



ÉCOLE DE
TECHNOLOGIE
SUPÉRIEURE
Le génie pour l'industrie Université du Québec

GRIDD

GROUPE DE RECHERCHE
EN INTÉGRATION ET DÉVELOPPEMENT DURABLE
EN ENVIRONNEMENT BÂTI

Delivering Affordable Housing at Scale through Industrialisation

Beyond Europe –
some lessons from Canada and Quebec

Ivanka Iordanova, Ph.D.

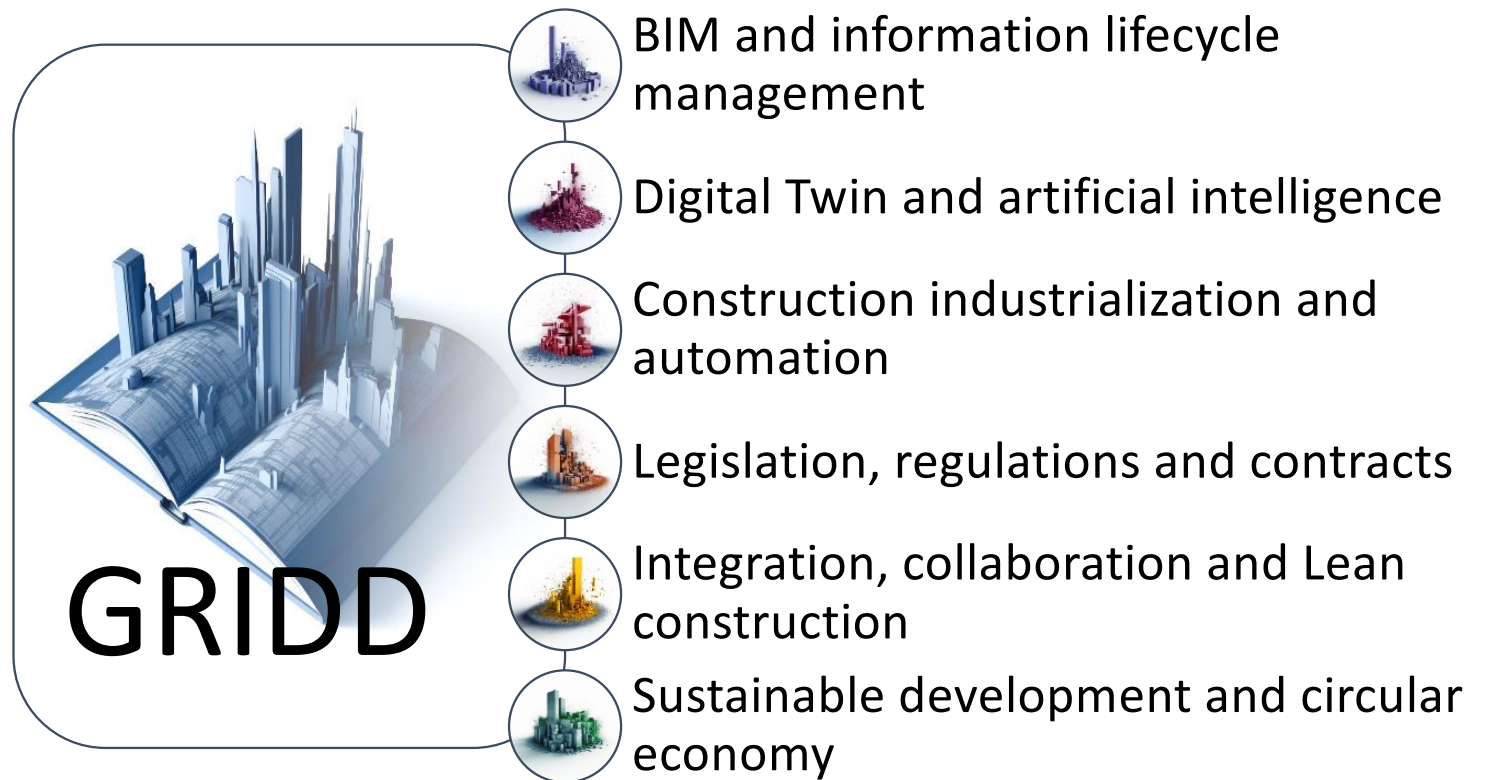
Professor, Construction management, ÉTS-Montreal

www.etsmtl.ca
GRIDD.etsmtl.ca



Groupe de recherche
en intégration et
développement durable
en environnement bâti

Research Groupe
on Integration &
Sustainable
Development in the
Built Environment



