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METROSKY
The future of Urban Air Mobility

Executive Summary

In a context in which cities are rapidly evolving, the design of **urban mobility** and new smart solutions can play a major role. As the roads in urban areas become more congested, it is getting harder to commute at the ground level.

The overall aim of the Metrosky project is to exploit the **new class of aircraft** known as **eVTOL**, to design a fully sustainable Urban Air Mobility system in the framework of the **Metropolitan City of Turin and Milan**: the creation of unseen routes, coupled with the traditional transportation system, will strongly enhance the quality of the urban mobility. Metrosky's proposal deals both with the intangible, such as the design of the service and with the tangible aspects, such as the architectural and urbanistic development of the vertiport.

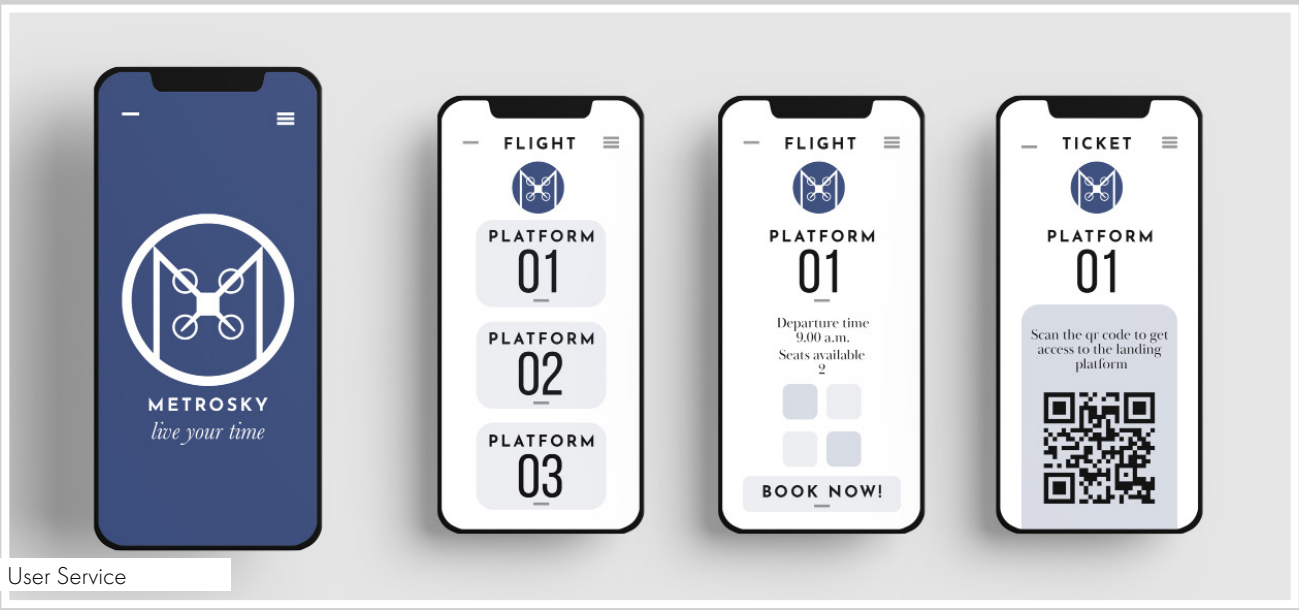
The service envisioned leverages the inherent key properties of the eVTOL technology: **rapidity, flexibility** in the choice of the routes, and **accessibility** from the urban fabric.

The architectural choices of the vertiport reflect the considerations that have been made so far: a **modular approach** to the design of the architecture allows the building to be flexible and adaptable to every urban fabric. For very dense areas the solution of **parasite architecture** has been adopted, posing the vertiport on top of pre-existing buildings. Furthermore, aeronautical requirements and technical aspects are considered to provide an architectural outcome that lets technical functionality and care towards the user experience coexist. Regarding the design of the interiors and its service inside the stations, these are thought to make the user experience not only **fast** but also **safe** and **comfortable**. This conceptual work is then exploited to build a realistic proposal of how the vertiport should decline in the test cases of **three distinct scenarios** in the city of Turin. The first scenario deals with a **public-type vertiport** located in the heart of the city, in Piazza San Carlo, challenging the capacity of adaptation in a very dense historical urban fabric; the second shows an example of a **private hub**, positioned on the top of the Intesa San Paolo skyscraper; the third is a prototype of a **temporary installation** for events in a non-constrained environment, such as the Valentino Park.

