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Session chairs

Paolo Ciuccarelli and Silvia Barbero

Editorial

Paolo Ciuccarelli, Nathan Felde, Paul Pangaro, Silvia Barbero

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The politics of metadesign

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This is a conceptual paper that explores the notion of metadesign which is premised on redesigning design itself. It interrogates the claim that metadesign is ‘open’, ‘fluid’ and ‘democratising’ by analysing its literature and practices. The paper makes two arguments. First, that metadesign is a theoretical power grab that prioritises language at the expense of material design which separates it from other design approaches. Second, that metadesign currently does not offer conceptual tools for observing and analysing the politics of real-world metadesign. If metadesign wants to be a democratising force, then it needs to question its legacy of transcendent language and engage with metadesign in practice and the politics it enacts in the world. Metadesign must shift towards ‘practice-based metadesign’ and work with concepts from Science and Technology Studies such as ‘infrastructural inversion’ to observe the politics of infrastructure and destabilise assumptions about discourse as immaterial and structures as material.

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Anatomy of a “technology”: Proposing a meta-design framework for sustainability literacy that addresses the issue of efficacy in modern socio-technical cultures

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In the era of the Anthropocene, where the climate crisis forces humankind to rethink its values and systems of production, sustainability literacy becomes crucial for any design practitioner. This paper aims to contribute to the extensive literature that regards meta-design as a reflexive practice for the study of design purposes, processes, methods, and outputs by outlining a meta-design framework to tackle the modern artificial environments in which humankind has become naturalized. Specifically, by inscribing modern “technologies” within Simondon’s concept of “technical object”, it delineates the preliminary guidelines of a research approach for design education that, drawing from Lemonnier’s chaîne opératoire and Leroi-Gourhan’s degrés du fait, applies locally situated ethnographic explorations with system analysis to the study of modern artifacts to stimulate self-reflexivity on “efficacy” biases in design thinking.

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Designing for what? Approaching necessary production and consumption for a circular economy

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Circular economy (CE) is currently a ‘hot topic’ in design discourse. The focus of these discourses has centered on product design, which is a core aspect of material circularity. However, CE is more than products. This assumption is the base for a research question: what should be the intention in designing for a CE? The recognition of CE as a systemic transition opens up opportunities for other forms of design. These forms should contribute to societal goals concerning why and what is produced –more than the profit-making. We contend that a CE should not be approached from the perspective of the usual actors, reduced to business/industry and waste management. We propose instead to take discussions about the governance of production and consumption as the starting point. Finally, we demonstrate the opportunity to open the futuring of CE through participatory and discursive methods based on cycles of speculation and visioning.

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Regeneration in action: Toward a new path for sustainable research projects

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As COP26 just ended with moderate commitments from governments to keep global warming under 1.5°C, how can designers contribute to fight climate change? Systemic design has proposed to change design perspective from the user to the system in which the user and the designer operate to envision better our social and environmental impact. Regenerative design adds that we should aim for positive instead of net-zero impact and change our mindset and practices to create the conditions for all forms of life to thrive. If regenerative guidelines exist in urban design, it is unclear how UX/UI designers should change their practices and profession for regeneration. Based a participative research approach in a web design project, the authors created a regenerative design compass to guide UX/UI practitioners to make their projects regenerative. We also present the concrete actions we took to make our website regenerative.

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Design for wellbeing during COVID-19: A cybernetic perspective on data feedback loops in complex sociotechnical systems

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The COVID-19 pandemic has put wellbeing on the global agenda like never before. Many businesses, organizations, and even governments have recognized wellbeing as a formal policy goal. This paper addresses the question of how to design complex systems to improve the wellbeing of their stakeholders. We present a case of helping a university adopt a systematic approach to wellbeing assessment and improvement during the COVID-19 crisis. To support the improvement of student and staff wellbeing, we adopted a cybernetic perspective. Practically, this involved focusing on the design of a feedback loop that used wellbeing assessments to inform organizational actions. We argue that “off-the-shelf” assessments of wellbeing are often insufficient for supporting a systemic response to data because they lack context-sensitivity and actionability. While a “cybernetic perspective” may evoke a sense of the inhuman or mechanical in the optimization of wellbeing, our case study suggests otherwise. At least from our perspective, a society that aims to improve wellbeing may look more like a deliberative or dialogical democracy than an automated AI system.

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A Meta-design research project to enhance the User Experience of university's digital services ecosystem

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Digitalisation is essential in contemporary institutions. Politecnico di Milano started to re-think its digital services to design an application that could help students manage every aspect of their daily university life, starting from their own goals and unmet needs, while considering the complexity of the university system. The Meta-design approach was adopted to redefine a public university's digital services, assuring the users' centrality in the research and design process. Meta-design is a circular and reflective method that enables the designer to continuously provide innovative solutions, updating the product to the ever-changing user needs. This methodology is the basis of User Experience practice. This paper demonstrates how Meta-design and its pillars - 'user research', 'market analysis', and finally 'technology investigation' - led to the ideation of an innovative and proactive concept for a mobile app where students are the protagonists.

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A meta-design research project to enhance the user experience of university's digital services ecosystem

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Abstract: Digitalisation is essential in contemporary institutions. Politecnico di Milano started to re-think its digital services to design an application that could help students manage every aspect of their daily university life, starting from their own goals and unmet needs, while considering the complexity of the university system. The Meta-Design approach was adopted to redefine a public university's digital services, assuring the users' centrality in the research and design process. Meta-Design is a circular and reflective method that enables the designer to continuously provide innovative solutions, updating the product to the ever-changing user needs. This methodology is on the basis of User Experience practice. This paper demonstrates how Meta-Design and its pillars - 'user research', 'market analysis', and finally 'technology investigation'- led to the ideation of an innovative and proactive concept for a mobile app where students are the protagonists.

Keywords: Meta-Design; University Digital Services; Human Centred Design; User Experience;

1. Introduction

Italy started a process of development and improvement of digital services in public administration to face the digital transition of our era. Citizens expect to manage public administrative procedures in an agile and mobile first manner.

United States and United Kingdom were the first to implement the digitalisation of government services, respectively in 2002 and 2010 (Mergel, 2019; UK Government, 2016). In particular, UK accurately defined and shared its operative process through the Government Design Principles (Central Digital and Data Office, 2019). UK guidelines have been a fundamental factor to demonstrate how complex organisations can efficiently become digital thanks to a defined methodology and structured principles shared in a working framework. Similarly, Italy is advancing its digital transition through the creation of



the Digital Transformation Team. The aim is “to make public services for citizens and businesses easily accessible, via a mobile-first approach, with reliable, scalable and fault-tolerant architectures [...]. To support the different central and local government departments in making the best data-driven decisions. (Digital Transformation Team, 2018)”

In this context, it is fundamental that educational organisations focus on the digitisation process of services offered to students, going beyond the pure didactics and administrative ones. The pandemic has accelerated this need to allow students to get familiar with the university reality remotely and get to know and live the whole academic experience (Sullivan et al., 2021).

Politecnico di Milano (Polimi) already provides several digital services across different platforms internally developed by its ICT department (ASICT). This system exists mainly via browser, and the realisation is top-down: once a necessity is identified, a new feature is created and indexed with an additive approach. Digital services were developed to be accessed by computer but not designed to be used via mobile. Although, students expect to access these services dynamically, i.e. when moving from one class to another. In addition, Polimi's digital ecosystem involves numerous people and activities. Indeed, to manage its degree of intricacy, digital services are currently developed following a database functional logic, perceived by the users as distant and complicated.

Therefore, Polimi invested in redesigning its digital services to propose an agile and user-friendly experience, starting by understanding the university's digital context and its users. For the first time, a design lead approach was adopted, creating an interdisciplinary operative team to face the ecosystem complexity adequately and introducing the use of Meta-Design. Indeed, the team was composed of Design Department researchers, an external design group from Tangity¹, the team from ASICT and engineers from the Computer Science department.

