

DV4CUL

Digital twin for building new urban logistics from
capillarity



Smart Cities and Smart Logistics

DV4CUL: Digital twin for building new urban logistics from capillarity

With the contribution of:



- capillar IT



- Urbike



- Rayon9



- Coopcycle



- Coursier Wallon



- Deliver-e



- **Les Tartes de Françoise**



- **ITAINNOVA**

Challenge & Context

Urban freight and the rise of last mile operations have a [disproportionately high impact on congestion](#), use of space and emissions, which negatively impacts the quality of life in cities, while increasing delivery cost at a level that puts supply chain viability at risk. [Demand and offer](#) are atomized, largely relying on SMEs or independent workers, who don't have the tools, funding and mentality to cope with it by consistently addressing the operational, business and governance dimensions of the challenge.

Convenience is behind such a surge that is turning supply chains around as satisfying increasing demand for convenience triggers new commercial channels that pull this new urban logistics and hack the conventional logistics business models by making delivery a key part of the buying experience.

The most performant value chain in this context is Amazon's, [despite reporting losses](#) again after the pandemic. It relies on resources mutualization, mastering logistics capillary capacities and mastering data exploitation from production to end customer:

1. It has progressively opened to competitors the infrastructure and services that it has developed to support commerce such as AWS, its Marketplace and most recently its logistics through the [Buy with Prime service](#).
2. It has the [Delivery Service Partner](#) programme to secure the last mile by fostering its best employees to become operators, taking care of staff and vehicles to distribute its orders using technology that it provides. It has switched the focus from developing warehousing capacity to filling

cities with its own stores entering right into urban real estate development. It is the [main investor in the LEV manufacturer Rivian](#) to secure the supply of a dedicated Electric Delivery Vehicle for the last mile.

3. Its [digital advertisement business](#) is also gaining momentum both internally against other lines of business, as well as [over market competitors](#).

Slow down of business trends after the pandemic comes along [Rivian losses impacting](#) Amazon's plans, [Amazon's main EV](#) supplier in the EU market [Daimler stepping into Rivian](#), and Amazon bets on mutualization of its logistics resources to cash its assets by launching Buy with Prime as a service for its retail competitors.

This puts collaboration and data exploitation control at the center of the viability of logistics and commerce, whether it concerns Amazon with its full-stack business model, or independent retailers and its logistics services providers (LSP), while the sector simply has no culture for it.

Collaboration increases the complexity already inherent to this context.

There is a need for information to deal with it. This information comes from many different sources, with systems speaking their own languages. This information is required for operation, and access to it has to be quicker and quicker.

But there is also a need for information beforehand to decide how to organize the business that now goes through collaborating with others in such a fragmented baseline of urban logistics, where most stakeholders are not equipped with IT systems, there are no IT solutions tailored to it, and there is limited awareness of the data value chain. Here is where our experiment makes sense and i4Trust is a key enabler. The experiment copes with the current need for IT tools for taking strategic decisions in capillary logistics, which triggers awareness about the potential of exploiting data in the sector. This is key because the MVP enables the basic conditions to start working on additional services to customize and automatise data operations and develop the adoption of the i4Trust technological framework as a market advantage.

Solution

DV4CUL builds on making available a tool that helps urban logistics stakeholders, both LSPs and its clients, realize how they can adapt to the market conditions that disruptors like Amazon are installing. It does so by simulating how they can integrate capillary logistics into their business, or develop it further, as well as set up collaborations that give them control over their data and awareness of strategies for getting more value out of it.

Assessing the impact of collaboration in different scenarios makes companies realize how sharing information can enable them to improve their performance and make decisions accordingly on when and how to collaborate to develop their organization and their value proposition.

Being the tenants of the most capillary capacities to cope with the urban commerce and logistics challenge, cyclelogistics companies are key to:

1. Generating the EPCIS events and data models for the last mile distribution
2. Building and calibrating the best models for running the simulations.
3. Define the new collaborative scenarios to set up

Despite them being the lowest equipped, IT literate and invisible in the sector. Hence we focus the service development on providing specific functionalities for cyclelogistics first, easing off-the-shelf interoperability with most adopted and data-management empowering standards, and securing customized access and management of data through automatable parametrization.

