

Digital innovation process in the academic sector - The case of the University of Geneva

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Abstract. In this paper, we describe an innovative process towards digital transformation in the high-educational field, developed at the University of Geneva since 2016. It aims to provide novel services identified proactively as of high value for improving student and university members experience. This approach is made possible through our Digital Innovation Hub and its different tools. One of these tools is the “Accelerator of digital science and services”, born from the original combined effort of two main digital actors of the university: The Information Systems Division (DISTIC) entity, providing professional expertise in developing and deploying digital services, and the Computer Science Center (CUI), providing research-led innovations. Through the Accelerator, we experiment and incrementally build new innovative services to be scaled up and deployed. This paper reports on our experience gathered throughout the establishment of this innovative process and its impact on governance and structure.

1 Introduction

The academic field is an extraordinary place for developing and experimenting, supporting, and even deploying digital innovation. Research, teaching, learning, and the provision of efficient services for a whole academic community are core business activities of Universities. Students, researchers, teachers and all the university members need services to fulfill their duties, to support their projects and ideas in an optimal manner.

Developing and experimenting innovation is a central aspect of research and scientific activities, in particular digital innovation for research related to information systems, computer science or more generally to service science. This activity generates various digital artefacts, ranging from novel methods, paradigms, up to proof-of-concept and prototypes.

Supporting digital innovation concerns any member of an academic organisation, from students and researchers wishing to further develop ideas or projects into actual effective entrepreneurial activities or social innovations with an impact, to University staff interested in changing business processes, including digital novelties to facilitate everyday work.

Deploying digital innovation relates to industrialisation of innovative digital services targeting various, if not all, members of a University community. Here the challenge goes

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beyond providing a prototype, it consists in providing a dependable service for thousands of people.

According to Gartner¹, by 2021, the top 100 higher education institutions will need to adopt artificial intelligence technologies to stay competitive in research. And over 30% of institutions will be forced to move towards a personalisation strategy to maintain student enrollment levels.

AI-based technologies are well suited for innovation and can perfectly help students who are facing a large number of choices and information during their journey. They can for instance provide help, advice and guidance to the students. As an example the Deakin University developed Genie², a personal digital assistant helping students with varied tasks, from reminders to help with revisions, breaking down the main task into sub-tasks, or even proposing additional material to revise in preparation of exams.

This paper reports on steps taken by the [University of Geneva \(Switzerland\)](#) to favour digital transformation and innovation, and on our personal experience related to specific aspects of digital innovation at the University of Geneva (Unige). Part of this process is born from the original establishment of a team composed of researchers and IT professionals aiming at experimenting digital innovation with a potential impact for the University community. Sustained by service science principles, we discuss how we evolved from these preliminary ideas aiming at favouring digital innovation services for the Unige community, to a concrete innovation process and its impact on organisation and structure.

Section 2 discusses the Unige global strategy towards digital transformation and innovation. Section 3 explains the progressive changes brought to the organisation and structure of some Unige entities, in order to provide an efficient innovation process aiming at maximising industrialised innovation. Section 4 reports on a series of digital innovation services that we developed and supervised at Unige. Section 5 describes the current process going from preliminary ideas up to prototypes, and concrete industrialised innovative services. Section 6 discusses the approach in the context of Service Science. Section 7 positions the Digital innovation process wrt other surveyed initiatives. Finally, Section 8 discusses steps forward and concludes the paper.

2 Digital transformation and innovation at Unige

The work presented in this paper takes place in the larger context of the [Digital strategy of the University of Geneva](#). Unige first set up the [Digital Transformation Office](#) in 2013, which carried out a large consultation process. It involved representatives of the different sectors of Unige (administration, research, students), and ultimately provided input for the digital strategy. Unige then included a Digital Strategy Action Plan in its strategic plan in 2015. The digital strategy is organised along five axes: *teaching and research*, *open science*, *services to the society*, *services to the Unige community*, and *governance*. Among the main notable points of the concrete action plan, we can report the following objectives:

- Digital skills for all;
- Digital services and support to transform the University;
- Towards a responsible digital society;
- A digital backbone for advanced research;
- An open ecosystem for digital innovation;
- An agile and participative governance.

