company (Dealtry, 2002; Jansink *et al.*, 2005) and their relationship with corporate strategy (Rademakers, 2014). In particular, some authors (Hilse and Nicolai, 2004; Walton, 2005) promote CUs as a part of the organization's human capital long-term development strategy, being able to support (with effectiveness) formal learning and knowledge creation processes within an organization. Others (Waltuck, 2003; Li and Abel, 2011) support the idea that the goals of a CU are strictly linked to organizations' strategic objectives, which can be easily achieved through human capital investments.

These perspectives fit with a key theory in the area of human resource development – human capital theory – which links investments in the organization's key asset (i.e. employees) to increased productivity and sustained competitive advantage (Lepak and Snell, 1999). This also supports the resource-based view of the firm: an organization develops its resources in such a way that they become rare, valuable and difficult to imitate to develop and sustain competitive advantage (Grant, 1996).

According to Allen (2007), this strategic dimension is what actually distinguishes CUs from traditional training departments: the mission to meet organizational objectives and priorities transforms CUs into a key organizational weapon, where training and learning are driven by corporate strategy, goals and major initiatives (Andresen and Lichtenberger, 2007; Lee *et al.*, 2010; Ben-Hur *et al.*, 2015).

However, configuring a CU is not easy because of the complexity of its system of operation (Dealtry, 2001b; Lui Abel and Li, 2012). Many authors focus on single building blocks of the CU system, such as:

- how to shape the relationship with corporate strategy (i.e. *strategic alignment*; Rhéaume and Gardoni, 2016);
- how to design the governance of the CU (i.e. *governance*; Prince and Stewart, 2002);
- how to define the population covered by the CU (i.e. *clusters*; Pedrini, 2011);
- how to design the learning plan for participants (i.e. *learning programs*; Hilse and Nicolai, 2004);

- how to decide the range of training methods offered by the CU (i.e. *learning approaches*; Rademakers, 2014);
- how and where to build the structure of the CU (i.e. *physical organization*; Dealtry, 2001a);
- how to choose the technological components supporting the CU (i.e. *technology*; Homan and MacPherson, 2005); and
- how to evaluate learning activities and outcomes (i.e. *training evaluation model*; Cheetham and Chivers, 2001).

Other scholars described CUs through classification and evolutionary frameworks with different approaches (Fresina, 1997; Walton, 2005; Allen, 2007; Abel, 2008; Rademakers, 2014), but only a few of them really provide a comprehensive view of how to design the whole CU system. With this regard, Prince and Stewart (2002) propose a detailed model (the "CU wheel") describing processes, elements, key actors and duties characterizing CUs, while Dealtry (2000b) describes the CU design blocks by adapting the 10:10 RealTime Corporate University Blueprint. Rademakers (2014) positions CU in the transformational process of "acquiring new insights, skills, routines and behaviors that help to re-establish the fit between market, the business and the organizational system", distinguishing between three types of Cus, school, college and academy, each one described in its characteristics; according to his empirical analysis, a lot of the CUs have a mix of all three types, despite a focused strategy is suggested (i.e. choose one type for supporting specific strategic goals).

## 3. Configuring corporate universities: enlarging perspectives

When setting up a CU, an interesting view is provided by Lui Abel and Li (2012), who distinguish between four types of processes (and actions) that should be implemented:

(1) organizational processes (i.e. establishing governance; creating a vision of the future);
(2) learning delivery processes (i.e. defining who the participants will be; creating a measurement system);
(3) operational processes (i.e. finding the financial sources; defining the technological support); and
(4) partnership processes (i.e. selecting learning partners).

Starting from this broader perspective, the present work proposes a structured approach for managing, in a dynamic way, the CU design process to clarify:

- the sequential steps that should be followed (in particular, when setting up the governance structure and the training programs);
- the roles that are involved and what responsibilities are assigned to these; and
- the tools supporting the execution of the design activities.

### *3.1 The framework*

The preliminary process model was designed based on past contributions on CU architectural design, which clearly distinguish the architecture definition phase from its implementation, also describing the main activities of each one (Dealtry, 2000c, 2001b; Lenderman and Sandelands, 2002; Prince and Stewart, 2002; Lui Abel and Li, 2012).

