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Northern Periphery and Arctic

Output 1.3 Technology Transfer Mechanism Developed Through Cooperation Between Digital Beacons and Research Organisations

RCO10_1.1: Enterprises cooperating with research organisations

Output Reference	Output 1.3: Technology transfer mechanism developed through cooperation between Digital Beacons and Research organisations
Programme Indicator	RCO10_1.1: Enterprises cooperating with research organisations
Target Value	2 enterprises (Good4U and Seamless Aluminium)
Achieved	2 enterprises. Both pilots designed and built with the companies and now running on each company's own laptop: Good4U since September 2026, Seamless Aluminium since November 2026 (Section 3.4).
Lead Partner	AIM Centre, Sligo, Ireland
Partners involved	AIM Centre (Ireland) · NKCC (Finland) · LTU (Sweden)
Digital Beacons	Good4U (Sligo, Ireland) · Seamless Aluminium (Ballyshannon, Co. Donegal, Ireland)
Delivery Period	Period 4 (Months 19–24)
Version	3.0 (replaces 2.0, September 2026)
Date	November 2026

Output Description

Two Digital Beacon enterprises, Good4U and Seamless Aluminium, cooperated with digital labs based in research organisations (AIM Centre, with NKCC and LTU as Arctic Edge partners) with the aim of developing a technology transfer mechanism through an architecture based on the broker and gateway/client approach, ready to connect to the broker and suited to the needs of each Digital Beacon. The outcome of this cooperation is an architecture fitted to each Digital Beacon's use case, working systems for both companies, and documentation of the technology transfer mechanism, which will be used for other SMEs.

This document constitutes Output 1.3 of the Arctic Edge project. It provides:

- A description of the Arctic Edge technology transfer model and how it was adapted from the RoboDemo/Centria approach for the context of digital supply chain connectivity.
- Documentation of the actual cooperation process with both Digital Beacon companies, from first meeting to deployment: the use cases, the architecture proposed and delivered, what changed on the way, and the lessons learned.
- The evidence of technology transfer: what each company can now do, and which reusable materials came out of the cooperation.
- The six-phase mentoring model as a reusable mechanism for transferring this knowledge to other SMEs in the NPA region.
- Three illustrative SME case examples showing how the model applies across different contexts.

Links to further project materials:

- Project website: https://www.interreg-npa.eu/projects/arctic-edge
- Video outputs and case studies: to be published on the Arctic Edge YouTube channel: https://www.youtube.com/@InterregNPA_ArcticEdge

1. Background: Adapting the Technology Transfer Approach for Arctic Edge

The Arctic Edge technology transfer model is tailored from the technology transfer approach developed in the RoboDemo project (NPA, 2022–2025), led by Centria University of Applied Sciences. Activity 1.1 of the Arctic Edge application committed to establishing a knowledge sharing mechanism based on the Centria model, which had been tested successfully with 26 enterprises across the NPA region during RoboDemo.

The original RoboDemo model focused on reducing barriers to physical automation and robotics adoption. It combined awareness raising, needs assessment, lab and on-site demonstrations, simulations, investment appraisal tools, and follow-up to support SMEs in their automation investment decisions.

In Arctic Edge, this logic is adapted to the context of digital supply chain connectivity. The focus shifts from physical automation to digital interoperability, specifically how SMEs can connect their order management, inventory, and supplier communication systems using lightweight, open-source IoT and MQTT-based tools. The table below sum-

marises the key adaptations made from the RoboDemo model to the Arctic Edge context.

Dimension	RoboDemo Model	Arctic Edge Adaptation
Focus technology	Robotics, physical automation, cobots, manufacturing equipment	Digital supply chain connectivity: MQTT, Node-RED, ERP integration, IoT data flows, brokers, data analytics
Demonstration format	Lab demonstrations and on-site equipment demonstrations with physical robots	Live pilot demonstrations (Pilot 1), Digital Beacon site deployments, joint webinars and online sessions
Discovery process	On-site interview, Company Case Need Assessment document, consent for photos/video	On-site or remote scoping meeting, data file analysis, floor walk, structured needs assessment, pilot scoping document
Simulation tools	Process simulation software to model automation feasibility before investment	Live Pilot 1 supply chain simulation as the reference model; prototypes and backtests built on real company data before deployment
Investment appraisal	NPV, ROI, payback period calculations to support investment decision-making	Cost-benefit framing of open-source tools; no-licence-cost architecture; integration with existing tools to avoid disruption costs
Reference cases	30 company case study videos published on YouTube from RoboDemo partners	Digital Beacon cooperation documented as reference cases in this output; explainer video; architecture proposals
Scale of engagement	Individual SME engagement through direct outreach from partner institutions	Two Digital Beacon companies in deep cooperation; lessons transferred to wider SME group through mentoring programme (Output 2.1)
Staged transfer path	Research organisations → SME via demonstration	Research organisations → Digital Beacons → wider SME uptake through mentoring

A central adaptation is the role of Digital Beacons. In Arctic Edge, research organisations and technical partners first develop, test and refine the digital architecture together with Digital Beacon companies. These companies provide real-life validation environments where the technical approach, implementation challenges and practical benefits

can be observed. The validated knowledge and lessons learned are then transferred to a wider group of rural manufacturing SMEs through demonstrations, mentoring, advisory support, roadmap development, educational materials and toolkit guidance.

The technology transfer pathway therefore follows three stages:

Stage 1	**Stage 2**	**Stage 3**
Research organisations develop and refine the digital architecture	Digital Beacons validate and demonstrate the approach in real-life environments	Wider SME uptake through mentoring, demonstrations and toolkit guidance

2. About the Project

The Arctic Edge project aims to strengthen supply chain operations in the Northern Periphery and Arctic region by developing and implementing a cloud-based, IoT- and MQTT-driven digital architecture for rural manufacturing SMEs. The project addresses the limited adoption of advanced digital technologies in SME supply chains and seeks to improve efficiency, resilience and adaptability through better connectivity, interoperability and real-time data use.

