Wood Manufacturing Clusters
International Case Studies

Prepared for:
Te Uru Rākau - New Zealand Forest Service
Ministry for Primary Industries - Manatū Ahu Matua
Wellington

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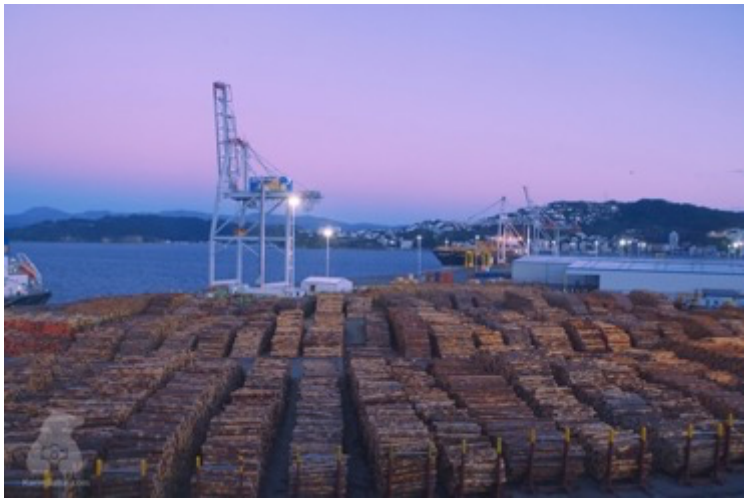
1. INTRODUCTION

This report has been prepared to inform Te Uru Rākau - New Zealand Forest Service's work on an industry transformation plan for forestry and wood processing. Currently, raw log exports account for 60% of the radiata harvest. Domestic processing has been static.

The report reviews the experiences of thirteen countries that are taking a very different approach to New Zealand in adding value to their forestry resource, centred on regional clustering.



Eighteen international case studies are presented, each an example of a regional wood processing cluster.

These clusters have been selected by the authors, drawing on their cluster development experience across Europe and around the world. Some initiatives are mature and well-developed, others are well grounded start-up initiatives. Some are slow moving and struggling. The report is structured as follows:

Section 2	Introduces clusters and cluster development. The many similarities amongst the international case studies, and the differences, are identified.
Section 3	A summary of the international case studies.
Sections 4-21	The eighteen international case studies are presented. Each draw on interviews with the cluster managers and published materials.
Section 22	A further 24 examples of regional clusters with a wood processing focus are identified, all except one in Europe. No wood related clustering initiatives are identified in British Colombia, USA, Chile, or Australia.

We acknowledge the generous participation of the cluster managers we interviewed. The findings and interpretations are the authors.

Phase 2 will draw on this international experience, exploring for New Zealand the options to accelerate the development of regional wood value-adding clusters.

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2. CLUSTER CASES – SIMILARITIES, DIFFERENCES

Introducing Clusters
Over the last two decades, the development of clusters has become a powerful tool to strengthen regional economies. Cluster development has been introduced across a wide range of sectors in many countries, supporting business growth and community engagement. These interventions have provided a low-cost, high-impact route to building resilient and sustainable regional economies.

Our interviews with wood processing clusters across thirteen countries has confirmed the value of this approach. While each of the clusters examined are natural occurrences, their development has not been left to chance.

Clusters underpin strong regions
New Zealand's regions have different specialisations… sauvignon blanc in Marlborough, kiwifruit in the Bay of Plenty, apples in Hawke's Bay, Auckland as the 'City of Sails', the oceans/blue economy in Nelson. Across Europe, some 3,000 similar regional specialisations, or clusters, have been identified.

These clusters are geographical concentrations of businesses and other organisations (research, education, public agencies, civil society) operating in related sectors in a specific region.

3,000 clusters in Europe

1 in 4 jobs
Half of all exporting jobs

The European Commission highlights that such clusters matter. It is within these clusters that a region has the better paying jobs, the higher growth businesses, and the more successful start-ups. This is because clustering fosters localised competitive pressures and simultaneously enables better access to pools of skilled labour and specialised infrastructure. Active clustering also facilitates knowledge spillovers and the coordination of supply chains. As the international case studies demonstrate, physical co-location is an asset for many of the clusters. Social proximity is essential.

Introducing Cluster Development [1]
Cluster development is about lifting the performance of regional specialisations, the regional clusters. It is not about creating clusters. Centre to cluster development is cooperation, based on trust. It is about co-opetition amongst business, with businesses both competing and

[1] Ifor Ffowcs-Williams' Cluster Development Handbook addresses in detail the logic for, and the practicalities of, cluster development https://www.clusternavigators.com/product/cluster-development-handbook

collaborating. It is about public agencies and academia being more closely aligned around business needs.

Clustering initiatives are proactive interventions to strengthen the collaborative dynamics between the clustered businesses and other organisations. These initiatives are often operationalised through cluster organisations, specific legal entities dedicated to supporting collaboration within clusters. These organisations provide meeting points for the triple helix of business, research, and government [2].

The roles of cluster organisations are becoming even more central with the need to accelerate green and digital transitions. As collaboration hubs between large and small firms, research organisations and public agencies, strong cluster organisations can catalyse transitions and become a key asset for structurally weak regions.

The international case studies provide many examples of cluster organisations facilitating collaborative projects, bringing businesses together in contexts that lead to increased knowledge, innovation, and business opportunities. These collaborative projects, along with other cluster development activities, are driven by a small team within the cluster organisation. A measure of the success of this team is the scaling-up of the clustering initiative over time. The case studies show some impressive changes:

Clustering Initiatives Scaling-up

Ontario's *Wood Manufacturing Cluster* has grown over 10 years from 7 participating firms to 130.
Estonia's *Wood Houses Cluster,* over 13 years, has grown from twenty to fifty members. Exports reach 70 countries.
Sweden's *Paper Province cluster* has grown over 23 years from one staff person to a team of 16 today, the number of participating companies has grown from 7 to 125, and the clustering initiative's budget has increased **ten-fold**.
Norway's *WoodWorks! Cluster* has grown over 17 years from 17 members to 75 today, the clustering initiative's budget has increased **twenty-fold**.

Clusters
Responding to Change
Many of the wood processing initiatives have been introduced in response to a crisis:

[2] This section draws on a 2021 Discussion Paper, 'Building strong clusters in structurally weak regions', prepared for the EC's European Cluster Collaboration Platform. https://clustercollaboration.eu/in-focus/resilience/building-strong-clusters-structurally-weak-regions

- In Luxembourg, a country with extensive forestry, just two sawmills remained. Many parts of the value chain were missing.
- Upper Austria was under pressure with competition from wood processing centres in eastern Europe, some with half of Austria's labour costs.
- Due to the 2008 recession, Estonia's prefabricated housing manufacturers were in survival mode.
- In Central Norway, the regional wood processing industry was sourcing timber from Russia and the Baltics.
- In northern Sweden's Örnsköldsvik region, a major downturn in the pulp and paper industry instilled urgency amongst community's leaders.
- In Värmland, Sweden, the forestry industry was viewed in economic and political circles as a ´**sunset industry´.**

Other forestry and wood processing regions were prompted to change by an emerging opportunity, rather than a crisis:

- In Bulgaria, Romania, Slovenia, Spain's Basque Country and in Ontario, Canada the opening of new export markets presented fresh opportunities.
- In parallel, the introduction of cluster development support programmes in Europe provided the inspiration and the framework for businesses, through engaging as a team, to develop export markets.

Cluster Development

Initiators and Funders

Cluster development as an intervention requires an initiator. The case studies show the lead in kick-starting the clustering journey has frequently been a regional economic development agency[3]:

- In Sweden, each of the four clusters examined were regional initiatives. Later came support from a national agency.
- In Norway, the two clusters reviewed were regional initiatives, with national support following.
- In Austria, the provincial economic development agencies in Lower Austria and in Upper Austria took the lead in developing the cluster initiatives.
- In Spain's Basque Country, it was the provincial economic development agency that sponsored the establishment of the *HABIC Cluster.*
- Similarly, in North West Romania, the regional EDA took the lead in establishing the *Transylvanian Furniture Cluster***.**

[3] Many of Europe's regional economic development agencies are resourced much more substantially than their New Zealand equivalents, giving them the scale and staff to significantly make a difference within their community. In addition to local funding, many of Europe's regional / provincial EDAs have access to national as well as European Commission resources.

A regional focus on adding value to wood facilitates local experimentation, leading over time to regional differentiation

In the smaller countries reviewed - Estonia, Ireland, Latvia, Luxembourg, and Slovenia - it is national agencies that have taken the lead. For two of the case studies, in Bulgaria and Ontario, the lead was primarily taken by business.

The European Commission's policy and funding encourages regions to identify and then focus on their strengths. The Commission has, for example, been proactive in encouraging related European clusters to collaborate, in part to accelerate SMEs into distant markets. Financial support of up to six years is available for some cluster projects [4].

Cluster Development

An Evolving Journey

Many of the case studies have evolved considerably. These direction changes are easier when decision makers are close to the local situation.

- The journey of Sweden's *Paper Province Cluster* has substantially evolved, from supporting individual companies to **collective efforts** within a knowledge area, with joint value creation. The initiaitve has also moved on from traditional cluster activities (skills supply, process technology, etc.) to becoming the key intermediary in the gap between business, public agencies at the regional and the national levels, R&D and educational institutions, to accelerate innovation processes.
- In Upper Austria, the development journey of the *Furniture & Timber Construction Cluster* has had twists and turns. The initial emphasis was on the entire timber industry, but little in common was found between forestry, sawmills, and timber construction. Later, the cluster concentrated on wood construction and furniture manufacturers, but again little in the way of collaborative agendas was found. The development agenda has now substantially moved on to Value Networks.
- Norway's *Treklyngen Cluster* has significantly changed direction, moving from directly investing in projects to now acting as a neutral broker, facilitating investments that have co-location benefits.
- Lithuania's *House Cluster* is broadening its scope by attracting as members architects and engineers.

[4] In addition, the European Commission supports national cluster programmes such as in Estonia and Lithuania. Most of the European wood processing cluster reviewed have direct, or indirect, support from Brussels.

- Slovenia's *Wood Industry Cluster* has, with some difficulty, successfully pivoted to European project funding, following the demise of the country's national cluster programme.
- A decade ago, 95% of the the *Basque HABIC Cluster's* projects originated with the cluster management team. Today, 95% of projects are determined by the companies.

In three regions, clustering initiatives have been merged by sponsoring public agencies:

- In Lower Austria, the roots of the *Green Building Cluster* were the merger of the Timber Cluster and the Green Building Cluster, facilitated by the provincial government.
- With facilitation by the Basque Government, the Wood Cluster was merged with the *HABIC cluster* that already included furniture.
- In southern Sweden, the national innovation agency encouraged the integration of two regional proposals, one from a glass research institute and the second focused on wood construction, to establish the *Smart Housing Småland Cluster.*

Each of the clusters started within a well-defined region, often shaped by travel time to work, and reflecting the tight geography of innovation. Some clusters have broadened over time their geographic reach from the initial hub, often as outlier firms and support organisations have seen value in aligning with an emerging 'hot spot':

- The Basque County's *HABIC cluster* has attracted businesses from neighbouring provinces and from across the border in France, businesses that see benefits in participating in the intervention and are willing to financially contribute.
- Canada's *Wood Manufacturing Cluster of Ontario* has broadened from the immediate locality to attract businesses from across Ontario, and broadened from furniture to encompass cabinetry, millwork and CLT.
- While the home base and the prime focus of the *WoodWorks! Cluster* is central Norway; the cluster now has members and projects throughout the country.
- The geographic area served by Sweden's *Paper Province* is now in part evolving from the region to national and international initiaitves, with the support of the national agency, Vinnova.
- Sweden's *Smart Housing Småland Cluster* has been developing a strategy for the broader Baltic Sea region.

Ireland's *Wood Connect Cluster* has taken a different route, taking a national approach with its base of geographically spread businesses.

A Long Development Journey, in Short
Firms → Sectors → Clusters → Regional Ecosystems

1st A shift from engagement with individual firms to groups of firms.
2nd Broadening from a sector to a cluster approach. For example, a furniture cluster will likely include, along with the core furniture manufacturers:

- Timber, panel product and other suppliers…glass + hardware + packaging materials + …
- Service companies…furniture designers + export agents + machinery suppliers + IT + freight logistics + finance + …
- Support organisations…regional EDA + training institutions + schools + public R&D + industry associations + relevant national agencies + …

3rd Moving from clusters to developing a regional ecosystem broadens out the connections and collaboration opportunities further. The shift is from adding value to raw materials to adding value through innovation … necessitating collaboration well beyond a wood processing cluster.

Clusters and Small Business Development
Each of the eighteen cluster case studies are largely composed of SMEs, often 80-90% of the businesses. The clustering initiatives have given these SMEs the critical mass to attract attention in distant markets and to deliver outcomes that would be difficult to achieve through businesses engaging individually:

- Engaging as a team, the firms in Bulgaria's *Furniture Cluster* have furnished 3,500 Peugeot & Citroen showrooms across Europe.
- Romania's *Transylvanian Furniture Cluster* has engaged as a team in developing **e**rgonomic chair designs, and processes to accelerate the aging of wood surfaces.
- The *Wood Manufacturing Cluster of Ontario* has organised trade missions to the US, Europe, and Dubai.
- Basque's *HABIC cluster* has organised outward and inward missions with key export markets.

A very visible activity for many clusters is establishing Flagship Projects. These serve to build the local team and to penetrate new markets, often distant ones:

- Basque's *HABIC Cluster* partnered in developing, in 2017, the largest wooden structure in southern Europe, a demonstration CLT construction using radiata.
- Estonia's *Wood Houses Cluster* has established The Timber Construction Competence Centre in Tallinn, a high-profile showroom for domestic and international customers.

- Upper Austria's *Furniture & Timber Construction Cluster* supported the construction of one of Austria's most future orientated projects, Vienna's timber-hybrid HoHo Hotel.

Most clusters around the world have a specific focus on start-ups and SME development. For the European Commission, SMEs are central to their support for cluster development. Specialised incubators can be a component of that strategy. Two examples in adding value to wood:

- Sweden's *Processum Cluster* supports start-ups through the incubator Biz-maker Forest Business Accelerator, with a facility in Örnsköldsvik.
- The Swedish *Paper Province Cluster* has partnered in setting up a national incubator organisation supporting start-ups and business ideas in the bioeconomy field, with a facility in Värmland.

Clustering initiatives have also been successful in attracting increased attention (and resources) from academia:

- In the Basque Country, the *HABIC Cluster* has supported the development of a Masters Degree in Design, Structures and Building in Wood, and a Masters Degree in Design of Gastronomic Spaces.

Building a cluster's ecosystem is in part ensuring that those companies that are ready to scale-up are fully grounded in the region, rather than seeking a more fertile ecosystem elsewhere. An example of a grounded scale-up:

- Scandinavia´s largest manufacturer of CLT, Södra[5], is a member of the *Smart Housing Småland* cluster.

