Dutch Ecosystem: *District Factory Factsheet*

03.06.2026

Terminology

Term	Definition
Pop-up factory (PuF)	Pop-up factories are temporary manufacturing and/or assembling facilities that can be quickly set up and taken down to produce components for construction projects. A factory in the district itself for the time of the district retrofitting program. The factory will develop and assemble industrialized prefab building components that will be installed in the retrofitting projects.
On-site	Refers to the closeness of the pop-up factory to the construction project. Usually, it means that the factory itself is located in close proximity to the construction site (usually up to district or regional level).
Off-site	The opposite of on-site concept, where a factory is located in a different geographical area from the construction site.
Service	Here refers to any type of service that is provided locally, on-site specifically for construction/retrofitting projects. This could be a consultancy service offering advice on retrofitting activities. Could be a platform to bridge the local demand and supply for renovation projects. It could be a non-profit organization to connect local stakeholders and facilitate knowledge sharing about retrofitting, LCA tools or circularity frameworks.
Manufacturing	(Pre-)Fabrication of materials/products used for construction projects.
Assembling	Assembly of (pre-)fabricated materials/products used for construction projects.
Temporary structure	When a pop-up factory is set-up in a temporary way, e.g. housed in a container, industrial tent or modular building.
Permanent structure	When a pop-up factory is set-up in a permanent building, e.g. in an abandoned building, old industrial building.
Just-in-Time (JIT) delivery	JIT is a well-known Lean Management technique that involves small-scale production at the point of demand. The term "Just in Time" is often used in the construction industry to describe the delivery of goods to a job site. It means that materials will be brought to the site of final installation and installed right away, without being delayed by storage in a laydown or staging area.

Overall PuF Concept Background

Table 1: Pop-up Factories Key Features Comparison

Feature	Mobile On-Site	Satellite	District	Assembly	Service
Location	On or very near site	Near site	Regional/district	Near site or district	In community areas
Main Function	Manufacturing & assembly	Adaptation & assembly	Full integration	Assembly only	Support & guidance structure
Type	Modular units	Warehouses/containers	Industrial facilities	Warehouses	Community spaces
Permanence	Temporary	Semi-permanent	(Semi-)permanent	Temporary/semi-perm.	Temporary/semi-perm
Scalability	High (modular setup)	Medium (region-based)	High (multi-project)	Medium	Context-dependent

Categorization Framework

PuFs vary significantly in their setup and purpose, depending on the specific needs of construction projects. To support effective planning and deployment, a categorization framework has been developed based on four defining features and these provide a practical reference for identifying and selecting the most suitable factory model for a given context,

- Purpose: PuFs fulfil a range of functions within the construction value chain. While some are focused on the production of specific components or entire systems, others offer services such as consultancy, design, engineering, installation, maintenance, or end-of-life processing. This includes contributions to circular economy practices, such as repair, reuse, and recycling—aligned with the R-imperatives.
- Design: this refers to the physical configuration and technological setup of the factory. Factors such as mobility, equipment type, automation level, and sustainability measures define the flexibility and complexity of each PuF. Setups can range from compact, fully mobile units to semi-permanent installations with advanced capabilities.
- Scale: the scale dimension considers both production capacity and physical size. Some PuFs are small and portable, ideal for localized or temporary tasks, while others are designed for high-throughput operations and larger footprint requirements.
- Location: the factory's geographical positioning is a key operational consideration. PuFs may be deployed directly on construction sites, at nearby district hubs, or in regional or off-site facilities. Location affects logistics, accessibility, and cost-efficiency.

To facilitate consistent evaluation and comparison of different PuF setups, Table 5 presents classification criteria under each of these four dimensions. It also introduces a fifth element, Factory Scenario, which summarizes the combination of features into the five PuF types: mobile, satellite, district, assembly, and service factories. This categorization tool (see Table 2) serves as a decision-making aid, enabling stakeholders to match factory models with project requirements. By encouraging flexible and context-specific configurations, the framework supports more efficient, scalable, and sustainable construction practices.

Table 2: Checklist criterion for Pop-up Factory scenarios

Criteria / Pop-up factory		Mobile on-site factory (m)	Satellite factory (s)	District factory (d)	Assembly factory (a)	Service factory (se)
Purpose						
P1	Provides localised manufacturing and assembly of construction components and systems in a specific region or district			☑		
P2	Supports more extensive manufacturing facilities by producing components or products in a more decentralised manner on a local scale		☑			
P3	Assembles (pre)fabricated components locally				☑	
P4	Provides specific services related to construction and renovation projects					☑
P5	Produces customised components on-site	☑				
P6	It aims to create jobs and boost economic growth locally.			☑		☑
P7	Provides JIT delivery for specific projects	☑				
Design						
D1	Mobile, easily transportable structure	☑	☑			
D2	Semi-permanent structure			☑	☑	☑
D3	Temporary structure	☑	☑		☑	☑
D4	Permanent structure			☑	☑	☑
D5	Uses innovative and flexible manufacturing processes	☑	☑			
D6	High level of automation and precision		☑	☑	☑	
D7	Uses sustainable and eco-friendly solutions			☑		
Scale						
S1	Large-scale manufacturing		☑	☑		
S2	Small-, medium-scale manufacturing	☑	☑			
S3	Large-scale assembling		☑	☑	☑	
S4	Small-, medium-scale assembling	☑			☑	
Location						
L1	Near the construction site (on-site)	☑			☑	☑
L2	District level		☑	☑	☑	☑
L3	Within proximity (regional level)		☑	☑		☑
L4	Off-site (away from the construction site)		☑			