Meta-Design approach was internally applied to overturn the design logic of university services by involving users in the exploratory phase. The 'project of the project' (De Moraes, Celaschi & Manzini, 2010) allowed to manage the research, identify students' needs and develop a concept that considers academic and didactics services, including those that make learners feel part of a broader community.

Indeed, Polimi provides its members with a wide variety of possibilities, and it is essential to accommodate students with the proper tools to orient themselves among opportunities, promoting proactive behaviours on curricular and extra-curricular offers.

The project aspires to an application to help students manage every aspect of their daily university life, starting with their own goals and unmet needs. The potential problems are related to the numerous stakeholders and the differences between the student population.

¹ Tangity is the design branch of NTT Data, one of Polimi technological partners

The organisation of the project itself through the Meta-Design approach has been a fundamental step to untangle all the interconnections among the different elements of the Polimi system, identifying the emergent needs and defining the design direction.

2. The value of Meta-Design in complex systems

By definition, a system consists of interconnected elements coherently combined to deliver or accomplish anything. Its etymology comes from ancient Greek σύστημα systēma: "whole concept made up of several parts or members, the system" ("System", 2021).

From its meaning, a system must include three components: elements, interconnections, and a function or purpose (Meadows & Wright, 2008).

During the first attempt at understanding Polimi's services, it was evident this complex system 'happens all at once'. As Meadows (2008) explains in her book 'Thinking in Systems': systems are connected not only in one direction, but in many directions at the same time. To understand and modify them adequately, it is essential to use a medium capable of expressing its complexity simultaneously, sharing several of the same properties.

Drawing a diagram of a complex system represents what the designer knows about the systems and help identify what is still unknown. It facilitates the shaping of problems, and it can involve the visualisation of insights, concepts, perspectives, values of the system (Ricci, 2009).

Thus, the visual representation better describes its intricacy rather than the use of words. By this means, it is possible to observe all parts of an image concurrently (Meadows & Wright, 2008).

When designing, we incorporate insights that influence the delivered product. This is accomplished by creating visual maps and models that form ideas about what is feasible, plausible, and preferable (Morville & Callender, 2010).

For this need, we used an online platform - Miro - allowing us to design and visualise the connections of the various stakeholders included in the services of Polimi and the multiple bureaucratic and didactic processes.

APPLICATION	SERVICE	DEVICE					TOTAL
		DESKTOP	null	PC	SMARTPHONE	TABLET	
Registration to exams	Registration to exams - access	622485	482881	433210	651476	21105	2211157
	Honor code	28893	24912	22403	9319	444	85971
	Total	651378	507793	455614	660795	21549	2297129
Appointment management	Appointement booking with Registrar's Office	39254	11908	36451	55480	1397	144490
	Ticket booking cancellation	51	18	42	188	2	301
	Appointement booking management	4689	736	1580	207	6	7218
Total	43994	12662	38073	55875	1405	152009	
Classrooms: characteristics and occupancies	Classrooms: characteristics and occupancies	32	4	31	1		68
	Total	32	4	31	1		68
Degree Programme Web (Manifesti web)	Degree Programme Web (Manifesti web)	1211	298	984	39		2532
	Total	1211	298	984	39		2532
FAQ_Web Configuration	Questions? FAQ and contacts with Authentication	10807	3857	10067	3808	211	28750
	FAQ: Ask a question	15638	9840	21811	13353	362	61004
	FAQ: helpdesk request	27374	4125	11741	679	59	43978
	General FAQ renderer with template poli	103	19	84	3	3	212
	FAQ: application assistance	12298	3640	9942	4652	183	30715
	Mail helpdesk: new address request	33	30	38	15	1	117
	Request form helpdesk hosting	100	62	181	6		349
	Assistance request for WiFi	159	85	121	74	1	440
	FAQ Configurator: managed work stations: hardware and software assistance	77	37	38	2	1	155
	FAQ Configurator: Software license assistance	6600	2194	4369	435	19	13617
	FAQ Configurator: SmartPC Assistance	114	31	62	3		210
	Assistance "Submission - degree thesis approval"	845	216	627	150	4	1842
	Assistance "Submission - PhD thesis approval"	63	20	70	8		161
	PoliCard assistance	614	165	605	366	25	1775
	Students' mail assistance	458	172	466	273	13	1382
	Helpdesk UGOV request	421	109	242	13	1	786
	Client - New utility/transfer request	32	8	43	2		85
	Request submission	229	34	193	12	1	469
	Pollmaps assistance	10	2	1			13
	Virtual Desktop assistance	170	152	141	14		477
	Computerized classroom assistance	15	11	19	3		48
	Printer-Share and File-Share request	5	5	4			14
	Email address extension request	298	103	304	163	9	877
	Career Service report (authenticated user)	17	1	10			28
	Report and comments Online Services		1				1
	Webconference - request and activation	1					1
	Chat entrance for test		1				1
	School of Architecture - Bachelor Degree	476	130	398	240	5	1249
	School of Architecture - Master Degree	1061	327	979	336	2	2705
	School of Design - Study Plan	319	95	408	255		1077
	School of Design - Exams	84	34	100	86		304
	School of Design - Optional	185	79	249	205	10	728
	School of Design - Degree Examination	195	49	172	108		524
	School of Design - Changing Degree Programme	170	44	187	168	3	572
	School of Design - Internship	169	48	160	50	3	430
	Students Area: International Students	1235	361	1502	785	34	3917
	Sharepoint on line request	14	14	16	1		45
	School of Design - Learning Goals	55	15	89	38	1	198
	School of Design - Master Degrees	433	79	553	190	6	1261
	Students' Registrar's Office - State Professional Examinations	671	260	394	141	3	1469
Students' assistance request	32208	11010	27960	13994	511	85683	
School of Engineering - Exams	698	187	630	353	7	1875	
School of Engineering - Master Degree Admission	1	1				2	
Students' area - Ticket for 150 hours students' office	397	148	301	277	9	1132	
Students' area - equivalence request	341	42	316	49	2	750	
Intervention request on OTRS	30	16	51	13	1	111	
Assistance and request institutional questionnaires	16	1	8	2	3	30	
Contact ICT Services webmaster	41	19	44	22		126	
School of Design - Incoming	12	10	24	10		56	
School of Design - Outgoing	26	11	47	16		100	
FAQ: help DSU (University Financial Aid)	5770	1648	5311	4057	55	16841	
Assistance request on Intranet for research and Timesheet (Projects accountin	170	59	67			296	
Support for websites, manuals and translations (ASICT employees)	18	8	16			42	
School of Design - Internal Double Degree	3	2	12			17	
Request to submit additional bank details	13		4			17	
Total	121292	39617	101177	45430	1548	309064	
Lecture timetable	Lecture timetable	1360968	743804	694458	953949	61104	3814283
	Total	1360968	743804	694458	953949	61104	3814283
PoliMaps	Access to PoliMaps	6943	1691	4332	2651	98	15715
	Passage from Address Book to PoliMaps	217	60	130			407
	Area visualization by OTRS	432	3	101			536
Total	7592	1754	4563	2651	98	16658	
Study Plan submission	Study Plan submission	148298	59261	109036	86647	3202	406444
	PSPA option submission	3380	1228	2969	2867	81	10525
	Study Plan submission - simulation	1095	146	680	7		1928
Study Plan submission	Study Plan submission	148298	59261	109036	86647	3202	406444
	PSPA option submission	3380	1228	2969	2867	81	10525
	Study Plan submission - simulation	1095	146	680	7		1928
	PSPA option submission - simulation	11		5			16
	Study Plan biannual change	45788	19456	31691	31306	1534	129775
Study Plan biannual change - simulation	182	28	107			317	
Total	198754	80119	144488	120827	4817	549005	
Career documents consultation	Career documents consultation	403456	300560	293639	661500	14494	1673649
	Total	403456	300560	293639	661500	14494	1673649
Students University Career_Portal	Students University Career_Portal	40231	63049	26475	22442	854	153051
	Visualization of data related to Students' University Career	25440	31287	17433	9977	309	84446
	Total	65671	94336	43908	32419	1163	237497
ISEEU: Equivalent Economic Situation Indicator	ISEEU: Equivalent Economic Situation Indicator	139273	55289	85326	88790	3467	372145
	Total	139273	55289	85326	88790	3467	372145
Student tuition fees, scholarships and financial aid	Visualization of made payments	284930	128737	172014	178699	6118	770498
	Total	284930	128737	172014	178699	6118	770498
Exemption_Application	Exemption_Application	20041	9422	12134	13976	485	56058
	Total	20041	9422	12134	13976	485	56058
TOTAL		3298592	1974395	2046409	2814951	116248	10250595