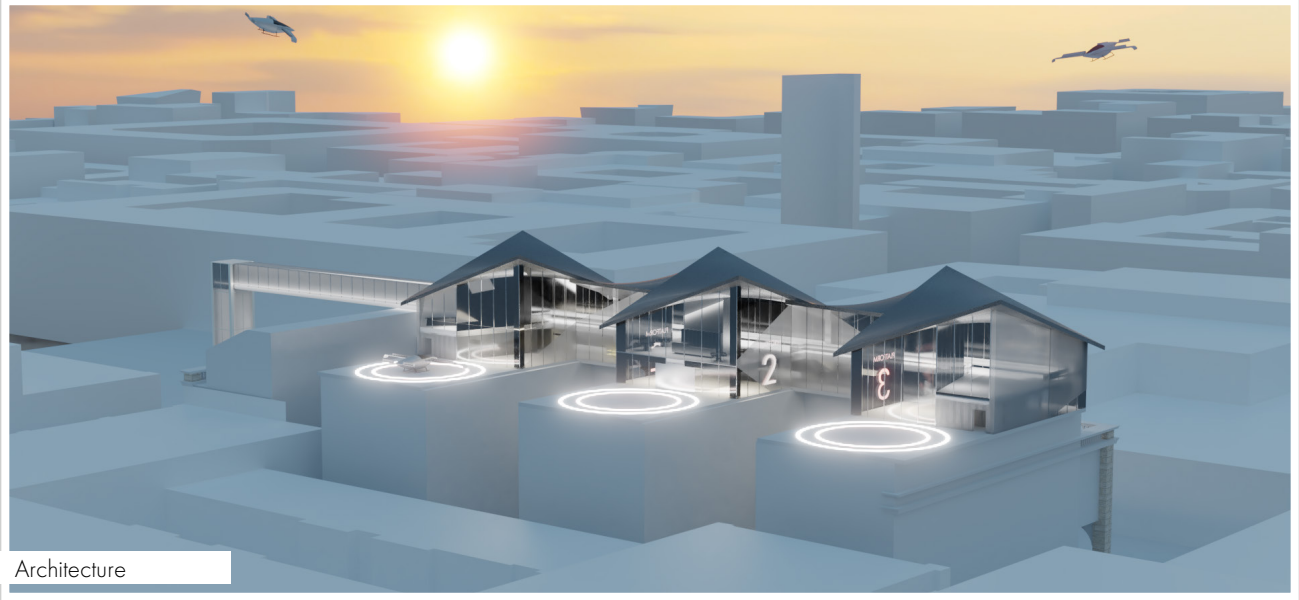
The results obtained by this study have produced a **flexible and iconic vision** that can be used as a starting point for the establishment of UAM in the cities of Turin and Milan, and as a model for other cities around the world.