The i4Trust framework allows our solution to include such features, starting with identity controls, customized access, exchange, publication of data... while making it easy and agile. It turns out to be an enabler to build engagement with users step by step in our product and service development, based on evidence. It also allows us to start to work on developing further functionalities over our decision making support MVP tool, as added value services regarding data handling that the market was just not aware of so far.

These features and awareness about the benefits of data availability and exchange, whether for its direct impact on performance, as well as for the possibility of indirect profits due to the value it has for others, make the

difference regarding incentivizing collaboration in the current context that forces business models to adapt and are a key asset to our commercial strategy.

In addition, they put cyclelogistics on the radar of IT providers to consider the exchange of data and the use of standards in their designs, as IT interoperability turns out to be a main barrier in the sector.

The initial scope consists of performing basic simulations with cyclelogistics companies, to self realize how they perform and how they can improve it, at the planning level. Hence our i4Trust experiment includes three companies of different profiles regarding their data value chain - Urbike, Rayon 9 and Coursier Wallon-, to assess relevant strategies to get them onboard and validate our commercial strategy. Urbike has already addressed its integration with customers' systems, as well as the exploitation of data for strategic analysis. Hence we have been able to advance together in 5 main aspects:

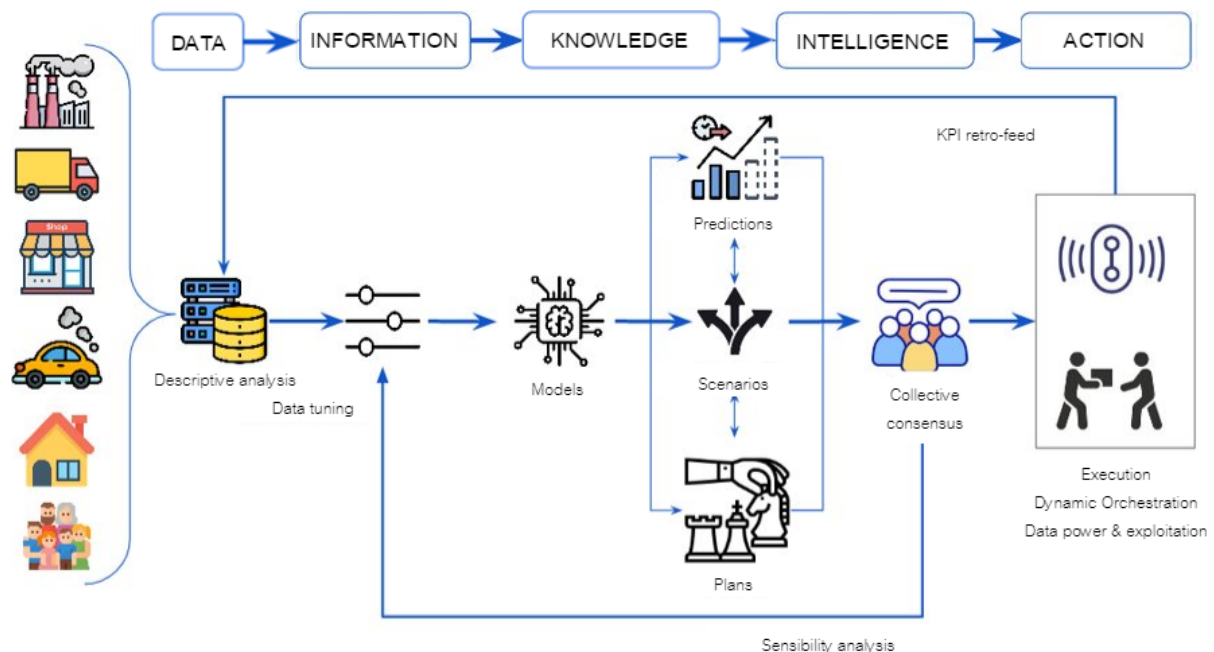
- The convergence of standards for the definition of our data models
- The normalization of data for automatising exchange
- The prioritization of new data sets and the IoT to gather on field sources
- The definition of the basic IT infrastructure of an urban hub for collaborative logistics
- The benefits of the simulation tool by increasing agility and accuracy of strategic analysis

These simulations are the base to identify larger scenarios involving their clients (both larger intercity operators and shippers) showing directions to improve their current collaborations, and drawing their interest towards the tool. Also, the MVP shows the potential to streamline strategic analysis allowing for more accurate and faster results, reducing a 3-month study to less than a week of work.