Digital Beacons are pioneering rural manufacturing SMEs that collaborate closely with project partners to adopt, test and demonstrate the project's digital architecture in real-life supply chain and production environments. Their role is not only to benefit from the technology themselves, but also to help validate the technical approach and generate practical learning for other SMEs. Through this structure, Digital Beacons act as the bridge between research-based technology development and wider SME adoption.

3. Digital Beacon Cooperation: Evidence of the Technology Transfer Mechanism

This section documents the cooperation between AIM Centre and each Digital Beacon company, from first meeting to deployment. It is the main evidence base for Output 1.3: two enterprises cooperated with research organisations, the same mechanism was applied to both, and each now uses a system fitted to its own needs: both on the company's own laptop. Figure 1 shows how the two cooperations ran through the delivery phases in 2026.

Role of the research organisations. AIM Centre led the day-to-day work with both Digital Beacons, from scoping and design to building, testing, installation and training.

NKCCI (Finland) and LTU (Sweden) contributed through the shared Arctic Edge architecture. To-gether with AIM Centre, they built and ran Pilot 1, the three-country supply chain in which NKCCI acted as the Tier 1 supplier and LTU as the Tier 2 supplier, connected through an MQTT broker. The broker and gateway/client design and the lessons from Pilot 1 were the starting point for both Digital Beacon pilots. NKCCI also brought its ex-perience in ERP integration and knowledge transfer to SMEs, and LTU its experience in technical modelling and validation. The results of the Digital Beacon cooperation feed back to all three partners through the mentoring model described in Sections 4 to 6.

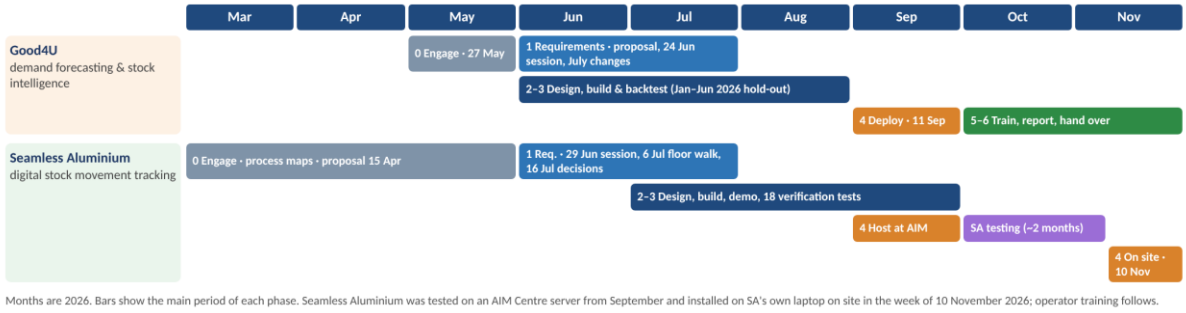


Figure 1. The two Digital Beacon cooperations through the delivery phases, 2026

3.1 Good4U: Demand Forecasting and Stock Intelligence Pilot

Organisation	Good4U, Sligo, Ireland
Sector	Food manufacturing: natural, health-benefit packaged foods for retail and hospitality
Supply Chain Role	Rural manufacturer supplying major UK and Irish retailers
Research Organisation Partner	AIM Centre
Cooperation commenced	May 2026 (scoping meeting 27 May 2026)
Pilot type	Demand forecasting, seasonal stock intelligence and raw-material planning
Architecture approach (delivered)	Python application on a Good4U laptop reading six Smartsheets through a read-only API; Prophet-based forecast; BOM engine; Streamlit dashboard; no replacement of existing tools
Status (November 2026)	Deployed on the Good4U laptop in September 2026; training and handover complete.

3.1.1 Supply Chain Challenge Identified

Good4U manages demand planning and procurement using Smartsheets. These sheets hold dispatch records, finished goods stock levels, raw material intake movements, and supplier information. Initial analysis of 9,677 dispatch records from 2021 to 2025 identified three structural problems in the current approach:

Seasonal blind spots	Demand peaks in summer and drops in winter. The flat or rolling-average ordering approach treats every month the same, causing overstocking in winter and potential shortfalls in peak months. The peak-to-trough ratio across the year is about 2.3×; for the top SKU (G4U110 Salad Topper Super Seeds) about 3.1×.
No raw material planning link	There was no automated connection between finished goods demand and raw material ordering. Knowing more product is needed in June did not feed into ordering the right ingredients in April.
No early warning system	Stock levels and minimum thresholds existed in Smartsheets, but there was no alert when a material approached its minimum. 62 of 324 raw materials were already below their minimum at the time of initial analysis.

3.1.2 Architecture Proposed and Delivered

The architecture connects to Good4U's existing Smartsheets without replacing any current tools or workflows. It adds an intelligence layer on top of what is already in place. The table shows what was proposed in June 2026 and what was delivered.

Component	What it does (as delivered)	Status
Smartsheets API (read-only)	Reads six live sheets: two dispatch records, Finished Goods Master, Stock Management File, Goods In Tracker, Intake & Stock Movements. Nothing in Smartsheets can be changed by the system.	Delivered
Forecasting model	Runs on the Good4U laptop. Cleans the data (customer name variants, one-off orders, faulty rows), forecasts 29 core products and all active customers with Prophet blended with the recent 12-month level; thin series get a labelled average instead of a forecast.	Delivered (method changed from the proposal)

Component	What it does (as delivered)	Status
Raw material engine	Uses Good4U's cleaned multi-stage recipes for 22 products, applies 93% yield at every stage, and compares need with stock, open orders and supplier lead times.	Delivered (extended from 1 to 22 products)
Streamlit dashboard	Five views: product forecast (with typical and live weather shown for context only), customer forecast, raw-material plan, colour-coded reorder alerts and a recipe editor, with plain-English notes and an optional AI summary (uses an online AI service; the dashboard works without it). CSV download of every table.	Delivered
Smartsheets write-back	Proposed: forecasts written daily to a new sheet.	Not built in this version;replaced by CSV downloads

3.1.3 Technology Transfer Process with Good4U

Phase 0: Initial Engagement | Complete

What happened	Six data files shared by Good4U. Initial analysis of 9,677 dispatch records. Architecture scoping. Scoping meeting held 27 May 2026.
Technology transfer activity	Discovery session. Listening-led. Problem identification. No solution proposed before the data was understood.