Key Words
Urban Air Mobility, future, eVTOL, speed, vertiport

Stratified city



User Service



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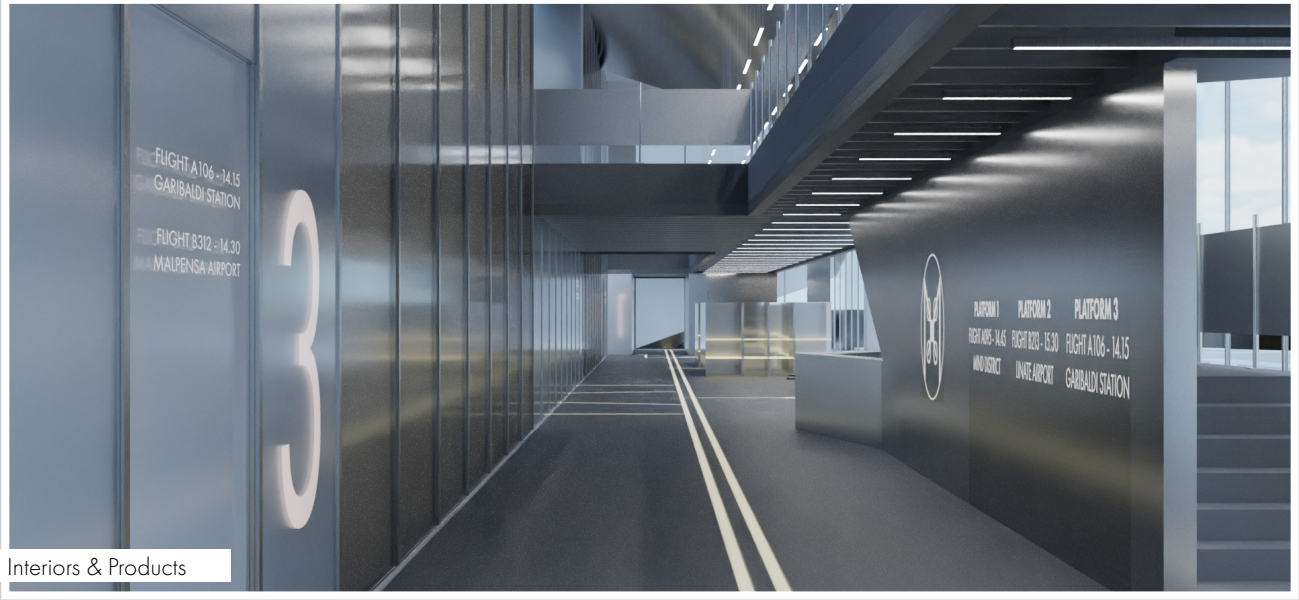


Interiors & Products

Project description written by the Principal Academic Tutor

The METROSKY project aims to explore the relevance and potential of **innovative urban mobility** and its possible **social fallouts in the cities of the future**. It has been developed by the METROSKY ASP students' team in partnership with Metropolitan Authorities and local aerospace industries.
The **experience** and knowledge of Italy and **Turin in aerospace-related industries and technologies** is widely recognized as a national and regional asset, and is at the core of the future Aerospace innovation center that is under construction in the Aeritalia area.
The innovative form of fast airborne transportation by electric Vertical Take-Off and Landing aircrafts (eVTOL) will lead to the **radical renovation of airspace** in the near future and will require **new urban infrastructures**, to be defined in coordination with space agencies and aviation regulatory entities. This is now happening at international level.
In this context, the **METROSKY project focuses on the development of the Metropolitan Air Mobility Infrastructure** (MAM) meta-project for people and goods transport.
In this innovative and comprehensive system conception, eVTOL aircrafts, vertiport location and architecture and the overall control and management system are part of a single socio-technical, **multi-scale infrastructure**.
At the core of this infrastructure are landing/charging buildings hubs: the "verti- ports". They are inserted in the dense and historical urban context of city centers, and provide the access to **short and medium range connections** at metropolitan and inter-metropolitan scale.
The proposed infrastructural hubs designed by the METROSKY team are based on one side on **users' demand**, experience and perceptions - thus focusing on the technological and logistical but also human dimension of transportation – on the other on the industry' business development targets – thus focusing on the logistical flows of users and provisions between aircraft, vertiport and city in each hub.
The result is a complete feasibility study defining possible site specific (yet replicable) prototypes of the MAM vertiport component of this multiscale infrastructure.

Team description by skill

The Metrosky team consists of **three architects**, **three designers** and **two aerospace engineers**. The multidisciplinarity of the group was fundamental for the success of the project: everyone made their own contribution and guided the rest of the group during the different phases of the work.

