Interreg Co-funded by the European Union | Arctic Edge
Northern Periphery and Arctic

Output 1.4 Jointly developed pilots at project partner facilities aiming at testing conceptual framework for skeleton digital architecture through selected use cases

RCO84_1.1: Pilot actions developed jointly and implemented in projects

Supply Chain Pilots for SMEs

A practical look inside one live three-country supply chain, plus two real SME pilots: what was built and what it proved

Project	Arctic Edge (NPA0700189), Northern Periphery and Arctic Interreg Programme
Output Reference	Output 1.4: Jointly developed pilots at project partner facilities
Programme Output Indicator	RCO84_1.1: Pilot actions developed jointly and implemented in projects (target 3.00)
Audience	SMEs, business support organisations, and anyone exploring digital supply chain visibility
Companion Document	D.1.3.1 Joint Deployment Documentation — the full technical report submitted to the Programme

1. Why This Matters to SMEs

If you run or manage a manufacturing SME, this probably sounds familiar: a customer order comes in, and from that moment you are chasing information. Has the supplier confirmed it? Is the raw material on its way? Will it arrive on time? In most small and medium manufacturers across the Northern Periphery and Arctic region, this information lives in different places: emails, phone calls, spreadsheets, and the memory of whoever last spoke to the supplier. Nothing is wrong with any single system; the problem is that nothing connects them.

This fragmentation causes real, everyday costs. Delays are discovered only when goods fail to arrive, not when the risk first appears. Stock shortages are noticed when the shelf is already empty. A small, genuine increase in customer demand can spiral through the supply chain as each tier over-reacts and over-orders, a well-known effect called the bull-whip effect. And because so much of the process runs on manual follow-up, none of this scales as the business grows or takes on new partners.

Output 1.4 exists to answer one practical question for SMEs: can you fix this without ripping out and replacing the systems you already run your business on? Arctic Edge built

and ran a real, live, three-country pilot supply chain to find out, and the answer is yes. This document walks through exactly what was built, at three real partner sites, in enough detail that another SME could realistically follow the same path.

2. What We Built and Tested

The Arctic Edge partnership jointly developed a lightweight digital architecture (Output 1.2) built around three simple ideas, then tested it live across three real partner sites in three countries. None of this requires an SME to replace its accounting software, its shop-floor system, or its existing supplier relationships.

The three building blocks

- **MQTT messaging:** a lightweight, low-cost way for different organisations to send each other real-time updates (a new order, a delay, a shipment) without needing matching software.
- **Node-RED:** a free, visual automation tool that listens for those messages and decides what to do next (check stock, alert a supplier, update a dashboard) without a developer writing custom software from scratch.
- **Your existing system, untouched:** whatever you already use to run the business (an ERP like Odoo, a shop front, a spreadsheet-based process) keeps doing its job. The new layer sits on top and talks to it through standard, well-supported interfaces.

The moving parts, in plain terms

Component	Role in the pilot
MQTT (via HiveMQ Cloud)	The messaging backbone: carries real-time events (orders, delays, shipments) between organisations.
Node-RED	The automation brain at each site: decides what happens when a message arrives.
Tulip (used at AIM)	A cloud database and lightweight MES used to track orders and inventory at the End Manufacturer site.
Odoo (used at NKCCI and LTU)	The existing ERP system at both supplier sites: handles sales, purchasing, manufacturing and stock, left completely in place.
WooCommerce (used at AIM)	The customer-facing shop where pilot orders were placed.

Component	Role in the pilot
Dashboards	Live, browser-based views of order status, delays and performance, built inside each site's own system rather than as a separate platform.

This is a broker-based architecture: a distributed but structured way of exchanging data that avoids the cost and risk of forcing every partner onto one shared system. It gives SMEs real-time visibility across every tier of a supply chain (not just their own corner of it) while keeping the cost and complexity of adoption low. It is also intentionally incremental: a business can start with basic visibility and only add forecasting or automation once the basics are working and trusted. Every order in the pilot carries one shared reference number, generated at the point the customer order is placed and passed through every message and every partner's own records. This single design choice is what makes it possible to trace one order across three countries and three completely different internal systems.

3. The Three Pilot Actions

Output 1.4 is being delivered as three pilot actions, together demonstrating the architecture in both simulated and real business conditions:

#	Pilot action	What it proves	Status
1	Lab-conditions pilot at AIM (Ireland), LTU (Sweden) and NKCCI (Finland)	A full three-tier, three-country supply chain can run live on this architecture, end to end, with real order volumes.	Complete (detailed in Section 4)
2	Real-life deployment at Good4U (G4U)	The same approach works inside a real trading SME, not just a research-lab simulation.	Deployed at Good4U and fully handed over to the company (detailed in Section 6)
3	Real-life deployment at Seamless Aluminium (SA)	The approach transfers to a second, different SME sector and operating context.	Installed on the company's system on site (November 2026); management using it, operator roll-out next (detailed in Section 7)

Pilot Actions 2 and 3 build directly on the cooperation and technology-transfer work already carried out with these two Digital Beacon enterprises under Output 1.3. Sections 6

and 7 give a short, high-level summary of what was built at each company and where each pilot stands at the time of writing (November 2026). Short explainer videos have also been made for each of the three pilot actions (see Section 8).

To make Pilot Action 1 concrete and testable, the partnership simulated a real three-tier manufacturing supply chain: a ballpoint pen. AIM Centre in Ireland takes customer orders and assembles the finished pen (End Manufacturer); North Karelia Chamber of Commerce (NKCCI) in Finland supplies and manufactures a component tier (Tier 1); and Luleå University of Technology (LTU) in Sweden supplies the raw ink-pipe material (Tier 2), including a small robotic rig that models physical raw-material extraction and transport. A pen was chosen deliberately: simple enough to follow easily, complex enough (three colour variants, multiple components, two supplier tiers) to expose the real coordination problems SMEs face. The pilot ran live, with real orders flowing automatically between all three sites over MQTT, with no emails, phone calls or spreadsheets in the loop.