Clusters and Investment Attraction

While each of the case study regions welcomes the arrival of new businesses, investment attraction is not a cornerstone strategy for most of clusters reviewed. As the clusters have deepened their technical competencies and raised their international profiles, international investors have found their way to the cluster:

- An Indian textile multinational, Adita Birla Group, acquired Domsjö Fabriker, a company within Sweden's *Processum* 'Biorefinery of the Future' cluster, for US$340 million in 2011.
- Lixea, a university spin-out from Imperial College, London, has established a pilot biomass plant in Sweden's *Paper Province*, attracted by the region's bioeconomy.

[5] Södra is Sweden's largest forest owners' association, with 53,000 owners. HQ is in Växjö. The company's by-line is 'We convert wood raw material into climate-smart products'.

Such investors are not looking for subsidies and tax breaks. They are seeking relevant knowledge ecosystems that offer a fertile base for their investment, and are willing to pay a premium, to buy their way into such ecosystems.

- An exception is southern Norway's *Treklyngen Cluster*, still seeking inward investors as a core development strategy, though now acting as a facilitator rather than as a co-investor.

Governance of Clustering Initiatives

A common organising principle amongst the international case studies is cluster governance through a triple helix board, with business in the lead and public agencies and academia in support. These boards are decision-making, not advisory, and elected. They serve in part as high-level coordination mechanisms across the regional cluster. Their legal structure is often as a not-for-profit organisation.

- Initially, Sweden's *Paper Province* cluster initiative was financed by the municipalities and regional authorities, with politicians dominating the steering committee. After 18 months, company representatives were dropping out of the board meetings. There was a substantial gap between the politician's views on the forward agenda and how the company representatives wanted action to be taken, creating a significant obstacle to the process of cluster development.
- Norway's *WoodWorks! Cluster,* as it formalises, will have three-quarters of the new board from business, joined by at least one representative from research and educational institutions and at least one board member from a public agency.

Not all the case studies have triple helix boards…

- Estonia's *Wooden Houses Cluster* is managed as a project within the country's national cluster programme.
- The *Wood Manufacturing Cluster of Ontario's* governance is through an elected board of 10 manufacturers and 3 suppliers, with a manufacturer in the chair.
- Luxembourg's *Wood Cluster* has an Advisory Board reporting to a Minister.
- Upper Austria's *Furniture & Timber Construction Cluster* had two Advisory Boards earlier, now one.

Cluster Management Organisations

Usually reporting to the board is a small team of economic development professionals. They are in place to support…and to challenge. As change agents, they are doing much more than servicing an 'industry association'.

A role of a cluster organisation is to assist their businesses in navigating through what can be a clutter of national agencies. The forward agendas of the clusters are broad. Activites often include skills development, R&D projects, market development, export promotion, SME development, Flagship projects, career awareness, etc. Projects to address these aspects are the cluster's engine room, particularly business-driven projects.

- The Basque Country's *HABIC Cluster* has several working groups and five committees covering thier broad forward agenda: Technology, Internationalisation, SDG & Sustainability, Marketing/Communications and Design.
- In Upper Austria, where all the cluster managers and their teams are co-located, developing cross cluster links becomes easier. In such situations there can be specialist staff shared between the clusters, such as for managing trade fairs, organising export missions and for PR.

Staffing in the international examples ranges from one to a team of 16. Staffing tends to be stable over time, an important aspect as personal relationships are a key to effectivness.

- The CEO/Cluster Manager of Norway's *WoodWorks! Cluster* brings 26 years of experience in public administration with forestry, four years in business management and five years in cluster management to the role. The cluster's six project managers have experience in the wood and forestry companies, in construction, in R&D management and in cluster management.
- Romania's *Transylvanian Furniture Cluster* has a management team of 10 covering project management, business development and internationalisation.

A cluster organisation is largely self-help and learning-by-doing, rather than a lobby organisation:

- Slovenia's *Wood Industry Cluster* has a close partnership with the Wood and Furniture Industry Association at the Slovenian Chamber of Commerce and Industry. The cluster's emphasis is on business competitiveness, the Association's on lobbying and industry policy.
- Estonia's *Wood Houses Cluster* is closely allied to Estonia's Wood Houses Association.

We are the link between the different agents of the value chain
Basque Country's HABIC Cluster

We help turn ideas into invoices
Upper Austria's Furniture & Timber Construction Cluster

Connecting Clusters
An important focus for many of the cluster organisations is making connections with other wood processing clusters.

In many of the regions surveyed, particularly the more urban regions, several clusters are under development. This provides those regions with the opportunity to connect related clusters. This bridge-building is made easier when the cluster managers are based on the

same premises. With digitalisation on the agenda of many of the wood processing clusters, connecting with IT clusters has been an early priority.

- In Luxembourg, most cluster development projects are across clusters, with the *Wood Cluster* working closely with the ICT Cluster, the Materials & Manufacturing Cluster, and the CleanTech Cluster.
- The Basque Country's *HABIC Cluster* works closely with the IT Basque Cluster (for digitalisation), with the Machine Tools Cluster (for wood working machinery) and the Automotive Cluster (for advice on production techniques).
- In Upper Austria, two of the eleven clusters under development are the *Furniture & Timber Construction Cluster* and the IT cluster.
- Sweden's *Manufacture with Wood* cluster is actively tapping into the deep competencies of the neighbouring automotive industry (Volvo's HQ is around the corner) and the aerospace industry.
- Romania's *Transylvanian Furniture Cluster* is supported by the regional economic development agency, who are also engaged with the IT cluster and the Transylvania Digital Innovation Hub.

Connecting clusters within the home region also provides the foundation for a region's innovation strategy and as inputs into, and delivery of, regional smart specialisation strategies.

At the national level, connecting related clusters provide a bottom-up building block to establishing national priorities and development agendas. These could include common export and skills development activities, addressing common regulatory issues and engagement for mission-orientated challenges.

Many of the case study examples give examples of international connections, often in Europe with support from the European Commission. Such connections support B2B connections and A2A, academic connections, drawing in knowledge from other centres.

Measurement and Evaluation

There is no easy methodology to measure the ROI on public investments in cluster development, particularly the funding of cluster organisations.

However, a large proportion of an initiative's funding will be in projects which have metrics attached, such as the number of participants at a training course, or the number of businesses participating in a trade mission. With most clusters, co-funded projects such as establishing a show room in an export market, or a collaborative R&D programme, proceed only when the co-funding from participating businesses is locked in.

Two quick measures of cluster success

1. Are businesses paying the annual cluster membership fee?
2. Are the businesses that are scaling up, firmly rooted the region?

Role of National Agencies

The cluster case studies in the larger European countries show that capital cities, and national agencies, are primarily in a support role, rather than driving regional clustering initiatives.

- Vienna was not the driver behind the regional clustering initiatives in the two Austrian provinces examined.
- Stockholm was a remote player at the start of the four Swedish case studies.
- Oslo was not in the driving seat for the two Norwegian examples.
- Madrid was a marginal player, at best, in the development of the Basque clusters.

Each of the clusters reviewed were bottom-up initiatives, with regions driving, owning and passionately behind **their** cluster, **their** agenda.

While national co-funding has been influential, it is the local politicians and their local economic development agencies that have shown the patience for long term support, comfortable in moving forwards with many small increments. The regional support, in Austria, Sweden, Norway and Spain, has in many instances been for well over two decades. National agencies have at times been able to offer ten years of support.

That said, the national agencies in many countries, including Norway and Denmark, offer more than financial support to the clusters that have won their national competitions. This includes extensive support and training to the cluster organisation teams as well as to the boards. National agencies are proactive in connecting clusters, where relevant, within their country and globally.

The national agencies with responsibilities for cluster development varies, with shared responsibilities in several countries:

- Norway's national cluster support programme is a joint initiative owned by the Ministry of Trade & Fisheries and the Ministry of Local Government, with implementation through three agencies: Innovation Norway, the Research Council of Norway and SIVA, the national agency for incubators and industry parks.
- Cluster Excellence Denmark, the lead cluster support organisation in Denmark, is funded by the Danish Agency for Higher Education & Science and the Danish Business Authority.

- Luxembourg's *Wood Cluster* was kick-started as a joint initiative by the State Secretaries for the Environment and for the Economy, through Luxinnovation, the national innovation agency.
- In Sweden, the lead in supporting cluster development is moving from Vinnova, the National Agency for R & D, to the National Agency for Economic & Regional Growth.

International Case Studies
Reflections

The core idea of cluster organisations is to support and challenge cluster actors to develop, thus cluster development work is at is nature a continuous process. It is about learning-by-doing, rather than drafting long term plans.

As the case studies show, the development of clusters, and their ecosystems, is through broad forward agendas. No cluster has a silver bullet. The development of the ***physical infrastructure*** – industry parks, incubators, transport links – is a relatively easy aspect of cluster development, and relatively quick fix. Strong clustering initiatives also address the ***knowledge infrastructure*** (from high schools through to universities and public R&D) and the ***social infrastructure,*** building the connections within the cluster's community.

Most of the case studies place emphasis on social proximity, removing isolation. The bio-processing case studies also place emphasis on physical proximity, the co-location of related facilities.

Developing clusters that add value to wood is not a quick fix. Rural regions have significant challenges, with limited assets and few related clusters to draw on. Developing new processes and technologies, exploring new transformations and applications, developing new markets, all to add value to a commodity, takes time.

The global need for transition has led to emphasis on strong bio-based economies. Many of the successful transitions described are centred on the initiative and persistence of regional economic development agencies, supported by national agencies. Many of the case studies show over two decades of public agency engagement, especially at the regional level.

Most of the clustering initiatives reviewed are now contributing to the necessary transition to the bioeconomy. The wood processing case studies demonstrate that cluster development has become a well-tested framework to support business growth and regional transformation.

Clusters are industry driven, education fuelled, and agency supported
Ireland's Wood Connect Cluster

3. CLUSTER CASES – SUMMARIES

International Case Studies, Wood Manufacturing Clusters

	Cluster name Main products	Date established, Geography, Governance	Cluster evolution	Financial structure
AUSTRIA	**4. Furniture & Timber Construction, Upper Austria** *(Page 20)* Exterior timber construction, furniture, small scale carpentry	Est. 1998 Provincial EDA initiated. Triple helix based advisory board. Staff: 6	From timber to innovative value networks, including architects, engineers & designers.	70% (5% 1998) funding from participating businesses (annual subscription & projects) and 30% (95% 1998) from provincial government.
	5. Green Building, Lower Austria ** *(Page 24)* Construction materials, design, builders, energy tech, architects, furniture, carpenters	Est. 2008 Provincial EDA initiated, merging 'Timber' & 'Green Building' clusters.	From materials (timber, glass, concrete) to collaborative projects, e.g. Climate-adaptive, Construction efficiency, & Digitalisation	Largely funded by regional government, with an annual membership fee.
BULGARIA	**6. Furniture, Sofia **** *(Page 26)* Contract furniture, design & project management	Est. 2006 National cluster. Business initiated.	Initially furniture manufacturers, now including soft furnishings & designers.	80% of funding from members, 20% from public agencies
CANADA	**7. Wood Manufacturing Cluster of Ontario** *(Page 27)* Cabinetry, commercial millwork, furniture, CLT.	Est. 2011. Local initiative, community college & businesses. Board: 10 manufacturers (one in the chair) & 3 suppliers. Staff: 3.5	Initially local furniture businesses, now including cabinetry, millwork & CLT, Ontario wide.	Largely business funded. Stuttered Federal & Provincial support.

ESTONIA	**8. Estonian Wooden Houses, Tallinn **** *(Page 29)* Prefabricated timber buildings.	Est 2008. National initiative, led by a cluster council and an executive team, under the umbrella of The Estonian Woodhouse Association.	Initial focus on exports, now broadened to green transformation, digitalisation, industrialisation & the domestic market.	Funded by Estonian's national cluster programme (with EU support) & member fees. Projects funded by EU.
FINLAND	**9. North Karelia** No cluster organisation *(Page 34)* Forest-based bio economy*	No cohesive cluster organisation in the region.	Regional university leads development projects, incl. green transition of wood construction, low carbon construction & digitalisation.	Regional and EU funding for project development is available.
IRELAND	**10. Wood Connect, Galway** *(Page 36)* Panel products, timber, frames, fit outs, joinery, furniture	Est. 2021 National initiative Steering Group under formation	Still under development. Connecting three industry associations.	Supported by Enterprise Ireland
LITHUANIA	**11. Prefabricated Wooden House, Vilnius **** *(Page 38)* Modular buildings, timber frames & panels	Est. 2014 National initiative	Focus on manufacturing efficiency, new product development & joint marketing.	Funded through the national cluster program, and EU funds.
LUXEMBOURG	**12. Wood Cluster, Luxembourg** *(Page 39)* Forest-based bio economy*	Est. 2016 National initiative Triple helix Advisory Group, reporting to government	A government driven initiative – rebuilding the forest industry value chain.	90% funded by government (4 years) with 10% from business organisations. No direct business funding.
	13. Treklyngen, Hönefoss *(Page 42)* Bioeconomy* industrial park	Est. 2012 Local initiative, owned by the local forest owners' association	Co-location of forest bioeconomy businesses.	Financed by rents, operating revenues & local forest owners' association.

NORWAY	**14. WoodWorks!, Trøndelag **** *(Page 44)* Industrialisation of wood construction, wood fibres & forest products	Est. 2004. Regional EDA initiative. In 2022 will establish an independent cluster organisation. Staff: 7	Includes forestry industry, pulp & paper, sawmills, bioenergy production, prefabricated housing. Transforming to a forest-based bioeconomy*	Funded firstly by regional government. Since 2016, co-funding from Norway's cluster program.
ROMANIA	**15. Transylvania Furniture, Cluj **** *(Page 48)* Home & office furniture.	Est. 2012. Initiated by the Regional EDA. Board: company representatives. Staff: 10.	Export focus. Broadened from furniture to furnishings.	Funded through a range of EU programmes.
SPAIN	**16. Basque HABIC, Bilbao** *(Page 50)* Interior furnishings, homes & offices	Est. 2009. Initiated by Provincial EDA, based on a furniture industry association. Triple helix board, business led.	Broadened from furniture to interior items. Shift from resource driven to market driven.	66% from annual membership & fee for services, 18% Basque government, balance national and EU grants.
SLOVENIA	**17. Wood Industry, Ljubljana **** *(Page 54)* Sawmilling, joinery, prefabricated housing, bio energy, furniture.	Est. 1999. Initiated by the Ministry of Science, centred on a wood technical centre. Staff: 3.	From a wood technical centre, to developing & managing projects offering financial support to project partners.	Funded by the Ministry to 2005. Today financed by membership fees & incomes through running joint projects with EU support.
SWEDEN	**18. Paper Province, Karlstad **** *(Page 56)* Forest-based bio economy*	Est. 1999. Regional initiative, initiated by the industry but started as a project handled by 5 municipalities. Triple helix board. Staff: 16.	From responding to needs of individual pulp & paper firms to collective efforts, joint value creation. Now with a national mission to develop the forest industry bioeconomy.	Financed by member fees, local & regional public funds + EU funding. Project funding from Sweden's Innovation Agency.
	19. RLSE Processum, Örnsköldsvik	Est. 2003. Started as a Technology Park	Started focusing on the main areas for development of the	Partly (51%) owned by RISE, Sweden's

	(Page 62) Forest-based bio economy*/ bio refinery.	on the initiative of 20 companies. Evolved into a cluster initiative in 2005. Staff: 32.	forest process industry by upscaling & commercialisation from ideas to finished products & production processes.	Research Institute. Funded by membership fees from companies, revenues from R&D projects & public project funding, incl. EU.
	20. Smart Housing Småland, Växsjö *(Page 66)* Industrialisation of wood & glass construction	Est. 2013. Initiated by two different groups within RISE, now a project owned by RISE. Triple helix board. Staff: 8.	From the traditional house building & glass industry to a connected industrial innovation network, with research actors in digitisation, automation & internationalisation	Regional & national funding (50/50) and in kind from companies participating in cluster activities.
	21. Manufacture with Wood, Trollhättan *(Page 70)* Industrialisation of wood construction.	Est. 2019 Established by a Science Park. In transition to a cluster initiative, 2022.	Development of wood-based industry processes, drawing on knowledge & development resources from the car & aerospace industries, e.g., for automation, digitisation, industrial logistics.	Funded by regional & national agencies with EU support.