The aerospace engineers, **Edoardo Monti** and **Michele Nava**, directed the design choices made by the group based on their technical background in aeronautics. **Benedetta Ballabio** and **Diletta Casolari** , students of Architecture - Built Environments Interiors, and **Federica Mungo** who studies Building Architecture, contributed during the urban research phase, in the design of the building itself, and during the interior spaces design. **Sarah Joy Giacomelli**, thanks to her background in Systemic Design, led the studies on the vertiport service, together with the other designers **Matteo Mojoli** and **Valentino Stella**; furthermore Matteo e Valentino, specialized in Product Design, followed the final part of the project by designing the interior furniture.

Goal

Metrosky's goal is to develop and offer a **new air taxi service** that connects different urban and metropolitan areas in a fast, flexible and sustainable way. The goal, shared by the whole Urban Air Mobility - UAM - community, which is strongly committed to being part of the **ecological transition**, is also to offer innovative solutions to provide concrete and "adaptive" responses to the lifestyles of the future and following sustainable and responsible transition strategies (SUMP - planning of sustainable urban mobility).
The request from the external institutions aims to strengthen, in the future of cities, the relevance of smart urban mobility and foresee its social repercussions, concerning metropolitan territories and local aerospace industries; in fact, the Italian and Turin experience in aerospace industries and systems is recognized as a national and regional asset.
The innovative form of **fast transport with electric vertical take-off and landing** (eVTOL) **aircrafts** will soon usher in a **radical renewal** of the airspace and will require new urban layout arrangements, in coordination with aerospace agencies and regulatory bodies, and this is also taking place on an **international scale**.
In this context, the Metrosky project focuses on the development of the Metropolitan Air Mobility Infrastructure **meta-project** for the transport of people. The proposal, in addition to offer the innovative system of eVTOL aircraft, aims to investigate **the distribution of vertiports as street furniture** and the overall s**ystem of control and management of the short and medium-range connection** on a metropolitan scale.
The final goal is to develop a **feasibility study** and a **prototype of the vertiport component**. The technology-driven approach suggested to the Team aims to develop a proposal to enable mobility infrastructure systems involving local stakeholders, in terms of awareness and impact on the territory. In fact, the territory of the Metropolitan City of Turin (CMTo) and the local communities are involved in the project proposal, as beneficiaries of the project itself.