Figure 1. Polimi provides students with more than 80 different digital services, on two platforms: Online Services and Polimi App. In 2020 there were more than 10 million accesses. The aim of the image is to give a glimpse of the quantity of the services provided

2.1 The adoption of meta-approach to re-think Politecnico di Milano digital services

The meta-project is typical of the polytechnic approach and commences with the project's preliminary research phase (Collina, 2005) with the aim to investigate and define the context of the project. It has the potential to establish the right background leading to the ideation of multiple solutions throughout the whole process (Mendini, 1969).

Meta-project is based on three pillars, giving rise to the skeleton of the project design. The first is 'user research': an in-depth study of their habits, needs and wishes regarding the university experience. The second is 'market analysis', a benchmark investigation on how similar institutions run digital services, to analyse what already exists and avoid reinventing the wheel in a complex context. The last pillar is 'technology': examining the possibility of integrating technologies already used in distinct fields to provide an even more satisfying and familiar experience, intending to compose innovative interactions.

Meta-Design, as conceived by Collina (2005), fosters the generation of changes within enterprises; a method able to comprehend dynamics and business balances, but at the same time to imagine a possible better future.

The meta-project does not focus on single elements but works on comprehensive scenarios; it dwells on the single artefact but reflects on the system.

The Meta-Design approach has been used to ensure the conception for a more innovative project. The meta-project is not intended uniquely as an antecedent part of the project but as a process that comprehends the project's entirety: before design (research), during, and after (throughout the product use) (Tamekuni, 2014). This circular and reflective process enables the designer to continuously provide original solutions, updating the product to the ever-changing user needs. This process is the basis of User Experience practice.

Before User Experience, design researchers have started exploring the role of Meta-Design and its influence on the final product presented to the user. Celaschi and Deserti (2007) conceive the Meta-Design approach as a response to the need for a new design strategy in our fluid society, able to design contemporary merchandise that conveys the modern interconnections of our community.

Meta-Design can be considered as the culture of the project or the protagonist of the digital product innovation process. This approach has a systemic vision and it has been codified with the advent of Design Thinking to which a different exploratory pragmatic dimension is added. Therefore, Meta-Design happens during the divergent phase of the ideation process.

"Thinking like a designer can transform the way organisations develop products, services, processes, and strategies. This approach, which is known as design thinking, brings together what is desirable from a human point of view with what is technologically feasible and economically viable." (Brown, 2018)

Thanks to the interdisciplinary composition of the team, led in the forefront by the Design department, the Meta-Design approach allowed to go beyond the classic Design Thinking approach; as the project concludes with a prototype, following the Design Doing approach. For this reason thanks to the Meta-Design approach, the project includes its preliminary organizational phase, the study of its context, users and technology, landing in a prototype.

Adopting this design approach, allowed to re-think the Polimi digital services from a different point of view.

In fact, it is already possible to execute most of the bureaucratic actions on the official platforms given by Polimi to students. Although, Online Services - students' personal university page - only correspond to a mere version of an indexed reproduction of all the possible operations to perform. This is because the system was developed focusing mainly on its technical aspects, solving one issue at a time, without involving users in the early stages of the project. This is where the real problem resides.

Hence, the project entirely revisited the arrangement and interactions of Polimi platform in an intuitive way for students, facilitating their daily life. This goal can be achieved through an exploratory investigation on their use of our university portal, while also considering secondary stakeholders' behaviour. The research methodology, to destructure and redesign Online Services, begins with a cyclic investigation based on users, followed by a conception phase, prototyping and then agile testing of its wireframes. Each iteration is based on the data acquired during the former execution cycle. This method, also known as 'Lean UX', gave us the possibility to continuously learn from the user and promptly integrate the new data into the products to correctly meet their needs (Gothe & Seiden, 2016).

The process should come to a definite end solely when the results are appropriate or when the dedicated time is up.

The continuous project review with the destined users led to constant incremental improvements of the product. Such an approach had never been adopted before at Polimi; hence it completely revolutionised the concept of its Online Services, significantly enhancing the user experience despite being an incremental change and not a radical one (Norman and Verganti, 2014).

So, the greatest project innovation was to involve users in the initial stages of the research, when the project was not yet outlined, to discover both the pain points and the possible design opportunities. The Human-Centred research consists in the explicit understanding of users, conceiving their tasks and the context of the performed action, which is crucial for establishing the system requirements (Chammas et al., 2015).

Additionally, as Norman (2006, p.50) states, Human-Centred Research needs to end before the product's design starts because "most projects are enhancements of preexisting projects". Such a complex redesign clearly involves many stakeholders and professionals from other fields, so once the project's direction is taken it is impossible to change it since

too many people are involved. Getting the user research right is fundamental to save time and money in the operational team.

3. Research

We conducted Meta-Design research based on three main pillars: market, user research and technological investigation.

The research aimed to understand stakeholders needs and how the identified requirements have been solved on digital platforms in different fields.