* **Forest-based bio economy** links the whole forest value chain from the management and use of natural resources to the delivery of a wide range of products and services, including biofuels, chemicals, packaging, fabrics, construction, and energy.

** **ESCA Quality Labelling Award:** These clusters have chosen to apply for an award from the European Secretariat for Cluster Excellence and achieved a Bronze, Silver or Gold Award. (https://www.cluster-analysis.org)
These Awards are also identified in the case studies that follow.

4. AUSTRIA

Furniture & Timber Construction Cluster Linz, Upper Austria	
Main products	Architecture, design, furniture, wood construction, carpenters & suppliers
Cluster web site	https://www.m-h-c.at/en/
Cluster members	2021: 194 businesses
Cluster budget	2021: Euros 0.85 million p.a.
Cluster staff	2021: Six

Background
Upper Austria's population is 1.5 million. The province adjoins Germany and Czech Republic. The area around the provincial capital, Linz, is considered Austria's leading economic region.

The province's economic development agency, 'Business Upper Austria', has a strong track record in cluster development, starting in 1998. The agency has become known as 'Clusterland'. Their research has shown that businesses that take an active part in their clustering initiatives grow faster than non-participants.

The "Wood Cluster" was the third of eleven provincial clustering initiatives, drawing on the region's strong tradition in wood processing.

At the beginning, in 2000, the partner approach was focused on the entire timber industry, but it was shown that there was little in common between forestry, sawmills and timber construction. In 2002 the cluster concentrated on the areas of wood construction and furniture manufacturers and thus referred to itself as the "MHC Furniture & Timber Construction Cluster". Since then, three segments have been addressed:

1. Furniture industry, mid-sized and larger enterprises, industrial processors.
2. Small scale carpentry, mainly family firms with 5-30 staff.
3. Exterior timber construction – housing, bridges etc.

Again, little in the way of commonalities and collaborative agendas was found across these segments. Two Advisory Boards were in place. The cluster was viewed more as a lobbying group than a self-help innovation initiative. Whilst a well-developed value chain was in place, few initiatives reached both ends.

Activities with sub-groups included running furniture trade shows, upgrading interior design skills and awareness campaigns on timber v. alternative construction materials. Every second year, the prestigious Upper Austrian Wood Construction Awards are held, open to builders, architects, and wood construction companies.

During this period, there was increasing price-based competition from neighbouring wood processing centres in eastern Europe, some with half of Austria's labour costs. This competition accelerated consolidation amongst the Upper Austrian companies. Many sawmills now produce laminated timbers.

MHC's operating mantra
'We help turn ideas into invoices'

Current situation
The MHC cluster has moved to 70% funding by participating businesses (on an annual subscription and project basis) and 30% from the provincial government. Two decades ago, at the cluster start-up, businesses contributed just 5%. Annual membership fees range from € 395 (under 10 employees) to € 1520 (over 250 employees).

The cluster team make regular company visits. Support to an individual company includes advice on project ideas, funding sources and project partners. Funded collaborative projects need to include, along with the participating businesses, an R&D or a training facility. Projects could be competing, exploring alternative routes.

A current project is a consortium developing lightweight building materials for dry walls, involving prefabricated house builders, architects, and glue producers. Any IP that is developed is owned by the consortium.

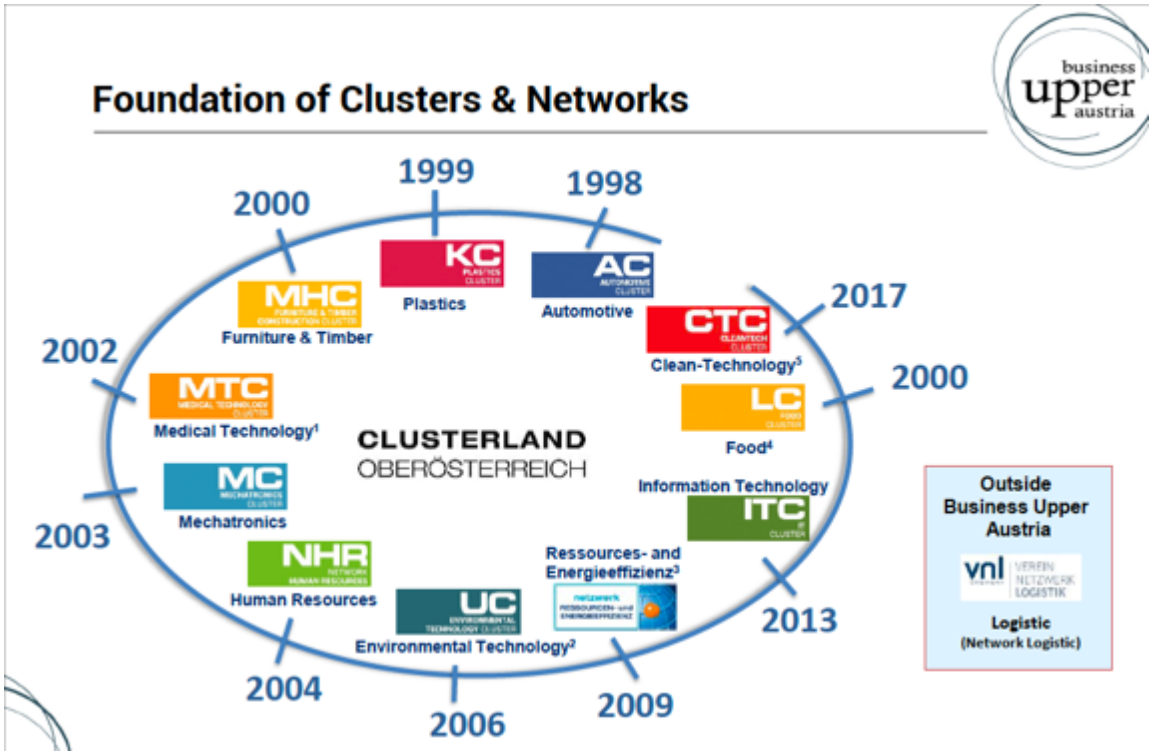
The MHC's team of six includes a project manager with a timber-construction focus and one with a carpentry focus. The Cluster manager has a background in design and acts as a project manager for the design & architecture segment. The Advisory Board of ten includes businesses and academia and is chaired by a furniture manufacturer.

A flagship project for the MHC team has been the development of the HoHo Hotel, Vienna. It is one of Austria's most future oriented projects, with an engineered timber hybrid construction.

While regulations remain in the way of progress, the HoHo Hotel provides an opportunity to shape the future of timber-hybrid construction.

The key performance indicator is business satisfaction with the cluster initiative, particularly expressed through renewal of the annual subscription.

Most projects involve collaboration with Upper Austria's other clustering initiatives, including IT and Cleantech. The MHC cluster team is co-located with Upper Austria's other cluster organisations - a key collaboration enabler.



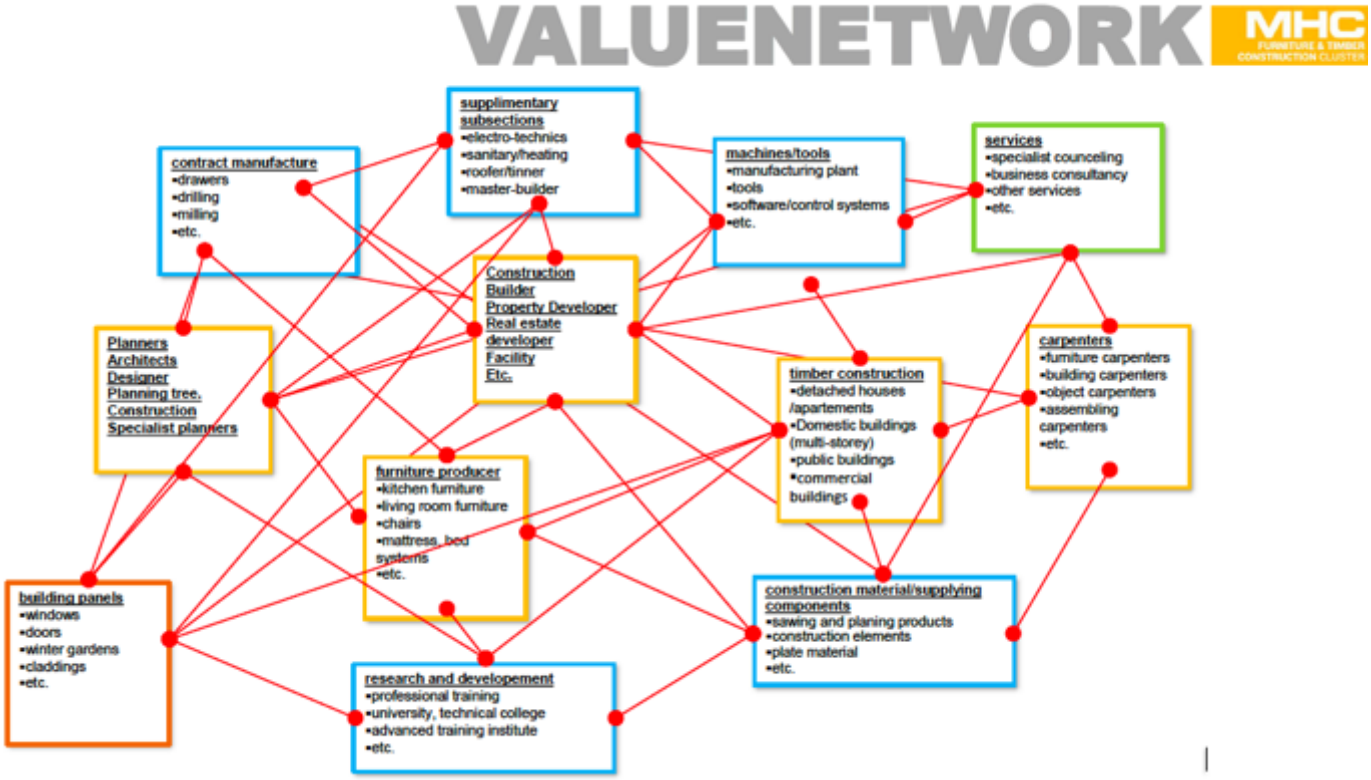
Many projects now include collaboration with clusters across Austria, and beyond, particularly with EU supported projects.

Over two decades, the MHC initiative has substantially evolved. The current topics/platforms include skills shortages, the training of apprentices and promoting entrepreneurship.

A further, and major, evolution in the cluster's development journey is set for 2022. This takes the cluster well beyond materials to adding value through innovation.

Forthcoming topics draw on the cluster's 20-year journey: Smart production, Modular construction, User centred architecture, Interdisciplinary cooperation, Bio based materials and CO2 neutral building.

Centre to the new strategy is Value Networks, bringing together an increasingly wide range of businesses and competencies that need to be integrated into tomorrow's buildings:



5. AUSTRIA

Green Building Cluster of Lower Austria St. Pölten	
Main products	Construction materials & systems, architects, design, furniture, energy technology providors, timber construction companies, environmental building technology, carpenters & suppliers, digitalisation & sensor technology …
Cluster web site	Green Building Cluster of Lower Austria (ecoplus.at)
Cluster members	2021: 220
Cluster staff	2021: 4 FTE

Cluster Background

Lower Austria's population is 1.7 million. The province surrounds Austria's capital, Vienna. The provincial economic development agency, 'Business Lower Austria' has over two decades of accumulated experience in cluster development. The agency's mantra is *'Innovation through Co-operation'*.

Currently four clustering initiatives are supported: Food, Plastics, Mechatronics and Green Building. All clusters have been awarded a Gold Medal for European Cluster Management Excellence.

Each clustering initiative has a development agenda that includes bringing relevant companies and support organisations together for cooperative projects and sharing information on specific topics.

The roots of the Green Building Cluster are in two clusters that merged in 2008. It was realised that the province's Timber Cluster (started in 2000) and the Green Building Cluster were stagnating, in part due to competition over building materials.

Current Situation

The Green Building Cluster of Lower Austria represents innovative, sustainable construction. The cluster promotes innovation in the domestic construction industry and boosts business by pooling potential and expertise into a network of stakeholders from business, research and training. The cluster also draws in specialist organisations and the Lower Austrian government.

The cluster does not have a focus on materials (timber, glass, concrete etc) but on three topic themes and it is here where collaborative projects are particularly in play-

- **Climate-adaptive technologies** opening new opportunities: sustainable cooling, building ventilation, improving the microclimate in and around buildings.

- **Constructive efficiency**: resource-efficient use of materials, multifunctional construction elements and materials.

- **Digitization in construction:** use of digital technologies in planning, building and business processes to accelerate change, implementation of Building Information Modelling tools, development of Virtual Reality and Augmented Reality applications, lean construction principles.

Companies pay an annual membership fee, ranging from 280 euros (under 4 employees) to 1,120 euros (over 50 employees).

Cluster partners benefit from each other and work together on innovative, future-oriented projects. The cluster provides a company with a neutral platform to implement cross-company innovation projects through cooperative effort. A special emphasis is placed on the needs of SMEs (comprising 95% of members) across the entire value-added chain of the construction industry.

The aim of the Cluster's work is to ...
make the companies fit for the challenges of the future.
Our experience has shown that one of the best ways to tomorrow's success
is to work together in inter-industry collaborative projects.
Johanna Mikl-Leitner, Governor of Lower Austria

6. BULGARIA

Bulgarian Furniture Cluster Sofia	
Main products	Contract furniture; design & project management
Cluster web site	https://www.furnitureclusterbg.com
Cluster members	2021: 45
Cluster staff	2021: 3 FTE

Cluster background
The initiative started in 2006, bringing together furniture manufactures and designers from across Bulgaria with a sharp focus on servicing the contract export market. A leading Bulgarian FF&E supplier (furniture, furnishings, wall coverings, fixtures & hotel equipment) took the lead in establishing the cluster and continues to lead its operations.