R9 is currently addressing the convergence of IT tools into a single routing software by Coopcycle, which allows gathering all their operational data together, and with a minimum amount of data for meaningful simulations. The experiment has allowed Coopcycle to advance in the normalization of its data outputs to automatize exchange and look at the convergence between standards to ease the interoperability of its routing solution for cyclelogistics cooperatives worldwide.

CW and Deliver-e are in the process of adopting a routing solution to have a consistent register of their operational data and assess their potential partnership. The experiment has equipped CW with a first mobile app customized for some of its flows allowing also to track routes, to realize the benefits in time, traceability and customer interaction, by choosing the right software. It has also provided the requirements to compose their data strategy to comply with the data models to converge GS1 standards with NGSI-LD.

How it works



Technically, our solution builds a digital twin around a powerful simulator that allows to run different scenarios of LSPs, cities, and customer interactions to make predictions of how the logistic operation can be optimized in an economical, social and environmental sense.

It aims to unleash the power and value of data for overcoming some of the barriers to improving urban logistics by means of data standardization for seamless interoperability, and parametrizing and customizing data interexchange to generate trust.

Our first prototype used to run on an online platform with specific, singular data models making logistics operators dedicate a long time to understanding how data should be exchanged and preparing it. Nowadays, this problem has been solved with FIWARE smart data models that use linked data. This linked data allows users to more easily understand all data exchanged with its different fields, for customizing controls accordingly.

On the one hand, the use of the policies and the iSHARE satellite provides a standardized way to manage the identity of the different data producers and consumers, making our solution robust and more scalable.

At the same time, the use of a Context Broker and Kong simplifies all the processes related to the access of data. Even more, the use of new NGSI-LD-defined variables such as geo properties allows people to directly obtain the data in GIS format which is direct-to-use data.

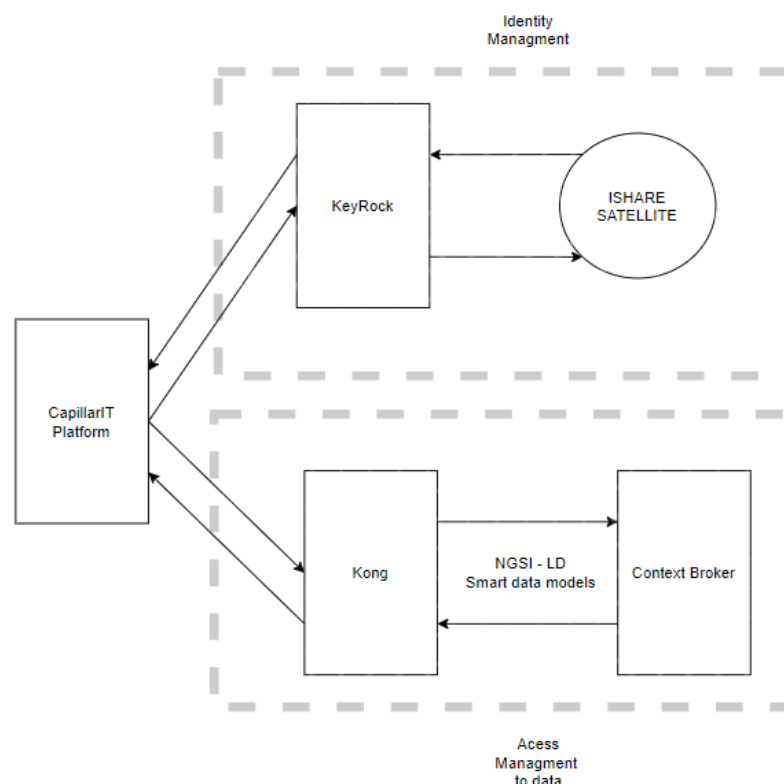


Figure 1 - DV4CUL high level architecture.