Phase 1: Requirements Gathering | Complete

What happened	Written proposal (June 2026). Scoping session on 24 June agreed read-only API access, the core product list, the customers in scope, Tesco account naming and the yield assumption. Read-only Smartsheet token provided. Further decisions in July: Cookstown treated as a sale; rapeseed oil removed as a frying carrier; 93% yield at every process stage.
Technology transfer activity	Joint decision-making on data rules. AIM explained what each rule would do to the numbers; Good4U decided the business meaning.

Phases 2–3: Design, Development and Testing | Complete

What happened	Data pipeline, forecast model, raw-material engine and dashboard built. Good4U delivered a cleaned BOM in July, which extended the raw-material plan to 22 products. A data-sufficiency rule, a dormant-customer rule and cover-based reorder alerts were added. The model was tested on January–June 2026, next to two simpler methods, and the results were shared openly (the same months also helped set the blend weight, so the test is repeated on new months). In November 2026, recipes were moved out of the code into a Smartsheet that Good4U edits from a new Recipes tab, and pack sizes are now read from the Finished Goods Master.
Technology transfer activity	Co-development with the Good4U team. Sample outputs shared for sense-checks. Honest backtest report written in plain language, including where the simple method did better.

Phase 4: Deployment | Complete

What happened	Application installed on the Good4U laptop and connected to live Smart-sheet data. First live run with the team on 11 September 2026.
Technology transfer activity	Joint first run: reading the live forecast and reorder list together.

Phases 5–6: Training and Handover | Complete

What happened	Walk-through of each dashboard view and how to read forecasts, ranges and reorder colours. Handover of the application file, final report, backtest report and a user guide written for both a day-to-day user and a technical maintainer.
Next	First quarterly model review with AIM.

3.1.4 Key Findings and Lessons from the Good4U Cooperation

Data is often the primary barrier	Good4U has rich historical data but it was spread across many sheets, with 27 spellings for 9 customer accounts, one-off bulk orders and a faulty row. Making sense of existing data was the most valuable first step.
Seasonal patterns are invisible in flat averages	Five years of data revealed a clear seasonal swing that flat ordering does not account for. Quantifying it at the start gave the pilot a concrete business case.
Architecture must fit the existing workflow	The team updates Smartsheets every day. Reading them in the background meant nobody had to change how they work.
The company holds knowledge the data does not	The multi-stage yield rule, the rapeseed-oil carrier and the Cookstown decision all came from Good4U staff. Regular short check-ins were essential.
Raw material planning is the high-value connection	Linking the forecast to recipes is where the forecast turns into purchasing decisions. The cleaned BOM was the critical dependency.
Honest testing builds trust	Scoring the forecast against simple methods, and saying openly that monthly timing is hard, set the right way to use it: multi-month totals for ordering, monthly values as a shape.
Plan for self-sufficiency from day one	Several routine changes needed code edits. Moving recipes into a sheet that staff edit from the dashboard removed the most frequent one; new products, customer names and promotion windows still need a small code edit.
ERP transition creates a natural upgrade pathway	Good4U plans a new ERP. The data connection is kept in one place, so it can switch from Smartsheets to the ERP without rebuilding the forecast.

3.2 Seamless Aluminium: Production Stock Tracking and Management Dashboard Pilot

Organisation	Seamless Aluminium Ltd, Ballyshannon, Co. Donegal, Ireland (established 1975)
Sector	Manufacture and distribution of aluminium rainwater products: gutters, downpipes, fascia and soffit

Supply Chain Role	Rural manufacturer with its own slitting, roll-forming and powder-coat lines, supplying installers and customers across Ireland
Research Organisation Partner	AIM Centre
Cooperation commenced	Early 2026 (pilot proposal presented 15 April 2026)
Pilot type	Production line stock tracking, replacing the paper clipboard system with tablet-based digital recording, an approval step, a management dashboard and an ERP import file
Architecture approach (delivered)	Designed to run fully on site: Node-RED hub and SQLite database on the management laptop; browser forms on tablets at five recording points; no internet needed; no data leaves the building. During acceptance testing (September to November 2026) the same system ran on an AIM Centre server, reached by SA over a secure link (a dedicated IP address protected by Cloudflare)
Status (November 2026)	Installed on SA's management laptop on site in the week of 10 November 2026, after about two months of hosted testing by SA management. Management is using it on site; operator training is next

3.2.1 Supply Chain Challenge Identified

Seamless Aluminium recorded stock movements on the fascia production line on paper clipboards at each stage. At the end of the day the sheets were collected and the office typed every line into Profile Technology, the company ERP. Stock levels were not visible during the working day, every line was written once and typed again, and scrap noted on the slitting sheets never reached the ERP. With more than 1,900 product lines, even small errors took time to find.

3.2.2 Architecture Proposed and Delivered

The architecture was designed to be as simple and low-friction as possible. It is built to run entirely on site with no internet dependency, which was an explicit requirement given the production environment. Only for acceptance testing was it hosted at AIM, so that SA could test it and AIM could make changes quickly (see Phase 4). Feedback during development added five features that were not in the first proposal: the approval step, the dispatch point, user management, data correction and a stock-code screen.

Component	What it does (as delivered)	Status

Component	What it does (as delivered)	Status
Tablet forms (×5)	Browser forms at Goods In, Stage 8 slitter, Stage 9 roll former, Stage 7 store and Dispatch. PIN sign-in; codes picked from lists; weights checked on the form.	Delivered (Dispatch added)
Local hub and database	Node-RED and SQLite, built to run on the SA management laptop with all entries stored on site and no internet needed. Hosted on an AIM Centre server during acceptance testing; installed on the SA laptop in November 2026.	Delivered; on site
Approval step	Every entry waits for an office check and can be approved, corrected or rejected before it changes stock.	Added after SA feedback
Management dashboard	Live stock of master coils, slit coils and finished fascia; production charts; transaction history; user and data management screens; a stock-code screen (add, edit or turn off codes; codes are never deleted or renamed); views for today, 7 days, 30 days or chosen dates.	Delivered
Profile Technology link	First proposal: manual reference only. Delivered: an export file in the exact layout Profile accepts, from approved production, for any date range, downloaded or saved straight to a folder for import. Direct two-way link is a future phase.	Delivered as CSV export

3.2.3 Pilot Scope and Boundaries

The scope boundaries were carefully documented from the outset. Before scoping, there had been a gap between what Seamless Aluminium expected the pilot to cover and what was achievable within the project. A written "What is not in this pilot" section protected both parties and set clear expectations. After the requirements session on 29 June 2026 and checks against Profile's own stock lists, the scope was revised from 72 to 27 products.