Using the framework and supporting literature, five main PuF types were identified. These categories are based on the four defining features: purpose, design, scale, and location. While each factory type has a general profile, the location is often influenced by local ecosystem conditions. Therefore, we defined proximity thresholds tailored specifically for the BUPS project rather than based on external sources. These thresholds help classify the factories according to their distance from the construction site:

- On-site factories: these include mobile on-site, service, and assembly factories. "On-site" may refer to the exact project location, but due to practical constraints, we consider any location within 15 km as on-site. At this distance, transportation costs and logistics are negligible compared to conventional supply chains.
- District-level factories: located within 30 km of the site, these typically include manufacturing, assembly, or service operations. They strike a balance between mobility and production capacity.
- Regional-level factories: these are usually satellite factories, placed between 30 and 100 km from the site. While still relatively accessible, they may require some logistics coordination.
- Beyond 100 km: at this distance, factories operate as part of a traditional supply chain, with significant reliance on transportation, storage, and logistics infrastructure.

Building on the framework used to characterise and distinguish between different PuF scenarios, the next step is to translate these insights into a practical management tool. This involves setting up a digital environment that supports the design, planning, and coordination of PuFs across their lifecycle. By integrating the checklist criteria into a digital platform, it becomes possible to streamline the configuration and monitoring of tailored factory setups, ensuring they respond effectively to project-specific goals and local conditions. The following section outlines the development of this digital PuF management environment.

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1 French Ecosystem PuF Development Storyline

The Dutch PuF scenario is anchored in two different pilot projects, which resonate with the development of a district/assembly Pop-up Factory (PuF) model. Their hybrid condition allows for a more informed understanding of the actual state of a PuF and on its possible implementation.
The first pilot relates to the deep renovation[1] of four portico-style[2] apartment blocks constructed in 1957 and located in the neighbourhood of Hoesnbroek in the Dutch city of Heerlen (Limburg). The renovation of the 36 apartments, owned by a local Housing Association is managed through a formal tendering process, followed by the execution phase, with apartments renovated over multiple months. Works are planned under occupied conditions, meaning tenants remain in their homes during renovation and are supported by temporary arrangements to accommodate those who stay at home during the day. The renovation scope includes façade upgrades, new window frames, additional insulation in roof and storage areas, and broader building-technology improvements such as (partial) asbestos removal. In addition, the renovation of kitchen and bathroom/toilet unit is also carried out, in accordance with the tenants.
The second pilot relates to the renovation of a residential building block type located in the neighbourhood of Pottenberg in Maastricht and owned by a local Housing Association. The renovation includes the replacement of the façade systems with a new prefabricated façade. This renovation related to 145 apartments and is structured according to a formal tendering process, followed by an execution phase, with apartments renovated over multiple months. Also in this case, works are planned under occupied conditions with temporary arrangements to accommodate residents who are at home during the day. The renovation scope includes prefabricated façade upgrades, heating system upgrade, ventilation system installation, and internal kitchen/bathroom/toilet renovation, with (partial) asbestos removal.

In parallel to defining the renovation scope, the Dutch ecosystem positions the Pop-up Factory concept as a way to address the ecosystem's **maturity gap**: while many housing associations currently renovate toward **energy label B**, deeper renovation ambitions require more systematic and scalable approaches. To frame this, the ecosystem develops a **complexity matrix** (Figure 1) and proposes that pop-up factories could support deep renovation by **bundling demand across larger building portfolios** and organizing renovation in a more systemic way.

[1] Although Deep Renovation (or Deep Energy Renovation) concept doesn't reach a shared agreement on its core definition, we adopt the definition developed by GDPN, which sees this concept as "is a term for a renovation that captures the full economic energy efficiency potential of improvement works, with a main focus on the building shell, of existing buildings that leads to a very high-energy performance. The renovated buildings energy reductions are 75% or more compared to the status of the existing building/s before the renovation. The primary energy consumption after renovation, which includes, inter alia, energy used for heating, cooling, ventilation, hot water and lighting after the deep renovation of an existing building is less than 60 kWh/m2/yr. (GBPN, 2013, p.19)

[2] The authors refer to the Dutch housing typology of *portiek etageflat*, defined as a multi-family dwelling with several floors, where the flats are accessible via a communal, covered and lockable porch, which is centrally located at the main entrance of the building. Unlike a gallery block (*galerijflat*, in Dutch), where the flats are located along an open corridor on the outside of the building, the front doors of a porch block are located around a central stairwell. For more information, see: https://kennis.cultureelerfgoed.nl and https://www.tudelft.nl/beyondthecurrent/benadering/typologie