Customers include hotels, retail outlets, showrooms, and hospitals. The exported products use MFC, MDF, solid wood & other materials, and upholstery.

Successful projects have involved hotel refurbishments across Europe (including Hilton and Marriott); 3,500 Peugeot & Citroen showrooms and furniture for 3,000 French post offices. IKEA is an important customer.

Current situation
Cluster members are 36 furniture manufacturers (all SMEs) + five design studios + the Association of Bulgarian Designers + three universities. Around 20% of cluster financing comes from public agencies. Exports now account for 85% of total turnover.

Considerable effort goes into export promotion, including trade fair participation. Collaboration with European clusters includes the EU financed **Furniture Go International, supporting eight clusters to reach new markets.** Joint purchasing of hardware and other componentry is undertaken.

Skills development is on the cluster's agenda. A co-innovation laboratory for product develop and testing is being explored, financed through a national initiative, *'Innovative Together'*.

7. CANADA

Wood Manufacturing Cluster of Ontario Hannover	
Main product areas	Cabinetry, commercial millwork, furniture, modular mass timber, flooring, other niche wood products
Cluster web site	https://www.wmco.ca/
Cluster members	2011: 7 companies 2021: 130 companies
Annual budget	$500k
Cluster staff	2011: 0.75 FTE 2021: 3.5 FTE

Cluster background

The cluster initiative was started in 2011. The cluster core group was seven local value-added (VA) wood manufacturers in furniture, flooring, and cabinetry, in a timber growing region 200 km north of Toronto.

Representatives have twice attended Upper Austria's Cluster Academy which provided the knowledge foundation on 'how to cluster'.

As a wider range of VA wood manufacturers heard of the initiative, many located beyond the immediate area, the original 'Bluewater Wood Alliance' extended its catchment area to include the whole province and rebranded to the 'Wood Manufacturing Cluster of Ontario'.

This was one of Canada's first clustering initiatives. Financing the clustering initiative has been challenging from the start, with public funding programmes at the Federal and Provincial levels having limited flexibility to support clusters.

Further, there has been little emphasis in practice in Canada on adding value to the timber resource. The country remains primarily an exporter of raw lumber.

Current situation
The largest grouping is now manufacturing cabinets, followed by commercial millwork. Furniture is the third grouping, facing competition from imports. A growth area is modular mass timber, including CLT. The cluster's services are tailored to include all segments.

Cluster membership has grown as wood processing businesses welcomed the opportunity to participate in plant tours, using Kaizen principles to brainstorm a specific problem. WMCO offers five training programs, networking events and a provincial health & safety insurance rebate program for the cluster.

Export initiatives to the US, Dubai and the EU have been developed.

Cluster governance is through an elected board of 10 manufacturers and 3 suppliers, with a manufacturer in the chair. Suppliers cannot become chair, or contribute to a quorum, but can vote. This keeps the cluster 'manufacturing centric'.

8. ESTONIA

Estonian Wooden Houses Cluster Tallinn	
Main products	Prefabricated timber houses, modular timber houses, log houses
Cluster web site	https://www.woodhouse.ee/en/
Cluster members	2008: 20 2021: 50
Cluster budget	2021: Euros 250,000 +
Cluster staff	2021: 1.5 FTE

Cluster background

The timber industry is of great importance for the Estonian economy, in value creation and regarding jobs, especially in rural areas. There are over 100,000 forest owners in the country.

Over the last decades, Estonia's wooden building manufacturers has grown their international business and are now Europe's biggest exporter of timber buildings, representing a total value of 450 + million Euro. 90% of the prefabricated timber building production is exported, mainly to the Nordic countries but in total to over 70 countries globally. New Zealand is one of those export markets. Estonia now accounts for 25% of the EU's exports of wooden houses.

The Estonian Wooden Houses Cluster initiative was started 2008 by the Estonian Woodhouse Association. It has significantly developed its operations and was acknowledged in 2018 as Estonia's '*Promoter of Entrepreneurship*' [6].

During the 2008 recession the timber houses sector fell under strong economic pressure. This crisis started the clustering initiative. The Estonian Woodhouse Association was facing fundamental questions, whether to continue and if yes, then how to adapt and change?

> ***'Back then, we decided that the focus had to be on export.***
> ***The framework for achieving that would be the Cluster.***
> ***Our goal was to become the biggest exporters of wooden houses in Europe'***
> **Argo Saul, one of Cluster's founders**

[6] https://www.puitmajaliit.ee/news/the-best-promoters-of-entrepreneurship-are-superheroes-and-estonian-woodhouse-association

To implement the plan, they started to create a cluster strategy. The Estonian government support through their recently launched cluster program was a welcome relief for the industry and proved to be one of the most efficient support measures of competence and capability for the Wooden House sector. It was recognised that a cluster is an extremely complex form and is based on trust. Successful team engagement is first and foremost related to strong and systemic management.

Cluster Initiative Start-up

The Estonian Woodhouse Association (EWA) was founded in 1999 as an umbrella organization for Estonian timber building sector. The Estonian Wooden Houses Cluster (EWHC) was established within this association with a clear purpose: to upgrade competitiveness and promote exports through collaboration - competence building events, R&D, marketing etc. The two organisations work closely, activities are very much related.

EWA is registered as a non-profit organization. EWHC has no legal form – the cluster initiative is managed as a project which is funded via Enterprise Estonia's (EAS) national cluster program, which in turn is funded from the European Regional Development Fund.

The cluster gained momentum as part of EWA, mainly due to the need of funding joint activities to support exports, using mainly EU project funds. The first application round for cluster support was opened in 2010 by the Ministry of Economic Affairs and Communications. At that time, 'clusters' as a network and a form of cooperation between companies was not well known in Estonia.

Current situation

The Estonian Wooden House Cluster has become as a network a reliable partner for companies, for cross sectoral organisations as well as for policy makers and public agencies. The network and action plan created by the cluster initiative of about 20 partners has today attracted more than 50 companies and affiliates from within and outside the sector. Four project periods and activities (e.g., towards internationalization and co-marketing) have created a solid base to continue. In other words – the cluster has become a visible and significant contributor to the sector.

The cluster's management team is led by a five-member cluster council, which currently has almost the same personal composition as the association's board (EWA board has 6

members). The members of the council direct the course of activities (ideas, contacts, action plan), but the management of activities is done by the executive team. In this sense, the cluster team has a great deal of responsibility and at the same time have trust from the council.

Current Cluster Financing and activities

The cluster itself has no members-fee but it is part of EWA and uses EWA members-fee to finance different cluster activities and the cluster management team. Depending on the activity, members will also contribute financially (participation fee etc.) and bigger events are supported by sponsors (marketing events, contests, conferences etc.).

Cluster is largely funded by EU project funds. The possibilities for financing the cluster after 2023 are unclear. From August 2023, the current main project funding through Enterprise Estonia will end, with probably no further application rounds. For that reason, the cluster is searching for new possibilities in other EU project funds to finance activities and management team. Options could include the EU's Erasmus+ project and Central Baltic/Interreg projects. Currently, it is difficult to finance the cluster without EU support.

Main activities:

- Research and development: support for members' ETA and CE certification process, research (fire resistance, load bearing capacity etc.), supporting the use of engineering software programs, co-operation with universities.
- Marketing: trade fare visits, information materials, organizing meetings with different parties, marketing events (e.g., Day of Wooden Houses, Prefab House of the Year contest), conference visits etc.

The most relevant area that describes the cluster is "production and engineering" as most of the cluster partners are timber building factories. Prefabricated timber building sector is an important part of the construction sector.

Cluster activities focus mainly on prefabricated timber building companies. Other partners include material producers and educational institutions.

The cluster is cooperating with Estonia's Digital Construction Cluster on the possibility of applying the CO2 footprint in the local construction market. Cooperation may develop with Estonia's ICT cluster for the application of IT with wooden house manufacturers – the modernisation and digitisation of business process-chains, including machine learning. There is currently no direct co-operation or projects with other wood clusters.

In recent years, Estonian wooden house producers have had to operate in increasing competition in their traditional target markets, especially Scandinavia and Germany. In addition, market requirements are tightened, input prices are rising as the demand for high-quality products develops. One of the most difficult development challenges for companies

in the context of the coming years is the EU market requirement, which presupposes that all wooden houses produced are CE certified. Already component and modular house manufacturers are required to hold certificates for participation in construction procurements.

To maintain and increase its competitiveness, the cluster launched, five years ago, the process of joint certification of partners, i.e., the joint application for the ETA and CE mark for wooden house manufacturers. As a direct result, the wooden house cluster and Estonia is the most certified timber building sectors in the EU (according to ETAG 007).

Over half of the 20 Estonian companies with certificates (ETA timber building kit) have been certified through the cluster initiative and supporting activities, in addition to the three certifications currently in progress. In contrast, in other countries with large wooden house production volumes, such as Finland, Austria and Germany, these numbers are 14, 8 and 6, respectively. The cluster has been an important catalyst, because when undertaken independently, it is difficult and more expensive for companies to go through. The cluster supported companies with the necessary competence (engineer, certification body, experts) as well as with documentation. As a result, the competencies of the cluster initiative have grown significantly, and similar support is offered to new cluster partners and to companies outside the cluster.

The cluster organises several large-scale marketing events each year. These have a positive effect on the overall image and visibility of the sector.

The most outstanding, complex and challenging common project so far is the Timber Construction Competence Centre in the Estonian Open-Air Museum and created for Estonia's 100th anniversary. **This is the cluster's Flagship Project.** A total of 120 companies participated in creating this demonstration building. The idea of building a demonstration house started and was proposed during the discussions of the cluster strategy 10 years ago.

The completion of the demonstration building and showroom has created an opportunity for the cluster team to better introduce the sector and the network. The Competence Centre helps share more knowledge about the building process of a timber house to people who are planning their own home as well as to professionals, to everyone who would like to receive information about modern technologies and possibilities in timber construction.
https://www.tehasemaja.com/en/

In 2017 and again in 2021, the Estonian wooden house cluster passed the EU's cluster evaluation process and was awarded the European Cluster Excellence Bronze label. This confirms that the cluster is making a conscious contribution to the development of the sector, quality management of the network and raising the quality of the partners.

In addition to the successful management of the cluster, the activities have also been evaluated and highlighted at local and international level. In 2018, two significant awards were assigned to the cluster. Recognition from State level (Ministry of Economy and Communications) award "Recognize the promoter of entrepreneurship 2018" and the City of Tallinn gave the cluster the title "Cooperation Project 2018". The cluster project was also among the top 19 in the European Enterprise Promotion Awards. The success story and co-operation of Estonian wooden house producers for the common goal has been noticed at the European level.

As a result of the cluster's communication and joint marketing activities, it is known in Europe that Estonia is the largest exporter of wooden houses in the EU. The Estonian wooden house cluster is currently one of the main channels where international customers and manufacturers meet and significant development activities are carried out.

Future issues

Today the cluster is back on track and has been able to achieve the main goal set in 2008, to become one of the biggest exporters of wooden houses in Europe. Next challenges to be addressed are the green transformation, digitalization, and industrialization, and in partnership with the umbrella association, to take a stronger grip on the domestic market.

There is an urgent skills issue, with a shortage of timber engineers inhibiting business growth. A proposed Academy of Timber Building Engineers would train specialists in the construction of wooden buildings.

The adoption / implementation of the CO2 framework in the local construction market could be accelerated. Assessing the carbon footprint in the construction sector would help to create a more sustainable living and urban space and provide opportunities to build more wooden buildings, including large-scale ones, in Estonia. There are good practices in the Nordic countries. Carbon footprint calculations would be an important step in developing the construction sector.

9. FINLAND

North Karelia: A development approach with cluster-like characteristics

North Karelia, the easternmost region of Finland, describes itself as 'The Forest Capital of Europe' and to being 'the world's leading business cluster in forest machine production'.

Annual forest usage is 6-7 million m3. The region is home to over 500 bioeconomy companies with a combined turnover of 2 billion euros. Out of a regional population of 160,000, some 6,000 are employed in the forest bioeconomy. The main city, Joensuu, is HQ for the European Forest Institute.

Whilst the North Karelia region has scale, currently the main activity is the export of pulp and paper boards to global markets, round timber to other regions in Finland, sawn timber to Europe, glulam, and plywood to Asia.

It appropriately describes itself as a forestry cluster, but at present does not have a cluster development approach with the intensity and focus of similar Scandinavian regions.

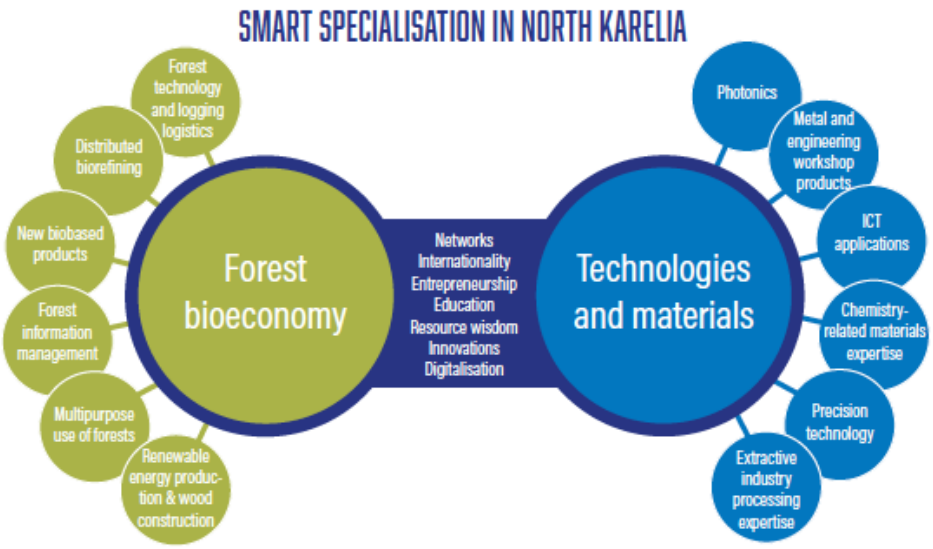
There is no cohesive cluster organisation in the region. Earlier, the Joensuu Science Park (now the Business Joensuu ltd) provided coordination, but when Finland closed its investment in the Center of Excellence, after a 10-year program (2000 - 2010), it became the role of the Karelia University of Applied Science, Joensuu to lead development projects These projects support the green transition of the construction industry in wood construction, low carbon construction and digitalization supported by project based funding from Regional Council of North Karelia and other financiers.

In the wood construction sector, the focus is to start from the needs of components and knowledge in the end product (buildings) and then go downstream, rather than from the raw material and upstream, to find the development potential in wood construction.

One of the current projects is on developing the region's bioeconomy through a shift from linear research to a networked innovation model. The three-year project is funded by the Finnish Ministry of the Culture and Education.