Item	Scope decision and rationale
Products in scope	Standard 0.7 mm fascia: 3 types × 3 sizes (6", 7", 8") × 3 colours (black, grey, white) = 27 SKUs, plus 9 slit coil and 11 master coil codes. A free-text field allows any other coil product to be logged so no movement goes unrecorded.

Item	Scope decision and rationale
Why 27 and not 72	The first list (six sizes, four colours) was replaced by the sizes and colours agreed with SA's production and office team on 29 June 2026 and checked line by line against Profile exports.
Products out of scope	Own-colour and bespoke powder-coated products (different process); fascia accessories (gable boxes, corners, finials made on the press brake); other product lines.
ERP integration	No direct two-way connection to Profile in this pilot. An import file in Profile's format is provided instead.
Hardware	Tablets and laptop provided by Seamless Aluminium; Wi-Fi is SA's responsibility. AIM does not supply site hardware. During acceptance testing the system was hosted on an existing AIM Centre server.

3.2.4 Technology Transfer Process with Seamless Aluminium

Phase 0: Initial Engagement | Complete

What happened	Site meetings, process maps of 12 product flows and 10 manufacturing stages from SA documents, and selection of the fascia line. Pilot proposal presented 15 April 2026; pilot project plan in May 2026.
Technology transfer activity	On-site discovery session. Production line walkthrough. Scope containment discussion. Expectations clarified.

Phase 1: Requirements Gathering | Complete

What happened	Requirements session at SA (29 June 2026) and revised proposal (30 June). Floor walk with photos of coils, labels, slitter and roll former (6 July). SA shared Profile stock exports, slitting sheets, a pick list, fascia labels and a sample Profile import file. Data review and decisions note (16 July).
Technology transfer activity	Joint mapping of the real material flow at product level, including how double-sided coils give two colours.

Phases 2–3: Design, Development and Testing | Complete

What happened	Database, Node-RED hub and tablet forms built at AIM. Prototype

	demonstrated to SA 09 September 2026. Approval workflow, dispatch form, user management and data correction added after feedback. 18 end-to-end tests passed; 3 defects found and fixed. Changes from hosted testing were made on the AIM server before installation, including the stock-code screen and a corrected coil-to-fascia colour rule (lists now show only the fascia colours each coil can make).
Technology transfer activity	Show-and-adjust sessions with SA management; features added on request without reworking existing stations.

Phase 4: Deployment | Complete

What happened	Stage 1, hosted acceptance deployment (September 2026): the finished system was installed on an AIM Centre server, a dedicated IP address was set up and protected by Cloudflare, and SA management was given secure remote access. Stage 2, on-site installation (week of 10 November 2026, after SA sign-off): Node-RED and the database installed on the SA management laptop, and the tablets connected over the site network with a check at each station.
Technology transfer activity	Remote walk-through of the hosted system with SA management, then a fix-and-review loop: changes are made on the AIM server and SA sees them at once. The on-site installation was done with the SA technical contact.

Phases 5–6: Testing, Training and Handover | In progress

What happened so far	SA management tested every station on the hosted system with real entries from September to November 2026, comparing against paper. System installed on site. Operator guide and technical handover guide handed over.
Still to do	Operator training station by station; tablets alongside clipboards until the numbers agree; decision on retiring paper.

3.2.5 Key Findings and Lessons from the Seamless Aluminium Cooperation

Scope containment is a specific skill	The most important early work was not technical. It was agreeing what the pilot would and would not do, and then narrowing to one product family that could be tracked fully.
Walk the floor before you design	The floor walk showed things no document had: two colours from one coil, scrap already written on paper but never in the ERP, and how coils are labelled and weighed.
On-site, no-internet architecture is the right choice here	For daily use, a local hub on the laptop and browser forms over the site Wi-Fi keep the system reliable during production hours and keep all data in the building.
Simplicity is a feature, not a compromise	Codes picked from lists, forms that only show what each station needs, and weights that check themselves make each entry quick and hard to get wrong.
Trust comes before paper is removed	The approval step and management testing first, then tablets next to clipboards, give people time to trust the new numbers.
Speak the ERP's language	Using Profile's own codes meant the pilot could produce an import file in Profile's format, which was not planned at the start.
Infrastructure readiness is a project dependency	Wi-Fi coverage at every station was a firm requirement. Treating it as a blocker early protects the installation visit from being wasted.
Test on the builder's server first	Hosting the finished system at AIM while SA tests it means issues and change requests are fixed the same day, with no site visit. The system moved in-house in November 2026, once SA had signed it off.

3.3 Comparison of the Two Digital Beacon Cooperation Experiences

Together the two Digital Beacon cooperations show that the same technology transfer method (discovery, needs assessment, architecture proposal, phased implementation, training and handover) can be applied to very different company situations and produce very different but equally fitting technical outcomes.