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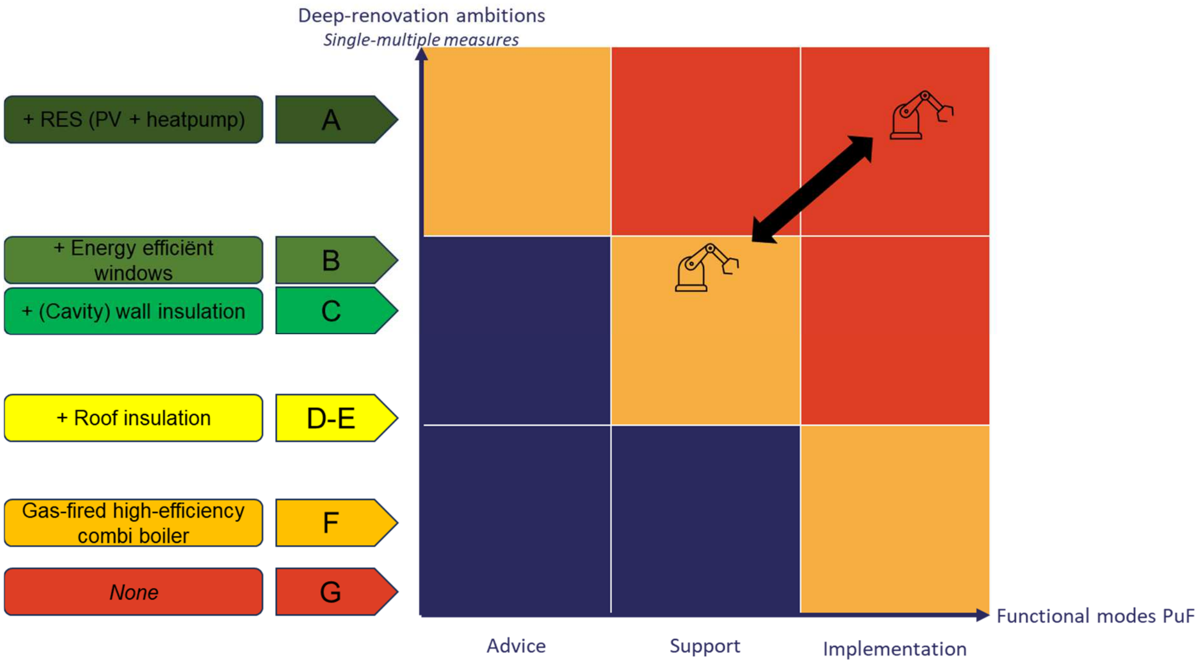

Figure 1: Complexity Matrix

A distinctive feature of the Dutch context is the influence of procurement procedures on the feasibility and organisational structure of renovation projects. Dutch housing corporations (woningcorporaties), although legally private foundations, operate within a highly regulated framework due to their public mandate in the provision of social housing. For large renovation projects they often apply procurement procedures aligned with the Dutch Public Procurement Act (Aanbestedingswet 2012), which implements the EU Public Procurement Directive 2014/24/EU (European Commission, 2014; Rijksoverheid, 2012). When contract values exceed the European threshold for works contracts (approximately €5.5 million for the 2024–2025 period), competitive tendering procedures are generally required and contracts must be published at the European level. These rules aim to ensure transparency, equal treatment, and fair competition, but they can also limit the possibility of directly selecting local firms or establishing pre-defined supply chains—an approach that would typically underpin a local Pop-up Factory ecosystem. As a result, industrialised renovation models such as Pop-up Factories must be structured through procurement-compatible mechanisms, including framework agreements, innovation partnerships, or integrated design–build contracts, which allow long-term collaboration while remaining compliant with European and national procurement regulations (European Commission, 2014).

Based on the characteristics of the Dutch building stock—particularly the repetition and standardization of many apartment blocks and row houses from the 1960s and 1970s—the ecosystem proposes a PuF based on a district/assembly model. The core logic is to identify groups of similar buildings within an area, develop a repeatable renovation approach, and place a larger bundled renovation package on the market in a single tender. This front-loaded organization is expected to reduce investment and execution inefficiencies and to enable faster renovation delivery once implementation begins.

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2 Mobile On-Site Factory Factsheet

2.1 Scenario & Strategy

PuF type	District Factory with an assembly-factory logic, developed through the Dutch pilots as a district-level model for bundled, repeatable renovation packages.
PuF purpose	Localised manufacturing, assembly and coordination of prefabricated renovation components for groups of similar buildings. The concept aims to aggregate demand, standardise repeatable modules, reduce site time and support deeper renovation ambitions in the Dutch housing-association context.
Deep renovation / reuse scope	Whole-building deep retrofit package. The scope includes façade/envelope upgrades, window and door replacement, roof insulation or roof refurbishment, floor/basement insulation, ventilation, heating-system upgrades, renewable energy/PV, and interior kitchen, bathroom and toilet works. Partial asbestos removal can also be part of the renovation works.
Priority components	Prefabricated façade systems and timber-frame (HSB) wall elements, integrated window and door systems with glazing and airtight/fire-resistant detailing, multi-layer roof insulation modules, prefab ventilation roof caps, modular kitchen units, bathroom/toilet finishes, PV components and selected circular material streams such as flat glass and partly window frames.
Target building typology	Repeated residential building typologies, especially post-war multi-family apartment blocks and row houses. The pilots include four portico-style apartment blocks from 1957 in Hoensbroek/Heerlen with 36 apartments, and a residential block in Pottenberg/Maastricht with 145 apartments. The source typology is described as a building block with brick and sand-lime-brick structure and external cavity walls.
Design intent	Create sufficient scale and scope within a district or region by bundling similar buildings into a larger renovation package. The concept combines mass-customisation, modular renovation packages, local supply-chain coordination, digital geometry/BIM support, low disturbance on site and shorter construction time at the building.
Best-fit conditions	Best suited to repeated building typologies, clustered renovation demand, limited on-site space, occupied housing renovation, local suppliers that can deliver standardised components, and procurement-compatible project structures such as framework agreements, innovation partnerships or integrated design-build contracts.

2.2 Factory Layout & Production Logic

Factory typology	Semi-permanent or permanent district/assembly setup rather than a small mobile container. The PuF logic is distributed between off-site manufacturing, district-level assembly/coordination and on-site assembly/service activities.
Production workflow	1) Identify similar buildings and define a bundled renovation package; 2) carry out point-cloud/BIM-supported design and engineering; 3) manufacture or pre-assemble façade, window, roof and selected interior modules off-site; 4) stage and coordinate materials through a district/local supply-chain setup; 5) deliver components just in time; 6) remove existing windows/facade elements; 7) install prefabricated façade/window systems and finish carpentry; 8) execute parallel interior, ventilation, heating, PV and asbestos-related works where required.
Main production streams	Three main workflows are identified: insulation shell works for façade and roof, installation of window frames or prefabricated façade systems, and energy-related works. Interior systems and finishing are also included, although not all workflows are equally suited to PuF logic; the window-frame/facade-system stream has the strongest repetition and mass-production potential.
Dimensions / space allocation	The pilot data does not define a fixed factory footprint. On site, assembly space depends on the product and building. Storage or buffer space near the building is typically about 60-100 m^2. A site setup may also include two containers, one for materials and one for the team, plus crane or hoist access for buildings above four floors.