In the High Level, the structure is composed by 3 elements, capillar IT platform with the digital twin, Keyrock and the iShare infrastructure that manage the identity of the users and Kong with the Context Broker that provides the secure and customizable access to data.

This basic infrastructure sets the ground of a dataspace where the users of the simulator (Urbike, R9, CW) are both data producers and data consumers of the outputs of the simulator. The place where these data producers can retrieve data from the simulator is the i4Trust prototype of the European Marketplace, with Keyrock as identity provider and Kong with a plugin for managing the access to data. Finally, data interoperability is achieved through smart data models and the NGS-LD API that Fiware has developed.

The smart data models for the moment are specific to our application although we are creating smart data models based on GS1 Standard.

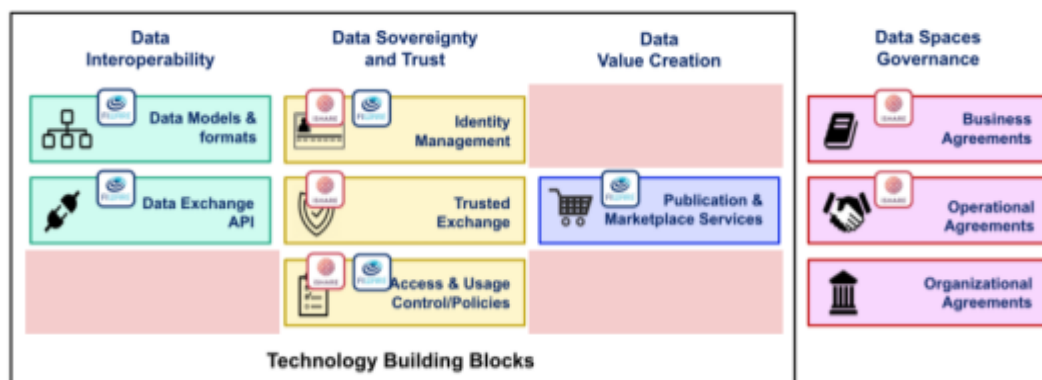


Figure 2 - Set of FIWARE and i-Share components used for the current Data Space baseline of DV4CUL.

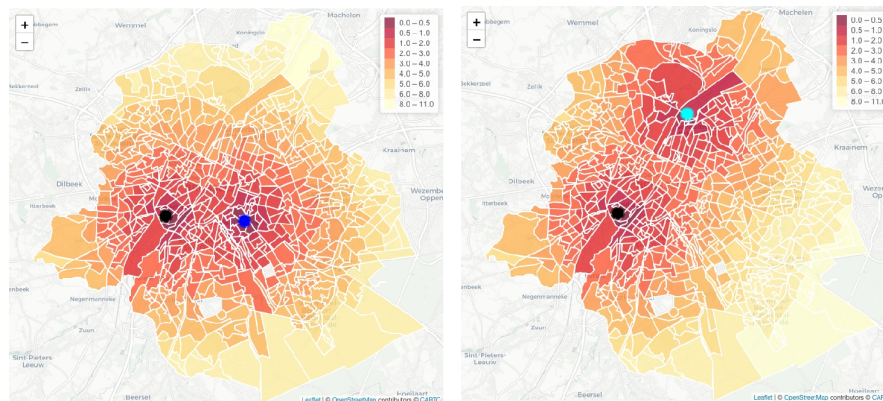
Regarding users, the experiment confirms the potential of data processing to add value for all parties, individually and collectively, making them prone to explore how to collaborate. First, by making more transparent and customizable data handling to answer strategic questions, which also builds trust and overcomes concerns about data sharing. For instance, it creates a bigger picture of what is going on inside the cities, which enables users to cope better with the last mile issue that challenges businesses and quality of life. It also sets a firm ground to define which data to share and how to do it, with the rules of access and use, and trade-off agreements.

Regarding technology, we learn how to build a Data Space that provides the supporting infrastructure and operating environment enabling our service to achieve full impact, by securing seamless interoperability with other services and enabling its customization depending on the visibility of the subsequent benefits, resulting in more functionalities and better users' overall experience.