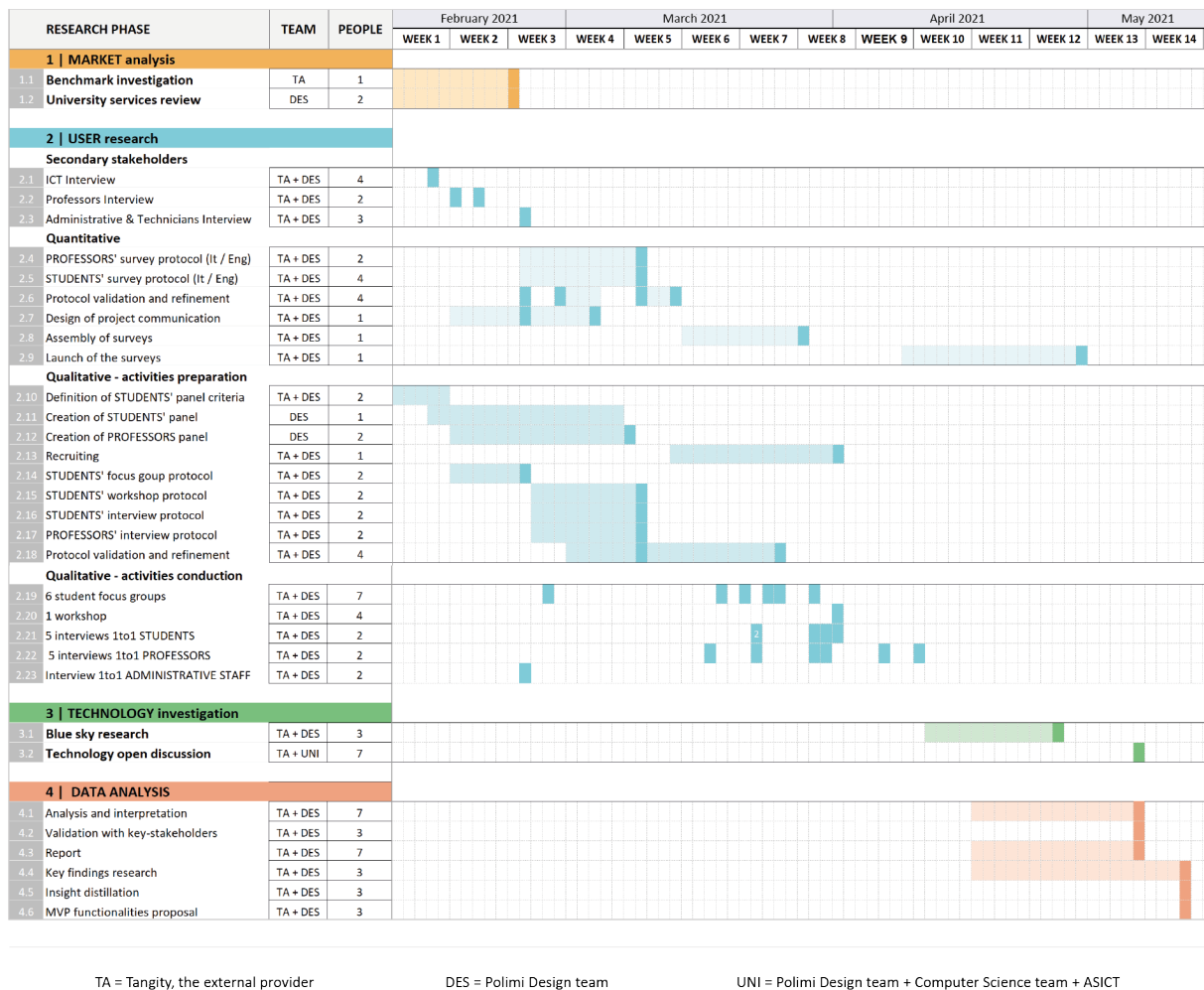


Figure 2. Gantt chart of the research process, based on the three main pillars: 'market', 'user research' and 'technology investigation'.

3.1 Market analysis

The market analysis consisted of a benchmark investigation and an in-depth review of the current services offered by Polimi.

Benchmark investigation

The benchmark investigation focused on examining the digital services provided by other universities to students, employees and prospects.

An analysis grid was defined, identifying the elements that resulted impressive from each university platform. Specifically, the research focused on:

- Platform target users;
- didactics, individual services provided;
- informative, collective services provided;
- additional services;
- platform design;
- platform visual elements.

Polimi's services in-depth review

This review evaluated the information and services provided to students on the Online Services, the university App, and Polimi official websites. The services were mapped into eight macro-areas, corresponding to different aspects of students' university life: management of university career, enrollments, studying at university, working at university, campus life, assistance and support services, software and access management, communication management.

We defined an illustrative journey of Polimi students' life, based on the macro-areas above mentioned.

This analysis represented the starting point for designing the tools employed in the research activities with students.

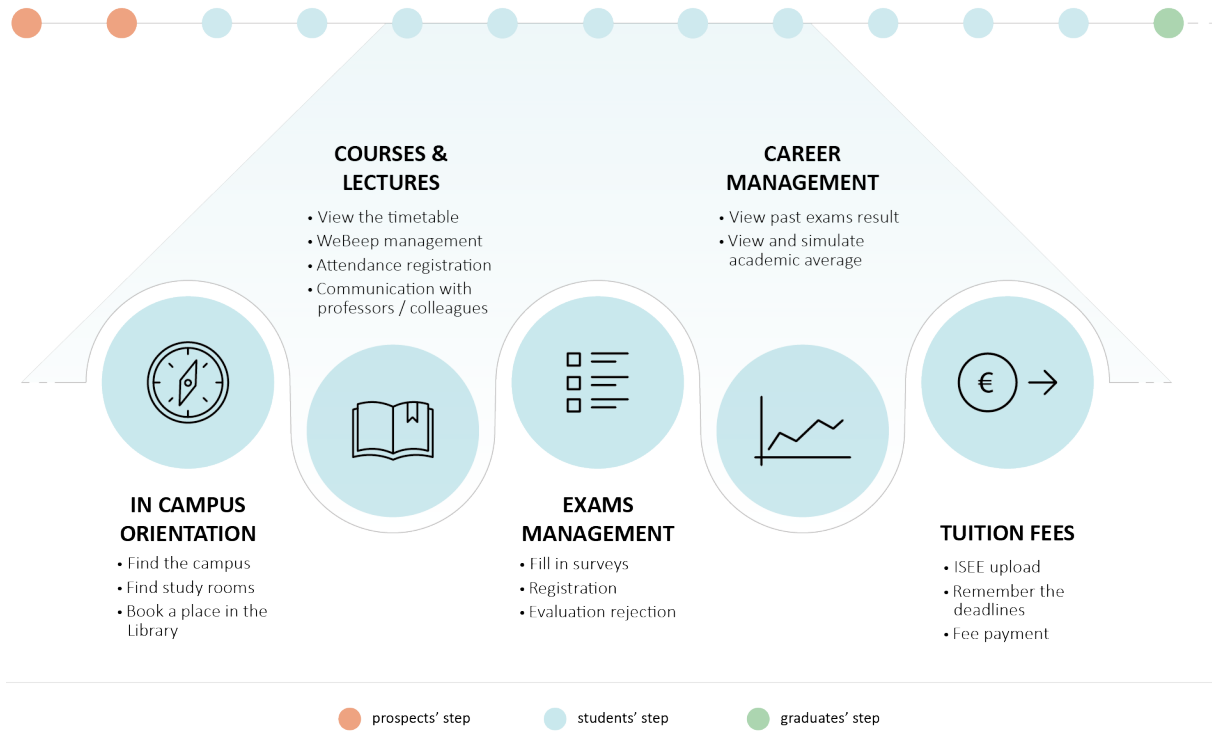


Figure 3. Illustrative journey of Polimi students' life, presenting the most relevant steps encountered by learners in their academic career.

3.2 User Research

Quantitative versus Qualitative

The user research was the most extensive phase of the project and aimed at studying the goals, needs and pain points of the potential users (Schumacher, 2010; Sauro & Lewis, 2016).

Even if the primary users of the service were students, it was imperative to consider all the university stakeholders and, particularly, their impact on students' university life. Indeed, changing even a single element of the institution, as its digital services, may modify the relationships among any of the involved stakeholders (Meadows & Wright, 2008). For this reason, the research phase started by interviewing key secondary stakeholders, as ICT and administrative personnel; and it proceeded by including professors.

It was crucial to consider that students do not compose a uniform population, but have specific experiences, behaviours and goals that depend on factors as the School attended, the study year and their personal and academic background.

Hence, this phase involved students from all the Schools, from different study years and both Italians and internationals.

The user research aimed at understanding:

- students' current use of mobile services;

- areas with a higher level of complexity and issues among the services emerged as priorities;
- students' needs and expectations related to the university services;
- students' expectations regarding the use of university services in mobility.

The qualitative methods consisted in focus groups, workshops and semistructured interviews, used to understand students' experience, especially regarding the obstacles that they encountered and solved (Albert & Tullis, 2013). The information was validated through a survey. This quantitative method allowed to collect data from a considerable portion of Polimi's cohort, without the need of advanced tools (Lazar et al., 2017).

	FOCUS GROUP	WORKSHOP	INTERVIEW	SURVEY
DURATION	3h 30'	3h 30'	1h 30'	15 days
PARTICIPANTS	35	7	5	2287
architecture	13	1	3	362
design	16	5	1	306
engineering	7	1	1	1719
ACTIVITIES	<ul style="list-style-type: none"> • discussion on university App • discussion about academic topics and services • card sorting to evaluate the level of criticality and mobile value of university services 	<ul style="list-style-type: none"> • discussion on university App • discussion on the academic experience of Andrea, a i1st year B.Sc fictional student • card sorting to evaluate the level of criticality and mobile value of university services 	<ul style="list-style-type: none"> • discussion on university App • discussion about topics related to the academic life • card sorting to evaluate the level of criticality and mobile value of university services 	<ul style="list-style-type: none"> • evaluation of mobile services and university App • Online Services evaluation • Mobile value evaluation of the main services
	QUALITATIVE			QUANTITATIVE

Figure 4. Diagram showing the methodologies adopted during the user research phase, highlighting sessions duration, number of participants and main activities.