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Operational scale	Pilot reference scales are 36 apartments in Hoensbroek/Heerlen and 145 apartments in Pottenberg/Maastricht. The intended scale-up logic is not one building at a time, but a district or portfolio of similar buildings offered as a larger renovation package.
Production / installation cadence	Vertical outside works are reported as about 28 days per block of 9 apartments in Heerlen, or about 1 day per apartment for the Maastricht façade system. Horizontal inside-apartment works are reported at around 18 days per apartment, while the R4 implementation table summarises the on-site operation as about 20 days per apartment depending on conditions.

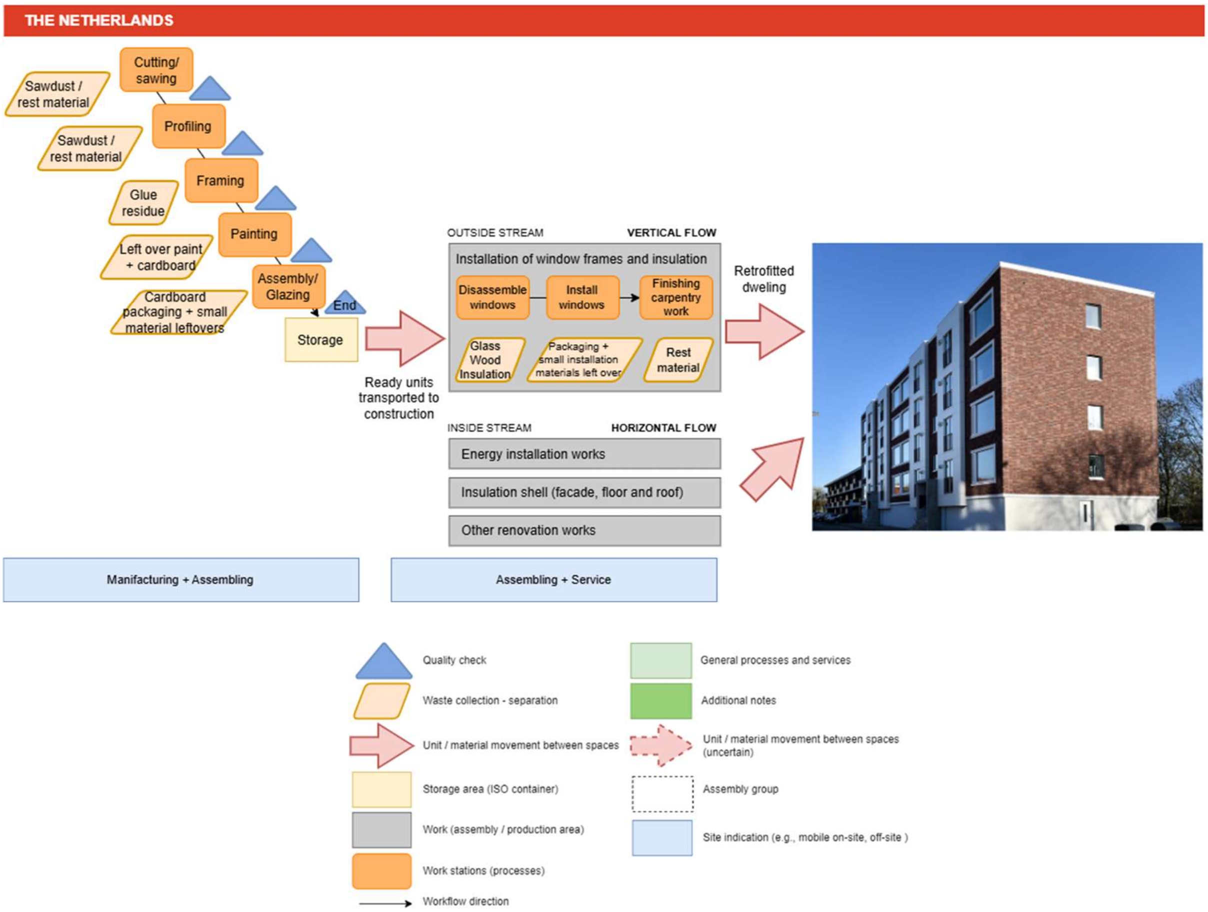

Figure 2 District Factory - Tailored Design

2.3 Resources & Utilities

Power & electricity	Three-phase electricity is required on site. The exact kW requirement is not specified in the pilot data and depends on the selected products, hoisting/cutting equipment and temporary construction-site setup.
Water & sanitation	Water is required for site and interior works, especially bathroom/toilet/kitchen-related renovation. Drainage is preferred where wet works are carried out. Exact water volumes are not specified in the pilot data.
Heating, cooling & ventilation	No dedicated factory HVAC system is defined. Building-side renovation can include heating-system upgrades and mechanical/balanced ventilation installation. Occupied-building working conditions and temporary resident arrangements remain important operational constraints.
Digital infrastructure	BIM software is used where possible; point-cloud or advanced geometric surveys can support design, engineering and production. The concept also highlights digital material passports, retrofit roadmaps, predesigned BIM catalogues and coordination tools for standardised renovation packages.

