EXPANDFIBRE

Accelerating the development of sustainable bioproducts
ExpandFibre (2020-2024) is a 50 M€ R&D collaboration and an Ecosystem launched by Fortum and Metsä Group and co-funded by Business Finland. It focuses on upgrading pulp fibre, hemicellulose and lignin from renewable and sustainable sources of straw and northern wood into new bioproducts. Its ambition is to meet the growing demands for sustainable textile fibres and other added value biomaterials.

The research and development in ExpandFibre, aiming at producing new ground-breaking technologies and smart business concepts, is divided into seven research themes:

- Textiles
- Biocomposites
- Packaging
- Lignin products
- Hemicellulose products
- Sourcing & fractionation
- Other fibre & wood products

ExpandFibre invites actors in these value chains to join in building a world-leading innovation ecosystem to eventually commercialize new bioproducts and green businesses.
ExpandFibre Programmes & Ecosystem

**ExpandFibre Ecosystem**
Projects and organisations aligned with the ExpandFibre vision and themes and funded by Business Finland, EU or by other means

**ExpandFibre Programmes**
50 M€ R&D entity launched and implemented by Fortum & Metsä Group and co-funded by Business Finland + subcontractors

- **Ecosystem Steering Group**
- **Industry**
- **Universities**
- **Clusters**
- **Research institutes**
- **SMEs**
- **Brands**
- **Associations**
- **Other members**

**Projects and organisations**
aligned with the ExpandFibre vision and themes and funded by Business Finland, EU or by other means
ExpandFibre Ecosystem aims at developing novel bioproducts with a reduced environmental impact

**Vision**
New bioproducts based on sustainable biomass contribute significantly to the reduction of the negative environmental impact of our everyday lives.

**Mission**
ExpandFibre Ecosystem strives to meet the growing demand for sustainable bioproducts by developing ground-breaking materials and technologies and smart business concepts.

**Short term objectives (2020-2024)**
- Build knowledge-based competitive advantage among the ecosystem members
- Create/strengthen test-beds for piloting and proof-of-concept validations in the theme areas
- **Identify and fill in gaps** in the R&D landscape within ExpandFibre themes
- Create a thriving business-driven innovation ecosystem for new biomass-based textile fibres

**Long-term objectives (2030 and beyond)**
- Provide markets with new bioproducts that have less than 20% of the carbon footprint of the current products
- Bring new revenue to ecosystem partners through the increasing production and sale of new value-added bioproducts and technologies.
- Significantly increase investments into biomass-based value chains.
Metsä Group

**Purpose**
Advancing bio-economy and circular economy by efficiently processing northern wood into first-class products

**Vision**
The preferred partner in developing sustainable business
Metsä Group | Sales* EUR 6.0 billion | Personnel 9,500 | Renewable energy** 27.7 TWh

Metsäliitto Cooperative | The Group’s parent company | Owned by nearly 100,000 Finnish forest owners

Metsä Forest | Wood Supply and Forest Services
Sales: EUR 2.0 billion
Personnel: 850

Metsä Wood | Wood products
Sales: EUR 0.6 billion
Personnel: 1,700

Metsä Fibre | Pulp and sawn timber
Sales: EUR 2.6 billion
Personnel: 1,400

Metsä Board*** | Paperboard
Sales: EUR 2.1 billion
Personnel: 2,400

Metsä Tissue | Tissue and greaseproof papers
Sales: EUR 0.9 billion
Personnel: 2,500

Metsä Spring | Innovation company

Participating in ExpandFibre

* 2021, internal sales eliminated
** Electricity and heat in total
*** Shares listed on the Nasdaq Helsinki
Fortum Group is a major European clean power and gas company

<table>
<thead>
<tr>
<th>Power and heat</th>
<th>Nuclear</th>
<th>E-mobility charging solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity and fuel trading services</td>
<td>Electricity retail sales</td>
<td>Environmental management and material efficiency services incl. plastic recycling and refining, metals recycling, and ash treatment</td>
</tr>
<tr>
<td>Engineering services for customers</td>
<td>District heating and cooling</td>
<td></td>
</tr>
</tbody>
</table>
Fortum Group is a major European clean power and gas company