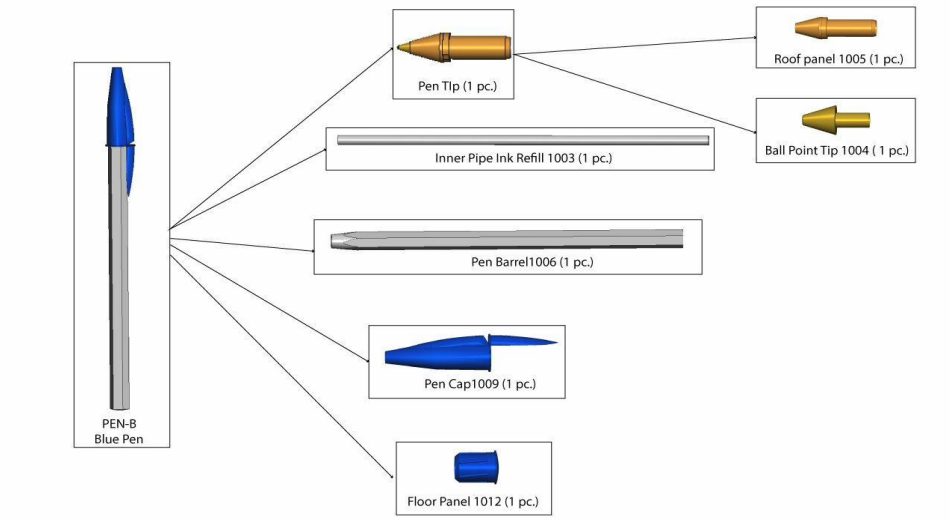


Figure 1. The pilot product: a three-variant ballpoint pen, with components sourced across both supplier tiers

4. Pilot 1 in Detail: One Live Three-Country Supply Chain

Pilot 1 is one connected supply chain combining three separate experiments, simulated live across three countries: a customer order is placed, an assembly site turns it into a finished product, a component-manufacturing site supplies a sub-assembly, and a raw-material site supplies what that sub-assembly is made from. What follows describes the pilot as a whole (the problem it solves, what was built, and what the live results show) rather than walking through each location as a separate story, because the value of this pilot is precisely that it works as one connected chain, not three disconnected pieces.

4.1 The Problem Before

Tracking a single order across three countries used to mean phone calls and emails at every step. Nobody at one end of the chain had a reliable way of knowing what was happening at the other end without contacting them directly. Stock was checked manually against spreadsheets; purchase orders to suppliers went out by email and could take hours or days to action; and shipment delays (for example a customs hold between two countries) were invisible until the delivery window had already passed. Important information was scattered across ERP records, emails, supplier messages, spreadsheets and manual notes, making it genuinely hard to answer quickly whether a new order had arrived, whether the related purchase order had been created, whether a supplier had confirmed it, or whether the final delivery was on track.

At the raw-material end of the chain, this fragmentation showed up in physical form too: stock updates were delayed, and where physical extraction or transport equipment was involved, that equipment was completely disconnected from the digital systems tracking orders and deliveries. Long transport distances, harsh weather, and fragmented logistics networks make this especially costly for SMEs operating in remote regions, where even a small delay can snowball into a much bigger disruption further down the chain.

4.2 What Was Built

A customer order enters the chain through a simple online shop. From there, an automation layer checks new orders every 30 seconds, checks stock against the bill of materials, and connects to all three countries' messaging channels at once, so a message published anywhere in the chain arrives wherever it's needed automatically, without anyone needing to send it there specifically. A shared reference number, created once when the order is placed and carried through every message and every record afterwards, is what makes it possible to trace one order across three countries and three completely different internal systems. This single design choice turned out to matter more than any other.

Critically, every organisation in the chain kept its own existing system exactly as it was. The assembly site kept its own cloud database and shop front; the component-manufacturing site kept its existing ERP system and simply added a lightweight integration layer around it, building its live dashboard directly inside that ERP rather than as a separate tool (an early attempt at a separate dashboard added unnecessary complexity, and moving it inside the existing system made it lighter and easier to maintain); and the raw-material site connected the same way, with its own dashboard tracking orders, stock, and delivery timelines. A plain-language AI-generated performance report is produced automatically every six hours, summarising order volumes, lead time trends and late deliveries without anyone needing to run a manual analysis.