Qualitative research

Focus groups and workshops provide the opportunity to gather a broad range of perspectives. Discussions can reveal analogies and dissimilarities between opinions. Indeed, groups support interactivity, with participants ideally balancing each other. This highly dynamic situation can stimulate participants to raise issues that might not be identified in one-to-one interviews (Lazar et al., 2017).

During focus groups, participants were to collectively discuss eight main topics related to their university career, underlining difficulties, frustrations and positive aspects: enrollment, Study Plan, courses and lectures, exams, tuition fees, scholarships and financial aid, Assistance and Registrar's office and international mobility.

From the activity, it was discovered how several services - as the Study Plan, tuition fees, scholarships and financial aid - are perceived as complex to be understood and managed. However, the existence of a learning curve emerged, as students repeat the same actions over time.

During the workshop, participants were to identify with Andrea, a fictional 1st-year B.Sc student, discussing the steps needed to successfully attend Polimi and the possible setbacks. This activity aimed to understand which difficulties newcomers encountered when dealing with services for the first time and how they eventually overcame them. In particular, it emerged that they have trouble orienting themselves among all the official channels to identify relevant information and the actions needed to complete the required processes.

Interviews with international learners involved students attending the Double Degree Program and fully enrolled, with the aim of understanding their needs and whether their experience at Polimi differed from Italian students. According to their personal experience, participants discussed the application process or enrollment, educational offer and Study Plan, courses, exams, tuition fees and financial aid, Assistance and Registrar's office. Through the interviews, it emerged that the overall experience of international students is akin to the Italians'. However, they have a lower autonomy level with university processes since they receive specific support from the administrative offices. They also expressed a stronger need to feel part of a broader community, connected to the will to discover the opportunities offered by Polimi.

At the end of each session, the participants were to take part in a card sorting activity. The aim was to understand which services are the most critical for students, in relation to their academic career, and which they would prefer to access on mobility. The use of this tool allowed to observe how students think and organise the received information, permitting to collect insights about the final prioritisation and students' opinions on the overall topics (Albert & Tullis, 2013). The main highlight was students' wish for mobile support in their daily lives.

Each research session was guided and stimulated by a facilitator. An observer kept track of the minutes from the participants, on a shared board, to guide the dialogue and allow students to clearly see the whole picture emerged (Meadows & Wright, 2008). The diagrams have been used as operational tools capable of detecting the weak points between the elements of the system. The connections traced in real-time evidently show the driving forces that can obstruct the user while performing an action within a system (Baule et al., 2007).

Let's talk about **enrollment**

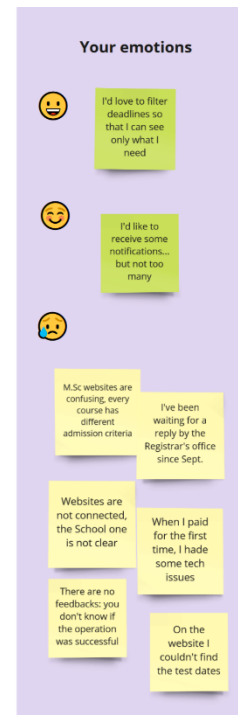
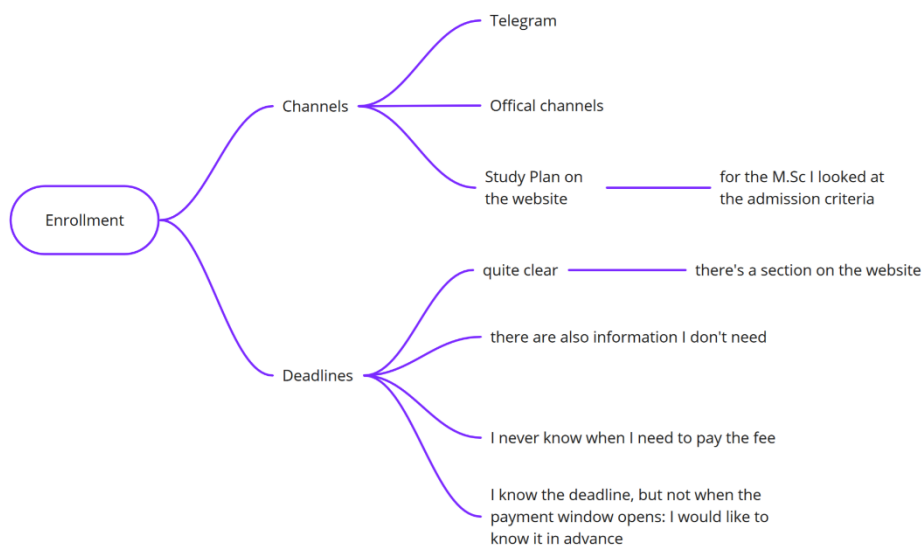


Figure 5. Example of the map compiled during a focus group session to guide students' discussion.

Quantitative research

Quantitative research was conducted through a Microsoft Forms survey sent to the whole student cohort of Polimi. The survey was sent to both Italian and international learners, respectively in Italian and English. Similarly, a second survey was sent to Polimi professors, to better understand the impact that their actions have on students. The students' survey was structured into four sections, for a total of 47 questions, divided into: 31 closed questions, 15 Likert scales and one open question.

After an initial profiling section, students were asked to select which channels they use for specific actions, i.e. information about extracurricular activities.

Students were then asked to reason on the processes - in terms of time consumption and information clarity - related to Study Plan, courses, exams, tuition fees and financial aid, Assistance and Registrar's office, enrollment.

The last section regarded how participants vision the future Polimi app. They were asked to evaluate the mobile importance of functions related to their academic career with the possibility to leave a comment.

The survey responses confirmed the aspects discovered with the qualitative research activities. It emerged that the amount of time students spend understanding and executing processes within the digital services is proportional to the importance given to the activity.

Research analysis

One of the most critical steps of user research was to discover students' unmet needs, going beyond what they explicitly expressed in the discussions and survey.

Unmet needs can be identified through two main components: goals and pain points (Gibbons, 2019). The information gathered with the investigative activities were organised in charts that visually displayed users' experience with Polimi digital services, their goals and pain points. This method allowed a deeper understanding of students' interconnections with the university system and how different factors affect learners' difficulties and actions. It was then possible to identify students' unmet needs, regarding the digital services offered by Polimi and their overall experience.

Specifically, six main unmet needs were highlighted as relevant:

- a management application to facilitate university activities;
- self-explicating digital processes, to simplify their experience;
- a guide for their university life, to access all the information and services anywhere;
- being updated about all the relevant information regarding their career, courses and events, to avoid missing out anything;
- an application that enables better navigation inside the whole Polimi digital system, proposing contents according to each specific user;
- being aware of all the opportunities provided by Polimi, that can strengthen their sense of belonging to the university community.

These needs became the starting point for the technology investigation through a blue-sky approach.

3.3 Technology Investigation

The technology investigation aimed at comprehending how other applications manage alike necessities and functions.

This research was conducted through a blue-sky approach, to explore how similar interactions were addressed by applications or platforms in different fields. Indeed, the aim of this step was to seek virtuous examples of User Experience (UX) interactions that could inspire the development of a fluid product in favour of our end users (Fig. 6).