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Equipment and materials	Cutting/gluing equipment, work benches, material storage, transport/loading areas, crane or hoist equipment, PPE and product-specific installation tools.

2.4 Site & Logistics

Site preconditions	A coordinated site layout is required with space near the building for storage, staging/loading, team facilities and safe resident circulation. Works are often performed in occupied buildings, so low disturbance, clear communication with tenants and careful sequencing are essential.
Access constraints	Truck and car access are needed. Typical working hours in occupied buildings are 7:00-16:00; in some cases the practical noise window may be 9:00-15:00. Public-space use is normally avoided, but in narrow sites a permit for public-space occupancy may be required.
Supply chain integration	The model links housing-association demand, a main contractor/system integrator, off-site or district assembly, and specialised subcontractors for façade systems, carpentry, masonry, PV, insulating glass, ventilation, tiles and kitchen components. JIT coordination is important because onsite storage is limited.
Storage & buffer strategy	On-site storage is typically around 60-100 m². The approach relies on small local buffers and early site planning rather than large intermediate storage areas. A private apartment or lockable space in the block may be used by contractors for personal items.
Waste handling	Waste streams include packaging, cardboard, leftover paint, old façade/window elements, selective demolition waste, and asbestos-related waste where applicable. The main contractor is responsible for waste management and coordinates specialist handling for asbestos and regulated streams.
Last-mile logistics	Prefabricated or partially pre-assembled components are moved from the off-site/district setup to the construction site by truck and then handled by the main contractor and subcontractors. Crane access is required for works above four floors.

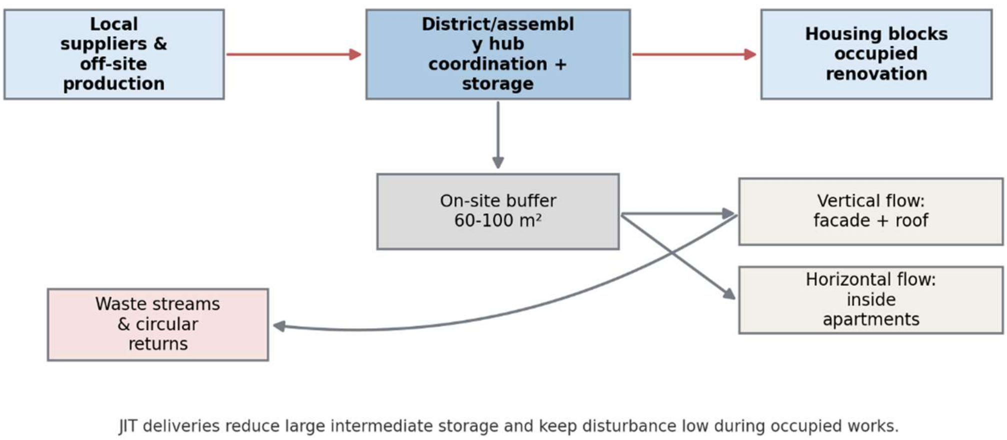

Figure 3: Indicative District Factory site and logistics setup

2.5 Actors, Roles & Governance

Factory owner / operator	No single dedicated factory owner is defined in the pilot data. Operationally, the main contractor acts as the central coordinator/operator for site and supply-chain activities, supported by subcontractors and suppliers.
Client / contracting authority	Local housing associations, with Woonpunt identified in the Dutch pilot context, act as the client, asset owner, demand-side partner and governance lead.

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Contracting and payment	The housing association signs contracts with the architect and the main contractor selected through tendering. The main contractor then contracts or coordinates the subcontractors and suppliers. The housing association pays for the renovation works.
Demand-side partners	Housing association as owner/client, tenants as end users, structural advisors, fire-safety and asbestos advisors, roofing-system and maintenance advisors, and concrete-component advisors.
Supply-side partners	Main contractor BCG, architecture studio, circular façade-system subcontractor, carpentry subcontractor, masonry subcontractor, PV subcontractor, insulating-glass subcontractor, ventilation-system subcontractor, tile subcontractor and kitchen-component subcontractor.
Governance lead	The housing association leads strategic decisions and procurement. The main contractor leads operational coordination, subcontractor management, site logistics, safety and resident-facing execution planning.