GRIDD: leadership, members, research assistants and post-docs



Érik Poirier



Ali Motamedi



ivanka iordanova



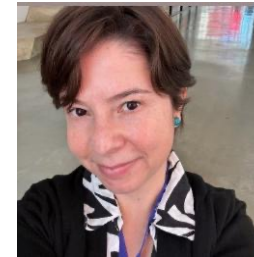
Gabriel Jobidon



Francis Bordeleau



Angélique Montuwy



Nathalia



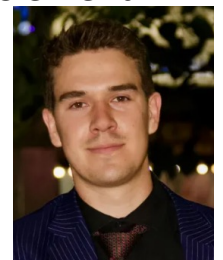
Clement



Luciana



Allan



Mathis



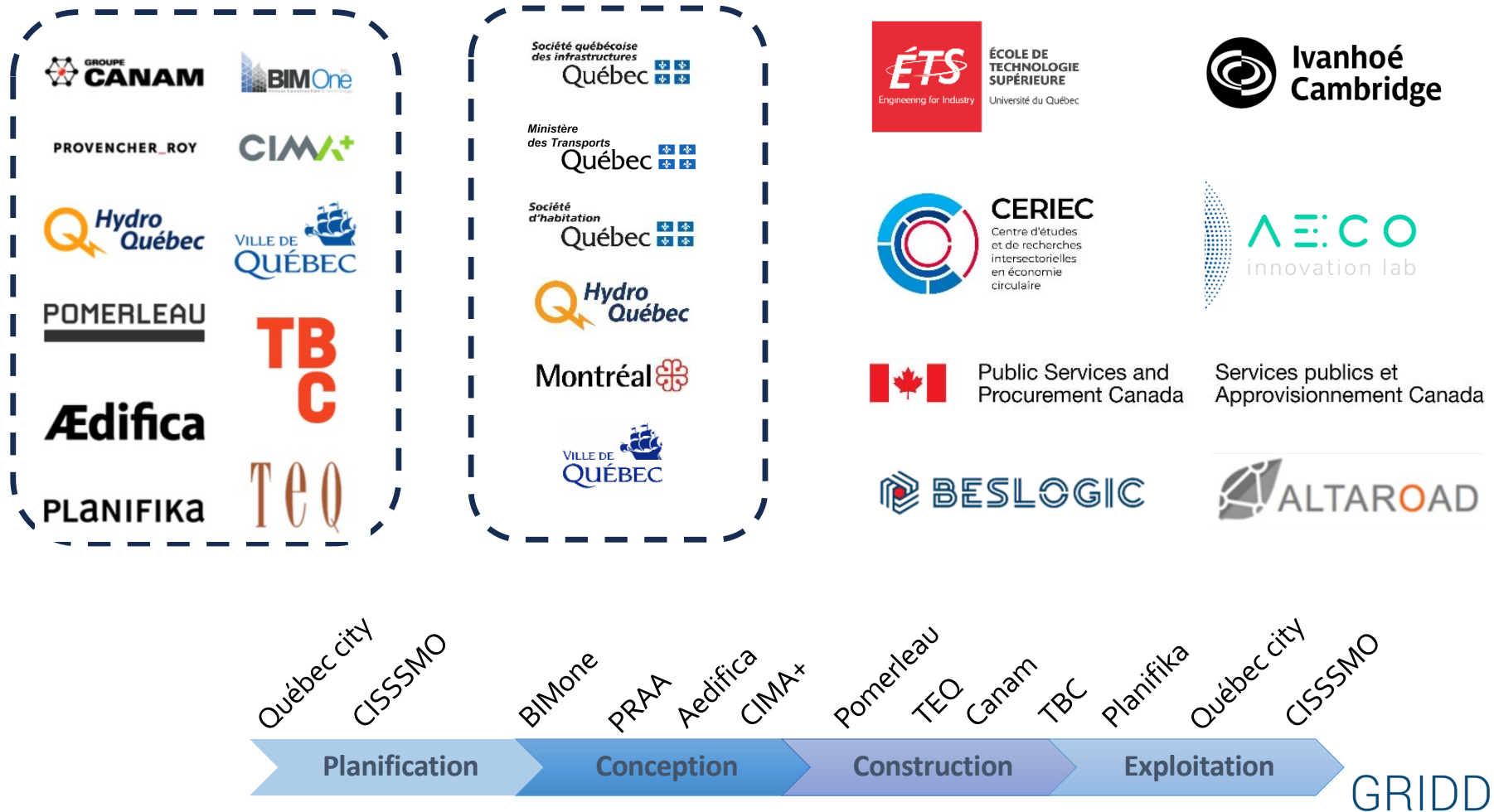
Daniel
Forgues
(founder,
retired)

Graduate students – Innover ensemble/together (2025)



<https://www.youtube.com/@GRIDD-ETS>

Collaborations: Industry, academy, public



Context and Scope

- Canadian governments at every level (federal, provincial, municipal)
 - programs to accelerate housing supply through prefabricated, modular, and industrialized construction.
- Working definition – Industrialized Construction (IC): “a major transformation of the construction industry, aimed at significantly increasing productivity through the integration of mechanization, automation, and advanced manufacturing technologies.”