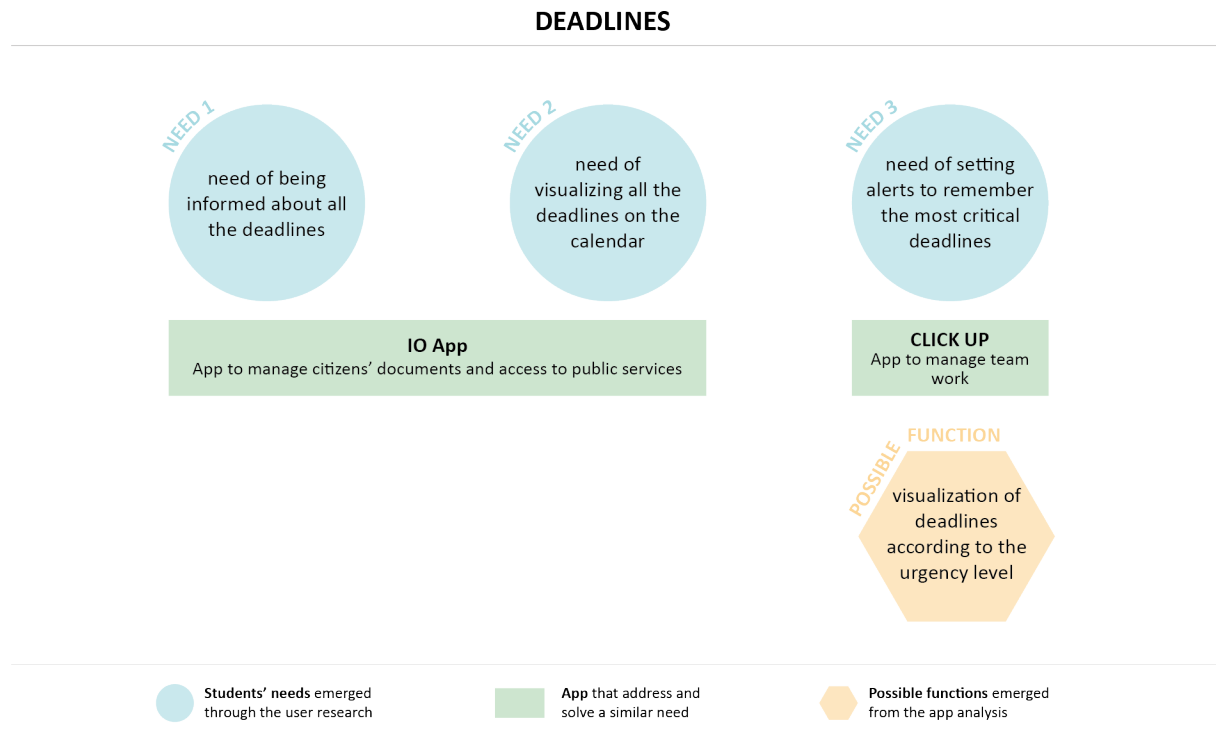


Figure 6. Example of technology investigation based on students' unmet needs. Starting from the topic of 'deadlines', two blue sky virtuous examples were selected and analysed. From this analysis, it emerged an additional interesting function for students: the possibility to classify and visualise deadlines according to their urgency level.

The blue-sky research was integrated with the examination of alternative solutions to the official Polimi app, cited by students during discussions. The aim of this activity was to understand which services students use to manage their academic life (Fig. 7).

ACADEMIC PROFILE

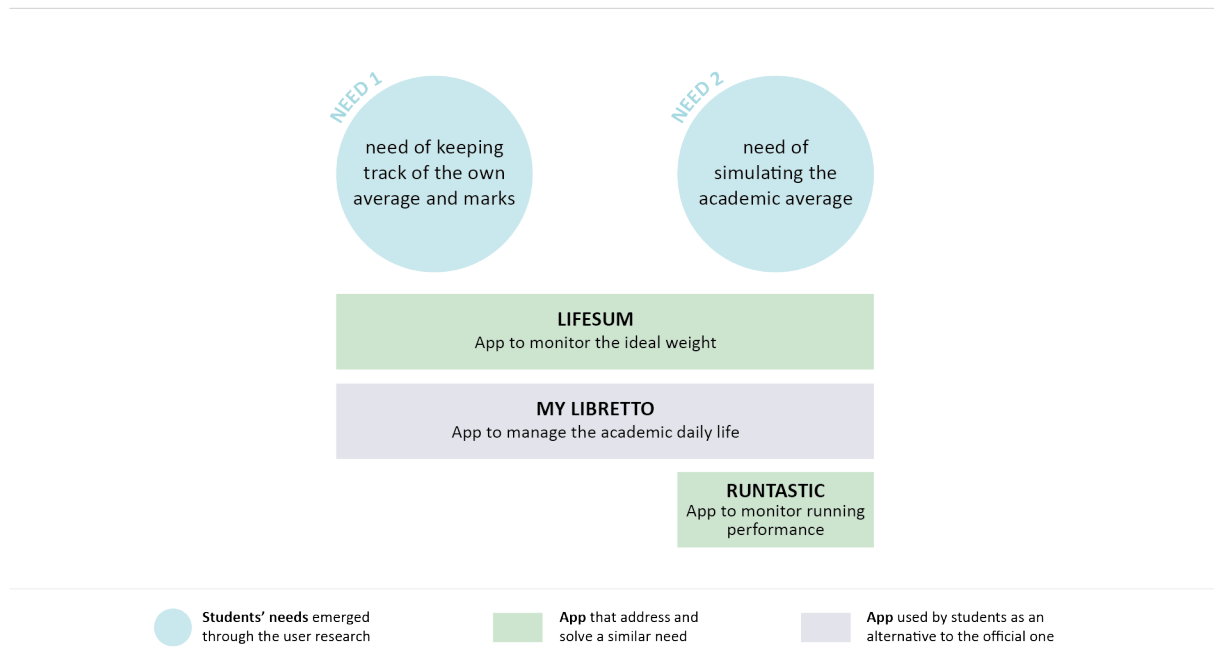
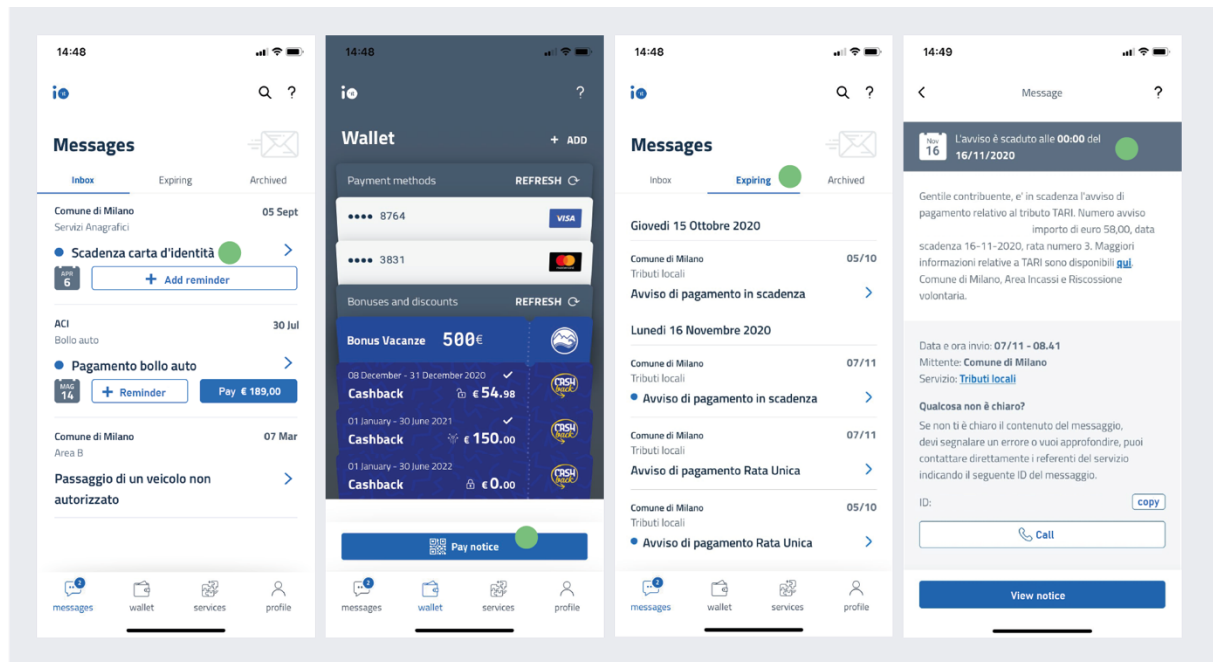


Figure 7. Example of technology investigation based on students' unmet needs. Starting from the topic of 'academic profile', two blue sky virtuous examples and one alternative app cited by students were selected and analysed.