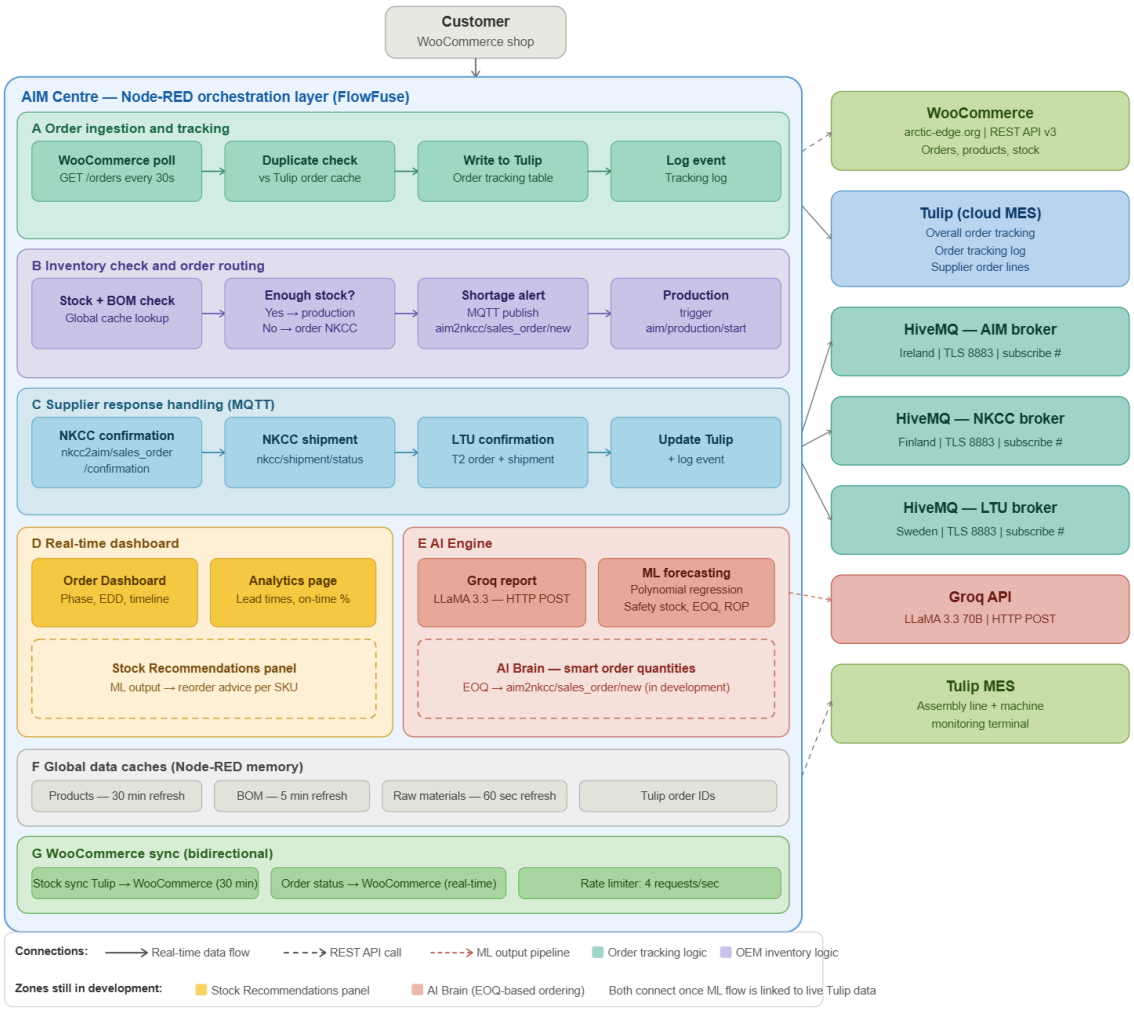


Figure 2. How the ordering and coordination layer is organised: order intake, inventory checks, cross-border communication, dashboards, and forecasting, all built from free or low-cost components

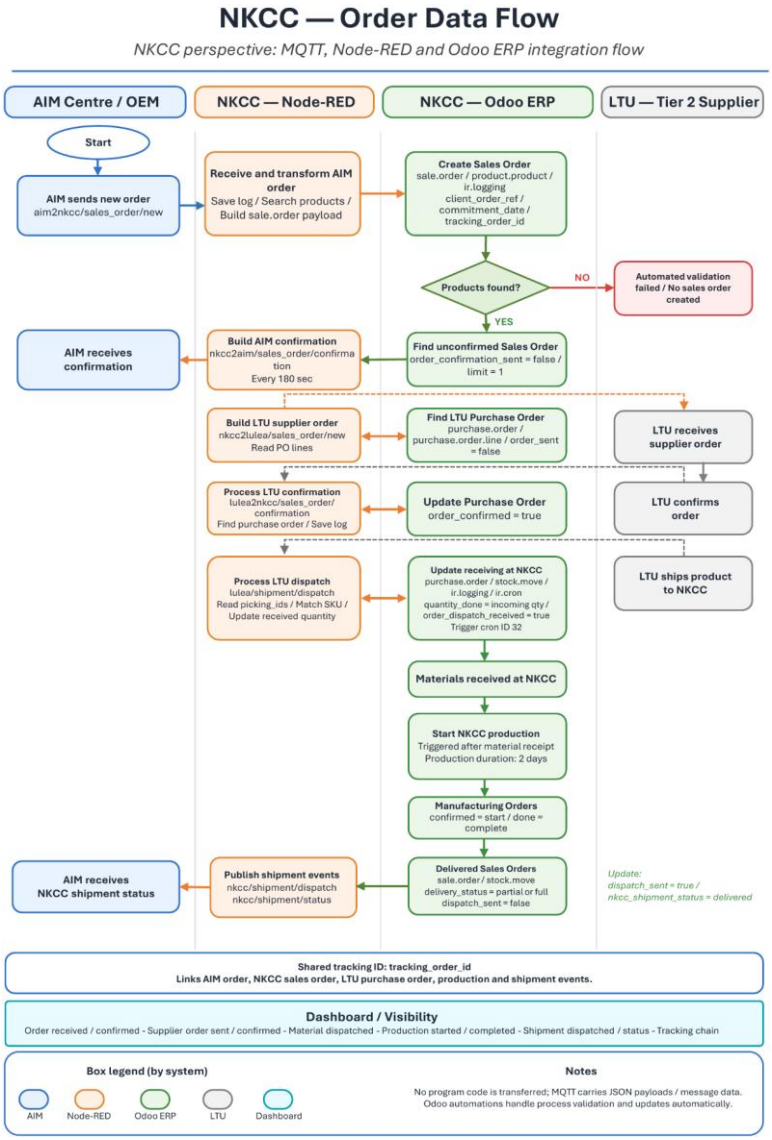


Figure 3. The same event-driven approach applied at the component-manufacturing stage, connecting an existing ERP system to the wider chain without replacing it