- Hydro generation
- Nuclear generation
- Renewables and decarbonization
- Corporate customers and markets
- Consumer solutions
- Circular solutions

(for a cleaner world)
Our biorefineries turn biomass into novel, high-value raw materials for a wide range of industries.
Fortum and Metsä Group aim to inspire a larger ecosystem to join the mission

**ExpandFibre is built upon a strong partnership**

- Both Fortum and Metsä Group have strategic targets to build new and sustainable biobased businesses of considerable scale.
- Focus is on different raw materials (straw for Fortum, wood for Metsä Group) but both companies have multiple complementing capabilities and solutions.

**ExpandFibre Ecosystem complements the partnership**

- The ExpandFibre Ecosystem, consisting of a multitude of bioeconomy players, has a central role in co-creating new technologies and concepts that complement the R&D efforts of Fortum and Metsä Group.
- All projects in the Ecosystem are on the same mission.
ExpandFibre connects to multiple R&D initiatives by Fortum and Metsä Group

- Collaboration with Chempolis and construction of the biorefinery in India (Fortum)
- Demonstration of sustainable straw-based textiles (Fortum)
- Development of novel materials utilising recycled plastics (Fortum)
- Development of a new 3D fibre-based packaging product to replace plastics (Metsä)

<table>
<thead>
<tr>
<th>Sourcing &amp; fractionation</th>
<th>Lignin</th>
<th>Hemicellulose</th>
<th>Textiles</th>
<th>Biocomposites</th>
<th>Packaging</th>
<th>Other fibre &amp; wood products</th>
</tr>
</thead>
<tbody>
<tr>
<td>High material efficiency through fractionation (Fortum)</td>
<td>Converting hemicellulose and lignin into value-added products (Fortum)</td>
<td>Development of sustainable textile fibre from paper-grade pulp (Metsä)</td>
<td>Establishment of Paperboard and Packaging Excellence Centre in Äänekoski (Metsä)</td>
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</tbody>
</table>
### ExpandFibre Ecosystem R&D&I focus points on the road towards the Vision 2030

<table>
<thead>
<tr>
<th>Textiles</th>
<th>Biocomposites</th>
<th>Packaging</th>
<th>Lignin products</th>
<th>Hemicellulose products</th>
<th>Sourcing &amp; fractionation</th>
<th>Other fibre and wood products</th>
</tr>
</thead>
<tbody>
<tr>
<td>• New, sustainable textile fibres for wearable textiles and nonwovens</td>
<td>• Raw material processing and converting</td>
<td>• New pulp-based plastic-replacing packaging solutions</td>
<td>• Lignin fractionation for material applications</td>
<td>• Hemicellulosic sugar refining and separation</td>
<td>• Sustainable, low emission agricultural residue supply chains and networks</td>
<td></td>
</tr>
<tr>
<td>• Staple fibre analytics and performance testing</td>
<td>• Material properties</td>
<td>• Tools and processes for designing sustainable packaging</td>
<td>• Lignin as functional ingredient for thermosetting resins as well as for thermoplastics and bio-composites</td>
<td>• Xylose, pentoses and furfural as industrial ingredients and platform chemicals</td>
<td>• New fractionation technologies for processing of agro-residual and woody raw materials</td>
<td></td>
</tr>
<tr>
<td>• New staple fibre applications and post-treatment technologies</td>
<td>• Recycling and end-of-life</td>
<td>• Barriers and binders based on natural polymers</td>
<td>• Lignin dispersants</td>
<td>• Polymeric hemicellulose as industrial ingredients and platform chemicals</td>
<td>• Process side-stream utilization</td>
<td></td>
</tr>
<tr>
<td>• Recycling and traceability</td>
<td>• Bio-composites containing fibres and lignin</td>
<td>• Additive chemistry</td>
<td>• Novel methods for lignin functionalization</td>
<td>•</td>
<td>• New materials based on pulp fibres and wood for high-volume applications</td>
<td></td>
</tr>
<tr>
<td>• Business models to speed up global market entries</td>
<td>• All-cellulose composites &amp; natural fibre polymer composites</td>
<td></td>
<td></td>
<td>• Novel chemistry for pulp fibre and wood modification</td>
<td>• New bioproducts available to the markets with significantly lower carbon footprint</td>
<td></td>
</tr>
</tbody>
</table>