FOUR PILLARS OF INDUSTRIALIZED CONSTRUCTION



Off-Site Construction

Volumetric modules and panelized systems built in factory conditions, transported and assembled on site.



Additive Manufacturing

3D printing of building components layer-by-layer, on- or off-site, enabling complex geometries.



Product-Based Labour Reduction

Larger, pre-cut, or modular products and materials that simplify and speed up site installation.



Process-Based Labour Reduction

Digital tools, automation, robotics, and Lean methods applied to planning and site processes.

Affordable Housing Initiatives — Categorization by Role

Research & Academic Foundations



INDIRECT EFFECT ONLY

- NRC–UNB Roadmap (with University of Alberta)
- CNRC/NRC university research (UNB, ÉTS, UQAM)
- NRC Decarbonization Platform (2023–2029)

Indirect — upstream scientific foundation only.

Industrial & Manufacturing Support



INDIRECT EFFECT ONLY

- Residential Constr. Tech. & Innovation Fund; NGen (Next Gen Manufacturing Canada)
- Regional Initiative for Innovation in Residential Construction (IRICR)
- Green Construction through Wood (GCWood) – Demonstration Stream

Indirect — strengthens industrial supply (cost/schedule).

Funding & Stabilization of Public Demand



EXPLICIT MANDATE

- Build Canada Homes; federal–municipal agreements
- Quebec Affordable Housing Program (PHAQ) – Stream 3
- Highly Prefabricated Multi-Unit Housing Initiative (500 units)

Explicit — central affordability funding mechanism.

Regulation & Institutional Standardization



INDIRECT EFFECT ONLY

- CMHC Housing Design Catalogue
- SHQ Quebec Housing Strategy
- Société québécoise des infrastructures (SQI) – public buildings

Indirect — reduces regulatory barriers, speeds delivery.