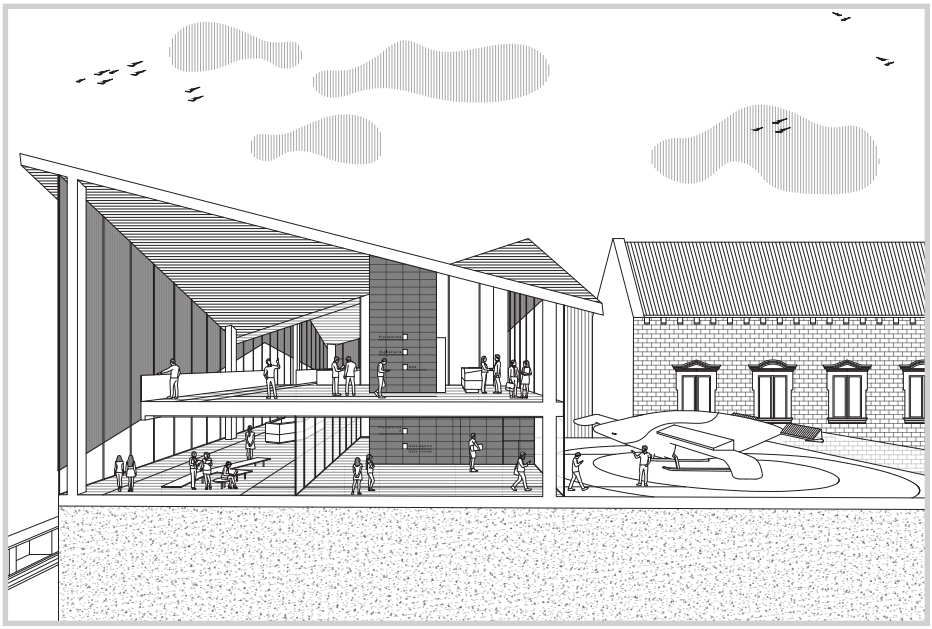
Understanding the problem

Today, 2022, discussion about sustainability, climate, environment are increasing to find solutions that address **radical environmental changes**.
The evolution towards an increasingly sustainable approach is taking place in all directions, from the largest to the smallest realities; despite this, it is inevitable to confirm that some sectors remain more **impactful** than others such as **industry, construction and mobility**.
The three sectors mentioned are pilots in large cities. In recent decades, the phenomenon of urbanization has become a global trend of social and economic development, it is an exponential increase in population that spills into environmental problems in terms of traffic congestion, pollution and resource depletion.
In the context of evolving cities, **traditional mobility networks are no longer sufficient**, so it is necessary to introduce new means of transport capable of keeping up with future challenges: eVTOLs - electric vertical take-off and landing vehicle -.

The Metrosky project, which envisages a n**ew network of the skies of the cities** of the future, faces challenges to manage two of the most impactful realities mentioned above: mobility (the service) and construction (the vertiport).
Urban Air Mobility must be confronted with internal problems to ensure the realization of the service. It is necessary to take into account the different problems that may be encountered during the development of the project. They can be classified into four macro-themes.
The first concerns the **technical requirements of the aircraft itself:** each system has specific pros and cons regarding speed, ideal routes, time to market, efficiency and market size; the technical specifications can sometimes be in contrast with the service urban studies.
The second includes the **certifications, laws and regulations** necessary for the approval, operation and maintenance of these new means of transport: there are still no standards in traffic management and safety, and this obstacle must be taken into account in the projects planning.
The third category concerns the **acceptance of the system**, essential for being a service to the public: the use and social acceptance of eVTOLs depend on resolving problems and doubts about the safety of the vehicles, the noise, and visual pollution created and proving that everyone will benefit from the UAM system, not just the more well-off.
Finally, the latest requirements concern the **support infrastructure**, including take-off and landing stations, the UATM system, charging stations and maintenance stations. The problems to be solved are perfect integration with the urban context, finding a balance between benefits and disturbances that bring to the city, connection with the existing system, integration with the technological aspects of aircraft.

The relationship between spaces.

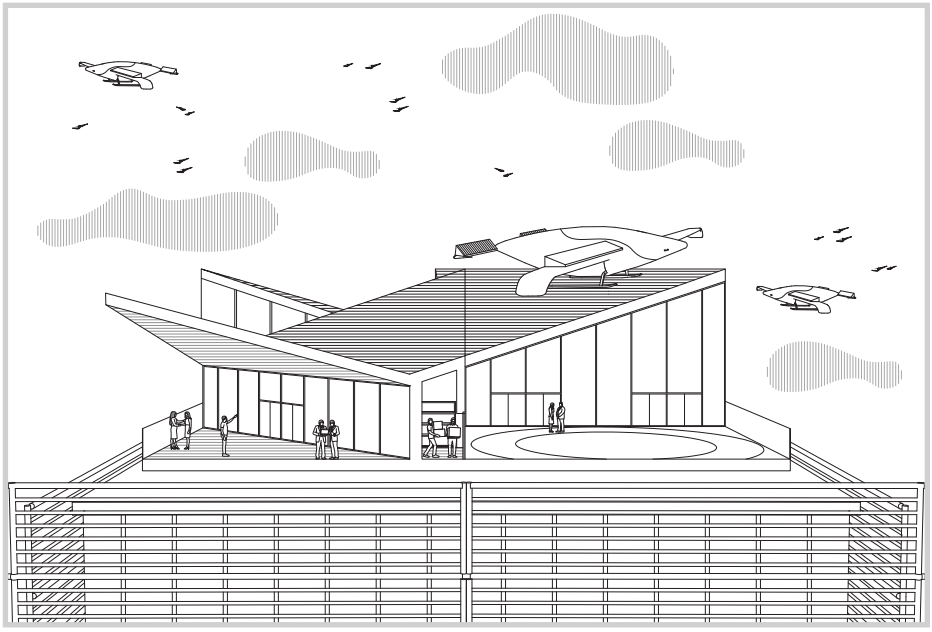
- Reception
- Retail area
- Waiting room
- Take-off area



Perspective section - Public vertiport, San Carlo Square, Turin

The outdoor spaces.