### Cross-cutting topics
- Replacing plastics and fossil-based materials
- Digitalisation & measuring
- Emerging technologies
- Sustainability assessment
- Design for circularity
- Piloting and test-beds for new applications
- Following regulatory environment

### Vision for 2030
- Investments in commercial production of new bioproducts (textile fibres, biocomposites, other bioproducts, etc.)
- New bioproducts available to the markets with significantly lower carbon footprint
- Sales and/or out-licensing of new technologies related to new bioproducts
- Professionals trained for new bioproduct businesses
- Sustainability awareness increased throughout the value chains
Overview of the Ecosystem*

- **97 Ecosystem member organizations** in addition to Ecosystem hosts Fortum and Metsä Group

- Member organisation nationality:
  - 81 Finnish members (83 %) and 16 international members (17 %)

- Organisation types:
  - Industry: **36 members** (37 %)
    - Large: **12 members**
    - SME: **24 members**
  - Service and/or technology provider: **37 members** (38 %)
    - Large: **5 members**
    - SME: **32 members**
  - Total company members in the Ecosystem: **72** (75 %)
    - Large: 12 + 5 = **17** (24 % of company members)
    - SME: 23 + 32 = **55** (76 % of company members)
  - University: **12 members** (13 %)
  - RTO: **5 members** (5 %)
  - Others: **7 members** (7 %)

*Situation as of Nov 2023*
Overview of the Ecosystem*

- 97 Ecosystem member organizations in addition to Ecosystem hosts Fortum and Metsä Group

- Member organisation nationality:
  - 81 Finnish members (83 %)
  - 16 international members (17 %)

- Total company members in the Ecosystem: 70
  - Large: 17 (24 %)
  - SME: 53 (76 %)

*Situation as of Nov 2023
23 Ecosystem projects*

FinnFiberColor  ValCel  SynBiPro  ECOLABNET

FoN  NUMOBIO  HydBondCell  SUSBINCO

4everPack  telavalue  BIOPROT  FOLD  HiPer  FurBio

SmartRecovery  SUSTAFIT  BioCVal  CERAFIM  GRAM

EXPANDFIBRE  efortum  Metsä

*Situation as of Nov 2023
<table>
<thead>
<tr>
<th>Project name</th>
<th>Theme(s)</th>
<th>Duration</th>
<th>Funding scheme</th>
<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>FinnFiberColor – From cellulose to new Finnish man-made cellulose fibers and sustainably colored textiles</td>
<td>Textiles</td>
<td>02/2021 – 01/2023</td>
<td>BF Research</td>
<td>Aalto, Fortum, Metsä Spring, Andritz, UPM, Kemira, Stora Enso, Orneule, Jokipiin Pellava, Tam-Silk, Sidoste</td>
</tr>
<tr>
<td>LigninReSurf – Novel Fiber Surfaces Functionalized by Lignins</td>
<td>Lignin &amp; packaging</td>
<td>01/2021 – 12/2023</td>
<td>BF Research</td>
<td>Åbo Akademi University (ÅAU), BOKU, IEM, CH Bioforce, St1, MetGen, Mirka, Kemira, 3D Tech</td>
</tr>
<tr>
<td>ValCel – Value for Cellulosics</td>
<td>Textiles &amp; other fibre products</td>
<td>01/2021 – 12/2022</td>
<td>BF Co-innovation</td>
<td>VTT, Univ. of Helsinki, Univ. of Oulu, Kemira, Metsä Fibre, Metsä Spring, Brightplus, Liuotin Group, Pixact, TopAnalytica</td>
</tr>
<tr>
<td>SynBioPro – Synthetic biology as enabler for scalable production of renewable chemicals and fuels</td>
<td>Textiles, lignin, hemicellulose</td>
<td>01/2021 – 12/2022</td>
<td>BF Research</td>
<td>VTT, Tampere University, Fortum, Neste, Kemira, Mirka, Olfactomics</td>
</tr>
<tr>
<td>SynBio powerhouse ecosystem</td>
<td>All</td>
<td>08/2018</td>
<td>BF Growth Engine</td>
<td>VTT, Growing synthetic biology ecosystem of current 1500 connections</td>
</tr>
<tr>
<td>ECOLABNET – Network of service providers for eco-innovation (ended)</td>
<td>Biocomposites &amp; cross-cutting</td>
<td>01/2019 – 12/2021</td>
<td>Interreg Baltic Sea Region</td>
<td>Centria, VAMK, Kaunas Univ. of Technology, Univ. of Tartu, Czestochowa Univ. of Technology, VIA Univ. College, Vilnius Univ., Lithuanian Business Confederation, Labsamera MB, Estrotech Ltd</td>
</tr>
</tbody>
</table>