¹<https://www.gartner.com/en/documents/3895923/5-best-practices-for-artificial-intelligence-in-higher-e>

²<https://genie.deakin.edu.au/>

2.1 Network of Innovation Hubs

To support innovation in a more larger manner, Unige developed a series of [Innovation Hubs](#) in various sectors, working as a network and collaborating under the guidance of the Digital Transformation Office. These hubs are active in the following areas and target different purposes:

- *Science Innovation Hub* - it acts as pre-incubator for research projects in the Faculty of Science, targeting fields such as physics, chemistry or biology;
- *Translational Accelerator* of the Faculty of Medicine - similarly it provides pre-incubator services to research projects in health;
- *Digital Innovation Hub*, managed by the Computer Science Center (CUI) - aims at supporting various activities linked to digital services across the University (see Section 3.1 for more details);
- *SGD solution space*, managed by the Geneva-Tsingua initiative - aims at supporting students projects in social innovation and sustainability;
- *Entrepreneurship Lab*, managed by the Geneva School of Economics and Management - aims at supporting projects with advice and help on entrepreneurship across the University;
- *Innovation Center of the Geneva University Hospital* - aims at supporting innovations coming from staff members or patients, favouring improvement and evolution of the hospital or its services.

3 Governance and structures

Under the guidance of the Rectorate and its Digital Transformation Office, we proposed and developed a series of structures favouring the adoption and industrialisation of digital innovations.

3.1 Digital innovation hub

The [Computer Science Center \(CUI\)](#) of Unige is an interdisciplinary research and teaching center of the University, specialising in computer science, information systems and informatics linguistics. It gathers 200 researchers from 6 different faculties and contributes to a large number of digital programs, from BSc, to MSc, to PhD and continuous education, while performing sustained research funded by various national and international bodies.

Set up in 2019 and managed by the Computer Science Center (CUI), the [Digital Innovation Hub](#) is part of the Digital Strategy Action plan and has the following three missions:

- Developing innovative services for the Unige community;
- Supporting students and researchers with their projects aiming at a social innovation or towards a commercial exploitation;
- Reaching out towards the public, private and organisational sector of the Geneva area.

The Digital Innovation Hub developed various specific tools to support these missions:

- *Accelerator of digital science and services* (see Section 3.2);
- *Digital Forge* - to provide reach out activities to the private, public, international sector, in particular through digital innovation provided as proof-of-concepts or prototypes;

- *Innovation clinic* - it supports student's innovation projects in any area from idea to real impact. Projects benefit from a personalised guidance process, visibility and opportunity to connect with other interested students.
- *FacLab* - an academic fabrication lab hosting a more traditional FabLab (digital fabrication lab). It supports the Digital Innovation Hub in its various activities. More generally, the FacLab provides an innovative learning space complementary to traditional teaching [1].

3.2 Accelerator of digital science and services

One of the missions of the Digital Innovation Hub of the University of Geneva is the development of innovative digital services for the University community. These services span the whole spectrum of University activity, from administrative services for students, to administrative services for University staff, to e-learning platforms, to education, to sports, culture or health.

The specific sector of the hub in charge of these innovations - the “[Accelerator of digital sciences and services](#)” - is born from the joint effort of two entities of the University: (1) the Information Systems Division ([DISTIC](#)) providing expertise in developing professional digital services to the whole University community, and (2) the Computer Science Center ([CUI](#)), a research and teaching center of the University, providing innovative technologies arising from research. Established in 2016, the Accelerator has been formally linked to the Digital Innovation Hub in 2019. Through the Accelerator and a joint coaching (from [DISTIC](#) and [CUI](#)), students' or institutional projects undergo an innovation process, going from ideation up to a fully working service prototype. The final user or stakeholder interested by the service takes over the final stages of deployment and maintenance.

The Accelerator is thus made up of the original combination of academic and professional experts of digital services. Its mission is to accelerate institutional or academic projects aimed at the university community. Managed by a dedicated team, the accelerator regularly offers new initiatives and innovative projects for the university community.

Section 4 reports on these innovations and success stories. Emerging from these experiences, we set up a digital innovation process (see Section 5) allowing projects to go from ideation, up to prototypes, and ultimately to industrialisation.