Dimension	Good4U	Seamless Aluminium
Core problem	No demand intelligence: seasonal patterns invisible in flat ordering; no link from demand to ingredients	No real-time production visibility: paper clipboards create a one-day lag in stock data

Dimension	Good4U	Seamless Aluminium
Existing digital maturity	Moderate: Smartsheets in active use, rich historical data, ERP planned	Low–moderate: ERP for stock and orders; paper on the production floor
Place on the data journey	Decide: use existing data to plan ahead	Capture: create clean data at source
Architecture complexity	Higher: forecasting model, API integration, recipe engine	Lower by design: local hub, browser forms, approval step, dashboard
Internet dependency	Partial: Smartsheet link needed; forecasting runs on the laptop; weather and the optional AI summary use online services	None in daily use (on site); a secure remote link was used only during hosted testing
Biggest change from the proposal	Forecast method, 22-product BOM, yield rule; forecasts not written back; recipes editable in the dashboard	Scope 72 → 27 SKUs; approval step, dispatch point, ERP export and stock-code screen added
How it was tested	Six-month backtest on real dispatches against two simple methods	18 scripted end-to-end tests, then SA management testing on the AIM-hosted system, then on-site installation (November 2026)
Status (November 2026)	Deployed on the Good4U laptop	Installed on SA's management laptop (November 2026), after hosted testing on an AIM server
Who maintains it	Good4U staff for recipes; a technical person who can edit Python for products, customers and promotions	SA admin screens for users, PINs, stock codes and exports; the technical contact for back-ups and new stations
Connection (gateway/client)	API connection: read-only link to six live Smartsheets; outputs structured and ready to share through an MQTT broker if need-ed later	Node-RED connection: hub linking five tablet stations to the database, dashboard and ERP export; each movement ready to share through an MQTT broker if needed later

Dimension	Good4U	Seamless Aluminium
Key transfer lesson	Data exists but insight does not: analysis and cleaning before architecture	Scope containment and a floor walk before development

How the pilots use the broker and gateway/client approach. Both pilots follow the same idea as the Arctic Edge architecture: clients collect or read data, and a central connection point passes it on in a standard form. At Good4U, the connection is an API link: the application reads six live Smartsheets through a read-only API and turns the data into forecasts and alerts. At Seamless Aluminium, the connection is a Node-RED hub: the five tablet stations act as clients and send each stock movement to the hub, which holds it for approval, stores it and passes it to the dashboard and the ERP export file. In both cases the data is already in a structured form, so it could later be shared with suppliers or customers through an MQTT broker, as shown in Pilot 1. This sharing step was not needed for either company's first use case. It is a possible long-term step, taken only if the company wants it.

3.4 Evidence of Technology Transfer

Technology transfer is shown by what each company can now do that it could not do before, and by the materials that can be reused with other SMEs.

	Good4U	Seamless Aluminium
Knowledge transferred to the company	How seasonal forecasting and blending work; how to read a range; why totals are more reliable than single months; how recipes and yield turn into raw-material need; how to keep recipes up to date in the dashboard	How a client–hub (broker) structure works; how to keep master data in line with the ERP; how weight checks and approval protect data quality
Tools now owned by the company	Forecast and stock intelligence dashboard on its own laptop, connected to its own live data	Tablet-based stock tracking system on its own laptop and tablets, on site
Documents handed over	Final report, backtest report, user guide (day-to-day and technical), application file with comments	Operator guide, technical handover guide, flow file and database

	Good4U	Seamless Aluminium
New capability	Plan raw materials from forecast demand; see shortages early; test forecast accuracy each quarter; update recipes without code changes	See stock during the day; measure scrap and yield; trace a coil to its supplier batch; produce an ERP import file
Still depends on AIM for	Quarterly model review (first year);	Operator roll-out support and the decision on retiring paper

Table 3.4.1. What was transferred to each Digital Beacon

Reusable materials for other SMEs

Material	Where it comes from	How it helps other SMEs
"What is not in this pilot" scope list	Both pilots	Sets clear expectations and avoids scope creep
Data-first discovery checklist	Good4U	Checks names, one-off events, gaps and history length before any model is proposed
Floor-walk and process-map approach	Seamless Aluminium	Finds how material and paper really move before design starts
Hosted acceptance testing	Seamless Aluminium	The SME tests the finished system with real data on the research partner's server, fixes are made at once, and the system moves in-house only when it is proven
Common pilot metrics	Arctic Edge performance metrics	The same measures of delivery, testing, data quality, use, value and self-sufficiency for any SME pilot
Two reference architectures	Good4U and Seamless Aluminium pilots	A "capture" pattern (on-site hub) and a "decide" pattern (intelligence on existing data)
Case studies and video	Digital Beacon case studies; Output 1.3 explainer video	Show real results and lessons in plain language

4. The Arctic Edge Technology Transfer and Mentoring Model

The six-phase mentoring model describes the reusable mechanism for transferring knowledge, methods and practical experience from the Digital Beacon cooperation to a wider group of SMEs in the NPA region. It is the structured expression of what was learned through the cooperation with Good4U and Seamless Aluminium. The phases used in Section 3 (Phases 0–6) describe how each pilot was delivered; the six phases below describe the mentoring model for other SMEs.

The model is agile, iterative and adaptable to the specific maturity, systems and supply chain position of each company. It does not assume that the company is ready for immediate implementation or that it has advanced digital infrastructure. It helps the company identify a realistic first use case, understand relevant technologies through demonstration, and define the organisational and technical steps required before larger investments or integration work.

Phase	Name	Purpose
1	Interest and outreach	Stimulate interest among SMEs and identify companies with practical development needs related to supply chain digitalisation, data utilisation or system integration.
2	Initial assessment and use case identification	Create a preliminary understanding of the company's supply chain challenges, current processes, digital maturity, and possible use case.
3	Technology presentation and demonstration	Introduce relevant technology concepts through a joint webinar, group demonstration, or company-specific session. Make the technology concrete before company-specific analysis.
4	Company-specific expert analysis	Examine how the Arctic Edge architecture, client–broker approach, real-time data flows, and Digital Beacon experiences could be applied in the company's own operating environment.
5	Roadmap and decision support	Produce a written summary and practical roadmap describing the company's starting point, identified use case, technical and organisational preconditions, and recommended next steps.
6	Follow-up, documentation and scaling	Document the results for project and model-development purposes. Collect lessons learned to improve future mentoring, demonstrations and Digital Beacon dissemination.