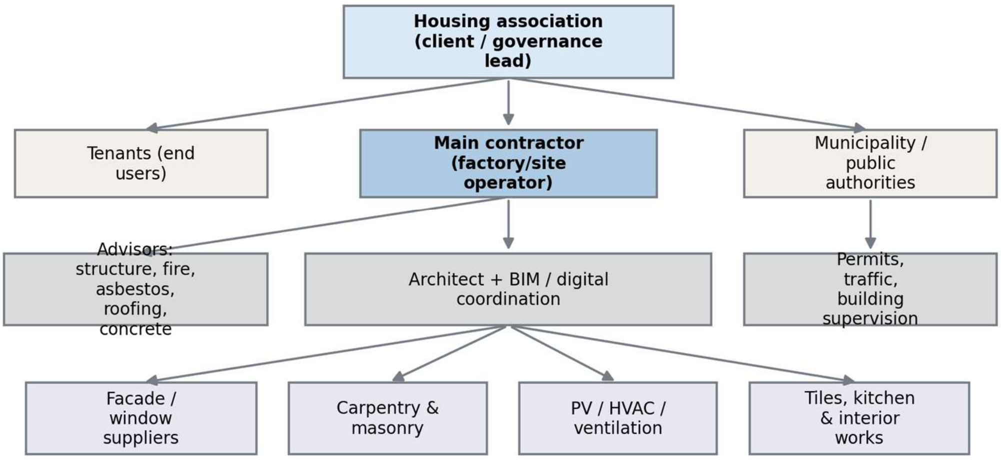

Figure 4: Stakeholder and governance structure of the Dutch District Factory

2.6 Labour Force & Required Skills

Typical team	No fixed PuF team size is specified. Labour is organised through the main contractor and product-specific subcontractors. The site model favours a small group of disciplines at the building site, supported by off-site or district-level preparation.
Core roles / indicative FTE	Site/factory supervisor, installer team lead, façade/window installers, carpentry and masonry workers, PV installers, HVAC/ventilation technicians, crane/hoist operators, BIM/CAD or digital-production coordinator, tenant liaison/resident manager, H&S officer, and specialist asbestos contractors where required.
Skills and certifications	Project-management experience, product-specific design-to-installation skills, façade/window installation, airtight/fire-resistant detailing, glazing, timber-frame and carpentry work, lifting/hoisting competence, asbestos-removal certification where needed, BIM/CAD coordination and occupational safety skills.
Training needs	Training depends on the product and supplier. Recommended training areas include energy-neutral building and renovation, integral construction budgeting, risk management, quality management, construction-process communication, and product-specific operator/installer training.
Labour sourcing	Main contractor selected by competitive tender, supported by subcontractors and local/regional suppliers. Workforce availability is a key dependency in smaller regional markets.
Shift model	One shift is indicated for occupied buildings, typically around 7:00-16:00, with shorter noise-sensitive windows possible depending on tenant conditions and local agreements.

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2.7 Legal & Regulatory Requirements

Omgevingsvergunning	The environmental/building permit is the overarching permit for renovation. It is issued by the local municipality and has an indicative lead time of 8-14 weeks where the renovation does not deviate from the zoning plan and is not heritage-protected. It includes the demolition permit component.
Asbestos notification / work plan	Asbestos-containing materials require formal notification and an approved work plan through the relevant inspection authority. Indicative lead time is about one week without complications. Risk Class 2 and 2A works require specialised certified contractors and an asbestos-free declaration after completion.
Terrain and traffic management	A Bouwplaatsinrichtingsplan (BIP) or site layout plan is required for transport, waste disposal and emergency routes. It is approved by the municipality, fire department and traffic police. Indicative lead time is 1-3 weeks, longer for complex cases.
Local building supervision	The contractor must notify local Building and Housing Supervision before structural or special activities. Under the Omgevingswet and Wet kwaliteitsborging voor het bouwen context, the start notification includes a quality-assurance plan and risk assessment and is submitted two days before the start.
Procurement and contracting	Housing corporations operate in a regulated procurement environment. Larger projects may require competitive tendering aligned with Dutch and EU public-procurement rules, so local PuF ecosystems need procurement-compatible structures such as framework agreements, innovation partnerships or integrated design-build contracts.
Incentives / subsidies	Desk-researched support options include SAH for gas-free rental housing, with approximately EUR 1,200-5,000 per dwelling, and related rental-housing sustainability subsidies. Earlier SPOR-type support is noted as no longer a standalone national scheme name; reported support levels are around EUR 4,000-7,000 per dwelling in larger gas-free renovation programmes.

2.8 Cost Structure

CAPEX	No CAPEX range is provided in the pilot data. Main cost elements are expected to relate to product-specific manufacturing or pre-assembly capacity, design/BIM coordination, site setup, containers/team facilities, crane or hoist access, and contractor/subcontractor mobilisation.
OPEX	No monthly OPEX range is provided in the pilot data. Operating costs are project-specific and include contractor and subcontractor labour, logistics, temporary site utilities, site facilities, tenant coordination, waste management and specialist works such as asbestos removal.
Cost basis	No €/m² value is reported for the District Factory model in the available data. Costs should therefore be treated as project-based and dependent on building typology, façade/system scope, number of apartments, site constraints and procurement outcome.
Revenue / value logic	For the housing association, value is mainly indirect and regulated rather than a direct factory revenue stream. Benefits may include asset-value improvement, rental-income stability, subsidy access, reduced disturbance, improved energy performance and potentially lower transaction cost through bundled demand.
Financing model	Dutch housing-association investments can be financed through WSW-guaranteed loans, reducing risks and interest rates. Equity is partially included in recent housing-association business schemes. Grant support may be available through relevant sustainability or gas-free housing schemes.
Payment chain	Housing Association -> Architect; Housing Association -> Main Contractor -> Subcontractors. No reuse-sales inventory owner is defined in the pilot data.

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2.9 Lifecycle & Time Schedule

Setup & commissioning	The 36-apartment case reports an overall setup duration of around 50 weeks, including 2 weeks of work preparation and about 3 days for construction-site setup. Procurement can take approximately 3-6 months, including preparation/publication, tendering, evaluation and award.
Permits and preparation	Permit approval is indicated at around 8 weeks, with additional time where environmental aspects, heritage protection, asbestos removal or zoning-plan issues are involved. Start of operations is indicated about 2 weeks after preparation milestones are completed.
Operational phase	On-site duration is approximately 20 days per apartment depending on project-specific conditions. For outside works, the Dutch narrative gives about 28 days per block of 9 apartments in Heerlen and about 1 day per apartment for the Maastricht façade system. Interior horizontal flow is around 18 days per apartment.
Decommissioning / wrap-up	No specific decommissioning duration is defined. Because the model is a district/assembly coordination setup rather than a temporary mobile factory, wrap-up is expected to consist mainly of removing temporary site facilities, clearing storage/staging areas and completing handover documentation.
Main dependencies	Permit sequencing, sufficient space near the building, management of inhabitants during occupied works, product and material availability, subcontractor coordination, workforce availability and design freeze conditions.