3.3 Towards an R&D unit

The first success stories of the Accelerator led to an increasing interest and enthusiasm from stakeholders, in seeing the digital innovation services deployed and efficiently provided to the Unige community (i.e. going from prototype to actual service). Various other Unige offices contacted us to develop additional digital innovation services tailored to their needs. From our side, we also pointed out further digital innovation, with high potential, to experiment and develop. Therefore, as a side effect of this success, we recognised the need for an additional structure sitting at the intersection between the Accelerator and the [DISTIC](#). The role of this structure would be precisely to take these innovations, evaluate them and industrialise them based on this assessment. Such a structure has the additional advantage of building in-house expertise related to these innovations and to their industrialisation – the lack of which being a worry frequently expressed by product owners.

Therefore, the positive and promising results of the Accelerator encourages the creation of an R&D unit, dedicated to scaling up new services based on advanced technologies, and making these services available to the University community. The Accelerator would be at the intersection of the Digital Innovation Hub and the R&D unit, itself under the responsibility of the [DISTIC](#).

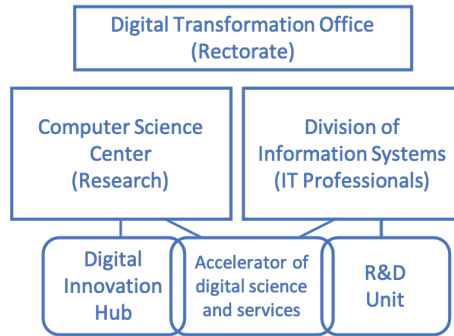


Figure 1. Digital innovation structures

Figure 1 depicts the above structures and their various relationships.

The main goals of the R&D unit are to:

1. Propose innovative projects giving rise to functional prototypes with strong added value and perform a technology watch;
2. Monitor the prototypes arising from the projects, evaluating the results and selecting the services to scale up and made available to the whole university;
3. Ensure the production and deployment of new services, train and develop internal skills of the teams who will be responsible for maintenance of the service.

4 A selection of digital innovation services at Unige

Our work takes place in the framework of the Digital Innovation Hub (Section 3.1), more precisely within the Accelerator of digital science and services (Section 3.2).

We developed a series of prototypes or proof-of-concepts experimenting various digital innovations, leveraging BSc, MSc or PhD students' projects achieved as part of their study program. A complete list can be found [here](#). Since 2017, together with colleagues of both CUI or DISTIC, we coached various projects, such as: projects management services, design of research data portal, automating tests for e-learning platforms, authenticating diplomas and other official documents with the blockchain technology, and more recently conversational agents. We will concentrate on the latter, as we developed diverse prototypes experimenting different digital frameworks, settings and applications domains.

4.1 Conversational agents

One category of novel services we experimented and prototyped are conversational agents (aka chatbots). Based on AI-Learning algorithms and Natural Language Understanding, they provide highly valuable services, enhancing student experience and relieving administrative staff. Some features include:

- Providing personalised answers;
- Being available 24h/24h and 7/7;

- Enhancing response performance;
- Guiding to the right answer instead of reading a large FAQ or finding the right document on the web sites;
- Relieving advisors or administrative staff from repetitive answers and letting them focus on issues out of the scope of the chatbot or that cannot be automatised;
- Improving chatbot knowledge base continuously and making it evolve using machine learning technologies and large amount of feedbacks.

We report here on a series of conversational agents developed for diverse Unige offices.

The **GSEM Chatbot** helps future students of the Geneva School of Economics and Management (GSEM) in their registration process for the MSc programs of the faculty according to their study situation. Through a series of textual interactions, it identifies: (1) the intention of the future student (which MSc does she want to apply to?), and (2) assesses her current situation (year of BSc graduation, alumni) and provides the registration form that corresponds to her situation. Well identified decision trees, representing the various conditions and regulations of the MSc of GSEM support the chatbot reasoning. Developed with Rasa, actually deployed during the registration period (in January and February of each year), it is currently being extended with an ontology.

The **CUI's Study Advisor Chatbot** relieves the student's office with recurring questions regarding BSc programs registrations (for future students), as well as questions regarding modules choices or specificities (for enrolled students) (e.g. what is the procedure to start an internship?), as well as any administrative questions (e.g. what should I do if I am sick before an exam? how can I announce a military service period?). Developed with IBM Watson, it aims at identifying as soon as possible the users' intentions, while still capturing the study's advisors and regulations knowledge.

The **Sport's Office Chatbot** provides information about registration to sports activities for different categories of users (students, alumni, staff, external), and information on the activities themselves: regular classes and ski camps. Developed with Rasa X, it relies on an underlying database providing prices, time and location.