Benefits & Impact

The experiment has dealt with five final users, managing to involve two of them on a regular basis with the tool while helping to define and activate the onboarding process for the others. It starts going beyond theoretical discussions of the importance of data and having a data strategy, to show representations of practical situations and question them, to point out how to get answers, which data sources are required and how to collect them. All of them can be potential customers, although only one is an early adopter to become a customer after making an upgrade to our prototype.

First results of comparing the current working set up of Urbike of two stationary hubs, with alternatives scenarios exploring other locations (cf. map 1) and formats (cf. figure 1) for its second hub reveals potential improvements beyond 28% (table 1) and up to 42% (table 2).



Map 1 - Minimal distances from the closest hub. Left: urbike set up 2021. Right: potential north-south scenario

New HUB	Performed Tasks	Performed Tours	Mean Distance	Tasks Proportion	Profit
Lorand	35,990	3,972	15.28km	25.9%	29.0%
Monnoyer	36,308	3,928	14.28km	22.9%	32.3%
Cinquantenaire	35,136	3,769	13.65km	37.4%	31.3%
Kanal	35,201	3,802	14.31km	43.0%	28.9%

Table 1 - Impacts on performance depending on the location of the 2nd stationary hub

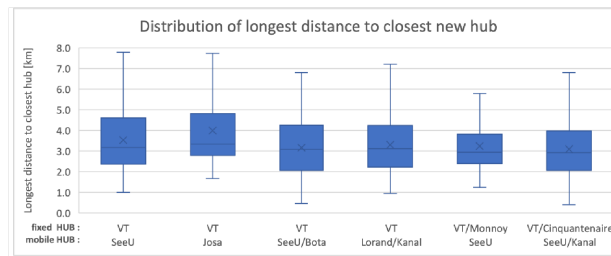


Figure 1 - Scenarios with 2nd mobile hub: distances distribution to the closest hub

HUBs	Performed Tasks	Performed Tours	Mean Distance	Open Days	Profit
Fixed : VT Mobile : SeeU	2499	264	12.41km	124	41.96%
Fixed : VT Mobile : Josaphat	2448	255	13.55km	20	40.6%
Fixed : VT Mobile : SeeU Mobile : Bota	2501	264	12.09km	77	40.5%
Fixed : VT Mobile : Lorand Mobile : Kanal	2446	253	12.17km	140	42.64%
Fixed : VT Fixed : Monnoy Mobile : SeeU	2446	247	12.25km	104	42.16%

Table 2 - Impacts on performance depending on the location of the 2nd mobile hub

Today the tool allows to increase the complexity, accuracy and speed of this kind of analysis. The MVP streamlines them, reducing a 3-month study to less-than-week work, and enables logistics enterprises and networks to develop to the capillary challenge.

Based on this evidence the MVP also raises awareness among users about the potential of exploiting their data. This is key because it enables the basic conditions to start working on additional functionalities to customize and automatise data operations, which makes i4Trust a commercial advantage and sets the ground to explore a market that the sector is not aware of so far.

Beyond the experiment, Uribke is an early adopter that opens the opportunity to access its clients (LSPs and retailers) as customers of the service. On the other hand, we can target similar profiles elsewhere.

Cities are the other target, after the second phase of development that has already started. Meanwhile, the tool supports the consultancy service that we are already offering them.

We target to offer a full version of our product through a dedicated data space in 23 to 29 months from now, growing the team with four profiles and adding 600k€ turnover to current provisions for 2024. An extra 400k€ in 2025 would allow us to have our solution deployed and running in 10 cities with at least 30 LSPs, within 3 years from now.

Target groups for us are robust cyclelogistics companies and cities. The firsts provide the best data to calibrate our algorithms to the reality of each city and support their growth and the spread of cyclelogistics. Meanwhile, cities are key to fostering LSPs and retailers to overcome current barriers that prevent them to address business and urban challenges, by providing the technological layer that enables them to share data complying with relevant regulations and concerns to

1. Analyze the trade-offs of collaborating.
2. Comply with traffic and environmental regulations.

Added value through i4Trust

The overall impression of i4Trust is positive because of the opportunity to know and learn its underlying framework, which fits our vision and enables us to fully achieve it. If we had had beforehand more visibility of its level of maturity, we would have defined the experiment differently. It has been a challenge to materialize our ambitions to keep developing our product and engage with potential users in parallel to adopting the framework. This has turned out to consume much more resources than expected in debugging with little flexibility to reallocate resources internally.