Smart specialisation is a common European approach that aims to boost growth and jobs by enabling regions to identify and develop their competitive advantages. Smart specialisation competencies often underpin several regional clusters.

North Karelia's Smart Specialisation Strategy acknowledges the interrelationships between the region's forest bioeconomy and the diverse range of technologies and materials that have developed within the region. The Strategy's two elements are new solutions for the bioeconomy and technologies and materials as growth enablers.



Further information:
https://www.pohjoiskarjala.fi/documents/33565/2422473/Smart+Forest+Bioeconomy+Brochure.pdf/7ecd1f6b-eb53-525d-298b-d56e5695ba2c?version=1.1

About the University project and research program:
https://rakentaminen.karelia.fi/en/about-us/
https://woodjoensuu.fi/en/network/

About the North Karelia region:
https://www.smarteast.fi/en

10. IRELAND

Wood Connect Cluster, Galway	
Main products	Panel products, sawn timber, timber frames, interior fit outs, joinery, furniture
Cluster web site	www.woodconnect.ie
Cluster staff:	1 FTE

This is the youngest of the cluster case studies. The initiative started in 2021.

Background
Ireland's public agency supporting manufacturing companies, Enterprise Ireland, has introduced a three-year programme to support regional clusters. Funding is in part from the EU, provided through the Department of Business, Enterprise and Innovation, and made available via regional Institutes of Technology. Following an open competition process, one of the twelve winning proposals was 'Wood & Furniture'.

Historically, public funding to support the sector has been directed at managing the wood resource, not at adding value. Fifteen years ago, Enterprise Ireland closed the country's Timber Research Centre. Ireland's annual wood harvest will double in the coming 15 years, to 8 million m3, mainly Sitka spruce.

This is a national initiative, based in Galway. Over 1,000 businesses, largely SMEs, are adding value to the local resource, and are geographically dispersed. Many of the joinery companies are situated along the east coast.

Around half of Ireland's wood exports of some 450 million euros are panel products, the other half sawn timber, with almost all shipped to the UK.

Current Situation

The key players across the sector are not well connected. Three industry associations play key roles within each of their sectors:

- Irish Wood and Furniture Manufacturers Network
- Irish Timber Frame Manufacturers Association
- Forest Industries Ireland

A Cluster Manager, with extensive sector experience, has been in place for nine months. At this early stage in developing the cluster, membership fees are not being considered. Accessing funding for any projects requires separate applications.

For cluster governance, an initial Steering Group, business led, is being established.

The current development priorities are:

- Cross industry collaboration – promoting linkages across the entire value chain, across a disjointed sector.
- Innovation & R&D - collaboration between industry, academia & community.
- Business development – supporting SMEs & start-ups.
- Talent & skills development – enabling a sustainable talent pipeline.
- Funding – identifying funding opportunities to deliver the strategic objectives.

A Flagship Project is re-establishing the Timber Research Centre to coordinate and commercialise research. An underpinning development priority is lifting awareness of the low carbon benefits of timber. Wood processing as a career option, particularly for women, needs to be addressed.

Connections have been made with related European clusters, including the Interior Cluster in Växjö, Sweden.

'Clusters are industry driven, education fuelled, and agency supported'

11. LITHUANIA

Lithuanian Prefabricated Wooden House Cluster PrefabLT, Vilnius	
Main products	Modular buildings, Timber frames & panels
Cluster web site	http://prefablt.com/en/
Cluster members	16 companies
Cluster budget	0.32 million euros
Cluster staff	1 - 5

The Lithuanian prefabricated wooden house cluster - PrefabLT - is a registered association, bringing together wooden panel, timber-frame and modular house manufacturers with engineering companies and suppliers. More than 90% of production is exported. Norway and Sweden are the main markets.

The initiative was started in 2014. PrefabLT currently has 16 members companies: ten prefab house industrial companies and five in the supply chain.

PrefabLT contributes to the development of members' competitive advantage through raising manufacturing efficiency, addressing quality standards, supporting new product development and joint marketing activities. The initiative also has a lobbying role. A key emphasis is on building relationships and trust amongst members.

PrefabLT was the first certified construction and manufacturing sector cluster in the Baltic countries. Lithuania has the ambition of being the leading country for wooden prefabricated house manufacturing in Eastern Europe.

The cluster is seeking architects and engineers as members, to broaden the initiative.

The cluster is supported by Lithuania's Agency for Science, Innovation and Technology (MITA). Collaboration with other Lithuanian clusters is facilitated through the Lithuanian Cluster Association that includes Baltic Furniture Cluster and IT Cluster.

A prestigious building by a PrefabLT member:
Abba Museum, Stockholm, Sweden

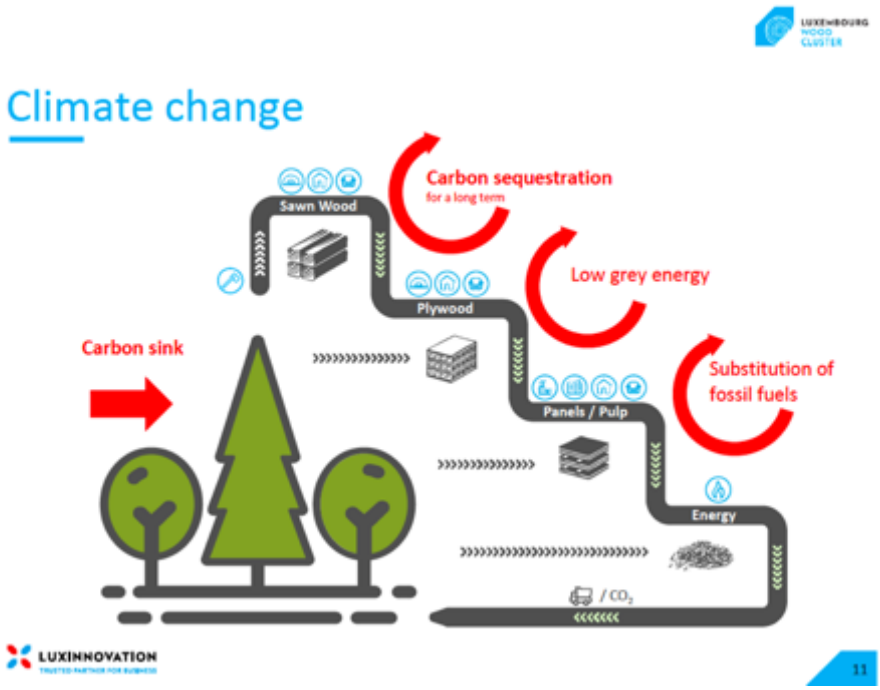
12. LUXEMBOURG

Luxembourg Wood Cluster	
Main products	Timber harvesting, sawmills, panel & paper, energy, architects & engineers, construction & carpentry, skilled crafts & woodwork
Cluster web site	www.luxinnovation.lu/cluster/luxembourg-wood-cluster
Cluster staff:	1 dedicated + support

Background
Luxembourg's population is 600,000. One third of the country is forested. The sector employs 19,000, largely in SMEs.

The Wood Cluster was established in 2016 at the initiative of the Ministry of the Economy and the Ministry of the Environment, Climate and Sustainable Development, with the focus on rebuilding the value chain. In a region with extensive forestry, just two sawmills remained. Many parts of the value chain were missing. Sweden, Norway, Finland, and neighbouring countries had become timber suppliers. The construction industry was failing to match housing demand. Just 10% of construction was in wood. A further challenge was CO2 reduction.

One of the first steps was a detailed mapping of Luxembourg's value chain, covering forestry, furniture, panel products, paper, architects, craftsmen, construction, energy, and universities. For details (in French): Microsoft Power BI



A triple helix steering committee was initially established. The cluster's dual governance - to this committee and to government – was later simplified to a triple helix Advisory Group that reports to government, with senior business participation.

The initiative is funded by the Ministry of the Economy, the Ministry of Higher Education and Research and private institutions (Chamber of Commerce, Chamber of Crafts and the FEDIL).

Government funding is for four years by means of a performance contract, with project priorities and KPIs identified. Success measures are amongst others number of companies assisted, number of RDI applications at national and European level, number of multi-party projects, etc.

There is no direct business funding for the Wood Cluster. The cluster's activities are open to all relevant businesses.

Current situation
Priorities for the cluster are sustainable development, the circular economy, developing the regional market for high quality timber, and digitisation, which is being addressed in collaboration with Luxembourg's Digital Innovation Hub.

Across the economy, nine clusters are in place, six of which (including the Wood Cluster) are managed by the national agency for innovation and research, Luxinnovation.

These clusters are not viewed as silos. Most of the development projects are across sectors, with the Wood Cluster working closely with ICT, Materials & Manufacturing and CleanTech - developing the circular economy.

This is an inter-dependant timber harvesting and processing region, with value added products in various stages moving seamlessly across the borders with Belgium, France, and Germany.

The Wood Cluster is engaging with related clusters in the neighbouring regions. Luxembourg's relationship with these other wood processing centres is one of collaboration, not competition. Germany, for example, is further developed than Luxembourg in prefabricated construction.

An annual Wood Cluster Forum has been held since 2018. This is a discussion and networking event that brings together over 200 of the key players in the cluster.

13. NORWAY

Treklyngen, Hönefoss, Southern Norway	
Main product areas	Bioeconomy
Cluster web site	https://www.treklyngen.no
Cluster staff	6

Cluster Background

With the downturn in demand for newspaper print paper, Norske Skog's Follum paper mill in Hönefoss was closed in 2012. A condition of sale was that the paper production machinery be dismantled.

The local forest owners' cooperative, Viken Skog, with 9,000 local members, acquired the land with the aim of establishing a wood-based bioprocessing cluster.

The core infrastructure and several buildings were refurbished to facilitate new industrial processes. A railway terminal for goods handling was established.

The search began for new possibilities for the forest owners, with the concept of the cooperative co-investing in new facilities to utilise some of the 3-5 million m3 of timber annually. The goal was to establish a cluster with several complementary firms co-located, producing for example construction timber, biofuels, and bio-chemicals. In the first phase, the cooperative invested in exploring a range of industrial projects, including:

- A biofuel plant with company who had experience in processing food waste.
- A plant for bio-jet fuel and charcoal, in partnership with a state-owned company.
- A new type of biochar-pellets for overseas power plants.
- Producing charcoal and bio-oil through pyrolysis [7].

Some of these substantial initiatives involved 3-4 years of feasibility studies and exploratory work. To-date, each initiative is either 'on hold' or closed.

[7] Drawing on: Antje Klitkou, Marco Capasso & Teis Hansen (2021) Understanding conditions for path development after path exhaustion, European Planning Studies, 29:8, 1538-1555, DOI: 10.1080/09654313.2021.1875995 Link: https://doi.org/10.1080/09654313.2021.1875995

The cooperative was also active in lobbying regional and national politicians and state agencies such as SIVA (responsible for government investment in incubators, science parks, industrial parks) and Innovation Norway.

Current Situation
In 2019, it was decided to no longer invest in the different projects, but to act as a neutral broker offering concepts for forest industry-related activities. The strategy is to focus on activities that benefit from coordination benefits.

The Follum site offers power, heat, steam, storage space, office space, rail tracks for large scale industrial applications. Preferred establishments will have a requirement for forest raw materials in their processes (to be delivered by members of the forest owners' association) and are likely to value a large area of contiguous land, which is a scarce item in Norway. By-products and residues from one plant could become feedstock for its neighbour.

An example now in place is Bio carbon, a company that develops processes for biofuels and other biomaterials. An option: it may be that a data centre’s hot cooling water can be used by process industries that need hot water for their process.

14. NORWAY

WoodWorks! Cluster Trøndelag, Mid Norway	
Main products	Timber construction & buildings, wood fibre utilisation, adding value
Cluster web site	https://woodworkscluster.no/english-info/ https://youtu.be/ZSeQJ6KDL54
Cluster members	2004: 17 2021: 75 businesses & organisations
Annual budget	2004: E 20,000 2021: E 400,000
Cluster staff	2004: 0.5 FTE 2021: 7

'The name of our cluster is WoodWorks!
and it is spelled with an exclamation mark.
Because that is what wood does. It works.
For our homes, for our minds, for our health, and for the Earth.
We help create works in wood'

Cluster background

At the beginning of the 2000s, the wood processing industry in Trøndelag imported timber from Russia and the Baltics. Local timber production could not meet the regional needs. Then access to imported lumber stopped and new channels had to be found. The situation impacted the region severely. Trøndelag now has a complete value chain with sawmills and wood processing industry.

The challenges in the region's forest industry led to the establishment of the co-operation forum 'Forest Industries in Trøndelag' in 2004/2005, formed as a political initiative by the County Council. In the years after its founding, the emphasis was on improved general conditions for the forestry and forest-based industries in Trøndelag. In the wake of the crisis, the initiative appreciated that society in general needed a better understanding of the industry and that meeting places and arenas were needed to discuss and engage around the industry's forward agenda.

In 2006 the local council also participate in the Coastal Forestry project for all counties along the extensive Norwegian coast, from Finnmark to Agder, over 1,500 km. The collaboration

was based on three main pillars: a joint political program at regional level, a collaboration between the coastal forest industries and the formation of a group of forestry specialists within the county´s administration. The forum 'Forest Industries in Trøndelag' continue to be members of the Coastal Forestry cooperation.

In 2014, the forestry organisations and forest industries in the Trøndelag region produced a proposal for a cluster initiative to be part of Innovation Norway's cluster support program at the Arena level, the basic level. The first proposal for a cluster initiative was submitted in 2015 but was not approved for Arena status. However, the collaboration forum further developed the proposal to include priority projects and was more specific about collaboration for the development of bioeconomy, including R&D organisations and actors active in construction, as new possible development paths for the future cluster. On this occasion, the application went through and in 2016 Arena Skog received cluster status in the Norwegian cluster program.

In summary, the WoodWorks! cluster has the status of Arena PRO in the Norwegian Innovation Cluster program funded by Innovation Norway, Siva, and The Research Council of Norway. It is now in the second period of national support to further develop the cluster and seek new opportunities with commercial, public, and R&D players. Its first period as Arena Skog in the Arena program was from 2016-2019 and it now continues in a second period as WoodWorks! in the Arena Pro program from 2020-2024.

Current Situation

Today, Mid-Norway is a forestry region with a well-functioning and complete industry cluster. The cluster includes forestry and forest industry, pulp and paper industry, sawmills, bioenergy production, prefabricated houses and nearly everything to produce timber houses.

The forest industry in the region has had a better rate of development than the rest of the country in the period 2011-2018 and exceeded Euros 1.1 billion in production values in 2018, a 23% growth since 2008, compared to 5% at the national level.

WoodWorks! has, since its inception in 2016, built up a unique position and a large network and has taken on a role in coordinating the collaboration between business, R&D actors, the authorities, and other partners. The cluster represents the entire forest and wood value chain end users, thus all segments in Porters Five Forces model.