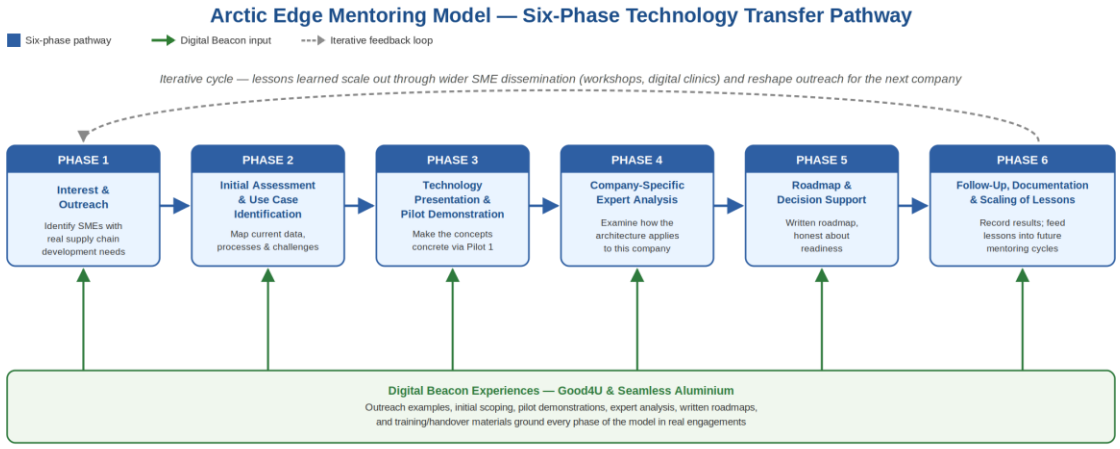


Figure 2. Arctic Edge mentoring model: six-phase technology transfer pathway. The diagram shows the six phases as a connected pathway, the feedback loop carrying lessons learned out through wider SME dissemination and back into future outreach, and how the Digital Beacon experiences (Good4U and Seamless Aluminium) ground every phase of the model.

5. Purpose and Users of the Model

The model can be used by organisations that have access to digitalisation expertise, supply chain development knowledge and networks of SMEs. They do not need to provide a complete turnkey solution, but they must be able to facilitate discovery, translate business needs into technical options, and guide companies toward realistic next steps.

Organisation Type	How They Can Use the Model
Research and educational institutions	Provide neutral expertise in digital supply chains, IoT, data analytics and integration architecture. Facilitate workshops, demonstrations and student collaboration. Help companies interpret technical options without vendor lock-in.
Digital innovation hubs (DIHs/EDIHs)	Offer digital maturity assessments, mentoring, funding advice and access to specialist networks. Identify companies with relevant supply chain digitalisation needs. Coordinate technical clinics and peer learning events.
Regional development agencies and business support	Promote the model through trusted regional and sectoral networks. Identify common bottlenecks across multiple companies. Organise group demonstrations and Digital Beacon site visits.

Organisation Type	How They Can Use the Model
Industry clusters and chambers of commerce	Act as multipliers by promoting the model to their members. Identify common challenges across companies. Organise joint webinars and group sessions using Digital Beacon experiences as reference cases.
Technology providers and system integrators	Support feasibility assessment and the transition from roadmap to implementation. Provide practical information on interfaces, APIs, data governance and deployment options. Collaborate with public actors where co-funded or pre-commercial support is appropriate.

6. The Six-Phase Process in Detail

Phase 1: Interest and Outreach

The first phase focuses on stimulating interest among SMEs and identifying companies that could benefit from the mentoring process. Outreach should use channels that SMEs already trust: regional business networks, chambers of commerce, municipal business services, industry clusters, direct phone calls, targeted emails, newsletters, project websites, seminars and trade events. In rural and remote regions, personal networks and earlier collaboration can be especially important.

Communication should focus on business problems rather than technical terminology. Companies may describe their needs as late supplier confirmations, manual order follow-up, stockouts, poor inventory visibility, duplicate data entry, uncertain delivery times, or difficulties coordinating procurement and production. These practical problems provide the starting point.

Digital Beacon experiences from Good4U and Seamless Aluminium, together with pilot examples make the topic concrete. They help show that supply chain digitalisation can begin with a narrow, clearly defined use case. Companies should be prioritised when a clear operational pain point can be linked to data exchange, system integration or supply chain visibility.

Phase 2: Initial Assessment and Use Case Identification

This phase creates a preliminary understanding of the company's supply chain challenges, current processes, digital maturity and interest in mentoring. It can be carried out through an on-site meeting, an online meeting or a structured phone discussion.

The specialist should focus on listening and translating operational problems into potential use cases rather than moving directly to technical solutions.

The assessment examines how information currently moves through the company and its supply chain. Relevant topics include order management, procurement, supplier confirmations, inventory updates, production status, shipment information, delivery schedules, forecasts and exception handling.

Key assessment questions: What supply chain information is difficult to access? What is updated manually? Which decisions are delayed because data is missing or unreliable? Which systems are used to manage orders, inventory, suppliers and deliveries? What data already exists, and what additional data would be needed?

The output is an initial use case or shortlist of use cases that can guide the demonstration, expert analysis and roadmap development. The assessment should also determine whether the primary challenge is technical, organisational, or process-related, and whether the company is suited to an individual mentoring pathway or a group demonstration approach.

> **From the Digital Beacons:** at Good4U, analysing the data files before the first proposal turned a general wish ("better planning") into a clear use case backed by numbers. At Seamless Aluminium, process maps of all flows made it easy to agree on one product family.

Phase 3: Technology Presentation and Pilot Demonstration

This phase introduces relevant technology concepts through a joint webinar, group demonstration or company-specific session. The purpose is to make the technical principles understandable before moving into detailed company-specific analysis.

Pilot 1, the three-tier supply chain simulation across AIM Centre (Ireland), NKCC (Finland), and LTU (Sweden), can be used as a practical reference model. It demonstrates how multiple supply chain actors can exchange event data in real time through a broker-driven structure using MQTT and Node-RED. Digital Beacon experiences from Good4U and Seamless Aluminium can increase credibility by showing how other companies approached similar challenges at different levels of digital maturity.

The demonstration should present the logic through practical supply chain events (supplier material availability updates, production status information, delivery status updates) rather than abstract architecture alone. For companies at an earlier stage, simpler concepts such as a shared dashboard, a digital stock record, or an automated stock alert may be the appropriate starting point.

> **From the Digital Beacons:** a working prototype on the company's own codes (SA) and sample forecasts on the company's own products (Good4U) did more to build interest than any general demonstration.