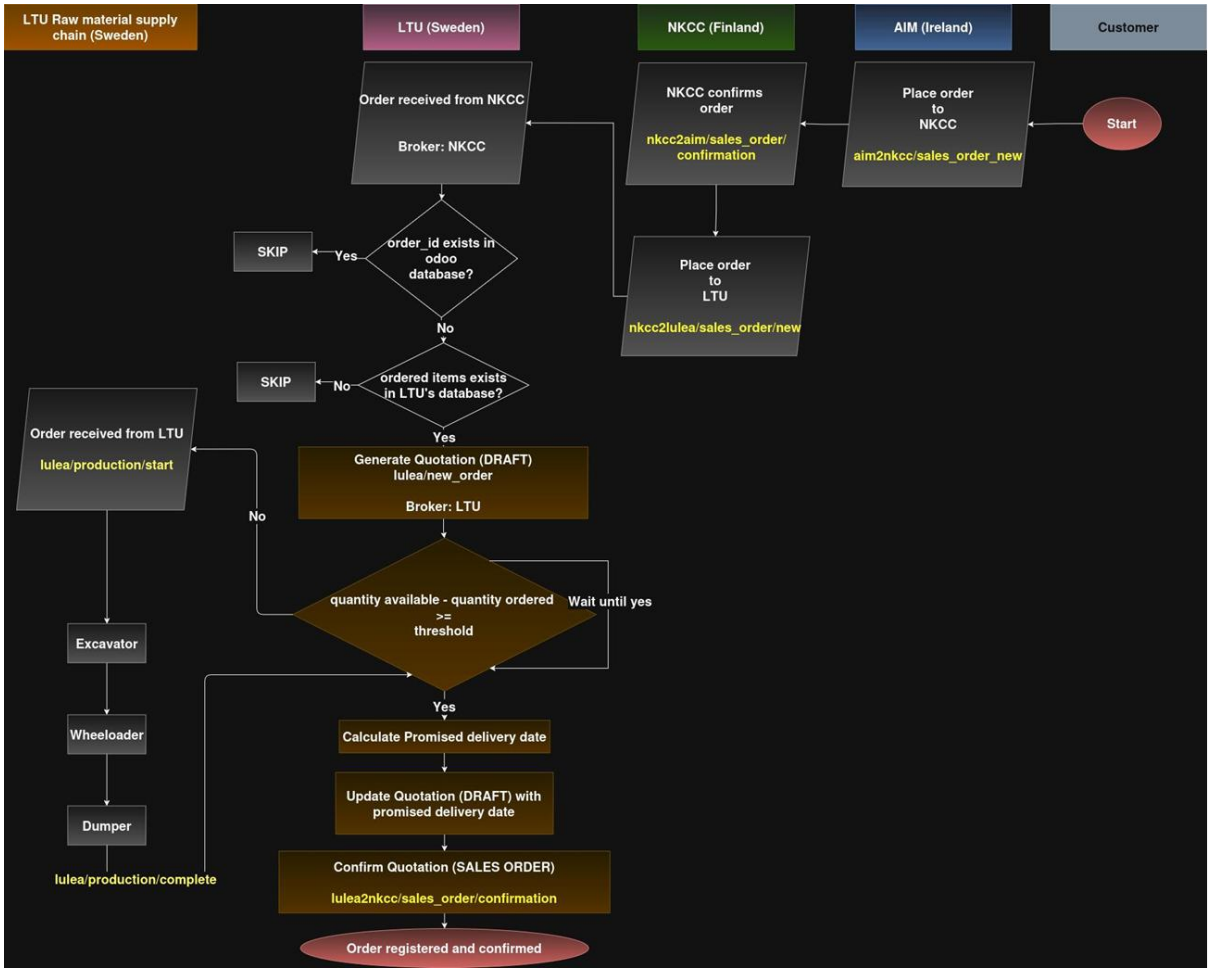


Figure 4. LTU system architecture, from customer order to order confirmation, showing all MQTT topics.

4.3 The Five Everyday Problems, Tested End to End

1. "Where is my order right now?"

Fully proven across the whole chain. When a customer places an order, it's picked up within 30 seconds, checked against stock, and (if needed) turned into a purchase order automatically. From there, the shared reference number connects the original order, the follow-on purchase order, the supplier's confirmation, the material receipt, and the final delivery into one traceable chain. Every status change, at every stage, writes a new timestamped entry automatically; nothing requires manual input, and the order's full life story is available on a dashboard at any moment, whichever end of the chain you're looking from.

2. "Something's gone wrong on the production line"

Proven at the ordering end, partially proven further down the chain. A production issue reported anywhere in the chain reaches the ordering site within about two seconds in testing (well before the delivery deadline would have passed) and updates the order status and expected delivery date automatically. Manufacturing status is visible at the component-manufacturing stage too, so missing or incomplete production steps can be spotted, though a fully independent automatic fault-detection alert isn't built yet at that stage. That's an honest, identified gap rather than a hidden one.

3. "This shipment is going to be late"

Fully proven. Delay notifications from any point in the chain (for instance a customs hold) are logged and reflected on the relevant dashboards immediately, so a delay can be communicated to the next customer in the chain before they have to ask. Across the pilot's live data, 63.2% of completed orders arrived on time and 36.8% were late, and those late orders aren't a failure of the system, they're the system working as intended: a reliable, data-backed picture of delivery performance that simply didn't exist before in any form.

4. "We're about to run out of stock"

Fully proven, and extended furthest at the raw-material end of the chain. Stock is checked automatically against a reorder threshold; when it drops to or below that level, a supplier order goes out automatically with no one needing to notice the shortage and act on it manually. At the raw-material end, this same trigger goes one step further: instead of just alerting a person, it can automatically set physical ground-based robots in motion to replenish the warehouse (see Section 4.4). A more advanced version (using demand forecasting to size the reorder intelligently rather than just reacting to the immediate gap) was also built, and is described honestly below as a promising next step rather than a finished feature.

5. "A spike in demand is about to cause chaos upstream"

Built, but the least mature capability tested. A forecasting engine at the ordering end analyses months of real order history to predict demand, recommend safety stock, and calculate the most efficient reorder quantity for each component, the intent being to let suppliers plan from real, shared demand data rather than reacting to (and amplifying) each individual order, which is what causes the so-called bullwhip effect. This is built and ready; the remaining step is connecting it permanently to live data rather than historical test data. It has not yet been built at the other stages of the chain, and is flagged honestly as a future opportunity rather than a proven result.

4.4 The Robotics Extension: When the Digital Chain Reaches Physical Equipment

At the raw-material end of the chain, the pilot goes a step further than messages and dashboards: it connects the same event-driven approach all the way down to physical equipment. Three small ground robots (an excavator, a wheel loader, and a dumper truck) simulate a raw-material mining and transport operation at a small, safe scale. Two "mine faces" are connected by transport routes; the excavator extracts material, the wheel loader moves it locally, and the dumper truck carries it between zones, mirroring how a real mining operation keeps material flowing continuously between machines.

When stock in the warehouse falls below a set level, that shortage is turned into a message and sent to a robot coordination system, which hands out tasks to the three robots automatically, so nobody has to notice the shortage and dispatch a machine manually. This is still an early-stage research demonstration rather than a finished commercial product: it currently works in scheduled batches rather than being fully autonomous, and making the robots work independently without any pre-set schedule is explicitly still in progress. But the principle it proves reaches well beyond mining: any SME with physical equipment (a forklift, a conveyor, a delivery vehicle) could, in theory, connect that equipment into the same kind of event-driven digital chain used for ordinary order and stock messages, rather than treating "the physical side" and "the digital side" of the business as separate worlds.