The cluster is developing, and now accounts for more than 75 members. The home base for WoodWorks! is the geographic middle area of Norway, but it has members and projects throughout Norway, and is becoming more involved in international cooperation and

project development. This is due both to global market trends and cooperation on innovation and production.

The vision of WoodWorks! is to contribute to solving the global climate challenges. The cluster will identify commercial growth opportunities in the bioeconomy sector, support companies' abilities to utilise these, and thus create restructuring and sustainable growth in existing and new value chains.

The focus is on the three fields of:

- Wood construction & buildings,
- New areas of utilising wood fibres, and
- Creating added value to the raw material (availability and qualities).

In these three areas, the cluster organisation has over 70 ongoing projects.

The strategy areas are innovation collaboration, development of new competencies, cross-linking value chains, developing new value chains, internationalisation, and cluster development. There are separate working groups for the cluster's focus areas. The working groups are designed to work on solving specific challenges, establishing joint initiatives, or/and planning various activities.

Next Steps

Step 1	Step 2	Step 3	Commersiali-sation	Sustainable profitability
Start-up phase	Maturity and development	Market orientation	3.6 billion euro	7.2 billion euro
Cluster turnover .5 billion euro	.9 billion euro	2.4 billion euro		

Through to the end of 2021, the cluster has been organised as a project by the Coastal Forestry initiative, covering all counties along Norway's extensive coastline.

From the start of 2022, WoodWorks! will be formalised as an independent cluster organisation with a separate legal entity - The WoodWorks! cluster. Three-quarters of the new board will consist of representatives from the business enterprises, with at least one representative from research and educational institutions and a minimum of one from public agencies. This triple helix structure will ensure that the WoodWorks! cluster represents the entire forestry industry chain.

The existing cluster organisation team consists of:

- CEO / Cluster Manager who has 26 years of experience in public administration with forestry and forestry industry and networking, four years´ experience of management of business and network development, five years of experience of cluster management.

- Six project managers (approx. five FTEs) with broad experience of management in the wood industry, forestry companies, construction and other industries, management in R&D, R&D projects, networking, and cluster management.

15. ROMANIA

Transylvanian Furniture Cluster Cluj, North West Romania	
Main products	Home & office furniture: chairs, tables, sofas, desks, cabinets, upholstered…
Cluster web site	https://transylvanianfurniture.com
Cluster members	2012: 23 members 2021: 88 members incl. 64 companies
Cluster staff	2012: 5 2021: 10
Exports	2015: 121.800 Euros 2021: 555.900 Euros

Cluster background

The clustering initiative was started in 2012 at the initiation of the Regional Development Agency, to upgrade competitiveness and to develop export markets. The manufacturing of furniture evolved from the local availability of timber. Cluster membership is triple helix, including educational and research institutions. A management team of 10 covers project management, business development and internationalisation. The Board is company representatives.

Challenges that the cluster has faced include unfamiliarity by national agencies with regional clusters, a lack of business interest in R&D and business hesitation in entering a first export market.

An important measure of success for this clustering initiative is the award, by the European Secretariat for Cluster Analysis, of Gold Label status in 2017 and renewal in 2019.

Current situation

The initiative has been successful in securing funding through a range of EU supported programmes. Projects include:

- Missions to export markets.
- Ergonomic chair design.
- Accelerated aging of wood surfaces.
- Furniture supply chain integration.
- Training young designers and Entrepreneurial training courses.

Should funding allow, a Centre for Excellence in Furniture will be established providing prototype facilities, enabling rapid testing, and supporting digitalisation and circular economy competencies.

The furniture cluster engages, when relevant, with other clusters that their Regional Development Agency is supporting IT, Creative, Energy and Agro Food. An increasingly important partner in the regional ecosystem is the Transylvania Digital Innovation Hub.

The cluster is proactive in linking with other furniture clusters across Europe. A 'Furniture Go International' project brings together European clusters to collaboratively engage in third markets, including the USA, Canada, and South Africa.

A second international collaboration, again with EU support, is the *'Furniture and Woodworking Cluster Partnership'* that links seven regional clusters from six countries:

16. SPAIN

Basque HABIC Cluster Habitat, Wood, Hospitality & Design Bilbao	
Main products	Interior furnishings for home & offices including furniture, lighting, floors & ceilings, security systems, air conditioning systems ...
Cluster web site	https://habic.eus
Cluster members	2021: 119 members
Cluster budget	2021: 1.3 million euros
Cluster staff	2021: 8

Cluster Background
Basque Country is a well-recognised pioneer in cluster development. It was an early adopter, following visits by Prof. Porter from Harvard in the early 1990's. The Basque Country continues to evolve its approach to cluster-based economic development. Currently, sixteen clusters are under development.

The HABIC cluster was established in 2009, based on a furniture industry association. With the encouragement of the Basque Government, the separate Wood Cluster (https://habic.eus/wood) was merged with HABIC, which already included furniture manufacturing.

In the Basque Country, 60% of forestry is radiata, with forestry ownership 50/50 government and private. Many of the timber stands have been pruned.

A decade ago, a crisis ensued when timber prices dramatically fell. A tornado in southern France had resulted in the timber market being flooded. The Basque Government then significantly changed it approach to forestry. Instead of forestry being led by the producers, the processing industry took the lead resulting in a very different, market-driven focus.

Wood!
'The most abundant raw material in our territory.
We work on the creation of greater added value,
in solutions oriented to design and architecture'

HABIC describes itself as *'The link between the different agents of the value chain.'*

Current Situation
Today, HABIC's members' export 45% of their production, with half of exports going beyond Europe. The cluster's agenda has evolved to include developing new solutions for urban areas and outdoors, additive manufacturing, industry 4.0 and surface coatings.

As well as developing technical competencies, HABIC has been organising joint participation in trade fairs and also direct and reverse trade missions to and from Argentina, Chile, Colombia, Egypt, France, Germany, Italy, México, Perú, South Korea, Sweden, UAE, U.K. and the U.S.A under the **'Basque Living'** brand. This is a brand developed by HABIC to promote all members and their services.

A major development has been the establishment of **'Basque Living'** Collaborative Showrooms in San Sebastian, Madrid, Mexico City and London, servicing architects and interior designers.

A further Basque Living Space is under development in New York. Each showroom has a business developer in charge and is funded by the companies from HABIC that display their products and solutions in the venue, each with 7 to 16 companies. The Basque Living spaces acts as a magnet and networking hub with local specifiers and clients, offering product presentations, technical workshops and other relevant events.

The London Showroom (photo) is situated in Cl**e**rkenwell, the centre with the world's largest concentration of these key specifiers and buyers. HABIC had the scale to charter an aircraft to take architects and interior designers from London to Bilbao, with participating cluster members covering the costs.

Around 90% of members are SMEs, most based in the Basque County though membership now extends to businesses from nearby provinces in Spain and from southern France, just across the border. The annual membership fee is 1,000 euros, equal for all businesses. No industry associations are members. Three technology centres, two universities and three vocational training centres along with the Basque VET Applied Research Centre (TKNIKA) are also members.

The Basque Government Cluster Support Programme contributes around 18% of HABIC's budget, with member's fees and fees for services amounting to nearly 66% and other local, national and European grants, through competitive calls, 16%.

The Board of 15 is triple helix with mainly business representatives and always business chaired. Three academic institutions are on the board, with voting powers. Government has a senior representative at Board meetings, 'with voice, but no vote'. The cluster's staff of eight includes representatives in Madrid and Mexico City.

HABIC has several working groups and five committees covering a broad forward agenda:

- Technology,
- Internationalisation,
- SDG & Sustainability,
- Marketing/Communications and
- Design.

Cluster HABIC was a partner in 2017 in establishing the largest wooden building in Southern Europe, using CLT radiata beams. This led to the development of apaprtments for social renting.

In response to Covid, HABIC organised a **Basque Living Virtual Fair**. Over two days, the 28 participating cluster members had over 1,000 'visits' and discussions with potential customers in 20 countries. To promote the event, the 28 companies shared their commercial contacts from around the world.

Digitalisation and technology is a major focus for business upgrading; HABIC and its members are currently involved in projects regarding BIM (*Building Information Modelling*), interactive virtual reality for product presentations, embedding IoT into furniture, 3D printing and addressing production costs through digitalisation. As a side effect of Covid, outdoor furniture has become a growth area. One collaborative project is developing outdoor furniture that is WiFi connected.

HABIC is also very active in sustainability initiatives and SDG strategy, with projects on the valorisation of composites waste or Life-cycle Sustainability Assesment services.

Regarding talent development, HABIC is fully engaged with local universities and architecture schools in several initiatives, such as 'Aula HABIC', the development of a Masters Degree in Design, Structures and Building in Wood, and a Masters Degree in Design of Gastronomic Spaces.

The HABIC cluster works closely with the IT Basque cluster (for digitalisation), with the Machine Tools cluster (for specific wood working machinery) and the Automotive cluster (for advice on production techniques and plant layout).

Internationally, HABIC is a founding member of the Furniture & Woodworking Cluster Partnership (FWCP) (https://clustercollaboration.eu/content/furniture-and-woodworking-cluster-partnership) bringing together seven cluster initiatives in the furniture and woodworking sector from six European countries. The main services of the

partnership are exchanges of experiences, knowledge transfer, strengthening inter-regional collaboration and partnerships across EU value chains and beyond, enhancing cluster managers' skills, and developing third country markets, including the US and Canada.

HABIC organises an annual members satisfaction survey. Objectives and projects are determined at the start of each year. A decade ago, 95% of the cluster's projects came from the cluster management team. Today, 95% of projects are determined by the companies.

Furniture businesses still remain the cluster's core. However, the considerable broadening of the membership base has given the furniture businesses, along with the other members, the critical mass to engage internationally, delivering complex solutions and entering the contract market, furnishing large hospital, hotel and other public and corporate buildings, including airports and conference halls.

17. SLOVENIA

Wood Industry Cluster - Lesarski Grozd Ljubljana	
Main products	Sawmilling, joinery, prefabricated houses, surface coatings, bio energy, furniture
Cluster web site	www.lesarski-grozd.si/en
Cluster Members	90 business and six support institutions
Cluster budget	Project based
Cluster staff	3

Background

The cluster encompasses one-third of the employees in Slovenia's forestry and wood processing industry, together with key research institutions. A wide range of businesses are supported, with the prefabricated housing companies developing strongly. The cluster has a close partnership with the Wood and Furniture Industry Association at Slovenian Chamber of Commerce and Industry; the cluster's emphasis is on business competitiveness; the Association's on lobbying and industry policy.

The initiative was started by the Ministry of Science in 1999 as a wood technology centre. When the financing for the technology centre failed to materialise, the proposal transformed into a clustering initiative. Subsequently, a national program to support clusters was launched. As with the other clustering initiatives established at that time, the Ministry terminated financial support in 2005.

The Wood Cluster was one of a few to continue, as companies valued the support. Members pay an annual fee, but this has been insufficient to support the cluster organisation. The cluster has successfully pivoted to developing and managing projects that offer financial support, particularly from the EU.

Since 2015, the cluster has been cooperating closely with the Special Directorate for the Wood Industry at the Ministry of the Economy, as wood has been declared as strategic material for Slovenia.

Current Situation

The focus is on needs-driven, collaborative projects. Priorities are innovation, circular economy, training, and the internationalization of cluster members, including trade fair participation.

Some examples of collaborative projects:

- Skills development, training; establishing a competence centre for woodworking 3.0
- Improving competitiveness in the context of climate change and transition to a low-carbon society
- Smart Specialization of Slovenia in smart wooden buildings
- Establishing a catalogue of investment opportunities in the forest-based sector
- Development of acoustic wooden doors for indoor applications
- Development of timber windows with thermally modified spruce.

The cluster has achieved Silver Status with the European Secretariat for Cluster Analysis.

The cluster has been proactive in connecting with related clusters across Europe, and their research institutions.

18. SWEDEN

Paper Province Karlstad, Värmland	
Main products	Paper, packaging, engineering companies, service providers, construction companies, energy producers, sawmills
Cluster web site	https://paperprovince.com/en/
Cluster members	1998: 7 companies 2021: 125 companies
Cluster budget	1998: Euros 20,000 2021: Euros 2.2 million
Cluster staff	1998: 1 2021: 16

Paper Province (PP) is today a world-leading business cluster within the forest bioeconomy.

Cluster Background
The initial inspiration for the clustering initiative came from a 1998 visit to the region by Clive Vokes, an economic development specialist from Wales. The visit was organised by Sune Nilsson from the region's Economic Development Agency, an agency co-funded by all five municipal governments. Sune had forest industry experience. Subsequently, Sune participated in discussions on regional development at a Stockholm seminar.

Sune then engaged six of the largest forest-related companies in the region to be part of the foundation of the initiative and named it 'The Paper Province'. The founders agreed to an initial commitment of 150,000 euros as start-up funding.

During 1999 there was a substantial decline in the national economy and in the pulp and paper sector, followed by corporate closures and industrial cuts. During this period, many negative things related to the forest-based industry sector happened in the Värmland region. Meanwhile, the ICT sector was booming with enormous public interest in the ICT industry and national investments in ´the new service economy´. This led to great difficulties in recruiting competent staff and in finding interested partners in cross-connections between the forest industry and other areas.

At the same time, major structural changes were underway in the industry globally, which led to several headquarters and development resources being closed or moved from the region to Stockholm and further afield. The forest industry was viewed in economic and political contexts as a *´sunset industry´*.

This led to a crisis both regionally and nationally. The forest industry had for the past 150 years been the backbone of the regional and national economy. It was suddenly seen as an industry in decline. Companies as well as the regional authorities came to realize that they needed to take action to rectify the situation, and that companies - large and small - could not change the situation in isolation.

In the end of 1998, the cluster initiative was set up by the Economic Development Agency and financed by the municipalities and regional authorities for the first three years. As a result, the steering committee was +50% represented by politicians. After the first 18 months, the company representatives were dropping out of the board meetings, as there was a substantial gap between what the political majority thought was the right way to act and how the company representatives wanted action to be taken. This situation created a significant obstacle to the process of cluster development.

In early 2002, both parties agreed that it was time for the project to become a legal entity owned by the cluster members and dominated by the companies. As the name indicates, there was a strong focus on the pulp and paper industry, including mills, machinery, equipment, engineering firms and other consultants. The forestry and wood processing industry were in essence excluded.

If the first three years, the cluster was very much focused on internal matters, such as how to find ways to organize and testing concepts, defining needs, and figuring out how to address them as a cluster organisation. There was not that much knowledge about cluster development at that time in Sweden. The following years saw improved conditions for progress, aided by a struggling ICT sector and better economic conditions for the pulp and paper industry.

The main products during these first 10 years were: pulp & paper (mainly packaging materials and including a world-leading exporter of liquid board) together with machinery for pulp & paper mills. Over 90% of production was exported.

PP started in 2000 with inventories of what was needed to be done change the ´sunset industry´. A 100-Point List was established, including marketing activities, and organising of a relevant regional education system. An early highlight was a first visit to the region in 15 years by Sweden's Minister of Trade and Industry.