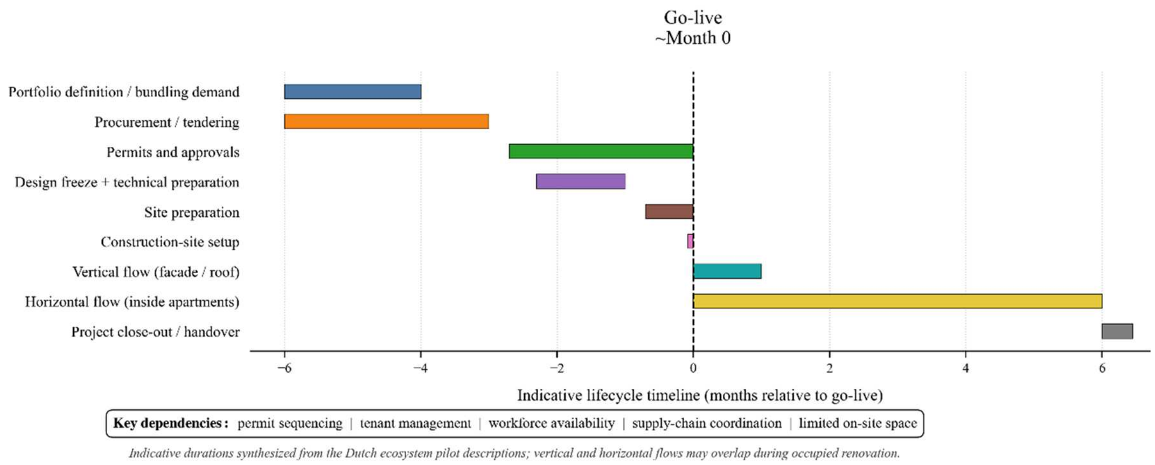

Figure 5: Indicative District Factory Life-cycle Timeline

2.10 Risks & Contingencies

Limited storage near building	Mitigation: early coordination with the municipality and careful site planning. Owner: contractor.
Product supply delays	Mitigation: early site-plan setup and supply-chain coordination. Trigger: component delivery delayed by more than 1-2 weeks from plan. Owner: supply-chain coordinator or contractor.
Presence of asbestos	Mitigation: request asbestos evaluation early, ideally directly after tender or before tender where possible. Owner: main contractor.
Shortage of skilled circular-product manufacturers	Mitigation: plan early integration of suppliers from outside the region when needed and use training incentives. Trigger: inability to secure the right workforce to respond properly to the tender. Owner: main contractor.
Procurement constraints	Mitigation: use procurement-compatible structures such as framework agreements, innovation partnerships, or integrated design-build contracts rather than relying on direct selection of predefined local supply chains.
Occupied-building disruption	Mitigation: clear tenant communication, temporary arrangements for residents who remain at home, careful noise-window planning, phased apartment-by-apartment sequencing and low-disturbance logistics.

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2.11 Scalability & Impact

Scalability approach	Scale through bundled district or regional renovation packages, repeated building typologies, standardised processes, modular products, increasing use of digital tools and coordination by the main contractor.
Distance threshold	The source document describes the scaling distance as within the region. The general BUPS framework defines district-level factories within about 30 km and regional-level factories up to about 100 km, so the Dutch model is best understood as a district/regional clustered approach rather than a long-distance supply chain.
Storage / volume threshold	No fixed storage duration, production volume or district-size threshold is provided. The practical limits are site space, workforce availability, product supply, tenant coordination, crane/access constraints and the availability of similar buildings within a coherent renovation package.
Adaptability mechanism	Adaptability is achieved through standardised processes, modular products, mass-customised variation, BIM/point-cloud-supported design, local supply-chain coordination and a building-module approach rather than a purely one-off project approach.
Environmental impact	Expected impacts include improved energy labels from below D toward A/B, thermal-envelope improvement, PV installation, smart ventilation, reuse of flat glass, circular wooden window-frame strategies, selective demolition, reduced transport through efficient planning and lower embodied-carbon material choices.
Social impact	The model supports occupied social-housing renovation with lower disturbance, improved comfort and energy performance, local/regional supply-chain participation, and more predictable delivery for housing associations and tenants.
Digital tools	BIM software is used where possible. Required features include geometry capture, design coordination, product/module catalogues, retrofit roadmaps, material-passport information and schedule/logistics coordination.

2.12 Contextual requirements for PUF application

Table 3: Contextual requirements as identified through the comparative analysis, retrieved from ecosystem's report Task 4.5.

Characteristic	**Description**
Multi-purpose Assembly PUF	The assembly PUF is applicable in various environments, such as stimulating re-use, stimulating efficiency and standardisation, and industrialising production whilst maintaining flexibility.
Energy performance	Improvements of energy performance of buildings is a consistent objective across PUF applications in various ecosystems.
Material re-use	Re-using materials during deep-renovation is difficult in traditional approaches due to logistical problems. The PUFs lend itself to stimulate re-use of materials and thereby avoiding additional embodied carbon emissions by the low proximity and extra logistical services it provides.
Institutional organisation of renovation	Important in the application of PUFs is the role of the government in facilitating large-scale renovations and projects, stimulating the need for adoption and application of the PUF.

2.13 General implementation of PUFs

Table 4: The general deduction of all ecosystem's business model canvasses, retrieved from the ecosystem's Task 4.5 report.