The **Cultures's Office Chatbot**, similar in spirit to the Sport's office chatbot, enables to discover the variety of culture's offer, and gives information on events, classes, registrations conditions and prices. It relies on a rich and detailed database, from which the chatbot gathers up-to-date information, allowing answers to complex queries (e.g. where is tomorrow's painting class given by Ms Dupont taking place?). It is also developed with Rasa.

Through these experiments, we acquired various experience with different frameworks and their respective capabilities (IBM Watson, Rasa and RasaX), various domains and their needs (sport, culture, students' advisor), and explored various technological cases (with well identified reasoning trees, with and without underlying databases, with and without semantic enrichment with ontologies).

4.2 Co-creating conversational agents with stakeholders

When developing the above chatbots, we discuss with the administrative staff the various requirements and needs that will be covered by the respective chatbot, and based on the expertise they have of their profession (e.g. sport, culture, admissions procedures), we co-create with them the bulk of knowledge necessary to build the chatbot.

Our approach towards the chatbot prototypes is incremental, we iterate by constructing FAQ agents applied to a specific domain. An FAQ agent answers a precise question and can't undertake a complex conversation. Through these simple agents we build and formalise the

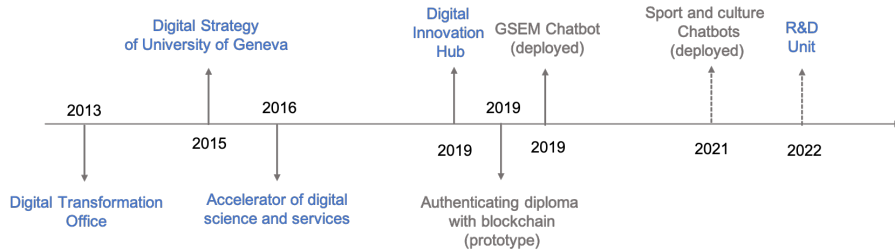


Figure 2. Digital innovation: timeline

decision tree along with the stakeholders, and progressively add maturity to the agent. End user’s test complement the process.

Based on these successful experiences, additional Unige offices are currently requesting additional conversational agents, possibly combining the existing ones in a more general one (e.g. an umbrella chatbot). This challenges the usual way of developing chatbots and even prompts us to investigate research aspects in order to answer this need, thus closing a virtuous loop going from: innovation, to business needs, to challenges, to research providing the next innovation.

Figure 2 reproduces a timeline showing the establishment of structures or selected success stories of the Accelerator.

4.3 Going beyond conversational agents

Inspired by Deakin University and the [Genie digital assistant](#), we are now launching a novel set of projects in the direction of intelligent digital assistants. Capitalising on the chatbot experience, we go further in developing personalised conversational agents able to actually assist students in various activities: for revising their lectures (e.g. can you help me find where in the lecture or in the registered session, does the teacher explain the difference between Internet and the Web?); for interacting with oral commands with the digital assistant; for helping students with assignments (e.g. dynamically retrieving assignments, deadline and material for the assignments from the e-learning platforms and notifying the students).

5 Digital innovation process

From these experiences, we derived a digital innovation process going from the ideation, through the prototype, up to the deployment and maintenance. This process follows the steps below:

1. *Ideation*: We start a design thinking process based on current trends, new technologies or/and our users need. Sometimes the initial point is a student focus group where we collect their needs and interests. Other times, the starting point can be an interest for a new technology which is ongoing in research but also widely used, for example Machine learning, NLP, etc.
2. *Scope of project*: We define a subject for master thesis, bachelor thesis or student internship. Sometimes, it is the students who comes up with a proposal for their thesis.

3. *Core process*: Collect information, experiment, supervise student, define a product owner from the application domain and go through several prototype iterations.
4. *Proof-of-concept or prototype and evaluation*: the outcome varies from a proof-of-concept up to an elaborate prototype. The evaluation serves to determine if the proof-of-concept or the prototype is promising, and it is valuable to go a step forward and to consider deploying it in production environment as a new service.
5. *Industrialisation (optional)*: depending on the above evaluation and on the impact the innovation can actually make on the stakeholder or product owner business activities, an industrialisation phase transforms the prototype obtained from the student's work, into an actual dependable service for the Unige community.