Phase 4: Company-Specific Expert Analysis

This phase consists of a company-specific expert analysis. Project specialists examine how the Arctic Edge architecture, client–broker approach, real-time data flows and Digital Beacon experiences could be applied in the company's own operating environment. The analysis builds on the initial assessment and the technology demonstration, but goes deeper into actual processes, systems, data sources and organisational readiness.

Key questions: What data does the company already have? Where is it stored? Is it structured and reliable enough for integration? What data is missing? Which systems should be connected? Are interfaces, APIs or export functions available? What manual steps could be reduced? What cybersecurity, access control or data governance issues should be considered? Which internal roles and external partners would need to participate?

The output is a structured interpretation of the company's situation, including how the identified use case could be connected to event-based data exchange, what constraints exist, and what kind of first experiment would be realistic.

> **From the Digital Beacons:** the floor walk at SA and the data questions at Good4U found the rules that mattered most (two colours from one coil; yield lost at every stage; three names for one customer). Plan time for the company to answer these.

Phase 5: Roadmap and Decision Support

This phase converts the findings of the mentoring process into a written summary and a practical roadmap. The roadmap describes the company's starting point, the identified use case, the possible application of the technology, technical and organisational preconditions, and recommended next steps. It should support internal decision-making, not only technical planning.

The roadmap should not overstate the maturity of the solution. If the company is not yet ready for technical integration, this should be stated clearly. Next steps may include process mapping, data cleaning, internal responsibility allocation, supplier communication improvements, or a low-code dashboard prototype. More advanced companies may be ready for a small integration experiment with one system, supplier or event data flow.

Where needed, results and the proposed roadmap can be reviewed together with the company in a follow-up meeting. This allows the company to validate the interpretation of its needs and discuss the feasibility of proposed next steps before larger technology investments.

> **From the Digital Beacons:** both pilots ended with a written list of next steps (for Good4U: sales-order data, forecast log, ERP switch; for SA: operator roll-out, Profile link, more product lines), and both named what the company must own itself.

Phase 6: Follow-Up, Documentation and Scaling of Lessons Learned

This phase focuses on follow-up, documentation and the scaling of lessons learned. The company should receive a clear record of the mentoring process and recommended next steps, while the project collects structured information to improve future mentoring, demonstrations and dissemination activities.

Documentation should cover: the initial challenge, current systems, identified data sources, selected use case, demonstration method, expert analysis, roadmap, recommended next steps, and any limitations identified. It should also note whether the company is likely to proceed toward implementation, continue internal preparation, seek external support, or postpone development.

Confidentiality must be considered carefully. Supply chain data, supplier relationships, system architecture and operational bottlenecks may be commercially sensitive. Case documentation should be stored securely, and public dissemination should use anonymised examples unless the company has agreed to act as a Digital Beacon or public reference case.

Lessons from several company cases can reveal common adoption barriers: poor data quality, unclear process ownership, limited interface availability, supplier reluctance, or uncertainty about business value. These insights can be used to refine future webinars, technical clinics, Digital Beacon materials and mentoring practices.

7. Illustrative Company Case Examples

The following cases are example cases created for illustration purposes based on the technology transfer model and the lessons learned from the Digital Beacon cooperation. They illustrate how the mentoring model applies across different SME situations and should not be interpreted as actual project reference cases. Actual Digital Beacon cases from Good4U and Seamless Aluminium are documented in Section 3.

Case 1: Improving Supplier Visibility in a Rural Machinery Company

Company profile	A small machinery manufacturer produces customised equipment for agricultural and food-processing customers. It works with several regional suppliers and subcontractors, but most supplier communication is managed through email, phone calls and spreadsheets.
Challenge	The company has limited visibility into supplier confirmations, material availability and delivery status. Production planning is often adjusted manually because supplier delays are detected too late.
Mentoring process	Initial assessment maps how supplier confirmations, purchase orders and delivery updates are currently handled. A pilot demonstration shows how supplier status messages could be shared through a client–broker model and visualised as near-real-time updates. The company-specific expert analysis identifies one realistic first use case: collecting standardised delivery status updates from two key suppliers and displaying them in a shared dashboard. The roadmap recommends which data fields to standardise, what systems to connect first, and what internal responsibilities to define before a technical pilot.
Outcome	The company does not immediately proceed to a full system integration. However, it standardises supplier status reporting, clarifies internal responsibilities, and starts planning a small pilot with selected suppliers.
Lesson applied	From the Good4U cooperation: the highest-value first step is often making sense of existing data before proposing new technology.

Case 2: Reducing Manual Inventory Work in a Remote Food-Sector SME

Company profile	A small food-sector company produces packaged products for regional retail and hospitality customers from a remote location. Raw material availability and packaging deliveries have a significant impact on production reliability.
Challenge	Inventory information is fragmented between an ERP system, spreadsheets and manual notes. Purchasing, production and sales teams do not always share the same view of stock levels, incoming deliveries or material shortages.

Mentoring process	The initial assessment identifies that the main issue is not lack of data, but that data is updated in different places at different times. The expert analysis focuses on one use case: improving visibility of critical raw materials and packaging components. The roadmap recommends a phased approach, starting with data cleaning and common inventory fields before any wider integration work.
Outcome	The company begins by improving its internal inventory data structure and creating a shared view of critical materials. A later technical pilot is considered once data quality has improved.
Lesson applied	From both Digital Beacon cooperations: data quality is often the primary constraint, not technology availability.

Case 3: Replacing Paper-Based Production Records in a Small Manufacturer

Company profile	A small manufacturer producing custom components for the construction sector tracks production output and stock movements on paper clipboards at several stages of the production line. Data is consolidated manually at end of shift for entry into the company's existing management software.
Challenge	Stock levels are not visible in real time during the working day. Management cannot identify discrepancies until paper records are consolidated. The manual aggregation step is time-consuming and error-prone.
Mentoring process	The on-site discovery session maps the production stages and confirms that the primary need is a real-time digital record, not a complex integration. The technology presentation focuses on simple browser-based tablet forms and a management dashboard, with no internet connection or app installation needed. The scope boundaries are set out explicitly in the pilot plan.
Outcome	A local system with tablet forms, an approval step and a management dashboard is deployed. Managers test it first; operators then use it alongside paper until the numbers agree, after which the clipboards are retired for the in-scope product lines.
Lesson applied	From the Seamless Aluminium cooperation: explicit scope documentation is as important as the technical design, and trust must be built before paper is removed.