- Sky bar terrace
- Battery storage
- Take-off area



Perspective section - Private vertiport, Intesa San Paolo Skyscraper, Turin

Exploring the opportunities

The global movement to improve environmental conditions could be a great opportunity for Metrosky to enter the market.
Metrosky takes advantage of an **electrical system** that could solve traffic congestion in cities, and the consequent **decrease in pollution**. In addition, this innovative system could be a potential **means of communication** and model toward a greener and more responsible future, both in the field of mobility and construction.
From an interurban point of view, using eVTOLs would **speed up travel** and ease the pressure on other means of ground transportation.
Although the integration of the **new ecosystem** can be problematic from an urban and regulatory aspect, on the other hand, the realization of it could represent an opportunity to reorganize the rules and open the doors to new innovative systems that could support the city.

Generating a solution

The Metrosky Team faced the problems mentioned by dividing the work into **four phases**.

1. The starting point was to **study all the public mobility** of the two cities under study - Turin and Milan - in order to answer the question "how will cities host the new system?" . This initial analysis helped to understand what the vehicles are, how they move, who uses them and why (it is easy to observe that the user of a taxi has different needs from the user of the subway or airliner). Furthermore, the analysis helped to understand **the major urban hubs** and the best hypothetical **locations for vertiports**. The result was the superimposition of the new vertiport areas on the existing **urban mobility map** of the two cities; the different take-off and landing points were chosen based on the main attractions present or planned for the cities.

2. The **service design** was a step carried out in parallel to that of urban design, as the study is based on the knowledge and requirements of the user, an area that involves both the urban scale and the process and circulation inside the vertiport itself. Service design follows the entire movement of the users, understanding their **needs, requirements, objectives** and the **activities** that involve them. For this type of analysis, it was useful to use theoretical models such as stakeholder analysis, power-interest map, journey map etc. These investigations have led the Team to some key points that need to be followed, such us the **speed of the service** ,the **recognizability** of the structure, the importance of the **digitalization,** the integration with the urban existing transportation, etc.

3. The third step was the **Architectural Design**. The approach to the architectural part of the vertiport was markedly different from the types of analysis previously explained: the infrastructure does not yet exist today, 2022, and therefore, the solution was that of comparison to create new hypothetical rules. Initially some station layouts for other types of transport were analysed (e.g., train stations, airports, bus stations, subways), and the common activities that corresponded to the user profile, framed with the service design, were taken into consideration.
   Subsequently, an **abacu**s was created with minimum and maximum measurements, **standardized activities and functions**. The purpose of such document is to provide designers, architects and engineers with a useful tool to use as a reference in the development of the design of a vertiport. With the basic abacus, it was then easier to approach the structure in a standardized way, creating a **basic module that could be reproduced in different contexts**.
   Three types of vertiport have been developed as examples: one **public** that is grafted onto the 'existing, a vertiport for **private** use again inserted on the existing, and a last **independent and modular public** typology to be collocated in case of events.

4. Among the last steps, the **interior design** has been developed, thanks to which the flows and Movements, studied during the service phase, can exist.
   The design proposal presents aseptic interiors that reflect the colours and shapes of the external modules, very clean from the formal point of view to ensure the **speed of movement inside** and the **immediacy of communication.** Furthermore, the goals of speed and immediacy have been achieved with a **wayfinding design**, based on the study of the user and the vertiport.

This methodology and type of study have produced a solution, a model, which addresses the main issues and which could be used as a model for other cities.

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