Municipal & Local Implementation



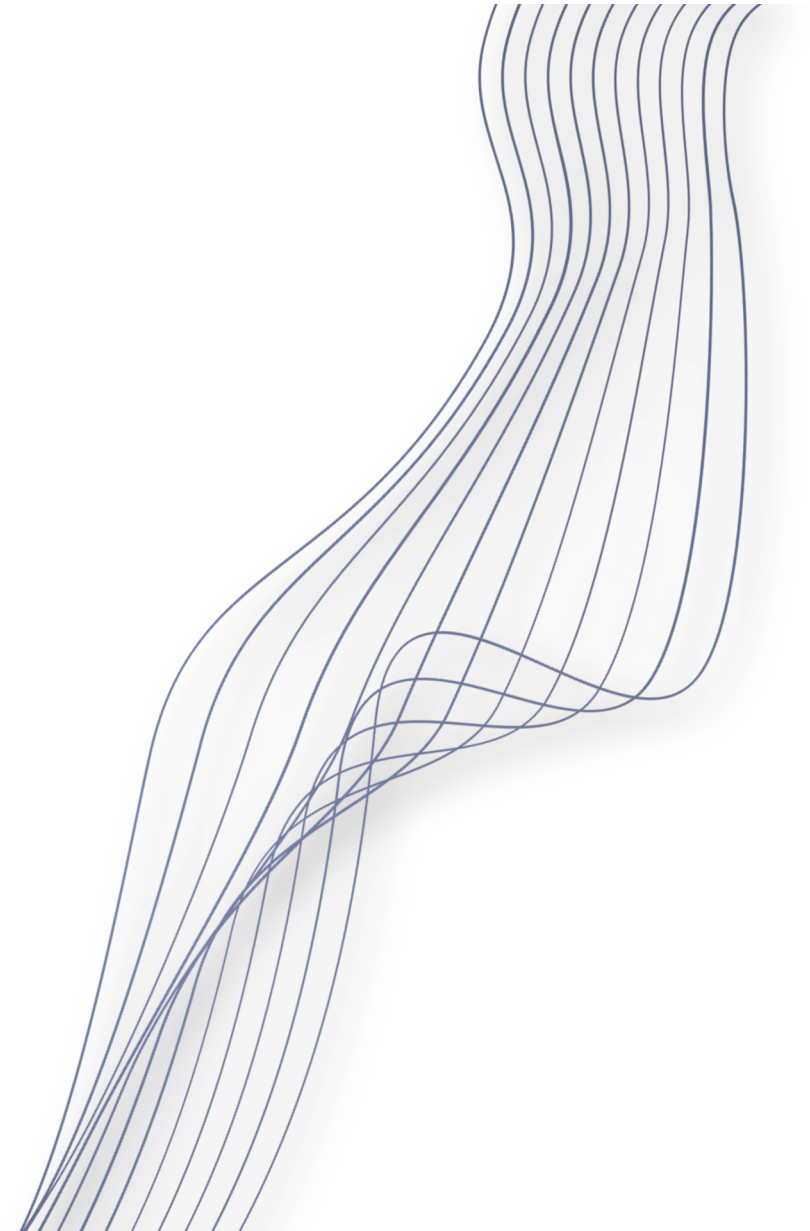
EXPLICIT MANDATE

- Ville de Québec – modular housing (homelessness, social housing)
- Municipalities in the 500-unit highly-prefabricated program
- Rural municipalities & RCMs (Gaspésie, Nord-du-Québec, Charlevoix)

Explicit — direct territorial anchoring of projects.

Only Categories 3 & 5 carry an explicit affordability mandate. Categories 1, 2 & 4 target industrialized-construction productivity generically — their effect on affordability is indirect.

Initiatives in Canada





Build Canada Homes (Maisons Canada)

Announced 2024 · Agency launched September 2025

FEDERAL

PARAMETERS

- \$25 billion in debt financing plus \$1 billion in equity financing dedicated to prefabricated home builders
- Federal agency acts both as a developer of affordable housing and as a lender to other builders
- GST eliminated on homes under \$1M for first-time buyers; tax incentives for purpose-built rental
- Bulk procurement and low-interest financing intended to stabilize long-term demand for Canadian manufacturers

RESULTS TO DATE

- Spring 2026: funding agreement for 77 new housing units across Quebec under the Canada–Quebec Memorandum of Understanding



✓ SUCCESSES

- Scale of dedicated capital signals durable demand — a precondition manufacturers cite for investing in modular plants

⚠ DIFFICULTIES

- Agency only operational since 2025–26: no aggregate delivery, cost, or timeline data yet available
- Several 2024 federal housing measures were reportedly archived/suspended, raising questions about policy continuity

Source: *Housing, Infrastructure and Communities Canada – Build Canada Homes; Canada.ca news releases (April 2026)*



Standardization, Innovation Financing & Research

CMHC Catalogue · Innovation Fund · NRC Platform · 2023–2029 (ongoing)

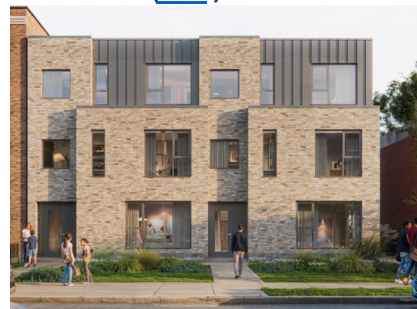
FEDERAL

PARAMETERS

- **CMHC Housing Design Catalogue** (2024): 50+ pre-approved, code-compliant designs (accessory units, semis, rowhouses, multiplexes); 7 adapted for Quebec, focused on energy efficiency and accessibility ([link](#))
- **Next Generation Manufacturing Canada (NGen)** Residential Construction Technology & Innovation Fund (2024): \$50M (target \$200M) plus \$500M in low-interest loans
- **NRC Platform for Large-Scale Decarbonization of Construction** (2023–2029): collaborative research on **MMC, digitalization, performance-based codes**
- **NRCan Off-Site Construction Challenge** and GCWood Demonstration Stream (2026 calls); university research led by UNB, with ÉTS and UQAM on contractual models and modular-vs-traditional performance ([link](#))

RESULTS TO DATE

- Catalogue designs published and available to municipalities, builders, and homeowners
- Research and demonstration projects in progress across Canadian universities (incl. ÉTS, UQAM)