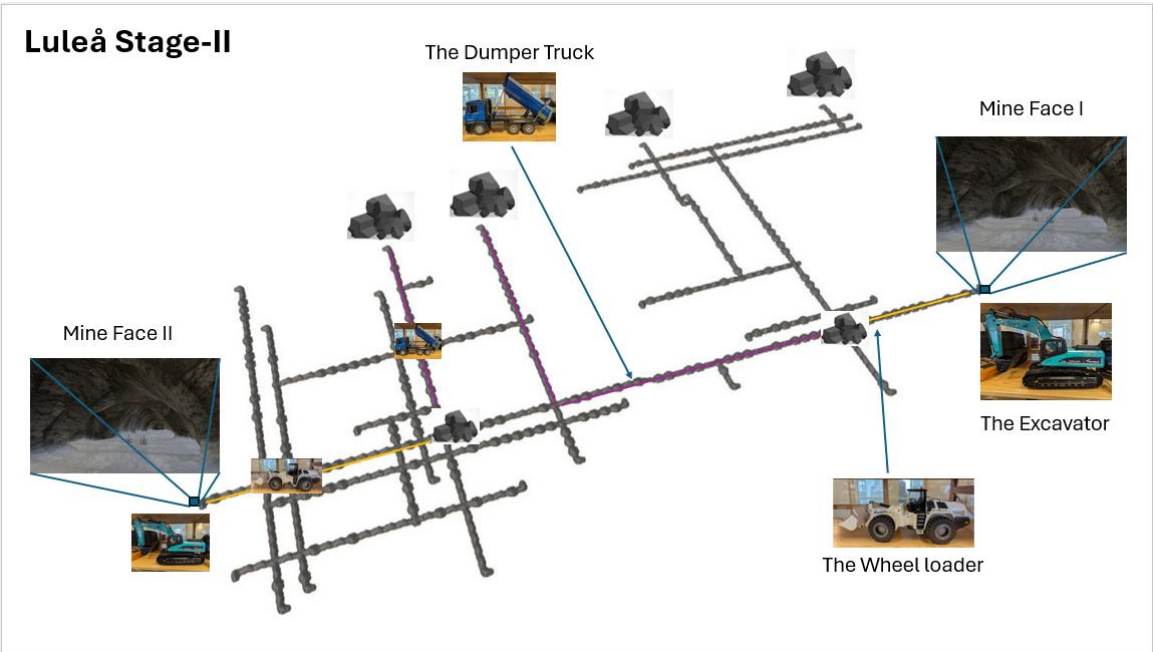


Figure 5. The raw-material end of the chain: order handling, delivery calculation, and dispatch, with an automatic trigger down to physical robotic replenishment when stock runs low

4.5 How the Demo Was Kept Simple

To make the pilot easy to follow, a few simplifying assumptions were used throughout: a straight-line, three-tier supply chain rather than a complex web of suppliers; fixed transport routes rather than dynamically chosen ones; and clearly agreed "transparency agreements" about exactly what each stage shares with its neighbours. None of this is a limitation of the underlying approach; it's a deliberate choice to keep a first demonstration understandable. The architecture itself never replaces any organisation's existing ERP or operational system; it sits alongside as an interoperable digital layer. The broader point for any SME reading this: you do not need expensive, enterprise-scale infrastructure to get real benefit from this kind of digitalisation: lightweight, interoperable tools can meaningfully improve transparency, resilience and efficiency even for a small operation in a remote location.

4.6 Results: Live Numbers From the Pilot

The pilot ran live from November 2025, with real orders flowing automatically end to end, with no emails, phone calls or spreadsheets in the loop:

Metric	Value
Orders processed automatically (customer end)	642, generating 2,618 tracking events with zero manual entry
Supplier orders triggered automatically by stock thresholds	297
Average lead time from order to component supplier	10.1 days
On-time delivery rate	63.2% of 201 completed orders (74 late deliveries automatically detected and logged); late orders on this Ireland–Finland leg arrived 19.5 days late on average
Incoming orders handled at the component-manufacturing stage	508, with 490 onward purchase orders sent automatically to the raw-material stage
Orders completed at the component-manufacturing stage	270+, with 160+ supplier deliveries received and tracked
Orders handled at the raw-material stage	762, of which 638 (84%) were dispatched to the component-manufacturing stage
On-time delivery between the raw-material and component stages	98.5% on time, based on 137 orders with full delivery data; 85% of receipts on time as measured at the component-manufacturing site
Delivery time at the raw-material stage	3.1 days on average when stock is available; 7–10 days when robotic replenishment is needed first
Cross-border messaging, order confirmation, stock-threshold detection, dispatch, dashboards, and delivery tracking at the raw-material stage	All successfully tested and verified working automatically end to end

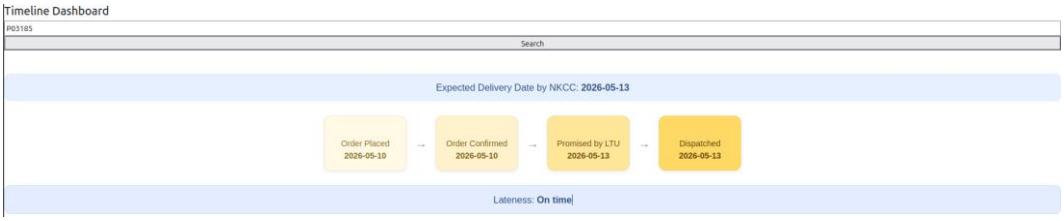


Figure 6. Order timeline tracked automatically: placed, confirmed, promised, and dispatched, with no manual entry

4.7 Before and After

Before (manual process)	**After (this pilot)**
Orders received by email or phone	Orders received and logged automatically within 30 seconds
Stock checked manually against a spreadsheet	Stock checked automatically against the bill of materials on every order
Purchase orders sent to suppliers by email (hours to days)	Purchase orders sent automatically in under 1 second once a stock threshold is crossed
The order and the follow-on purchase order to the next tier were separate, unconnected records	Both are linked by one shared tracking reference, so the whole chain can be followed as a single process
Delays discovered only once goods failed to arrive	Delay and shortage events appear on the dashboard the moment they happen
No visibility of what a supplier's own supplier was doing further up the chain	Full visibility across every tier from a single dashboard
Manufacturing, purchasing, receiving and delivery were only visible inside their own separate systems	One dashboard shows an order's progress across every stage, wherever you sit in the chain
Physical (robotic) operations at the raw-material end were disconnected from the digital supply chain	Robotic replenishment became digitally integrated into the same event flow as ordering and dispatch
Performance reviewed manually, if at all, at month end	Live on-time-delivery rate, lead times and trends visible at any time
No forecasting: orders placed reactively once stock ran out	A forecasting engine calculates predicted demand, safety stock and reorder quantity per component (built; not yet fully connected to live data)

4.8 What Worked and What Didn't

Across every stage of the chain, the same lessons kept coming back independently, which is itself part of the evidence that they're real, not a coincidence of one organisation's particular setup.