During 2003 - 2010, the cluster organisation arranged breakfast meetings at member companies, research lunches with representatives of Karlstad University, meeting arenas with regional union leaders, meetings with the MP´s from Värmland, and trips to Brussels and the EU organisations to present the Paper Province cluster initiative. Social connections were furthered across the cluster during 2010 – 2013 by breakfast meetings, Paper Makers Nights and establishing development teams such as for HR managers, development engineers and maintenance managers.

PP developed collaboration with the regional education system from preschool through to university and formed the preparatory work for a project to promote the future needs of technology- interested students, with the university taking responsibility for the long-term operation. PP also collaborated with other regional cluster initiatives on issues such as gender equality and skills development. PP organised and commissioned training based on common needs of the companies. It created a test bed in paper & pulp, The Packaging Arena AB. It arranged study trips and participated with stands at several annual international fairs under the Paper Province trademark. It also organised journalism trips to the region for the international business and the industry press, to share the success story of the ´**Hollywood of Pulp and Paper´: THE place to be'.**

The cluster organisation was, among other things, deeply engaged in the development of a new national education level and the region become a pilot region for the polytechnic education level. A vocational training centre was established, Karlstad Teknik Centre, in cooperation with the community of Karlstad with a focus on process technology and process design. As part of community engagement, PP created 'Fiberteket', a playground for technical experience for technology enthusiasts of all ages at the local museum.

PP was constantly seeking collaborations with other cluster actors in and outside the region. PP arranged an annual event with a national reach, based on the cross-connection between ITC and Pulp and Paper, 'The ICT Meeting for the Forest Industry'. It actively participated in the EU's programs concerning cluster development (DG Enterprise and DG Regions) and in the national contexts organised by Vinnova (Sweden's Innovation Agency) and the Swedish Agency for Economic and Regional Growth.

PP also collaborated with researchers at the Stockholm School of Economics within the framework of the European Cluster Observatory project. All these efforts were focused on the goal of establishing a position regionally, nationally, and internationally as **THE** cluster of pulp and paper technology.

A testbed, Packaging Greenhouse, was established with a separate legal entity. This testbed, with four employees and a turnover of, on average, 400,000 euros per year, was set up

because of the closure of Metso Paper's paper machine R&D Centre 2005. The testbed business was sold to a private engineering company in 2012.

In 2013, Paper Province was selected for Vinnova's development program Vinnväxt, in which the organisation was guaranteed public co-financing for up to 10 years, if the program's objectives and sub-goals were met during the period.

Current Situation and Beyond

The Värmland region hosts more than 200 companies related to the bio economy and is a national resource for developing the forest industry sector. Examples of how the cluster actors connect to each other and to the local and regional society include:

- Paper mills delivering waste heat to surrounding neighborhoods for central heating,
- A company producing soil improvement products from mill waste,
- An open test bed enabling companies to develop and scale up technologies to refine lignin into more climate-friendly fuels, chemicals, and materials.

As a Vinnväxt project, Paper Province has combined its two main development areas: the regional cluster, and a global innovation node in forest bioeconomy. The Vinnväxt mandate and support has enabled Paper Province to transform from a more traditional, network-based cluster into an innovation cluster (and what is sometimes called a 'system integrator'). Importantly, this mandate has enabled Paper Province to transform the regional ecosystem and even more critical it allows Paper Province to co-create with companies and stakeholders in the innovation ecosystem. National and regional policy has in this case accelerated the development of Paper Province, coupled with the development of an innovation ecosystem that is taking shape around the cluster.

The challenges to be tackled are (as for most cluster organizations) to find funding conditions for the further development processes and projects. For PP members, over the past few years, it has been possible to increase the approx. 100 000 euros in membership fees by 7 million euros in total project financing. But this is of course one of the tasks that a cluster organization must tackle and EU funds are a great possible source of co-financing for organizations in Europe.

Financing is available (at least in the EU or national level I Sweden) if you do the right things, but a challenge is to find a balance between companies' expectations on the one hand and the need to focus on change and innovation on the other. Based on the Vinnväxt funding (of up to 800,000 euros/year for 10 years) the timing was right to take the next steps in development, following the needs to transform the forest industry sector to meet the new global megatrends and to contribute to the necessary shift to a fossil-free society.

The strategy chosen was to clearly point out the development trends that were made visible to the companies through external monitoring and analyses, to challenge the companies to take new steps to meet the newly known and the yet-unknown possibilities in the market.

The strategy led to two clear transformation areas:

Transformation 1. Towards a forest bioeconomy, opening for value creation between value chains and co-creation between industry sectors.
Transformation 2. From a focus on traditional cluster activities (skills supply, process technology, etc.) to becoming an intermediary in the gap between business, society actors and R&D actors, to contribute to faster innovation processes leading to new collaborations between different areas of knowledge, and result in new research, new development, and new companies in new areas within the bioeconomy.

Through the Vinnväxt program and the development of various needs-adapted development projects that companies can take part in, PP has changed from supporting individual regional companies' needs to collective efforts within a knowledge area, with joint value creation.

All projects are created to involve companies and to meet collective challenges. This means that several, even competing companies, can together find new solutions for the development of their company and the development of their industry. The model is based on the ability to cooperate, based on trust in both the parties' ability to cooperate, even if, at the same time, they are competitors in certain contexts.

To be able to keep the orientations of the various projects aligned, PP evaluates all project ideas so that there is a direct link to PP´s vision and action plan, providing a clear management strategy.

PP has also made a strong contribution to transforming the system of regional innovation support. PP has changed from having no given place in the system at the start, just over 20 years ago, to currently holding a central role in the innovation system. The regional authorities have clearly pointed out the forest bioeconomy as one of the region's strongest development areas, with the greatest potential for both business development and for the development of the society in general. The cluster organisation now has a given place in the regional innovation system as an actor, as a reference body and as an enabler of profiling the region nationally and internationally.

This has led to 38% of the regional economic investments being made within the forest bioeconomy innovation system, in recent years in the Smart Specialisation Program. In addition to the investment in PP as a cluster organisation, this includes both investments in research at Karlstad University (Pro2BE) and the development of test beds, e.g.

- 3D print technology with cellulose-based media,
- Ligno City in the field of bioenergy, in partnership with RISE,
- Test bed for fossil-free laminates, FFLAM.

The positive development work goes hand in hand with industry investments in the region that take place continuously, and which, in recent years, have involved mainly the large companies developing the existing packaging paper industry (with investments of about 1 billion euros) and in the wood industry (with a 50-million-euros investment in a completely new manufacturing industry for cross laminated timber/CLT).

At the same time, start-up companies and international investors are establishing themselves in the region to take advantage of the opportunities offered here. A recent example is the spin-off company, Lixea, that was originally established at Imperial College, London. Lixea has invested E 2.5 million in a pilot plant for production of biomass products. Lixea sought the benefits of being in the forest bioeconomy region of Värmland.

PP will continue with its the focus on cluster development in collaboration with the regional actors. The cluster organisation is well established in the region, and a strategy is now being developed to extend PP´s vision to included regional cooperation in the whole Mid Sweden region, and at the same time to continue to connect the actors to a well- developed national, and not least, international cooperation that benefits the companies in the new forest bioeconomy.

It is important to be able to offer companies in all categories - especially the startups and scaleups - the tools and knowledge to reach international markets. Within PP's sphere of capabilities and knowledge, a company should not have to move abroad to verify an innovation / idea for an international market.

19. SWEDEN

RI.SE Processum AB Örnsköldsvik, North Sweden	
Main products	Bio economy, bio refinery
Cluster web site	https://www.ri.se/sv/processum
Cluster members	2021: 21 companies
Cluster budget	2021: Euros 4 million
Cluster staff	2017: 19 2021: 32

Cluster background

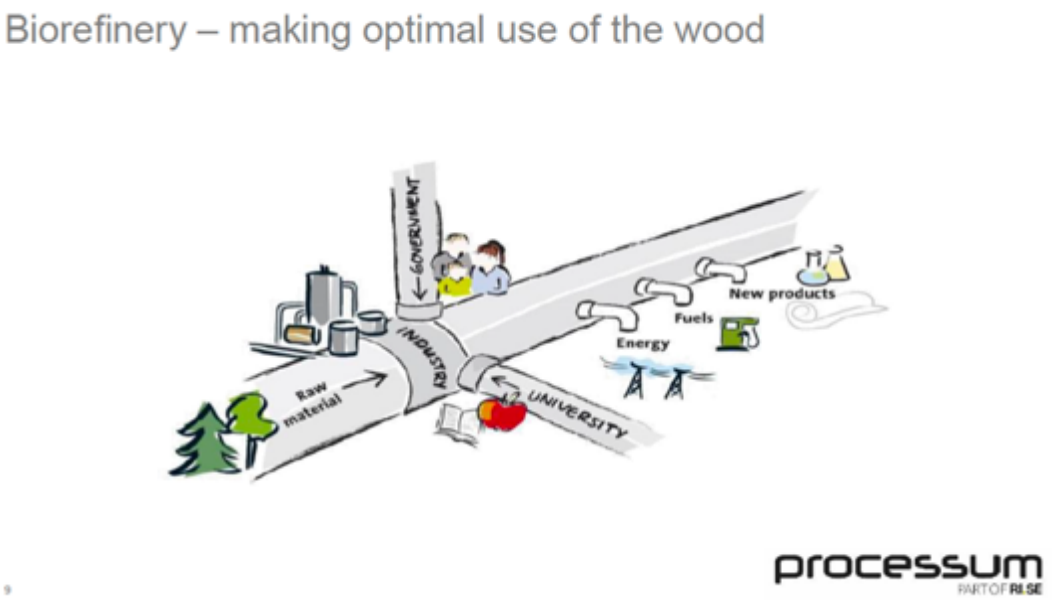
The Örnsköldsvik region in northern Sweden faced a serious downturn in the pulp and paper industry in the late 1990s. Businesses were closed, downsized, relocated to more central regions of Sweden or acquired by global corporations. This resulted in the loss of around 5,000 jobs in a region with a population of 56,000.

The regional decline instilled urgency amongst the local actors to create new industries and jobs in the region. The community's mayor was particularly active in bringing people together to discuss options based on the available timber resource. The concept of generating new activities centred on a novel biorefinery initiative, together with the increasing awareness of clustering initiatives, paved the way for a regional biorefinery cluster in the Örnsköldsvik region.

Processum was initially launched in 2003 as Processum Technology Park and has since evolved into a cluster initiative for development, upscaling, and commercialization from ideas to finished products and production processes.

With access to a large biorefinery equipment and a large network within academia and business, Processum connects individuals and companies with good ideas to relevant partners, helping them to test their ideas, commercialise and scale up ideas into production processes.

The Processum Bio Refinery Initiative AB became in 2005 a cluster initiative with companies that wanted to collaborate following the dissolution of Modo AB and the closure of the plant producing bleached pulp through the CTMP process. This member-driven cluster initiative took over Modo's empty premises with the ambition of developing skills in the process technology area. An interest group was formed with about 20 companies that started the development initiative Processum, with a focus on chemical conversion and biotechnology with research groups that support companies with ideas and processes.



The application for Vinnova's Vinnväxt programme (Sweden's national cluster support initiative) was accepted and in 2008 Processum became a Vinnväxt winner with the project **'Biorefinery of the Future'**. Vinnova's funding was Euros 600,000, a year, committed for ten years. Regional actors matched the central government. In 2011, construction began on a pilot park with equipment to be able to scale up ideas in the biorefinery area.

In 2013, Processum sold 60% of the share capital to SP/RISE, a state-owned research institute, with the cluster companies holding 40%. That year also marked a milestone, with 100 different development projects completed or underway since the start 2003.

In 2018, after 10 years, the Vinnväxt project came to its end. During the project the average yearly turnover has been 2.35 million Euro. An extra 1 million euros annually were provided by EU structural funds, member companies and public and private research funds (regional and national). All these activities were concentrated on biorefining R&D and cluster development.

After 2018, Processum continued to develop. Örnsköldsvik and the Västernorrland region continue to support the initiative, which is also part of the regional Smart Specialization strategy for Västernorrland. Other activities under this strategy include Advanced special production, Renewable energy, Govtech, Complex production and Operating systems.

Current situation

Processum is now owned by RISE Research Institute of Sweden and 22 companies. It cooperates with other biorefinery initiatives, industry partners and academic institutions to develop new products, processes, and energy solutions from wood raw materials and residual streams from other industry processes. Processum's scope include textiles produced from wood fibres, green chemicals, biofuels, animal feed, enzymes, and gelling agents.

The companies pay an annual membership fee and a service fee to the association. Companies are highly involved with the initiative through regular seminars on technical topics and member meetings. New projects continue to be initiated. The largest share of project financing now comes from EU projects, with companies participating with in-kind financing or with cash.

Start-ups are supported through the incubator Biz-maker Forest Business Accelerator with a facility in Örnsköldsvik (https://bizmaker.se/en/forest/)

At the Processum Tech Park, MoRe Research Örnsköldsvik AB is also active, a neutral and independent research and development company in the field of products and processes for e.g., the forest industry. MoRe is owned by RISE. In 2020, the Swedish Government allocated RISE 35 million Euro over two years, to intensify work on sustainable solutions in the bioeconomy. With the investment, RISE is now substantially scaling up to establish a world-class centre with test beds for biorefinery in Örnsköldsvik and the Processum area.

The biorefinery investment in Örnsköldsvik will include resources such as a visitor centre, innovation node and a cluster investment in bioeconomy. Construction is scheduled to start in early 2022.

The regional universities, the regional financing bodies and development authorities are not represented on Processum's Board. However, the cluster co-operate intensively with these actors of the helix as well. They take part in activities such as membership meetings and project meetings. Thus, the structure is open to all parties of the Triple helix cooperation. Non-member companies can also be part of the structure at several levels. However, the only formal owners are RISE and 'Processums Intresseförening' (the cluster association).

When the clustering initiative started, no university was present in the region. Today, five universities have PhD students based in the region, adding to the core knowledge. Further evidence of success came with an Indian textile major with facilities around the world, Aditya Birla, acquired in a local company, Domsjö Fabriker, as its global facility for cellulose, bioethanol, and lignin products.

The cluster plays an important role in the development of the Bio refinery initiative. It will continue to focus on product development in areas such as organic chemistry, biofuels, and related technologies.

20. SWEDEN

Smart Housing Småland Växjö, Southern Sweden	
Main product areas	Industrial production of timber houses & flat glass
Cluster web site	https://smarthousing.nu
Cluster members	70 organisations/companies
Annual budget	2 million €
Cluster staff	Eight

Cluster background

An important part of Småland's industrial history is linked to wooden houses and the glass industry. The Småland glass industry has its roots in 18th century iron handling. There were hundreds of glass factories in the region, many of which became world famous during the 20th century. Today, there are only twelve left. One is Kosta, founded in 1742, as a glass works manufacturing wine glasses, bottles, jars, and window glass.