		Pop-up Factory
Value creation	**Value proposition**	*The core value delivered by the PuF, typically improving efficiency, reducing waste, enabling circular construction, and delivering renovation or construction services closer to the site.*
	Customer relationships	*The way the PuF interacts with clients (e.g. housing associations, contractors), often involving long-term collaboration, co-creation, and close coordination during projects.*

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	Channels	*The means through which the PuF delivers its services and communicates its value, including direct project partnerships, procurement processes, and digital tools or platforms.*
	Customer segments	*The main users of PuF services, such as housing associations, construction companies, municipalities, and developers involved in renovation or new-build projects.*
Value delivery	**Key activities**	*The main operations of the PuF, including prefabrication, assembly, logistics coordination, material recovery, and on-site or near-site production.*
	Key resources	*The essential assets required, such as skilled labour, temporary manufacturing facilities, digital tools (e.g. BIM), machinery, and access to materials or components.*
	Key partners	*The organisations involved in delivering the PuF model, including contractors, suppliers, SMEs, logistics providers, housing associations, and public authorities.*
Value Capture	**Revenue streams**	*The ways the PuF generates income, typically through project-based contracts, service fees, or integrated renovation and construction services.*
	Cost structures	*The main cost drivers, including labour, equipment, logistics, temporary facility setup, and coordination across the supply chain.*

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3 Evaluation Questions for Assembly Factory Factsheet

Please review the attached PuF factsheet and answer the questions below. The aim is to assess whether the PuF concept is understandable, feasible, useful, and replicable in different local contexts.

For Questions 1–8, please use the scale:
1 = Very low / strongly disagree
2 = Low / disagree
3 = Moderate / neutral
4 = High / agree
5 = Very high / strongly agree

3.1 Concept clarity and relevance

1. **Clarity:** How clear and understandable is the PuF concept described in the factsheet?
   Score: [1–5]
   Optional comment:
2. **Relevance:** How relevant is this PuF concept for renovation, deep renovation, or circular construction activities in your context?
   Score: [1–5]
   Optional comment:
3. **User need:** Does the PuF concept respond to a real need or bottleneck in the renovation market?
   Score: [1–5]
   Optional comment:

3.2 Implementation feasibility

4. **Technical feasibility:** How feasible does the proposed PuF setup seem from a technical and operational perspective?
   Score: [1–5]
   Optional comment:
5. **Partner and governance feasibility:** Are the required actors, roles, and responsibilities realistic and complete enough for implementation?
   Score: [1–5]
   Optional comment:
6. **Legal and regulatory feasibility:** Are the legal, permitting, compliance, and policy aspects sufficiently clear for implementation?
   Score: [1–5]
   Optional comment:
7. **Economic feasibility:** Are the cost structure, financing logic, and value proposition convincing enough to support implementation?
   Score: [1–5]
   Optional comment:

3.3 Replication and scalability

8. **Replicability:** How easy would it be to replicate or adapt this PuF concept in another region, project, or market context?
   Score: [1–5]
   Optional comment:
9. **Main conditions for replication:** Which conditions are most important for this PuF concept to work?
   Please select up to three:
   ☐ Sufficient renovation demand / project pipeline

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☐ Similar building typologies
☐ Available local partners / SMEs
☐ Skilled labour availability
☐ Suitable site space and logistics
☐ Permits and supportive regulations
☐ Access to financing or subsidies
☐ Digital tools / data availability
☐ Market demand for circular or industrialized solutions
☐ Other: [please specify]

10. **Main barriers:** What are the most important barriers or risks for implementing this PuF concept? Please select up to three:
☐ High upfront costs
☐ Unclear business model
☐ Lack of skilled workers
☐ Lack of suitable partners
☐ Legal or permitting uncertainty
☐ Limited site space
☐ Logistics complexity
☐ Low market demand
☐ Lack of standardization
☐ Difficulties with resident/user acceptance
☐ Other: [please specify]

3.4 Impact and added value

11. **Expected added value:** What do you see as the main added value of this PuF concept? Please select up to three:
☐ Faster renovation process
☐ Lower renovation costs
☐ Better quality control
☐ Reduced disruption for residents/users
☐ Lower transport or logistics impact
☐ Higher circularity / reuse
☐ Lower CO_2 emissions
☐ Local employment or skills development
☐ Better coordination between stakeholders
☐ Other: [please specify]

12. **Most useful factsheet information:** Which parts of the factsheet were most useful for evaluating the PuF concept? Please select up to three:
☐ Scenario & strategy
☐ Factory layout and production logic
☐ Resources and utilities
☐ Site and logistics
☐ Actors, roles and governance
☐ Labour force and skills
☐ Legal and regulatory requirements
☐ Cost structure
☐ Lifecycle and time schedule
☐ Risks and contingencies
☐ Scalability and impact

3.5 Improvements and platform relevance

13. **Missing information:** What information is still missing or unclear in the factsheet to properly assess the PuF concept?

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14. **Suggested improvements:** What should be improved in the PuF concept, factsheet, or blueprint to make it more useful for future users?

15. **Digital platform support:** Which functionalities should a digitized market activation platform provide to support this PuF concept?
    Please select up to five:
    ☐ Match renovation demand with PuF solutions
    ☐ Identify suitable local partners / SMEs
    ☐ Compare PuF scenarios and suitability
    ☐ Estimate costs and financing options
    ☐ Support permit and regulatory checks
    ☐ Support logistics and site planning
    ☐ Provide standard templates / blueprints
    ☐ Track sustainability KPIs
    ☐ Support circular material or product matching
    ☐ Support stakeholder communication
    ☐ Other: [please specify]
16. **Final recommendation:** Would you recommend further development or testing of this PuF concept?
    ☐ Yes
    ☐ Yes, but only with major adaptations
    ☐ Not sure
    ☐ No

    Please briefly explain your answer:

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