- **One shared reference number is everything.** A shared order/tracking ID, created once and carried through every message, is what makes it possible to trace one order across three countries and three completely different internal systems. Without it, none of the automatic connections in this pilot would have been reliable.
- **You do not need to replace your core systems.** Every organisation in the chain kept its own existing system (the shop front, the ERP, the database) exactly as it was. The integration layer sat alongside each system, not inside it.
- **Agree the message format before you build anything.** Agreeing exactly what information a message contains, and when it gets sent, up front saved significant rework later at every stage.
- **Build dashboards inside the system people already use, not as a separate tool.** An early attempt at a dashboard outside the existing ERP added unnecessary complexity; moving it inside made it lighter and easier to maintain.
- **Start with visibility, not full automation.** The most reliable early win everywhere was simply making the existing process visible in real time; automation and forecasting are valuable next steps, not a required starting point.

On the honest-limitations side: demand forecasting, predictive delay detection, and predictive maintenance were all built and tested in this pilot, but none of them are fully proven, production-ready features yet. They need more historical data, more stable message quality, and clearer business rules before an SME should rely on them for real decisions. Cross-border messaging between multiple countries also needed careful debugging, and coordinating shared message formats and testing schedules across three countries and organisations took real, ongoing effort; it is not a one-off setup task. Treat the visibility and tracking capability in this pilot as proven; treat forecasting and prediction as a promising next step worth planning for, not a result to expect immediately.

4.9 Getting the Word Out

The pilot's approach was shared with the wider SME community through regional digital clinics held in Joensuu, North Karelia and AIM Centre, Sligo, reaching entrepreneurs, SME representatives, and regional business-support organisations:

Date	Theme	Speaker(s)
4 March 2026	Reimagining Supply Chain	Dr Seamus Dowling, Ireland
19 March 2025	The opportunities of artificial intelligence in business	Esa Riutta, Finland
7 October 2025	Practical AI examples for business	Teemu Piirainen, Finland
31 March 2026	AI agents in practical work	Esa Riutta, Finland
21 April 2026	How companies build software with AI	Rebooted Solutions, Finland

The events introduced entrepreneurs to practical, low-threshold ways of experimenting with digital tools and AI (without needing to be a technology company to benefit from one) and used the pilot itself as proof that existing company systems can be connected without replacing them. A lead-partner workshop and recorded video demonstrations of the live system were also produced (see Section 8, Learn More).

5. What Every SME Can Take From This Pilot

5.1 A Practical Adoption Path for Your Business

- Pick one supplier or customer relationship where orders and deliveries happen regularly, manual follow-up already costs real time, and delays or missing confirmations cause genuine business problems.
- Agree a small, clear set of events to exchange first: new order, order confirmation, dispatch, and receipt. Resist the urge to connect everything at once.
- Keep your existing ERP, shop system, or spreadsheet process exactly as it is, and add a lightweight integration layer (such as MQTT and Node-RED) alongside it rather than replacing it.
- Agree a shared reference number with your partner from day one: this is the single most important technical decision you will make.

- Prove the basics (visibility and tracking) before adding automation, alerts, or forecasting. Expand only once the first relationship is working reliably.
- Before investing, weigh the payback realistically: include the value of saved staff time, fewer errors, and faster response to problems, not just the cost of the technology itself.

5.2 For Policymakers and Business Support Organisations

A consistent message emerged for the people who fund and support SME digitalisation: the main barrier for most companies is not a lack of interest, but limited access to suitable expertise, time, funding and practical examples. Low-threshold experimentation (digital clinics, demonstrations, shared test environments, and funding for small proof-of-concept projects) matters more than large, all-at-once digitalisation grants, and should enable step-by-step development rather than requiring a company to commit to a large project up front. Special attention should go to companies in rural and remote regions, which may not have in-house digitalisation specialists; chambers of commerce, universities and technology centres can play a valuable role connecting these companies with experts and cooperation partners.

5.3 What's Next for This Technology

Beyond this pilot, several directions are worth exploring further: linking supply chain event data to the estimated financial impact of a delay (so a business can tell which disruptions are actually worth an urgent response); AI-driven demand forecasting; predictive maintenance for equipment; coordinating a whole fleet of autonomous vehicles rather than a handful of robots; “digital twin” simulations of physical operations; and smarter automatic scheduling. None of these are proven results from this pilot; they are the honest next steps identified by the teams doing the work, offered here so other SMEs and researchers know where this line of development is heading.

6. Site 4: Good4U Digital Beacon (Demand Forecasting and Stock Management)

Everything in Section 4 was run under controlled, lab-style conditions at three research and industry-support organisations. Good4U is where the same thinking was tested inside a real, operating food-manufacturing SME, as an Arctic Edge Digital Beacon working with AIM Centre. The system has been deployed at Good4U, connected to its live data and fully handed over to the company; this section gives a short summary of what was built and what the tests show.

6.1 The Problem Before

Before the pilot, Good4U managed demand planning and procurement using Smartsheets, which hold dispatch records, finished goods stock levels, raw material intake movements, and supplier information. The data exists, but the intelligence does not. Orders were planned using a flat or rolling-average approach that treats every month the same, which created three repeating problems: seasonal blind spots (overstocking in quiet months, potential shortfalls in peak months), no automated link between finished-goods demand and raw material ordering, and no live early-warning when stock is approaching a minimum threshold (that has to be checked manually).

6.2 What the Data Already Shows

Before any system was built, AIM's initial analysis of several years of Good4U's dispatch history confirmed the problem is real and specific, not assumed. Demand follows a strong, repeatable seasonal pattern: the summer months are consistently the peak, with a clear step-up starting in spring, and December is consistently the quietest month. The gap between the busiest and quietest months is more than double at the overall product level, and considerably wider for individual, weather-sensitive product lines. A flat, non-seasonal ordering approach is guaranteed to get this wrong twice a year in opposite directions.