The resulting model (Figure 1) is divided into two main phases: development (i.e. design of the CU structure and blocks) and management (i.e. implementation and control of the CU functions). In the first phase, the CU structure is defined by designing: its strategy and

positioning; its architecture and learning paths; and the development of courses and training events. Once the architecture is in place, the second phase realizes the actual implementation of the CU by: enrolling employees, delivering the courses and ensuring a continuous control of CU training and learning efficacy.

*3.2 Methodology*

To explore the framework, we implemented action research (Whyte, 1991; Coghlan, 2011). With this approach, a collaborative problem-solving process is established between the research team and the company to solve problems and generate new solutions and knowledge (Rapoport, 1970). In our case, two companies were selected as part of the study: one from the construction industry (Build Engineering; BE), the other from the insurance industry (Crown Insurance; CI). The research team collaborated with these organizations during the entire research period, partly as a member of the project team and partly as scholars undertaking research. In its dual role, the research team was able to influence the design processes, analyzing activities both with the people inside the companies and other researchers outside the system (Whyte, 1991).

Consistent with the action research philosophy, the research team followed the three-step approach proposed by McNiff (2013):they defined the general structure of the design process; focused on understanding the phenomenon; and implemented (for both cases) the entire (and same) process, thus validating and refining the initial hypotheses. This iterative cyclical process has been carried out in collaboration with company representatives for all the phases, and several top managers from different business units were involved in interviews (Table I).

Data collected during the interviews were carefully analyzed to further develop the framework, which has been then implemented implanted and tested. During this process, the joint collaboration between the research and the project team enabled the iterative redefinition of the framework toward its final structure.

*3.3 Case snapshots* BE is a multinational company operating in the construction sector, headquartered in Italy and operating globally. Because of some recent strategic decisions (a slightly shift of its core business and a growing attention on project finance activities), BE required the development of new technical and managerial competencies and decided to support this objective by building an internal CU.

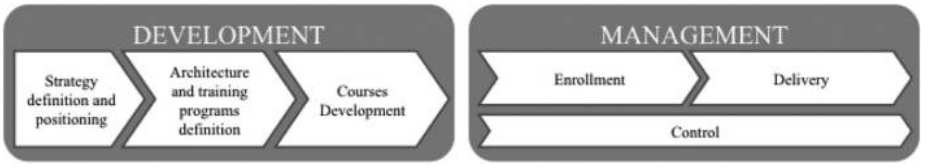


**Figure 1.**
The design process framework

| | BE case | CI case |
|---|---|---|
| Interview effort (days) | 40 days (interview time: 20 days; data analysis time: 20 days) | 15 days (interview time: 7.5 days; data analysis time: 7.5 days) |
| Number of employees involved | 23 | 20 |
| Typology of interviewees | Top managers (CEO, country managers and functional managers) | Top managers (CEO and functional managers) and middle managers |

**Table I.**
Interviews with companies' representatives for framework development

| Architectural characteristics | BE case | CI case |
|---|---|---|
| Role and responsibilities | *Sponsor*: HR Director<br>*CU manager*: HR Manager<br>*Scientifically responsible person*: School of Business | *Sponsor*: Distribution Director<br>*CU managers*: Agency network Director; Business Development Director; Agency Network Training Director<br>*Scientifically responsible person*: School of Business |
| Mission and objectives | *Mission*: support and lead the development of all the competences needed to execute the company strategic plan<br>*Objectives*: train more than 700 managers globally and institutionalize a common managerial way | *Mission*: transform agency network configuration through learning and development<br>*Objectives*: achieve the agency network transformation by 2020 |
| Design variables | *Targets*: all the managerial lines<br>*Competences*: managerial, technical and organizational behaviors | *Targets*: agents and agent collaborators<br>*Competences*: managerial, commercial and technical |

**Table II.**
First step results in the two cases

CI is a multinational company operating in the insurance sector, headquartered in France, with an Italian network of more than 700 agencies. In the past few years, changes in customers' behavior have raised new challenges, and CI decided to react through an evolution of its distribution strategy and agency network configuration. To develop competencies to enable this transformation, CI decided to build its own CU, targeting both agents and agency collaborators.

## 4. Case analysis

Because of the importance of CU development and the lack of studies on this topic, the focus of this research only embraces the development phase of the process (even though the entire process was implemented in both cases).