For each identified application, we analysed the main functions, valuable points and interactions with the user (Figure 8).



Examples of efficient interactions for navigation

Figure 8. Interaction analysis of IO App, an Italian Government's mobile application connected to citizens' digital identity to manage deadlines, documents and access to public services. IO App was identified as a virtuous example of UX for its 360° view on citizens' deadlines and for its contextual notifications and call to actions. (IO App, 2020)

This investigation allowed to identify possible functions and solutions that could be integrated into the university app to further enhance students' experience.

Part of this phase included an open discussion with ASICT and Computer Science engineers that exploited the intrinsic diversity of expertise present in our university, and therefore also in the operative team, pointing at the identification of the right technology to adopt. This dialogue led to the designation of a responsive web app as the optimal solution to develop a cross-platform usable on multiple devices.

4. From research insights to concept ideation

In order to concretise the notions acquired during the user research phase and shape the concept, the initial step was to outline and focus on both explicit and tacit user needs.

This phase guided us to some basic understanding to establish the foundation of our digital product. Introducing a new application would benefit students bringing a primary requisite of value to our institutional digital services.

Students expect daily support from the app: it should be an integrated tool in everyday life, an access point for managing most activities, i.e. timetable consultation. They expect to find quick answers 'at fingertips' to their bureaucratic perplexities. The app should mitigate the

fragmentation of institutional information, currently distributed on many channels, into a single personalised touchpoint.

Indeed, the app should be the central piece of a broader digital ecosystem. Mobile and desktop should interact in a fluid and bidirectional way. Students expect continuity of experience among the digital ecosystem of Polimi to be able to orientate themselves on any device and platform.

The app should become the closest reference point for students concerning campus life at 360°. Empowering them to have all the information in their hands can help create a sense of community. Being aware of what happens on campus fosters a sense of belonging, giving the student the chance to discover new events and opportunities.

The second phase compared the results of the blue-sky research and the review of the current digital services to find the present interaction obstacles. It led us to detect the technological gaps between the existing digital services and the aspired ones.

Several opportunities for innovation emerged from the comparison: optimising already existing processes to foster usability and efficiency and reduce errors. Integration of any component, including external services, into the app aesthetics to grant a harmonised use of the mobile digital ecosystem. Lastly, the redefinition of the navigation model to make the use of the app more effective.

In this light, we have recognised experience desiderata that users perceive as cross-service prerequisites: personalisation, contextual feedback, proactivity, personal data management.

Personalisation means that users get content adjusted to their preferences and relevant to their specific situation. Contextual feedback implies that the app should provide punctual guidance and propose adequate solutions to the users in case of problems. Proactivity means that the service promptly interacts with the user, indicating elements of priority, urgency or issues. Lastly, immediate management of sensitive information, at any time from anywhere.

Regardless of the app's functionalities, these prerequisites must be included in the digital services as they ensure that the user always feels at the centre of the system. The protagonist of their Polimi's world.

4.1. The new PoliMi App

Therefore, the objective of the application is to simplify the institutional experience of Polimi as much as possible. When designing the concept, usability needs to be considered to foster the effectiveness of information in the system. Through the app, the user should be able to perform operations that significantly alleviate a student's life, transforming an action that before was hard and time-consuming into delightful and satisfying thanks to its interaction technology. Furthermore, the app needs to be easy to learn and to remember, factors that influence its adoption rate (Krug, 2014).

With these three usability principles, we conceived the app as a personal agenda that automatically reminds users of the bureaucratic deadlines linked to their ID number. At the same time, the agenda will appoint optional leisure and educational activities that may be of interest to the user. Indeed, to keep the users posted with new activities, the onboarding process asks students to select their didactic interests and hobbies. The application will be an intelligent and proactive agenda that will relieve the student from the most stringent duties, functioning as an access point to the world of Polimi opportunities. The student will only have to worry about making the most of their university experience.

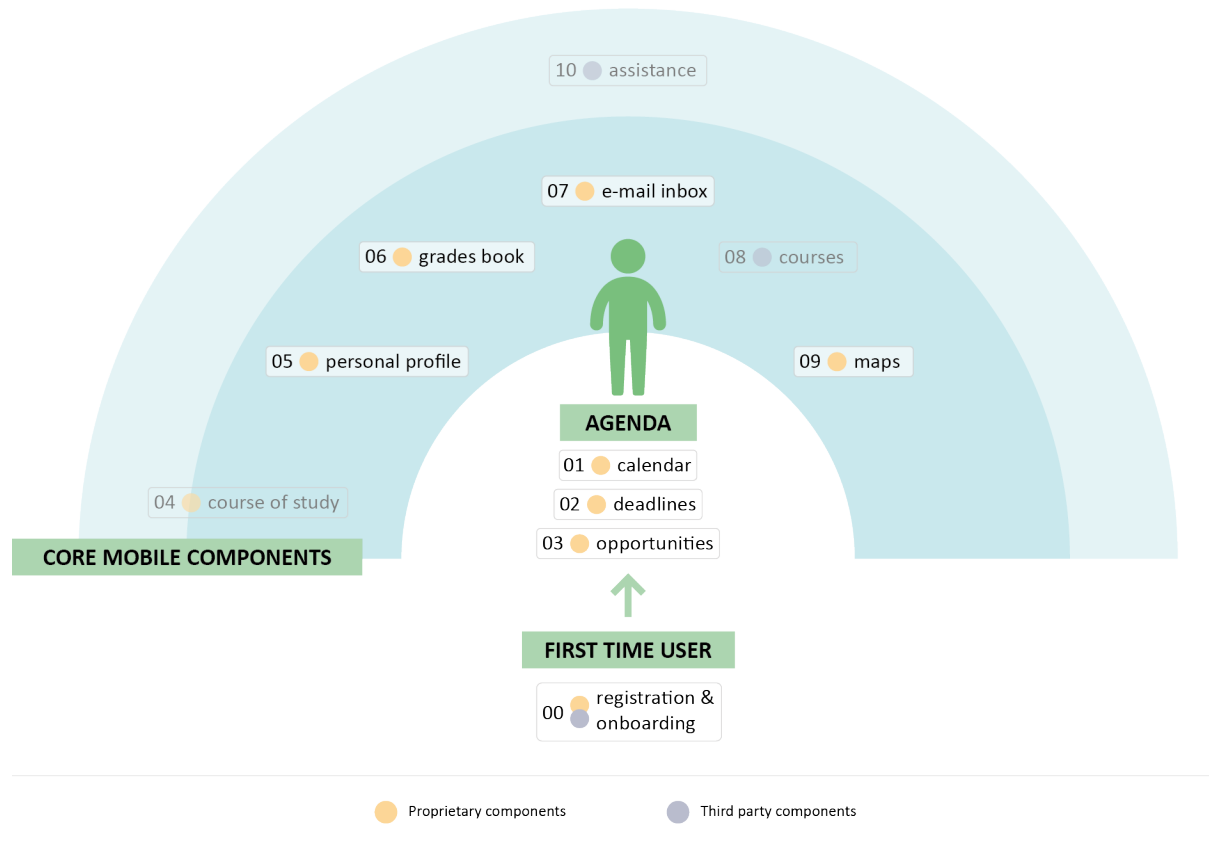
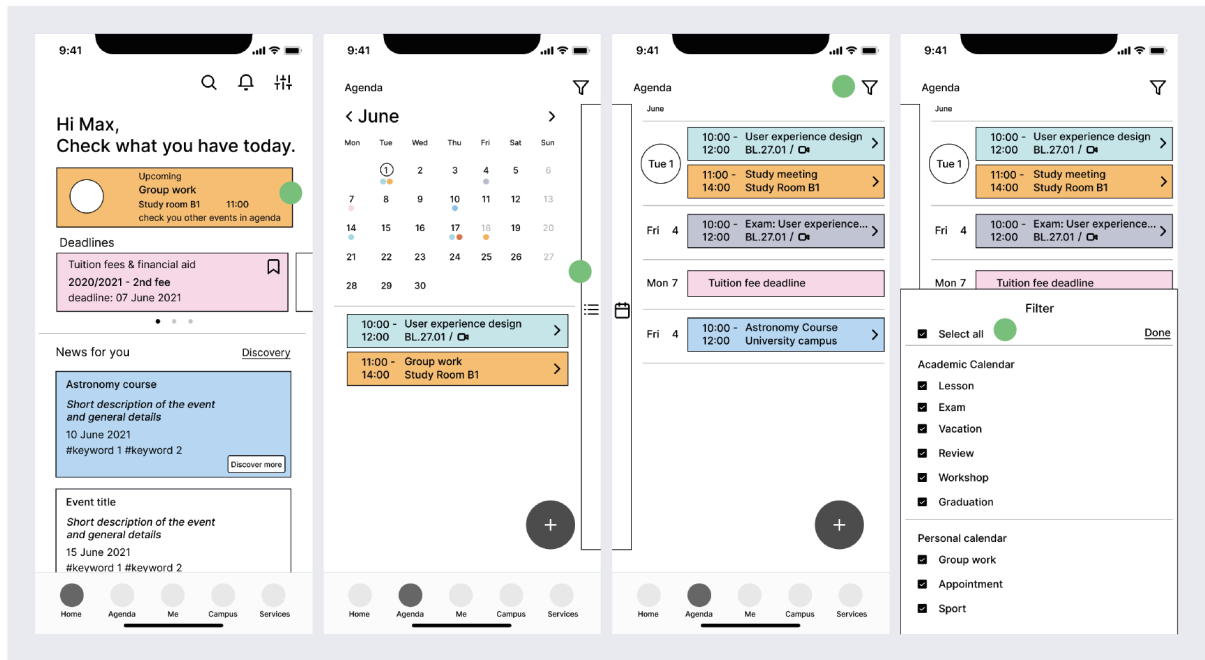