*Note: Ecosystem projects as of Nov 2023 – listing updated as new projects join the Ecosystem
## Ecosystem projects (2/5)*

<table>
<thead>
<tr>
<th>Project name</th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>FoN – Future of Nonwovens</strong></td>
<td>Textiles &amp; Biocomposites</td>
<td>05/2021 – 10/2023</td>
<td>BF Co-innovation</td>
<td>VTT, Anpap, CH-Polymers, Fortum, Infinitied Fiber Company, Metsä Spring, UPM Kymmene, Suominen, Valmet</td>
</tr>
<tr>
<td><strong>Carbon neutrality empowered by handprint</strong></td>
<td>Cross-cutting</td>
<td>09/2021 – 09/2023</td>
<td>BF Research</td>
<td>VTT, LUT University, Borealis Polymers Oy, Fortum Power and Heat Oy, Oy Hartwall Ab, HyXo Oy, Höyrtyys Oy, Konecranes Oy, Martela Oyj, Neste Oyj, Urbaser Oy</td>
</tr>
<tr>
<td><strong>NUMOBIO – Advanced NUmerical MOdelling for rapid development of BIOcomposite applications</strong></td>
<td>Biocomposites &amp; cross-cutting</td>
<td>09/2021 – 09/2023</td>
<td>BF Research</td>
<td>VTT, Tampereen yliopisto, Metsä Fibre Oy, Huawei Technologies Oy (Finland) Co Ltd, Primo Oy, Parlok Oy, Procomp Oy, Block Solutions Oy, Nature Line Cutlery Oy, Elastopoli Oy, Muoviteollisuus ry</td>
</tr>
<tr>
<td><strong>HydBondCell – Control of hydrogen bond formation in cellulose structures - one application area a biomaterial-based filter membrane</strong></td>
<td>Textiles, other fibre products &amp; cross-cutting</td>
<td>09/2021 – 02/2023</td>
<td>BF Research</td>
<td>Tampere University, Mirka Oy, Fortum Power and Heat Oy, Teho Filter Oy, Filterpak Oy Ab Ltd, Eagle Filters Oy, Nanoksi Finland Oy, Valmet Technologies Oy</td>
</tr>
<tr>
<td><strong>SUSBINCO – Sustainable Binders &amp; Coatings</strong></td>
<td>Biocomposites, Packaging &amp; Hemicellulose products</td>
<td>09/2021 – 11/2023</td>
<td>BF Co-innovation</td>
<td>Åbo Akademi University (ÅAU), Lappeenranta-Lahti University of Technology (LUT), Natural Resources Institute of Finland (Luke), Tampere University (TAU), University of Eastern Finland (UEF), University of Oulu (OU), VTT Technical Research Center of Finland (VTT), CH-Polymers, Metsä Board, Mirka, Montinutra, Teknos, and UPM-Kymmene, Brightplus, CH-Bioforce, Kiilto, MetGen, and Valmet Technologies.</td>
</tr>
</tbody>
</table>

*Note: Ecosystem projects as of Nov 2023 – listing updated as new projects join the Ecosystem*