### *4.1 Step 1: strategy definition and positioning*

Linking the CU mission to the company strategy is essential (Meister, 1998; Allen, 2007; Rademakers, 2014); therefore, the development phase should start with the definition of the CU strategy in line with company strategic guidelines. This usually starts by defining clear roles and responsibilities for the project. Three main roles are defined:

(1) the sponsor – usually a top manager – who guarantees alignment between corporate and CU objectives;

(2) the CU manager – the project manager – responsible for its organization and management; and

(3) the scientific responsible – guarantor of the CU content quality (an internal figure or an external educational partner).

The sponsor and the CU manager should first define the mission of the CU; then, the strategic design variables are defined in terms of targets (i.e. resources involved in the CU system, which may be selected according to professional lines, seniority or geographical zone; Lenderman and Sandelands, 2002) and competencies (i.e. type of knowledge domains

covered by the CU system: the more knowledge domains, the broader the field of competencies developed by the CU; Pedrini, 2011).

Table II summarizes characteristics of this step for the case studies.

In the BE case, the CU reports directly to the HR director and virtually to the chief executive officer. There is a single CU manager covering each area and serving as an interface for each function. Top management commitment is high – which is also thanks to the CU manager – and the CU is able to engage with and involve directors and influence resources globally. In this case, the CU has the objective to develop new managerial, technical and organizational behavior competences for all the company managerial lines to support the new business directions.

In the case of CI, the CU reports directly to the management committee (with the distribution director being the main sponsor), and three CU managers were nominated (as the project was split into three different parts). For CI, the CU objective is to effectively support the distribution network transformation, embedding new competences (i.e. managerial, commercial and technical skills) in all the agencies.

*4.2 Step 2: architecture and training programs design*

The second step aims to reveal the global CU architecture and its training programs (i.e. the sequence of courses that individuals will attend).

There are four main critical decisions that should be taken within this phase (Figure 2): clustering, knowledge domains, definition of the specific courses and design of the training programs (Figure 2).

*4.2.1 Clusters.* The variety of participant training needs often represents a major trade-off when designing the architecture of a CU (Analoui, 2001): defining education programs (and even single courses) coherently to take account of every single participant's needs would greatly increase the CU effectiveness, but would also dramatically impact its efficiency. This is especially true when courses are intended to be company- or context-specific and delivered through physical classes; the dream of a training program composed of personalized courses for each individual is still largely unfeasible, but, at the same time, delivering the same courses to all the participants is obviously as feasible as it is ineffective (Gustavs and Clegg, 2005). We propose to manage this trade-off by identifying clusters of participants characterized by similar needs.

Identification of main clusters of participants can be done by the CU manager and the scientifically responsible person, who will both respectively bring knowledge about the specific organization and the general implementation of CUs in similar companies/industries. Clusters can then be described through a matrix crossing company roles (Figure A1).

*4.2.2 Knowledge domains.* The second main step is the identification of the knowledge domains, defined as a "homogeneous set of competences, tools and methodologies needed to support one company's main operational processes" (Alexander *et al.*, 1994; p. 382); project management, operations management and organizational behavior are examples of knowledge domains.

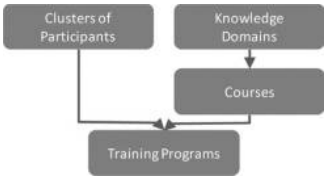


**Figure 2.**
Steps to design CU architectures and training programs

The correct definition of the knowledge domain must be inscribed in the design variables of the CU: if the CU encompasses single/few competences, there will be a low number of knowledge domains covered; however, if the CU targets the development of several competences (and different processes), its number of knowledge domains will be higher.

The identification of knowledge domain(s) is carried out together by the CU manager and the scientifically responsible person; the CU managers are also responsible for identifying internal subject matter experts (SMEs) for each knowledge domain, who will be the knowledge reference points for the scientific responsible. SMEs are normally senior managers of the company who can contribute to the detailed analysis of the training needs (Holland and Pyman, 2006). Companies can support this step by publishing a summary document (Figure A2).

*4.2.3 Courses.* The next step involves the macro-design of the courses. The expected output is two-fold:

(1) We expect to define which courses will be developed in each knowledge domain.

(2) We expect to fill in a form, for each course, encompassing main design inputs that will be provided and who will have to micro-design and deliver the course (Figure A3).

To identify courses in each knowledge domain, we propose a multi-step approach, with joint efforts of many different actors: the CU manager, scientifically responsible person, SMEs and other selected business line managers. The basic idea is to execute a set of workshops to perform the analysis of training needs for each cluster of participants (Reynolds, 1999); in these workshops, participants will hold discussions based on a list of main concepts, tools and methodologies that are crucial for the company in each knowledge domain to identify which courses are needed per each knowledge domain and what main design specifications they might have.