SUCCESSSES

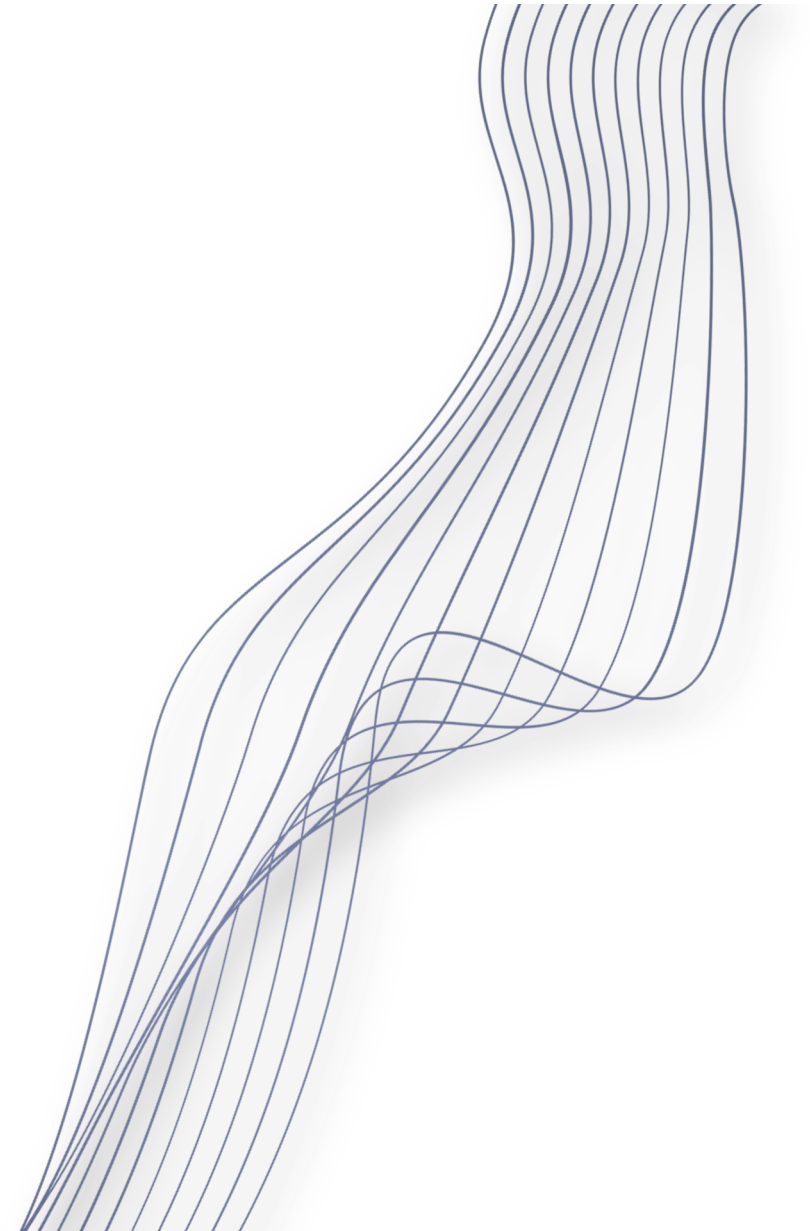
- Standardized, pre-approved plans reduce design and permitting time — a key bottleneck for prefabrication's repeatability advantage; research builds a Canadian evidence base rather than relying only on international literature



DIFFICULTIES

- Real-world design adoption still depends on municipal zoning/permitting, which varies locally; fund size is modest relative to national manufacturing needs
- Research remains at demonstration stage with multi-year horizons (to 2029); translation into standard industry practice is not yet demonstrated

Initiatives in Quebec and other canadian provinces





Highly Prefabricated Multi-Unit Housing Initiative

PHAQ – Volet 3 · Launched August 2024 · Pilot delivery targeted summer 2026

QUEBEC

PARAMETERS

- \$992M in combined federal–Quebec funding (Canada Housing Infrastructure Fund + equivalent Quebec contribution) ([link](#))
- 11 pilot projects; 336 units; medium-density buildings of 24–36 units, across 8 regions
- Uses pre-qualified “Solutions Immobilières de Référence” (SIR) designs and an integrated design-build delivery model
- Targets low- and modest-income households at SHQ affordability rent levels
- SHQ Quebec Housing Strategy, “Bâtir ensemble pour mieux se loger” (since 2020): names industrialized construction as a central productivity lever

RESULTS TO DATE

- 11 projects selected; delivery targeted by summer 2026 (not yet completed)



SUCCESSSES

- Described as the most ambitious highly-prefabricated housing program undertaken in Quebec to date; pairs demand aggregation with pre-approved designs



DIFFICULTIES

- 336 units is small relative to Quebec's affordable-housing shortfall; scalability beyond the pilot is unconfirmed
- Dispersion across 8 regions may limit manufacturing economies of scale



Industry Support & Institutional Framework Governmental Roadmap for Innovation in Construction

- Canada regional homebuilding innovation initiative (2024–2025): \$10.45M to support Quebec manufacturers — production-line automation, new materials/systems, local industrial capacity ([link](#))
- SQI public buildings (since 2019): prefab structural panels, factory-built MEP cores, advanced BIM on schools, courthouses, admin. buildings



SUCCESSES

- SQI's public-sector projects build institutional legitimacy and contractual/risk-management precedent for prefabrication

-> Government Roadmap for BIM (since 2021) -> Construction Innovation Roadmap (2026)

Coordinated provincial strategy for 8 major public project owners, with regulatory frameworks now integrated into their corporate policies. Quebec is the only Canadian jurisdiction with a structured government BIM strategy.