**Project preparation facilitated & coordinated by CLIC Innovation**
### Ecosystem projects (3/5)*

<table>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>4everPack</strong> – Circular business from reusable packaging for fast moving consumer goods</td>
<td>Packaging</td>
<td>08/2021 – 07/2023</td>
<td>BF Research</td>
<td>VTT, University of Vaasa, Brightplus, MetsäBoard, Borealis, Berner, Kiilto, Kotipizza, S-group, Kesko, HUS, City of Helsinki, Kamupak, NordicID, UpCode, Tomra</td>
</tr>
<tr>
<td><strong>FOLD</strong> - Novel folding technology for light-weight design structures and protective packaging</td>
<td>Packaging, Other fibre products, Cross-cutting topics</td>
<td>01/2022 – 12/2023</td>
<td>BF Co-Innovation</td>
<td>VTT, Aalto, Metsä Board, Anpap, Elomatic, Lumene, Mirka, Orfer, Soften, Stora Enso</td>
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</tbody>
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*Note: Ecosystem projects as of Nov 2023 – listing updated as new projects join the Ecosystem
## Ecosystem projects (4/5)*

<table>
<thead>
<tr>
<th>Project name</th>
<th>Theme(s)</th>
<th>Duration</th>
<th>Funding scheme</th>
<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>HiPer – High Performance Cellulose-based Composites</td>
<td>Biocomposites, Other fibre products</td>
<td>05/2022 – 04/2024</td>
<td>BF Co-innovation</td>
<td>VTT, Valmet Technologies Oy, Sulzer Pumps Finland Oy, Paptic Oy, NMC Cellfoam Oy, Isku Interior Oy, Metsä Fibre Oy, Volar Plastic Oy, Koskisen Oy &amp; CH-polymers Oy</td>
</tr>
<tr>
<td>SmartRecovery</td>
<td>Lignin products</td>
<td>01/2023 – 12/2024</td>
<td>BF Research</td>
<td>VTT, Fortum, Metsä Fibre, Andritz, LignEasy, ProSolve, PrefereResins</td>
</tr>
<tr>
<td>BioCarbonValue - High value biocarbons from agricultural sidestreams</td>
<td>Cross-cutting topics, Sourcing &amp; fractionation of straw, Lignin products, Biocomposites</td>
<td>01/2023 – 12/2024</td>
<td>BF Research</td>
<td>VTT, Fortum, Neova Group, Sumitomo SHI FW, City of Heinola, Premix, Carbofex, CarboCulture, PUHI, FifthInnovation</td>
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</tbody>
</table>

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<th>Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CERAFIM – Cellular Agriculture for Sustainable Food and Materials</strong></td>
<td>Hemicellulose products</td>
<td>05/2022 – 04/2024</td>
<td>BF Co-innovation</td>
<td>VTT, Brightplus, enifer, Fazer, Fortum Bio2X, HighMetal, Kemira, onego Bio, Spinnova, UPM, Valio</td>
</tr>
<tr>
<td><strong>GRAM - Green adaptable method for refining lignocellulosic materials to high-value components</strong></td>
<td>Lignin products</td>
<td>05/2023 – 04/2025</td>
<td>BF Research</td>
<td>University of Oulu, Åbo Akademi, Fortum, UPM, Nordfuel, Sherwin-Williams</td>
</tr>
</tbody>
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*Note: Ecosystem projects as of Nov 2023 – listing updated as new projects join the Ecosystem*
Why should you join the ecosystem?

The ExpandFibre Ecosystem is an opportunity to:

- Finding innovation and collaboration partners – incl. access to exclusive member events and the ExpandFibre Ecosystem platform
- Finding new business opportunities
- Cross-discipline and end-to-end value chain cooperation
- Sharing thoughts and ideas with those who share the same vision for a sustainable future
- Connection to the Business Finland Veturi ecosystem funding scheme
- Being a part of a large-scale go-to-market vehicle
Why join? The ExpandFibre value proposition to non-Finnish members

The ExpandFibre Ecosystem is an opportunity to:

- Networking and collaborating with the Finnish innovation value chains
- Gaining overall visibility of and to the Finnish R&D landscape
- Cross-discipline and end-to-end value chain cooperation
- Better insights and connections to existing and upcoming project preparations between companies, and between companies and research institutes
- Sharing thoughts and ideas with those who share the same vision for a sustainable future
- Being a part of a large-scale go-to-market vehicle
Why join? The ExpandFibre value proposition to projects

The ExpandFibre Ecosystem is an opportunity to:

- Increase the visibility of the project and its results via dissemination
- Validate project results through dedicated workshops
- Find partners to take project results to the market to speed up commercialisation
- Identify and create next projects and find partners for them
- Expand the project scope and find new materials/technologies/other solutions to test
- Exchange ideas with those who share the same vision for a sustainable future, and engage in cross-sectional collaboration
Membership of ExpandFibre Ecosystem

• As a principle, ExpandFibre Ecosystem welcomes organisations as well as existing projects and project applications as a part of the Ecosystem, if their vision is in line with ExpandFibre vision and if they work in the ExpandFibre Theme areas.

• By joining the Ecosystem, you join a mailing list and give permission to use your organization's / project’s name and logo on the ExpandFibre website and other similar communications materials.

• ExpandFibre will send a questionnaire to each member annually, asking for certain public KPI’s to track the progress of the ecosystem.

ExpandFibre Programme Managers (=ExpandFibre Management Group) manage all membership issues:

• **Fortum**
  Gerardo Gómez Millán
  *Technology Expert*
  *Fortum Bio2X, Biobased Solutions*
  gerardo.gomez.millan@fortum.com
  + 358 50 4076257

• **Metsä Group**
  Katariina Kemppainen
  *SVP, Group R&D, Metsä Spring*
  katariina.kemppainen@metsagroup.com
  + 358 50 3752212
Process to join the Ecosystem

1. **Contact ExpandFibre Programme Managers** (by email or through the website contact form) to discuss and align common interests. See [https://www.expandfibre.com/join](https://www.expandfibre.com/join) for more information.

2. If interests are aligned, you will receive a link to an **online form** to provide information about your organisation or project.

3. ExpandFibre management decides on the approval and informs the member / project of the decision, and upon a positive decision collects their logo and adds them to the Ecosystem mailing list.
Ecosystem events & communication

• ExpandFibre targets to create awareness, facilitate match-making, identify gaps and initiate the preparation of new R&D projects through:
  • Actively meeting with ecosystem members and creating new links between them, with the help of the ExpandFibre Ecosystem platform tool
  • Arranging theme related workshops, ecosystem events and a public annual seminar
  • Co-operating and coordinating initiatives with other ecosystems
    • e.g. CLIC Innovation and its ecosystems (4Recycling), FinnCERES Materials Cluster & other Business Finland Veturi ecosystems
ExpandFibre event summary

**2020**
- **May 2020:** ExpandFibre officially starts
- **October 2020:** Virtual launch event of ExpandFibre

**2021**
- **February 2021:** Textile workshop with industry experts
- **March 2021:** Packaging workshop with industry experts
- **November 2021:** “2nd gen sugar valorization day” workshop
- **December 2021:** “Novel biomaterials in the construction sector” workshop w/ 4Recycling

**2022**
- **May 2022:** “2nd annual public ExpandFibre Ecosystem seminar
- **June 2022:** “2nd annual public ExpandFibre Ecosystem seminar
- **November 2022:** EU funding workshop for Ecosystem members
- **December 2022:** “Fibre-based biocomposites – success stories, industry insights & future outlook” webinar
- **October 2022:** “Functional biobased packaging” webinar w/ 4Recycling

**2023**
- **May 2023:** “Testbeds & piloting services for bioproducts” workshop
- **June 2023:** “Functional biobased packaging” webinar w/ 4Recycling
- **November 2023:** “Novel biomaterials in the construction sector” workshop w/ 4Recycling
- **December 2023:** “Fibre-based biocomposites – success stories, industry insights & future outlook” webinar
- **May 2023:** Joint webinar w/ Valmet’s Beyond Circularity Veturi: “Scale-up of bioprocesses”
Join us to meet the growing demand for sustainable bioproducts – we need players from every part of the value-chain