*4.2.4 Training programs.* Finally, the last step is the design of the training program for each cluster of participants. The expected result is the definition of different paths within the same set of courses/knowledge domain (Figure A4).

This step is performed together by the CU manager and the scientifically responsible person, and the result is normally a list of courses for each knowledge domain, progressively reduced by clustering similar courses and eliminating those with too low a number of participants. The final list will then be submitted to the manager responsible for the cluster and SMEs for approval.

This second step leads to different configuration in the two cases.

In the BE case, six clusters have been identified, encompassing profiles with different technical knowledge (i.e. project, procurement, operations senior, operations junior, administration and business development); this was necessary because of the wide scope of the CU in terms of functions and departments to be served. For example, in the operations cluster (including a variety of technical engineers and construction experts), participants were split by seniority, leaving variegated profiles together (i.e. senior and junior operations employees). In terms of knowledge domains, five key areas were identified (economics and performance management; operations and business processes; strategy and innovation; leadership and organizational behavior; and project management), each one with an internal (SME) and external (educational partner) lead. Five one-day-long workshops (one for each knowledge domain) took place, involving 25 managers and resulting in 23 courses. A tailored training program was developed for each cluster. Training programs are designed to last two or three years, with a minimum of 5 and a maximum 20 training days per cluster.

In the CI case, workshops resulted in the identification of three relevant clusters (i.e. agent general manager, agent insurance experts and mobile distributor), and each of the 1,000

people in the agency network could be connected with one of these profiles. In terms of knowledge domains, meetings led to the identification of four key areas (insurance finance and risk management; organization and human resource management; marketing and sales; and innovation and digital transformation), each one with an internal (SME) and external (educational partner) lead. Ten half-day workshops (two for each knowledge domain) took place, involving 43 managerial positions, with the identification of 64 courses to be included in the training programs. Each program is designed to last three years, encompassing an average of 24 courses with a duration of 25 training days per year and setting specific targets for participants to be reached in each knowledge domain (yearly competences ranking improvement and minimum knowledge-based score).

*4.3 Step 3: course development*

It is not uncommon that courses within a CU are developed and delivered by educational partners who can provide the highest level of performance in different knowledge areas. The role of the CU manager in this case is to assure that these partners share the same standards and a common set of rules (Rhéaume and Gardoni, 2016). Each partner is provided with a *development kit* composed of two main items: course standards and course development process.

First, every course within a CU must comply with a set of standards. Normally, this section includes the framework for the customer satisfaction form, the templates for the knowledge base test and the learning verification test (from the beginning to the end of the course in order; Simonin, 1997), the possible formats for their implementation and the standard reports showing the participants' results and progress. Course standards also include the ways to define and communicate the learning goals and the agenda (e.g. on a half a day basis). Finally, they include the classification of the possible teaching methodology to be adopted (e.g. lecturing, case studies, testimonials, group-work and simulations).

The development process defines the main milestones that every provider should deliver, and these include: design days, dry run and pilot (Riding and Sadler-Smith, 1997).

During the design days, the educational partner should meet with managers and possible participants to micro-design each course (e.g. agreeing about main topics on the agenda, time devoted to them and learning methodologies adopted). A second crucial output of the design days is the engagement of managers to provide material for company-based cases and examples, as well as testimonials during the delivery.

The dry run is the beta test of the course: it is an accelerated version of the course in which all the material is tested in its definitive version. Future trainers and facilitators must be present and manage part of the presentation, with an audience composed of managers involved in the design days, the CU manager, a sample of participants and the scientifically responsible person.

Finally, the first delivery of each course can be considered to be a pilot. Feedback from participants must be retrieved with special care and attention (even the selection of the participants must be meticulous), and this will provide information for further fine-tuning; only after this can the design process be considered complete.

In the BE case, design activities took 50 days, and four different educational partners were involved; then, dry-runs and pilots were carried out for each course.