Steps 1 to 4 are carried out by the Accelerator of digital science and services. To scale up the proof-of-concept or prototype and to go further, the involvement and active interest of the stakeholders are the drivers of the actual industrialisation. This phase needs to go through all the application life cycle management, such as setting up a professional team and all the necessary configurations for the new service.

Leveraging our experience with the chatbots, we observe that to move from experimentation to complete product, we need to take into account several considerations (e.g. chatbot complexity), which may differ from a use case to another. In order to scale up and provide different chatbots to different services, we then need to have a consolidated chatbot strategy for the university, such as building in-house expertise to deploy and maintain current and future conversational agents. More generally, we need an innovation strategy able to industrialise efficiently future innovations. As part of this strategy, and to support the industrialisation of innovations, we proposed the establishment of a dedicated R&D unit (Section 3.3).

6 Service science approach

The work described in this paper follows a service science approach, as it displays the following characteristics identified in service science activities [2].

- *Services: co-creation and innovation*. Stakeholders are fully involved in the co-creation of the services we developed, e.g. they provide knowledge to be incorporated into the conversational agents, they participate to the definition of the scope of the service, or they are pro-active raising a need and proposing a technological solution.
- *Service system*: we are clearly at the center of a system made of *people* (academic community - students, administrative staff, teachers), *businesses* (sports or culture office, students' offices, etc.), *technology* - the whole point in our work being to enhance or develop innovative services for the University community by bringing innovative digital technology (e.g. intelligent agents, blockchain, etc.).
- *Interdisciplinarity*: it is key in our approach. This starts from the Accelerator of digital science and services, which brings together researchers and IT professionals, and continues with the inclusion of various experts of specific domains brought together in the co-creation of the respective services (e.g. experts in Unige teaching programs regulations, experts in e-learning platforms, experts in delivering sport and culture to the University community, health experts for health and well-being services).

7 Positioning

Through their survey, Castro Benavides et al. [3] identified that the domain of “Digital Transformation of High Education Institutions” is an emerging field arousing the interest of several researchers during the recent past. Our own position sits us in a dynamic of action research. Picking up on their findings, we highlight here some of the points of this survey relevant regarding Unige:

- *Digital Strategy*: according to the survey “DT requires well planned digital strategy including the DT framework in which all key players and stakeholders can play an active role”. This was our case, since the University co-developed the digital strategy with the University community, and as a general rule favours bottom-up initiatives and active involvement, such as our various proposals for a Digital Innovation Hub and its Accelerator of digital science and services.
- *Digital transformation team*: “It is important a strong leadership and a specialized team that can confidently explain and implement the Digital Transformation in the High Education Institution plan [...]. Moreover, DT Team should manage diverse cultural, behavioral, and operational forms of digital disruption”. The Digital transformation at Unige is currently supervised by the Digital Transformation Office. Our proposal for an R&D unit addresses the more operational need for managing at an operational level various types of digital disruptions.
- *Actors*: the survey points out the “multiplicities of ways in which digital transformation is tackled at High Education Institution”, including “multi-disciplinarity and multi-actoral character”. Similarly, at Unige, innovation and digital transformation is addressed in many ways and from diverse entities, among the latest novelties, we can mention the [Digital Law Center](#) set up by colleagues of the Law Faculty and the [Data Science Competence Center](#) gathering researchers across the whole University around data science issues. From the Accelerator point of view, multi-disciplinarity and involvement of various actors, from students to end-users, is at the heart of our process.
- *Governance and structures*: the survey mentions them as part of the dimensions impacted by the digital transformation process. As discussed above, Unige reworked its governance and equipped itself with a series of dedicated structures to tackle digital transformation and innovation from different perspectives.

8 Conclusion

This paper reports on a digital innovation process and the progressive evolution of the structures taking place at the University of Geneva to sustain this process. The whole idea is initially born from the joint effort of academics and professionals of digital services wishing to experiment and deliver innovative digital services. Since 2016, a series of various success stories have seen prototypes actually deployed and made available to the whole University community. In order to sustain this innovation process, we proposed a series of structures ranging from a Digital Innovation Hub (*supporting digital innovation*), to an Accelerator of digital science and services (*developing and experimenting innovation*), up to more recently an R&D unit (*deploying digital innovation*) within the Information Systems Division entity (DISTIC) of the University. The role of the R&D unit being to pick up on promising innovation results and providing their industrialisation.

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