Month	**Relative demand (seasonal index, 100 = average month)**
January	84
February	80
March	118
April	104 (start of peak season)
May	113 (peak season)
June	125 (peak season)
July	125 (peak season)
August	125 (peak season)
September	96
October	97
November	80
December	54 (lowest month)

The analysis also found that a small number of raw materials were already below their set minimum stock level. These now show up on the dashboard's reorder list as soon as it loads, giving Good4U value from day one, separate from the forecast. One dominant product range accounts for the majority of dispatch volume and was modelled with particular care given how much of the business rests on it.

6.3 What Was Built

The system reads Good4U's live Smartsheets data (sales and dispatch history back to January 2020, finished-goods stock, raw-material stock, stock movements and the goods-in tracker), runs a Python-based seasonal forecasting model on a Good4U laptop, and shows the results on a dashboard that opens in a web browser on the company network. Every table on the dashboard can be downloaded as a spreadsheet file for day-to-day procurement use. Critically, the Good4U team keeps updating Smartsheets exactly as before; the system reads data in the background and changes nothing about their existing workflow.

Component	What it does
Seasonal demand forecasting	Monthly forecasts, normally six months ahead and shown with a likely range, for the 29 products with a steady sales history and for every regular customer account that has ordered in the last four months. The forecasts are built with Prophet, a free seasonal forecasting tool, from several years of real dispatch history rather than a flat average.
Raw material forecasting	Using Good4U's own recipes (bill of materials) for its core products, the finished-goods forecast is turned into the amount of each raw material needed, and compared with stock, open orders and typical supplier lead times. Recipes with more than one stage (part-made mixes used in several products) are followed step by step, with a yield allowance at each step, and the total need for each ingredient is added up across every product that uses it.
Live stock alert dashboard	All raw materials and packaging items (around 190) are checked in one colour-coded reorder list: reorder now, on order, running low, or OK. The status uses weeks of stock cover, open orders from the goods-in tracker and each supplier's typical lead time, so the team no longer has to check each sheet by hand. A suggested minimum stock level is also worked out from actual usage and lead time, capped so that stock is not bought faster than it can be used before its best-before date.

Component	What it does
Promotion-aware forecasting	Known promotional windows are flagged so a promotional spike isn't mistaken for a permanent shift in demand.
Recipe management	Recipes are kept in one dedicated Smartsheet and can be viewed and edited from the dashboard. Each recipe is checked before it is saved and again every time the dashboard loads; if a recipe has a problem, the last good copy is used and the issue is shown on screen.
Weather context	The typical temperature for each month, and a live 7-day forecast, are shown next to the product forecast as background for weather-sensitive lines. This is for context only and does not change the forecast numbers.
Plain-English explanations	Each part of the dashboard includes a short, non-technical explanation of what the numbers mean, and an optional short written summary of a forecast, so the system is useful to anyone on the team, not just people comfortable with forecasting models. The written summary comes from an online AI service, which is sent only a few summary figures for the item (such as recent and forecast averages and the busiest and quietest months), not the underlying sales records.

The whole system runs on free, open-source technology (Python, Streamlit for the dashboard, and standard statistical libraries), on hardware Good4U already owns, connecting to Smartsheets through a read-only link for all business data, so nothing in the existing sheets can be accidentally changed. The only sheet the dashboard writes to is its own recipe sheet.

6.4 Benefits and First Results

- Month-by-month demand forecasts grounded in real dispatch history, rather than a flat average, ordering the right amount at the right time of year.
- Raw-material needs for the core products linked directly to the demand forecast, removing manual calculation.
- Early warning when a raw material is at or near its minimum stock level, visible before it becomes a problem.
- Supplier lead times and open orders built into every reorder alert, so the list is not misleading when stock is already on the way.

- Visibility of demand by customer account, not just in total.
- No disruption to the existing way of working: the team keeps using Smartsheets exactly as before.

In a test against real dispatches from the first half of 2026, the forecast for total volume over the six months came within 2.4% of what was actually shipped. Single months were harder to predict, because large retail orders can land in one month rather than the next, so six-month totals are used for ordering and monthly values are read as a guide to the seasonal pattern.

6.5 Status and Approach

The system was deployed on a Good4U laptop in September 2026 and connected to the live Smartsheets data, with a walk-through of each part of the dashboard for the team. It has since been fully handed over: the final report, test report and user guide have been delivered, and the recipe tools added in November 2026 let the team keep recipes up to date themselves. The build was collaborative: the Good4U team took part in every key decision, all software used is free and open source with no vendor lock-in, and the documentation covers both day-to-day use and technical upkeep. Possible next steps identified with the company include linking the dashboard to its accounting and sales system (or to a new ERP when one arrives) and writing forecasts and reorder lists back into the spreadsheets. A short explainer video of this pilot is listed in Section 8.

7. Site 5: Seamless Aluminium Digital Beacon (Digital Stock Movement Tracking)

Seamless Aluminium is the second Arctic Edge Digital Beacon, working with AIM Centre to digitise stock movement recording on the factory floor. The system has been built, tested with management, and installed on the company's own laptop on site in November 2026; roll-out to operators on the production line is the next step.

7.1 The Problem Before

Before the pilot, Seamless Aluminium managed stock movements across all production stages using a paper-based clipboard system. At every station, operators manually recorded when materials arrived and when they moved on. At the end of each day, all clipboards were collected and re-entered by hand into the company's ERP system. With well over a thousand product lines across multiple production processes, this created three problems every single day: no live visibility of stock during the working day (shortages or progress can't be seen until the next morning at the earliest), a real risk of human error

at every step (from handwriting on a clipboard to re-keying it later) and a daily administrative burden on office staff that could be spent on higher-value work.