Figure 9. PoliMi App mobile ecosystem: the user is the central element and all the features revolve around the idea of the app as a smart agenda.



● Example of interactions with the new Polimi App

Figure 10. Polimi App concept: the app acts as a smart agenda, reminding students of their appointments and deadlines, sending notifications and allowing them to manage both their academic and personal events through a single touchpoint.

All the Polimi App functionalities were designed starting from the four identified prerequisites - as visible in fig. 11 - so that the 'personal agenda' could satisfy students' needs emerged from the research phase.

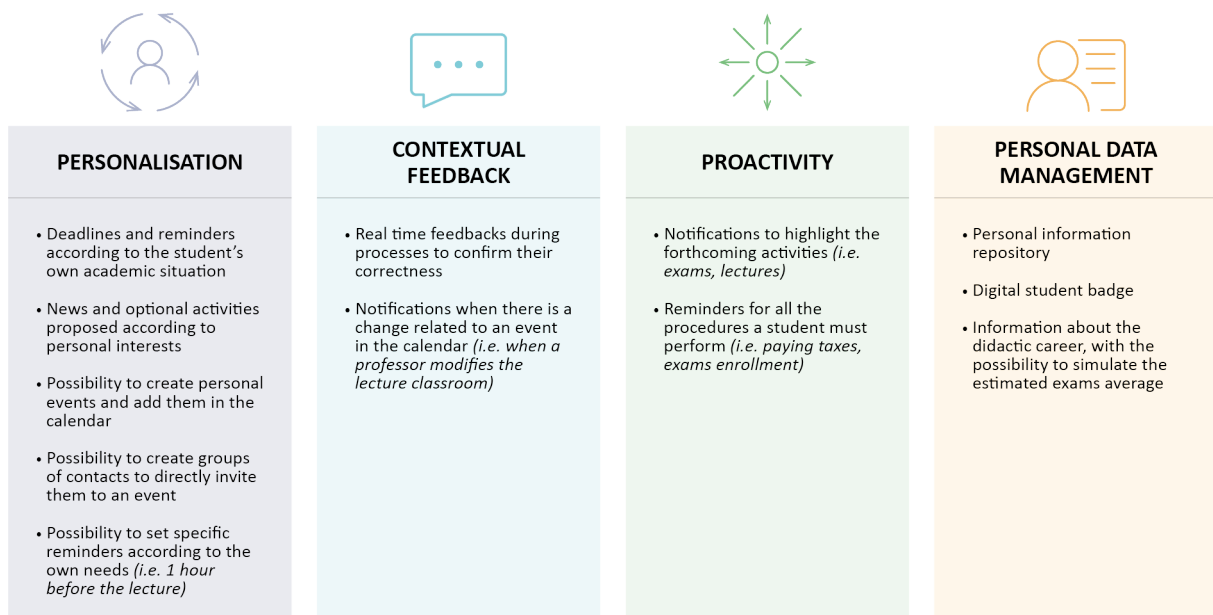


Figure 11. Polimi App main characteristics presented according to the four cross-service prerequisites.

The concept was user-tested with students in July 2021. We used a think-aloud protocol in which participants were asked to navigate a prototype of the app through a smartphone, explaining each action and choice they made and giving feedback in real time (Ericsson & Simon, 1998). The overall reaction was positive, especially because students recognized the benefits of having a proactive agenda that can guide and help them in managing their daily activities.

5. Conclusions

For the first time, Polimi internally applied a Meta-Design approach to rethink its mobile application, managing the research and identifying students' needs in such a complex system, overturning the logic through which the service is designed.

Meta-Design has been a fundamental step to untangle the potential issues related to the numerous stakeholders and the diversity in the students' population, formed of future architects, designers and engineers.

In order to correctly conceive the entirety of the university ecosystem an interdisciplinary team (composed by psychologists, engineers, designers and administrative figures) is needed, to be sure to give the right amount of attention to each aspect of the system.

The multidisciplinary team allowed us to put users in the centre of the project, analysing their lives and concerns, but always respecting the rules and constraints set by the institution.

From the data gathered we understood that students require everyday support from the app: it should be an integrated tool in ordinary life. Students confirm a high rate of interest for the mobile application as a reference point for all the services related to their university life. In this light, the app will be personalised on each student: the new Polimi application will be a proactive personal agenda to tidy up deadlines and duties for the student and offer extracurricular activities to stay up to date.

This concept is the best compromise between user expectations, and the technical and economic feasibility. The role of Meta-Design was precisely to facilitate the development of the project thanks to the investigation of its whole context, that accurately defined the design boundaries.

However, it should be considered that the activation of an innovation process such as the one conceived by Polimi App has intrinsic difficulties due to its complex nature and requires several steps to be applied. Indeed our next steps will be to foresee the development of the application and analyse what to realise in the first version and what to include in the future updates, letting the user adjust to the technological change and giving the possibilities to technicians to work agilely on the project.

With the purpose to activate the Polimi App replacement procedures, every aspect related to constantly evolving legislation and the system's increasingly fluid context must be

considered. In this sense, "design is never done" (Jitkoff, 2016), so that the development of services also follows the same logic, requiring continuous updating according to historical and social changes.

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