COLLABORATION

- PCI
- Modes de réalisation collaboratifs
- Le Lean appliqué à la construction
- VDC (virtual design construction)
- Gestion et partage des risques
- Carrefours collaboratifs – Espace de pilotage
- Développement des compétences et de la main d'oeuvre

MODERNISATION

- Construction Hors site (Préfabrication, construction modulaire, pré-assemblage)
- Fabrication additive (impression 3D)
- Chantier intelligent (inclus robotique)
- Traçabilité/surveillance/inspections
- Mise en service continue

TRANSFORMATION NUMÉRIQUE

- Jumeaux numériques
- SIG
- BIM
- IoT
- IA
- Integrative digital delivery (IDD)
- Cybersécurité – connectivité
- Modernisation des inspections



Municipal-Level Deployment

Québec City · 500-unit program municipalities · Rural MRCs · 2021–2026

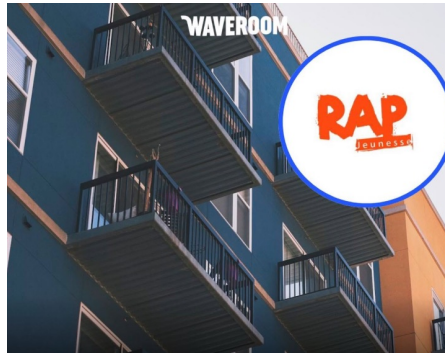
MUNICIPAL

PARAMETERS

- Ville de Québec (2023–2025): modular units for homelessness / social housing, in partnership with OMHQ and community organizations
- Municipalities in the 500-unit highly-prefabricated program (2024–2026): Montreal, Laval, Lévis, Granby, Rimouski, Paspébiac, Cap-Chat, Princeville, Coaticook, and others — providing land, adapting zoning, accelerating permits
- Rural municipalities and MRCs (Gaspésie, Nord-du-Québec, Charlevoix, 2021–2025): modular worker housing and prefabricated community buildings addressing labour shortages and seasonality

RESULTS TO DATE

- Québec City: reduction of several months in time-to-occupancy for transitional housing
- Rural MRCs: modular construction shifting from an emergency response to a structural housing solution



✓ SUCCESSES

- Territorial anchoring of industrialized construction; municipal levers (land, permits, zoning) shown to accelerate delivery

! DIFFICULTIES

- Municipal capacity to adapt regulation and permitting varies widely
- Smaller and rural municipalities depend heavily on provincial/federal funding and technical support



Housing for Northern & Remote Communities

Federal · Quebec (Nunavik) · Nunavut · 2022–2026

NORTHERN

PARAMETERS

- CMHC Housing Supply Challenge, Round 3 “Northern Access” (2022): \$80M (part of a \$300M national challenge fund) targeting supply-chain barriers — long shipping distances, short construction seasons, elevated material and labour costs
- Federal investment, Feb. 2025: \$62.8M for 1,661 housing units (244 new-build, 1,417 repair/renovation, via the Affordable Housing Fund and Rapid Housing Initiative
- Arctic Modular Homes (Winkler, MB): climate-controlled modular factory supported by the Northern Access round; first order for Nunavut Housing Corporation — 9 homes / 22 modules

RESULTS TO DATE

- Cambridge Bay (Nunavut): 9 modular homes shipped 8,090km, installed and occupied by November 2025; residents housed within 9 weeks of pod arrival
- Nord-du-Québec: ~40 units delivered at Chibougamau; BUT zero Nord-du-Québec projects selected in Quebec's first highly-prefabricated call (336 units / 11 projects)



SUCCESSSES

- Cambridge Bay modules matched conventional cost-per-square-foot while cutting build time and on-site crew needs — one of the few directly measured productivity results



DIFFICULTIES

- Construction costs in Nunavik run at least 3x southern Quebec (one Chibougamau project rose from \$23.7M to \$33.7M for 50 units); permafrost thaw is already cracking existing housing stock
- Short marine shipping windows (a few summer months) constrain delivery scheduling more than factory capacity does

Source: [CMHC news releases and Observer stories \(2025\)](#); [CMHC Housing Supply Challenge Round 3 \(2022\)](#); [CBC News](#); [Modulaire Québec](#)

Image: CMHC Observer photo of Arctic Modular Homes units arriving at Cambridge Bay, Nunavut

Initiatives in Other Provinces

British Columbia, New Brunswick, Alberta, and Ontario — a brief scan, not a full review like the Quebec/federal sections



British Columbia

BC

- Standardized Housing Designs (Sept. 2024): 10 free, pre-approved plans (duplex-to-quadplex, laneway/ADU), BC Building Code-compliant, stackable to 3 storeys
- Federal PacifiCan innovation fund (\$7.1M, 2024–2026) for BC modular/prefab, alongside the province's "Homes for People" plan (~80,000 homes since 2017)
- Difficulty: designs still require municipal adoption to actually shorten approval timelines