8. Monitoring, Outcomes and SME Benefits

8.1 Monitoring the Cooperation Process

Throughout the Digital Beacon engagement and subsequent SME mentoring, the progress of each company case is closely monitored and documented. Updates are shared among partners through regular project meetings and stored securely for project reporting purposes. Visual documentation, including pilot proposal documents, decision notes and phase progress records, captures outcomes at each stage. A common set of pilot metrics gives a standard way to record delivery, testing, data quality, use, value and self-sufficiency for each case.

Follow-up contact is made after the pilot or roadmap phase to assess whether recommendations were implemented, a further pilot was started, internal processes were improved, external support was sought, or development was postponed. These insights, positive or otherwise, are valuable for refining the model and may be shared as anonymised case examples.

8.2 Outcomes for Digital Beacon Companies: Expected and Achieved

	Expected (version 1.0, July 2026)	**Achieved (November 2026)**
Good4U	Seasonal demand intelligence feeding into raw material order recommendations. Stock alert dashboard replacing manual Smartsheet checks. Foundation for the planned ERP transition.	Delivered: monthly forecasts for 29 products and active customers; raw-material plan for 22 products with a cover-based status for each ingredient; colour-coded reorder list for all raw materials with a minimum level. Six-month total volume within 2.4% in development testing (a simple flat average was closer on total volume but has no seasonal shape). Recipes editable in the dashboard. Data connection designed to switch to the ERP. Still open: forecast write-back (CSV instead).
Seamless Aluminium	Real-time stock visibility across the production stages. End of end-of-shift paper consolidation for in-scope products. Dashboard as the reference for manual ERP entry. Foundation for future Pro-	Delivered: tablet recording at five points (dispatch added); approval step; live dashboard; import file in Profile's format (beyond the original plan); 18 of 18 tests passed; tested by SA management on an AIM Centre server, then installed on site

	Expected (version 1.0, July 2026)	Achieved (November 2026)
	file integration.	in November 2026; operator and technical guides handed over. In progress: operator roll-out with tablets alongside paper, then a decision on retiring paper.

8.3 Benefits for SMEs Using the Mentoring Model

Benefit	What This Means in Practice
Informed investment decisions	SMEs gain clarity on digitalisation feasibility for their specific situation before committing resources.
Realistic first use case	The mentoring process identifies a narrow, achievable starting point rather than an overwhelming full-system transformation.
Architecture that fits the company	Solutions are designed around what the company already has (existing tools, data and workflows), not around replacing them.
Process improvements without major investment	Even without new technology, companies can improve data quality, standardise communication, and clarify internal responsibilities as a result of the mentoring process.
Access to expertise	Ongoing support from research partners and, where appropriate, referral to system integrators and funding organisations.
Reduced uncertainty	A written roadmap reduces the uncertainty that prevents SMEs from taking a first digital step. It creates a basis for internal decisions and external conversations.
Long-term upgrade pathway	Pilots are designed so that the next stage is always visible, whether that is an ERP switchover, MQTT integration, automated ERP connection, or fleet scaling.

Appendix A: Arctic Edge Digital Architecture Reference

The following components form the Arctic Edge digital architecture used in Pilot 1 and the two Digital Beacon pilots, and are referenced in demonstrations and mentoring sessions.

Component	Role in Architecture	Relevance for SME Mentoring

Component	Role in Architecture	Relevance for SME Mentoring
MQTT (HiveMQ Cloud)	Lightweight publish-subscribe messaging connecting supply chain actors in real time (Pilot 1)	Shows how independent companies can exchange event data without replacing existing systems
Node-RED	Low-code orchestration layer for data flows, business rules and automation; the hub at Seamless Aluminium (on SA's laptop on site; hosted at AIM only during testing)	Accessible to non-developers; shows that integration does not require enterprise software
Tulip MES	Cloud-based MES at AIM Centre for order tracking, inventory and event logging	Reference for SMEs considering a cloud-based operational data store
Odoo ERP	ERP system used at NKCC (Finland) and LTU (Sweden) for order and inventory management	Reference for SMEs with existing ERP systems seeking to add connectivity layers
Smartsheet API (read-only for six sheets; writes only to the recipe sheet)	Live data connection used in the Good4U pilot	Shows that connectivity can start from tools the company already uses
Python, Prophet and Streamlit	Forecasting, recipe engine and dashboard in the Good4U pilot	Shows that forecasting is possible without enterprise analytics platforms
SQLite on-site database	Single-file database behind the Seamless Aluminium hub	Shows that digital tracking does not need internet or cloud infrastructure
Browser-based tablet forms	Station screens at Seamless Aluminium	Nothing to install on devices; all updates made once on the hub

Appendix B: Glossary of Terms

API: Application Programming Interface: a set way for one software system to read data from, or send data to, another

Backtest: Testing a forecast on past months that the model has not seen, to check how accurate it would have been

BOM: Bill of Materials: the list of materials and quantities needed to make a product (its recipe)

CSV: Comma-Separated Values: a simple file format for tables that opens in any spread-sheet

Digital Beacon: A rural SME that tests and demonstrates the Arctic Edge approach on its own site and shares its experience with other SMEs

LTU: Luleå University of Technology, Sweden

MES: Manufacturing Execution System

MQTT: A lightweight messaging protocol for sending data between devices and systems in real time

MQTT broker: The server that receives MQTT messages and passes them on to the sys-tems that need them

NKCCI: North Karelia Chamber of Commerce, Finland

NPA: Interreg Northern Periphery and Arctic Programme

NPV: Net Present Value

PIN: Personal Identification Number

ROI: Return on Investment

SA: Seamless Aluminium

SKU: Stock Keeping Unit: one specific product variant, for example one size and colour

SQLite: A small database stored in a single file

Streamlit: An open-source tool for building simple web dashboards in Python

Tier 1 / Tier 2 supplier: A supplier that delivers directly to the manufacturer (Tier 1), or to a Tier 1 supplier (Tier 2)