7.2 What Was Built

The pilot replaces the paper clipboard system on one production line with simple tablet-based digital forms. Operators at each stage record a stock movement the moment it happens, signing in with a short PIN, picking the product from a list, and entering the quantity (and, where it matters, the weight), with no handwriting and no risk of misspelled product names. Each entry is checked on the form, then approved in the office before it changes stock. Management can see live stock levels and a full movement history on a dashboard at any point in the day, instead of waiting for the following morning. Wrong or duplicate entries can be rejected with a reason, and nothing changes stock until it is approved. Each person only sees what their role needs: operators see the stages they work at, an administrator checks and approves entries, and management sees the results. Weight checks at each stage show any difference between what went in and what came out, and batch numbers link each finished length back to the coil it was made from.

A deliberate design choice worth highlighting for other SMEs: in daily use, the entire system runs locally, on the management laptop already on site. The tablets connect over the company's own local network to Node-RED and a small database on that laptop. There is no cloud dependency and no data leaves the building, which is useful for any SME that wants the benefits of digitisation without adding a new external dependency or ongoing subscription cost. During the testing period the system was hosted securely by AIM Centre so that any change the company asked for could be made straight away; in November 2026 it was moved onto the company's own laptop, where it now runs.

Production stage	What happens
Goods In	Raw aluminium coil arrives from the supplier and is logged into the system.
Slitting	Coil is slit to the required width for the product being made.
Roll forming	Slit coil is run through the roll former to create the finished profile.
Store	Finished lengths are stocked into the warehouse.
Dispatch	Finished lengths leave the store for customers.

The pilot's scope is deliberately focused: one standard product range, in 27 product, size and colour variants, plus the coils they are made from, tracked across these five recording points. Any other material moving through the line can still be logged via a free-text field, so nothing goes unrecorded even if it falls outside the pilot scope, and it is ready to be added as a fully tracked item in a future phase.

7.3 Expected Benefits

Management is already seeing the first of these benefits for the products covered; the full benefits depend on the operator roll-out described in Section 7.4.

- Live stock visibility during the working day, for the products covered, instead of waiting until the next morning.
- Fewer data entry errors, since operators select from validated options rather than writing freehand.
- Less administrative burden, since approved entries can be exported in a file layout the existing ERP system already accepts, rather than re-typing handwritten sheets. One click at the end of the day creates the file.
- A clear, timestamped audit trail for every movement, making stock discrepancies easier to investigate.
- Traceability from coil to finished fascia, through batch numbers recorded at each stage.
- Material losses between stages (scrap and weight differences) recorded for the first time, so they can be tracked and reduced.
- A foundation for further automation (more products, more production stages, and eventually a direct connection to the existing ERP system) without rebuilding the system from scratch.

7.4 Status and Approach

The system has been built and passed all of its end-to-end tests at AIM Centre. Seamless Aluminium management began testing it with real entries in September 2026, comparing it against the paper records. Following this testing period, the system was installed on the company's own laptop on site in November 2026 and management is now using it. The next step is to train operators station by station, with tablets running alongside the clip-boards until the numbers agree. As with Good4U, the build is collaborative: the compa-ny's production and office staff have shaped the system at every stage, and a company technical contact will learn it so the skills stay in-house rather than the system being

handed over as a black box. The operator guide and technical documentation have already been handed over, so Seamless Aluminium can maintain, extend and build on the system independently. Adoption results will be reported after the operator roll-out. A short explainer video of this pilot is listed in Section 8.

8. Learn More

Resource	What it covers	Audience
This document (Output 1.4)	Plain-language results, benefits and adoption guidance from the pilot, site by site	Operation managers, business owners, procurement managers, innovation managers, business advisors
Output 1.2: Skeleton Digital Architecture	The original design brief and conceptual framework this pilot was built to test	Technical experts, architects, operation managers, business owners, procurement managers, innovation managers, business advisors
Output 1.3: Technology Transfer Mechanism	How the Digital Beacon cooperation with G4U and SA was set up and carried through for the real-life pilots in Sections 6–7	Research organisations considering a similar cooperation model with SMEs
Output 1.4: Pilot 1 video, “Simulated Digital Supply Chain Architecture” (AIM, NKCCI, LTU)	A short narrated explainer of Pilot Action 1: three countries and three systems with no shared view, how one lightweight layer connected them, one order followed end to end, and the measured results	General / SME audience

Resource	What it covers	Audience
Output 1.4: Good4U pilot video, "Demand forecasting and stock intelligence" (Pilot 2)	How a family-run food SME moved from spreadsheets to seasonal forecasts: the data used, the product and customer forecasts, the raw-material plan, reorder alerts, benefits and next steps (illustrative data only, not real figures)	General / SME audience
Output 1.4: Seamless Aluminium pilot video, "From Clipboard to Tablet" (Pilot 3: Digital Stock Movement Tracking)	How one production line moved stock recording from paper to tablets: the five recording points, approvals, the live dashboard, the daily ERP file, benefits and possible extensions (sample data only)	General / SME audience

The videos listed above are part of Output 1.4 and will be published and promoted through Arctic Edge's regional dissemination channels (including the NKCCI digital clinics in Joensuu and equivalent partner events in Ireland and Sweden) so that SMEs across the NPA region can see, question, and adapt this approach for their own supply chains.

Appendix: Glossary of Terms

BOM: Bill of materials: the list of parts or raw materials, and how much of each, needed to make one product.

Broker: In MQTT, the central service that receives messages and passes them on to every system that has asked for them.

Digital Beacon: An SME that works with Arctic Edge to test and demonstrate a digital solution in its own business (see Output 1.3).

End Manufacturer: The company at the end of the supply chain that assembles the finished product and sells it to the customer.

Fascia: An aluminium roofline board, the product range tracked in the Seamless Aluminium pilot.

G4U: Good4U, an Irish food company and Arctic Edge Digital Beacon (Pilot 2).

LTU: Luleå University of Technology, Sweden; the Tier 2 raw-material supplier in Pilot 1.

MES: Manufacturing Execution System: software that tracks and controls work on the shop floor.

MQTT: A lightweight messaging protocol for sending small, real-time messages between systems.

NKCCI: North Karelia Chamber of Commerce, Joensuu, Finland; the Tier 1 supplier in Pilot 1.

PIN: Personal identification number: a short code used to sign in.

Prophet: A free, open-source forecasting tool that models seasonal patterns.

RCO84: Interreg programme output indicator that counts pilot actions developed jointly and implemented in projects.

SA: Seamless Aluminium, an Irish manufacturer of aluminium rainwater and roofline products and Arctic Edge Digital Beacon (Pilot 3).