Source: [Government of B.C. news release \(Sept. 2024\)](#); [PacifiCan](#)



New Brunswick

NB

- Strong academic research – UNB – Prof. Rankin, his group
- \$2.5M repayable provincial loan (NB Housing Corporation) to Ironwood Manufactured Homes to expand capacity ~10x, to 10–15 homes built simultaneously
- 12 Neighbours (Fredericton): 96 modular tiny homes delivered at roughly one per week
- Kent Homes: 14 affordable modular units delivered across three communities
- Difficulty: inconsistent municipal bylaws mean "you cannot build the same house from city to city," blocking repeatable designs



Alberta

AB

- Strong Academic research: Prof. Al-Hussein, U of Alberta
- \$112M (Oct. 2024) for 250 modular homes in Jasper plus 25 units in Hinton, for ~2,000 residents displaced by the July 2024 wildfire (~850 units destroyed). Built via the Evergreens Foundation; first units occupied January 2025
- Framed as permanent, fully-serviced housing that later folds into general rental/affordable stock, not temporary shelters
- Difficulty: a disaster-recovery response, not a standing province-wide prefab housing program

Source: [Jasper Local](#); [CBC News \(Oct. 2024\)](#)



Ontario

ON

- 2025 Budget: \$50M over 5 years (via Invest Ontario) to upgrade production-line machinery and scale modular manufacturing capacity
- Paired with a \$5B top-up to the Building Ontario Fund and \$2B for municipal infrastructure enabling ~818,000 homes
- Difficulty: housing starts are projected to fall to 71,800 in 2025 — well short of the province's 1.5-million-homes-by-2031 target, against which this funding is a small fraction

Source: [Ontario Budget 2025](#); [Storeys.com](#)

Lessons Learned

What these initiatives, read together rather than one by one, suggest for the next phase



LESSON: ENABLING CONDITIONS

- **Capital scale drives activity:** the initiatives with hundreds of millions to billions committed (Build Canada Homes, PHAQ Volet 3, the Quebec–Canada northern housing agreement) show measurable movement; smaller funds (IRICR, CVBois) stay at pilot scale
- Pairing demand aggregation with **pre-approved designs shortens delivery:** Quebec's SIR designs and CMHC's Housing Design Catalogue attack the same bottleneck — design and permitting time — from opposite ends
- Modular can match conventional cost-per-square-foot once production stabilizes (Cambridge Bay): **cost looks like a manufacturing-maturity problem, not an inherent penalty of the method**
- **Local research capacity** is building : NRC; in Quebec: ÉTS-GRIDD, UQAM, McGill, U Laval, Concordia; U of Alberta, U of New Brunswick, U Waterloo - **participates in policy rollout**