Despite the unexpected learning curve, we have managed to grasp the technology, with overall great support from the technical experts, and build a prototype that helps us to demonstrate the distinct value of our service and which feeds, along with a sustainability plan, our development and commercial strategy and activity right away. Networking and funding boot camps have turned out to be placed too early in the project roadmap, and they have provided us little more than better visibility of an emerging ecosystem with a lot of potential and many challenges. Likewise, the social media and events

approach has been less meaningful than if placed in a later stage, with a prototype working. Looking back, it would have been more useful for us to have a shorter welcome training, a first boot camp focused on technical training instead of networking, and a funding boot camp with the prototype ready.

The main value for us is realizing that i4Trust gives us the tools to build an environment (Data Space) with the tools to address the challenges of:

1. Data sharing in logistics
2. Data exploitation in commerce
3. Data monitoring in regulation compliance and environmental, social and governance reporting

That set the ideal conditions to complete the value proposition of our digital twin, pursue its development and commercialization; as well as to operationalize its results, starting with trust for considering collaboration as an option, and for implementing it if simulations back it.

Next steps (if applicable)

Next steps and milestones in the near future are well identified and include:

1. First upgrade of the simulation to fit better cyclelogistics dynamics.
2. Digital twin development with:
 - a. Algorithms for holistic optimization beyond operations and costs.
 - b. Users interfaces for customized make up of scenarios and visualization of its results.
 - c. Extra functionalities to improve the interaction between urban logistics customers and suppliers: customized, more accurate and dynamic offers; real-time visibility for operational suggestions; raise context visibility to anticipate, optimize, adapt and collaborate.
3. Development of the interoperability layer supporting an urban logistics Data Space where our Digital twin operates.
 - a. Developing further convergence with GS1's standards: Digital Link and Scan4Transport with NGSI-LD.

- b. Convergence with logistics' platforms of platforms frameworks - FEDeRATED and FENIX.
- 4. Development of further functionalities for data handling rules customization and automation.

Which we address in projects starting right now:

1. In Guadalajara, México, with two pilots that foster the implementation of cyclelogistics and electrologistics in Guadalajara within the framework of the Programa de Transporte Sustentable, funded by German international cooperation Agency GIZ.
2. In HorizonEU's Decarbomile project, going through June 2026, where we provide the digital infrastructure of a new model for an urban hub for collaborative last mile in 8 cities: Hamburg, Logroño, Nantes, Istanbul, Ghent, Getafe, Sarajevo, and Tallinn.

It is also the base to scale up a previous pilot to decarbonize Madrid's fresh food urban distribution, with a service built around its wholesale market Mercamadrid and its network of 46 Municipal Markets and 200 food galleries.

References

- Posts:
 - o i4Trust official video of the experiment: <https://t.ly/D5mM>
 - o Experiment's outline <https://t.ly/uJwJ>
 - o Outcomes of i4Trust Bootcamp <https://t.ly/-OPj>
- Press:
 - o DV4CUL and i4Trust as an example of Digital Innovation Hubs contribution to the Digital Single Market <https://t.ly/5b92>

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Categories

User(s):

Cities (Istanbul, Paris, Brussels, Guadalajara, Ciudad de México, Zaragoza, Logroño, Madrid, Nantes, Sarajevo, Athens, Getafe, Ghent, Hamburg, Tallin)
Region (Jalisco, Ile-de-France, Aragón), Business (LSPs, retailers associations, regional supermarkets, wholemarkets associations).

Key words:

SmartCities, New Green Deal, Interoperability, Collaborative Logistics, Sustainable Commerce, Cyclelogistics, Sustainable Last Mile, Digital Twin, Simulation, Digital EU, Business Collaboration

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Founding Partners



i4Trust has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement no 951975.