In the CI case, design activities took 75 days, and five different educational partners were involved; dry-run and pilot were carried out only for newly developed courses (5 for the insurance finance and risk management area, 9 for the organization and human resource

| Step | Sponsor | CU Manager | Scientifically responsible person | SME | Manager | Education partner | Methods and template |
|---|---|---|---|---|---|---|---|
| Role and responsibilities definition | A, R | C | C | | | | RAM |
| Mission and objectives definition | A | R | | | | | – |
| Design variables setting | | A, R | C | | | | – |
| Cluster definition | | A, R | C | | | | Cluster Matrix |
| Knowledge domains definition | | A, R | R | C | | | Brainstorming |
| Specific courses definition | | A | R | C | | | Workshop, course macro description form |
| Training programs design | | A | R | C | C | | – |
| Design days development | | A | C | C | R | R | – |
| Dry run implementation | | A | C | C | R | R | Feedback form |
| Pilot testing | | A | | C | R | R | KBT, LVT, CS form, standard report of results and progresses |

**Table III.** Responsibility assignment matrix for CU project

**Notes:** A = accountable; R = responsible; C = consulted

management area, 3 for marketing and sales area and 12 for the innovation and digital management area).

## 5. Discussion of findings: the linkage between CU design, responsibilities and tools

Our findings show that the proposed framework is applicable in both cases, even though project complexity and contexts are dissimilar. These variances lead to some small changes in the two solutions, but the main steps, methods and tools remain stable. In the CI case, for example, the CU project was split into three different subprojects (each one owned by a specific project manager) to effectively manage all of the different stakeholders, thus not realizing optimal project management conditions.

Moreover, it is important to note that the proposed process is described as a stage-gate approach, although activities are strongly correlated and interconnected; thus, a high level of flexibility is necessary, and recycling may occur (Buganza and Verganti, 2006). In the BE case, for example, much feedback was collected during the first year of implementation, and even though all the courses were first designed and developed for the entire cycle, training program plans were updated and reviewed to integrate these suggestions. The process (in terms of roles and support tools) should be then planned and configured in a flexible way.

Moreover, our experience shows that CUs (more than any other type of training initiative) need the commitment and involvement of many organizational figures and external people (Prince and Allison, 2003). To ensure that CUs reach the strategic goals they have been conceived for, designing the right process and using the right tools might be not enough. As described in our cases, CUs are strongly related with the strategy of the company, but their design and implementation can also require very tactical and operational skills. As with

every complex process that requires the interaction of many stakeholders and decision makers acting at very different hierarchical levels of the company, the coherence of the organization and the clear definition of boundaries and responsibilities are as important as the process itself.

With our study, we are finally able to provide a comprehensive view not only on CU design activities and support tools but also on actors involved, roles and responsibilities (Table III).

In designing and implementing a CU, the CU manager and the scientifically responsible person, in particular, emerge as pivotal figures, who must guarantee a constant presence throughout the process; the sponsor should be involved only at the strategic level (i.e. definition of project organization and CU mission and objectives), while SME, other managers and educational partners are involved in most of the operational activities (e.g. course definition, design and implementation). This means requiring companies to make an intense organizational effort; however, their commitment represents the key factor for a successful implementation of the CU as a sustainable training structure for skills and talent development in the long term (Wang *et al.*, 2010; Alagaraja and Li, 2015).

## 6. Conclusions

This papers aims to contribute to the actual debate on how to develop skills and talent in modern companies (Reynolds, 1999; Mayfield *et al.*, 2016) by proposing a process framework for CU design and development; coherently with the action research approach, this model was iteratively shared and reviewed with two companies attempting to implement their own CUs to support business objectives and resource development.

Our findings are intended to be relevant in two ways.

From an academic point of view, our work contributes to a broader stream of research on possible frameworks for CU design and management, tested theoretically (Dealtry, 2000c) or empirically (Lui Abel and Li, 2012). Although similar approaches are already present in the literature (i.e. CU wheel by Prince and Stewart (2002) or the 10:10 RealTime Corporate University Blueprint by Dealtry (2000b)), the theoretical framework we obtained represents an attempt to position these different perspectives about CU within the same model, providing a holistic and complete model instead of focusing on single aspects. Moreover, if compared with previous studies, our work is different in two ways. First, we tried to accumulate existing theories and findings instead of proposing a new one; and, second, we go beyond the theoretical proposal (Walton, 2005; Li and Abel, 2011; Rhéaume and Gardoni, 2015), testing it for real implementation through action research. Our model confirms the dynamic nature of the process (in its details on both the development phase and the management phase of the CU), which is unique in its type and form and can be used as a reference framework for future studies on CU design.