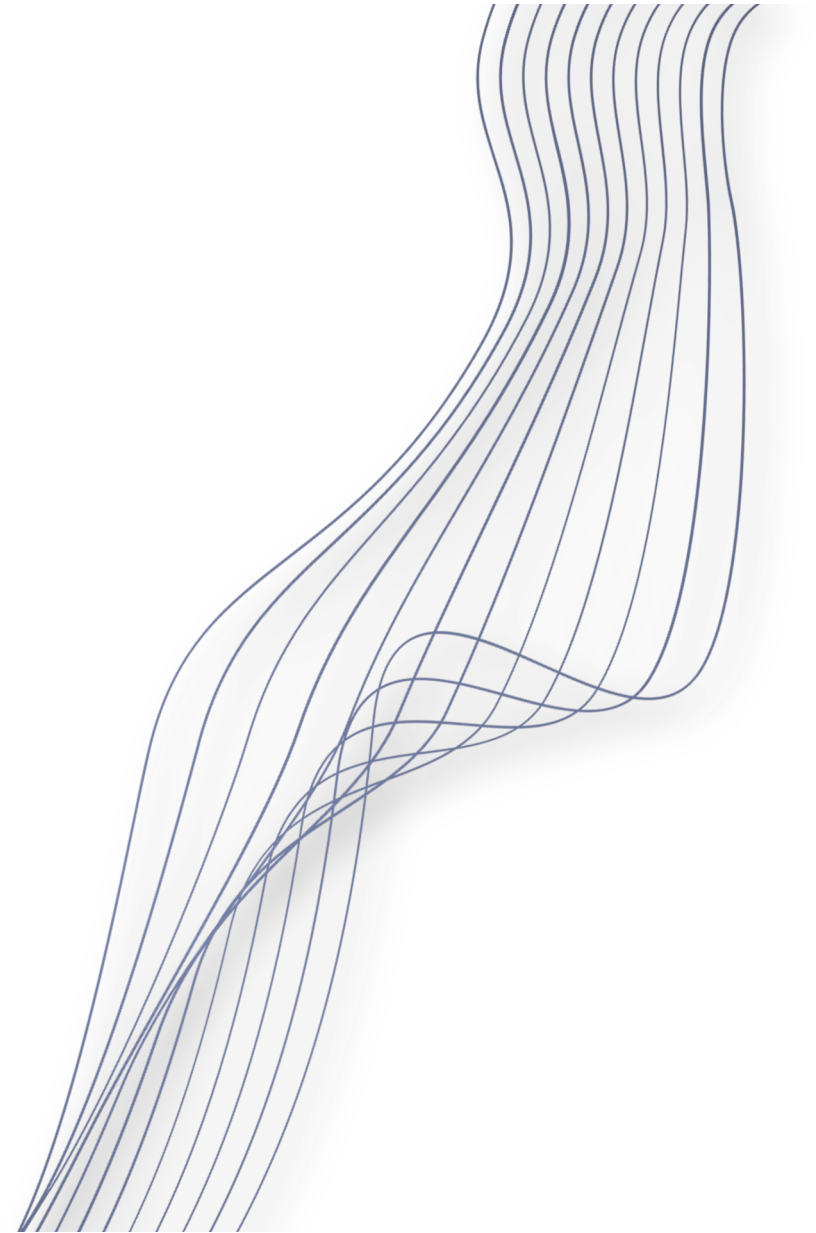


LESSON: PERSISTENT BARRIERS

- **Most programs are too recent to evaluate:** nearly all launched 2024–2026, so cost, quality, and durability outcomes will only be observable from 2027 onward
- Institutional adoption is uneven and reversible — **continuity, not just funding, is a precondition for industrial-scale investment**
- **Standard designs do not automatically travel:** solutions calibrated for southern/medium-density contexts need real adaptation, not just relabeling, for remote and northern ones
- **Logistics, not fabrication, is often the binding constraint up north:** short marine shipping windows and permafrost foundations set the pace in Nunavik and Nunavut more than factory capacity does

Research @GRIDD on Industrialization of construction

- 1. Prefabrication*
- 2. Digital fabrication*
- 3. Autonomous robot monitoring/reusable
elements detection - on site*
- 4. (Accompanying) Prefab roadmap for
public owners*



Recent Student Research: Industrialization & Automation

This GRIDD research domain applies robotics, AI, digital twins, and digital design/manufacturing to improve productivity, quality and sustainability in construction — with graduate research such as:

BIM-based configuration system for the early stages of modular residential projects

Bruno Llave — Sup. I. Iordanova — M.A.Sc., 2024

Design for Manufacture and Assembly (DfMA) challenges in off-site and on-site construction

Sadaf Montazeri — Sup. I. Iordanova — M.A.Sc., 2024

Two-stage BIM-based decision support system for selecting an industrialized building system

Amirhossein Mehdipoor — Sup. I. Iordanova — Ph.D., 2024

Scan to BIM

Majid Seydgar — Sup. A. Motamedi & E. Poirier — Ph.D., 2024

A computer vision approach to identifying missing welds on prefabricated steel components

Asa Sabahnia — Sup. A. Motamedi — M.A.Sc., 2023

Construction Productivity & Environmental Performance of Prefab. through Adequate Contractual Modes and Legal Provisions

Lead: Prof. Iordanova, with Prof. Jobidon (and 3 other Canadian universities)

Digital Construction Platform at NRC: Digitalization of National Construction Codes & a Common Data Framework

Lead: Prof. Poirier

NRC Data Dictionary Development – Phase I

Lead: Prof. Poirier

Standardizing Machine-Readable Language for DfMA

Lead: Prof. Iordanova

Plus 3 further student projects underway in this domain — 9 students involved, 13 publications to date.

Conclusion & Further Resources

Canada and Quebec have moved, since 2024, from isolated pilots toward a coordinated policy stack — financing, standardized design, and municipal levers all pointed at industrialized construction. But the shift from ad hoc demonstration to a structural housing market remains in its early phase, and most of the evidence needed to judge it — cost, quality, pace, durability — will only emerge over 2026–2029.

DATABASES AND RESOURCES FOR FURTHER EXPLORATION

 North America Prefab Manufacturers Map *C. Carbone, UQAM*
(updated 2025)

 Canada's Prefab Construction Navigator *Scius Advisory (Vancouver)*

 Innover Ensemble 6.0 (2025) – GRIDD *Productivity and prefabrication*

 CERACQ Forum on Prefabrication (2023)

 Mass Timber in Canada – Interactive Dashboard (SBMC) *Ongoing*

 Séminaires Interfaces – Université de Montréal *G. Lizarralde*

 Chair in Architecture, Energy and Environment *M. Jemtrud, McGill University*

Thank you!

GRIDD@etsmtl.ca

Ivanka.Iordanova@etsmtl.ca