The production of prefabricated wooden houses has long been concentrated in Småland. An inventory carried out in 2001 shows that there have historically been more than 77 companies linked to the housing industry in Småland, many small and existed for a short period.

Most of Sweden's housing companies are represented in the Småland wood and glass cluster. Together, they make Sweden a pioneer in sustainable industrial wooden house construction. The market for Småland's products is developing as the market for multi-dwelling wooden houses has grown rapidly in recent years in Scandinavia. The growth potential of the region's bioeconomy is reflected in this trend. For example, the forest industry group, Södra, invested in a pilot plant for cross-laminated timber (CLT) that is now being developed into a full-scale plant. Before it was even finished, Södra wished to expand their investment for an even bigger production plant on the same site. Thus, it will be Scandinavia´s largest manufacturer of CLT, and the CLT is suitable for tall buildings.

The cluster initiative started with two different applications to Vinnova's national cluster support programme, Vinnväxt; one from the glass research institute (Glafo, now RISE)[8], and one from Homes From Sweden/SP (also now RISE) focused on industrial processes for wood construction. One plan was to develop the traditional glass industry in Småland (with window manufacturers such as Elitfönster) and the other was to develop the traditional house building industry (for example, Myresjöhus) in Småland and to develop industrial wood construction.

Vinnova evaluated both applications and encouraged them to develop a joint application, which led to the Smart Housing Småland concept. With the combined application from Småland, they became winners in Vinnova's Vinnväxt competition in 2013 and now run the project with local/regional and Vinnova co-financing in a ten-year development project totaling up to about 20 million euros.

The initiative has been driven by research institutes, headed by people who had a good overview of the industry's development potential and the enthusiasm to want to change the traditional companies' manufacturing and marketing processes. Cluster manager (CM) from the start was Per-Erik Eriksson. In 2015, Mikael Ludvigsson took over as CM until 2020 and thereafter Kirsi Jarnerö took over as CM.

Current situation

Smart Housing Småland is a cluster initiative built on three main development areas: Society, Business and Innovation & Knowledge. It is organised from a triple helix perspective to ensure commitment from all actors in the cluster investment.

The aim of the cluster organization is to bring together the cluster companies and connect their innovation needs with the various actors in research, in areas such as digitization and automation, that will contribute to more resource-efficient production.

The organization has set challenging goals to achieve within the framework of the Vinnväxt project (10 years) and beyond:

- Continuous development of digital processes and adaptations in planning processes, industrial production, construction processes, construction, and user-centered design.
- Support academic breadth and excellence in the three areas of interest with a focus on wood and glass.

[8] RISE is also involved with the Processum clustering initiative.

- In-depth collaboration with a focus on innovation between companies and academia.
- Exchange at national level with competencies in housing, architecture, and community building.
- Establishes 'open innovation' around construction in wood and glass.
- New ways to combine wood and glass.

In the medium term (5–10 years):

- Collaboration and innovation capacity have been strengthened between players within Smart Housing Småland in strategic partnerships.
- Innovation-oriented partnerships between Swedish and foreign actors.
- Established contact with other international innovation environments.

In the long term (> 10 years):

- Consolidate the position as an internationally leading node around housing and a sustainable built environment based on glass and wood through global strategic alliances in research, education, and market development.

The initiative has thus started based on the Institute SP (now RISE) and the companies have mainly been recruited through workshops, research, and development projects, and through the organization of events/meetings.

The holding of show homes is being developed to showcase new solutions, develop new products, and create new arenas for collaboration for community development.

Since 2015, the focus (in addition to the regional and national initiatives) has more and more included internationalization, when the groups have been involved in e.g., the EU Baltic Sea Region, and have established collaborations far outside Europe, including with Prefab Homes Australia.

From the start, there were 11 people in the organizations process management, mainly from the public sector, with meetings held every six weeks. This first process management was distributed among the different triple-helix actors, some of whom had a role as observers. At present, however, there is a more streamlined process management consisting of eight people that have more operative roles, reporting to other representatives in a board and a reference group.

The process management is responsible for all processes but has a reference group acting as a support body to ensure relevance in developed projects. There is also a board group with representation from society, business, and academia. The board ensures environmental strategy and the financing of projects.

Smart Housing Småland is now in the last phase of the Vinnväxt programme with Innova financing, which ends in June 2023. With the current financing, the innovative funds are

balanced with the corresponding regional funds (as counter-financing). There is also a small proportion of co-financing by several industry organizations/associations and some of the largest companies. The companies' participation otherwise takes place through various projects in which they participate either with time (in kind) or with money, but no member fees or service fees are collected.

The big challenge (for all Vinnväxt winners) is how the organization, and its work can continue without the large proportion of Vinnova funds that have been contributed over 10 years.

The management of Smart Housing Småland has been proactive, planning well in advance for its strategic development, post Vinnväxt. Through several workshops with 70-80 participants, some "strategic orientations" have been developed which they now intend to transform into a business/development model that will lead to Smart Housing Småland continuing to be an important player for the house and glass industry development in the Småland region and beyond.

The challenges are that the process/business model needs an "engine": a cluster management that develops the project. For this, a financial base is needed, mainly to transition out of the Vinnväxt program, and a new financial model. Regional and local co-financing is sought in collaboration with interested business actors.

To complete the transition, it is now intended to apply for funding within the framework of the EU's The Green Deal and the New European Bauhaus program, in which funding is applied for as one of FIVE Lighthouse projects in Europe.

The idea is to gather actors based on the public sector in regions/municipalities in which a demonstration housing fair is to be created based on innovative projects. It is hoped that urban planners, architects, politicians, and companies will come together to solve a local challenge in urban construction. Smart Housing Småland is already conducting a pilot project in collaboration with the regional government, with a demonstration housing show being developed - BY2030 (Village2030).

21. SWEDEN

Manufacture with Wood / Tillverka i Trä Trollhättan, Västra Götaland County	
Main product areas	Wood construction, furniture, interior design
Cluster web site	https://www.tillverkaitra.se No English version available
Cluster members	34 companies
Cluster staff	5-10

This is a three-year project with a budget of 1.9 million euros. It is a project administered by Innovatum Science Park.

Manufacture with Wood (Tillverka i Trä) is an initiative from the wood construction industry and the wood-based interior design and furniture industry to develop circular processes and business models for better resource use.

By developing and using competence in automation, robotics, and design, it aspires to create innovative, efficient, and sustainable wood production for the future.

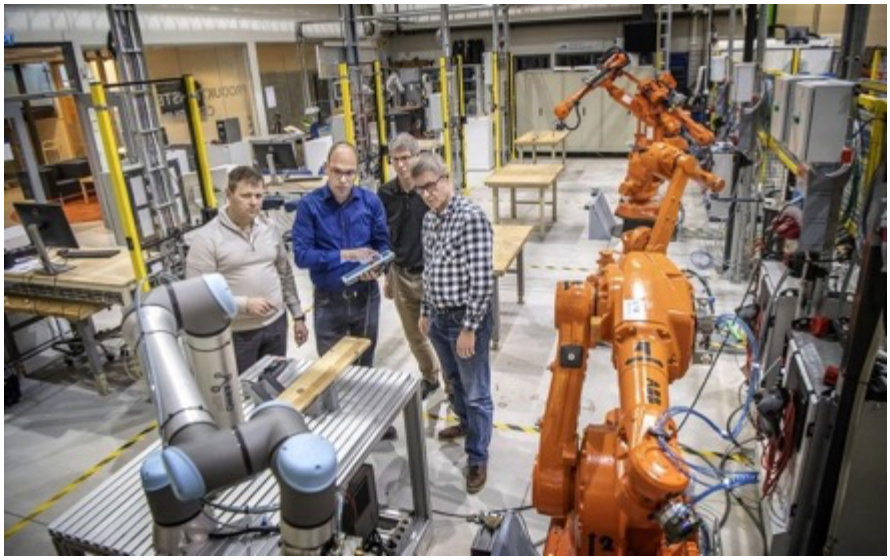
The region hosts both the car (Volvo's home) and the aerospace industry. The project owner, Innovatum, has already developed a competence center and test bed for these sectors in one of its assignments. That has created the opportunity to cross-fertilize needs and knowledge from the car and aerospace industry into the development of the wood-based industry processes in areas such as automation, digitization, industrial logistics etc.

Manufacture with Wood is a project that started in 2019 based on an investigation of Region Västra Götaland's industrial structure, where it turned out that the wood industry had more turnover than the car industry, but also that the wood industry needed transformation through innovation, based on competition and processing opportunities.

Within the framework of the project, an industrial network of companies was created, offering study visits, seminars, meeting places, skills development, project development resources, demonstrations, and test bed applications.

Manufacture with Wood has created development groups based on eight different areas of special interests, each based on common challenges or requests from companies.

- Digitalisation and BIM,
- Logistics,
- Production strategies,
- Building with CLT (cross laminated timber),
- Efficient window mounting,
- Implementation of innovations,
- Using tools from CAD to robot coding and
- Operator information with AR (augmented reality) to VR (virtual reality).



Next year, phase one of the project will end. There is an opportunity to receive further financing, and the application is under evaluation.

The network initiative of companies will formalize their cooperation in January 2022, with Innovatum as a host.

The network will be financed by the companies for a service fee, based on the individual company's size (approx. 50,000 euros as startup money). The network continues to offer an upshift of the service fee through new needs-based projects in cooperation with University Väst, Trollhättan, the regional and the local public sectors and the industry - triple helix in practice - but intends to work in a national perspective.

Within three to five years, the network intends to transform into a formal cluster initiative.

22. FURTHER EXAMPLES, INTERNATIONAL CLUSTERS

The case studies cover eighteen clusters in thirteen countries.

Many other clusters around the world are involved in adding value to wood, some with a construction focus, others with a bioenergy focus, some with a furniture and interiors focus. A further 24 examples of adding-value-to-wood clusters are identified here.

Brief comments then follow on the absence of forestry related clustering initiatives in British Colombia, Quebec, USA, Chile, and Australia.

Further International Examples Wood Related Clusters	
Austria	Wood Cluster Styria https://www.holzcluster-steiermark.at/en
Belgium	Cluster Eco-Construction, Namour https://clusters.wallonie.be/ecoconstruction/en
Czech	National Wood Processing Cluster, Ostrava http://www.wood-cluster.cz/en/o-klastru
Croatia	Wood Cluster Slavonian Oak, Vinkovci https://slavonski-hrast.com/en/about-us
Estonia	Digital Construction Cluster, Tallinn https://estoniandcc.com
Denmark	We Build Denmark, Albertslund https://webuilddenmark.dk/english Lifestyle & Design Cluster, Herning https://ldcluster.com/en/home/
France	Sustainable Materials & Buildings Cluster, Strasbourg http://www.fibres-energivie.eu/en/who-are-we
Germany	Bavarian Forestry & Wood Cluster, Munich www.cluster-forstholzbayern.de proHolzBW, Baden-Württemberg https://proholzbw.de
Greece	Cluster of Bioeconomy and Environment of Western Macedonia https://clube.gr/en/about
Italy	Wood Home Furnishing Cluster, Manzano https://clusterarredo.com/company-overview Innovation for Sustainable Buildings, Calabria https://www.greenhomescarl.it/en

Latvia	Latvian Wood Construction Cluster, Jūrmala https://woodhouses.lv/en/about
Portugal	Sustainable Habitat Cluster, Averio http://www.centrohabitat.net/en
Mexico	Nuevo León Housing Cluster http://www.clusterdevivienda.com/index.php
Norway	Norwegian Wood Cluster, Gjøvik https://www.nwcluster.no/about-us
Slovenia	Construction Cluster, *M*edvode https://www.sgg.si/en
Spain	Bioenergy & Biomass Cluster Catalonia https://www.clusterbioenergia.cat Habitat Clúster Barcelona https://www.hcb.cat/en/qui-som/ Furnishings Cluster, Tarragona https://www.cenfim.org/en/ Sustainable Business Cluster, Canary Islands http://clusterccs.org/what-is/ Wood Cluster, Galicia http://clustermadeira.com/?lang=en
Sweden	Interior Cluster, Växjö https://interiorcluster.se/in-english

All but one of these clustering initiatives are in Europe. While there are many naturally occurring wood processing clusters beyond Europe, there is little in the way of coordinated interventions to lift the competitiveness of those regional clusters.

In Canada, *Ontario's Wood Manufacturing Cluster* is included in the main text as the only case study from the Americas. No adding-value-to-wood cluster was amongst the five Canadian Superclusters winners, sharing $1 billion over five years.

British Colombia has a range of cluster-type collaborative initiatives underway; most are province wide:

- The provincial government has established the BC Bioenergy Network.
- The province also has an Office of Mass Timber Implementation, focusing on low carbon building materials.

- BC provincial government's Tall Wood Initiative is aimed at increasing the use of mass timber construction, especially for buildings over six storeys[9].
- BC has a Pulp & Paper Bioalliance of mill owners.
- The University of British Colombia has strengths in bioeconomy and woody-biomass to RNG pilots.
- A Federal imitative, www.canadawood.org , is based in Vancouver with offices in several Asian countries.
- Also with Federal support, there is a Forest Product Innovations initiative based at UBC Vancouver campus.

Quebec Province has been proactive in developing a *'Wood Use Strategy for Construction in Quebec'*[10]. The province has in the past supported clusters in 'Wood Construction' and in 'Furniture'. Neither intervention appears to still be active.

In the United States, there are many examples of 'Institutions for Collaboration' that bring together triple helix players within a region, but as yet nothing on the scale seen in Europe with 1,500 regional clusters now under development.
However, the U.S. Economic Development Administration has recently launched a $1 billion programme to transform regional economies by investing in industry clusters that generate high-value, inclusive economic growth. The programme is not sector specific. It is expected that $500,000 planning grants will be provided to an initial 50 to 60 regional finalists before investing $25 million to $75 million in 20 to 30 of those clusters over several years.

In Chile, the national economic development agency, CORFO, was heavily engaged in supporting regional clusters in 2008. This built on earlier experiences with competitiveness programmes in specific industries, including forestry.
With the arrival of a new government in 2011, the programme was discontinued. Public policy shifted from specific industries to a more general, horizontal approach.

In Australia, there are many naturally occurring forestry and wood processing centres, such as Mt. Gambier, but no regional clustering initiatives have been identified.
Three of Australia's nationally funded Industry Growth Centres (FIAL - Food Innovation Australia; METS - Mining Equipment Technology & Services and NERA – National Energy Resources Australia) are active in supporting regional clusters within each of their sectors. None of these Industry Growth Centres cover wood processing.

[9] https://news.gov.bc.ca/releases/2021JERI0025-000646
https://www2.gov.bc.ca/gov/content/industry/construction-industry/building-codes-standards/other-regulations/tall-wood-buildings-initiative
https://sustain.ubc.ca/research/research-collections/brock-commons-tallwood-house
[10] https://www.mern.gouv.qc.ca/english/publications/forest/publications/wood-use-strategy.pdf and https://www.archdaily.com/949277/quebec-canada-the-heart-of-mass-timber-construction