From a managerial perspective, our work provides a real blueprint not only for design but also for implementing a CU. The process is divided into main phases and single actions and tools and insights from the real cases provided. As the process embraces all kinds of activities ranging from strategic to operative ones, our work also provides managers with an organizational tool to identify the main roles and describes the most important ones to define their accountability and boundaries throughout the process.

This study also has some limitations. First, we present a two-step framework, but we only include results and comments on the development phase, as we first want to deal with the more strategic aspects and activities of CU design, leaving aside operational implications. Future research can be shaped around the exploration of specific activities, roles and tools for the on-going management of this system. Second, our framework has been refined and

validated using two specific cases; to increase its generalizability, future research can work toward its application in other organizations and industrial contexts, thus contributing to refining its structure.

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## Appendix

| Role | Cluster 1 | Cluster 2 | Cluster 3 | Cluster 4 |
|---|---|---|---|---|
| Project Manager Senior | x | | | |
| Assistant Project Manager | | x | | |
| Project Control Manager | x | | | |
| Role A | | | x | |
| Role B | | | | x |
| ... | | | | |
| Role N | | | | x |

**Table AI**
Example of clusters definition

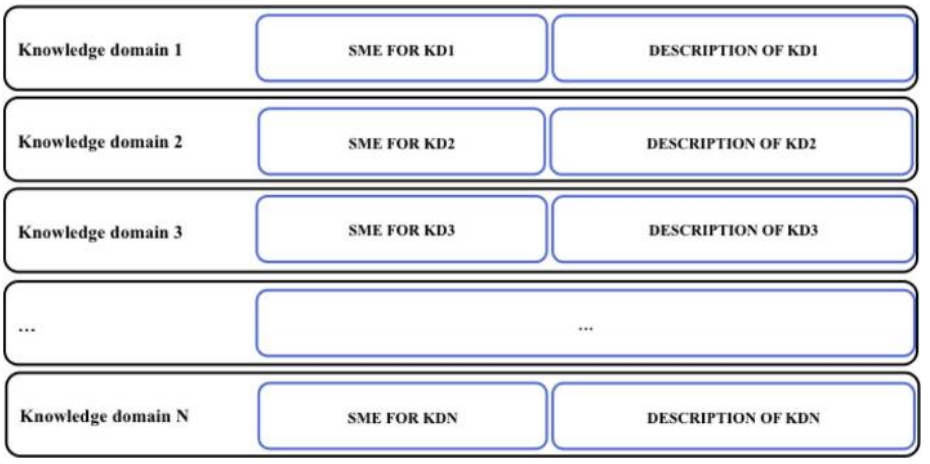


**Figure A1.**
Examples of knowledge domains definition

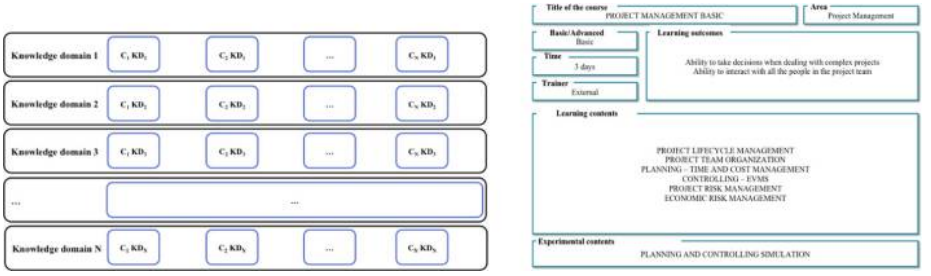


**Figure A2.**
Example of a) list of courses within a knowledge domain and b) single course design specs

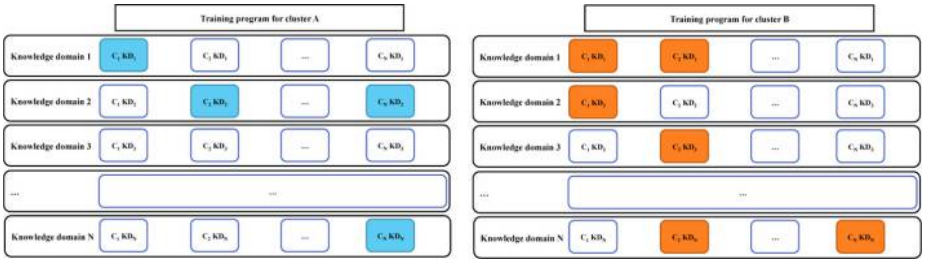


**Figure A3.**
Examples of training programs per cluster