Eco—i Manual

Chemicals Supplement

UN environment

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Eco—i Manual
Chemicals Supplement

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About the UN Environment Economy Division

The UN Environment Economy Division helps governments, local authorities and decision-makers in business and industry to develop and implement policies and practices focusing on sustainable development.

The Division works to promote:

- sustainable consumption and production,
- the efficient use of renewable energy,
- adequate management of chemicals,
- the integration of environmental costs in development policies.

The Office of the Director, located in Paris, coordinates activities through:

- The International Environmental Technology Centre - IETC (Osaka, Shiga), which implements integrated waste, water and disaster management programmes, focusing in particular on Asia.
- Production and Consumption (Paris), which promotes sustainable consumption and production patterns as a contribution to human development through global markets.
- Chemicals (Geneva), which catalyzes global actions to bring about the sound management of chemicals and the improvement of chemical safety worldwide.
- Energy (Paris), which fosters energy and transport policies for sustainable development and encourages investment in renewable energy and energy efficiency.
- OzonAction (Paris), which supports the phase-out of ozone depleting substances in developing countries and countries with economies in transition to ensure implementation of the Montreal Protocol.
- Economics and Trade (Geneva), which helps countries to integrate environmental considerations into economic and trade policies, and works with the finance sector to incorporate sustainable development policies.

UN Environment Economy Division activities focus on raising awareness, improving the transfer of knowledge and information, fostering technological cooperation and partnerships, and implementing international conventions and agreements.

For more information see www.unep.org

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PR.2

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List of activities with supplementary content

Eco—i Chemicals

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ST.11

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Generate ideas for the revenue streams block
BM.10

Generate ideas for the key resources block
BM.11

Generate ideas for the key activities block
BM.12

Generate ideas for the key partnerships block
BM.13

Generate ideas for the cost structure block
BM.14

List of activities with supplementary content

Eco—i Chemicals

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BM.15

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BM.16

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BM.17

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BR.2

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BR.3

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Pitch the implementation roadmap to the CEO
BR.4

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Create a project plan
IM.1

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IM.2

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IM.3

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RE.1

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RE.4

PREPARE

Prepare to engage a company and its value chain and build the potential company's interest in the rewards available from eco-innovation

Eco—i Chemicals

PR.1
Evaluate potential markets

Eco—i Chemicals

PR.1 Evaluate potential markets

Eco—i Chemicals

TIPS & TRICKS

ANALYSE END MARKETS TO IDENTIFY TRENDS IN SUB-SECTORS AND VALUE CHAINS

Since the chemical industry is typically integrated in other industrial value chains (e.g. automotive, agriculture, etc.), you may want to list important end markets (domestic and export) served by each chemical subsector in order to systematically include sustainability impacts over the full lifecycle of the products (goods or services) delivered by the sector. In addition, including the end markets in your analysis can help you to understand the market trends affecting each subsector. Prioritize the value chains containing end markets in which sustainability issues impact business decisions.

LOOK FIRST AT MARKETS WITH HIGH SALES AND OPPORTUNITIES FOR PRODUCT DIFFERENTIATION

It may be easier to make addressing sustainability issues profitable in markets with both relatively high sales and also significant product differentiation. For example, specialty and fine chemical markets can offer more sustainability business opportunities than commodity chemicals. In contrast to commodity chemicals, specialty and fine chemicals are sold according to their functionality and significant amounts of differentiation exist between products. Therefore, markets for specialty and fine chemicals are commonly organized according to application, resulting in numerous niche markets in which offering eco-innovation services can provide a competitive edge. The following markets typically account for the largest shares of specialty chemicals (HIS Markit, 2016):

- specialty polymers
- industrial and institutional (I&I) cleaners
- construction chemicals
- electronic chemicals
- flavours and fragrances.

IDENTIFY OPPORTUNITIES BY UNDERSTANDING HOW CHEMICAL PRODUCTS ARE USED BY DIFFERENT CUSTOMERS AND END CUSTOMERS

Many chemical products are intermediates that are processed further by chemical companies located downstream in the value chain. For example, ethylene glycol is used as antifreeze and hydraulic brake fluid. However, additional processing yields many derivatives used as emulsifiers in the application of fungicides and insecticides; as well as additives in the textile, pharmaceutical, and cosmetic industries. each subsector.

UNDERSTAND THE FUNCTIONALITY THE CHEMICAL PROVIDES TO EACH CUSTOMER WHEN ANALYSING THE VALUE CHAIN FOR ECO-INNOVATION OPPORTUNITIES

Customers use different chemicals to achieve a desired functionality. Ask how a specific chemical may contribute to a finished product (e.g. textile cleaning or bleaching), or what physical or chemical functionality a substance has in a product (e.g. biocide, flame retardant). For example, the functional chemicals used in the cosmetics markets include antioxidants, surfactants, emulsifiers, natural oils, UV filters, and actives (e.g. anti-aging ingredients). Furthermore, some chemicals possess properties of value to many different markets possibly offering more opportunities for eco-innovation. For example, BHT (2,6-di-tert-butyl-4-methylphenol) is an antioxidant used in cosmetics, food, fuel, lubricant, paints, plastics, pharmaceuticals, and rubber products (Pflug, 2013),

USE INTERNATIONAL BENCHMARKS TO IDENTIFY CHEMICAL MARKETS WITH HIGH POTENTIAL FOR IMPROVEMENT IN ENVIRONMENTAL PERFORMANCE

Table 1 provides an overview of material efficiency for selected subsectors of the German chemical industry and demonstrates that even best practice techniques in the chemical industry can generate significant waste (e.g. non-reacting components, such as solvents or process water commonly leave a chemical plant as waste). Investigate if the subsectors in your region also face similar resource efficiency and pollution challenges (e.g. pigments and dyestuffs, plant protection).

Table 1: Stoichiometric and material efficiency in selected German chemical subsectors Steinbach, 2013).

Selected subsectors	**Stoichiometric Conversion (%)**	**Material Efficiency (%)**
Pharmaceuticals*	86	20
Pigments and Dyestuffs	88	26
Plant Protection	89	36
Specialty Chemicals	90	62
Commodity Chemicals	90	76
Industry Average	88	38

** Regulations typically restrict the optimisation of processes and changing of recipe in the pharmaceuticals subsector*

→ Refer to *Background Information* for more benchmarks on resource use and pollution for selected chemical subsectors.

LEARNING CASE STUDY OF TARGET IDENTIFICATION

A - Sector-level analysis

Sector name: Textile

Analysis of chemical products' value chain using the *Target Identification* Template indicated that the textiles market has high potential for eco-innovation and was selected as a target market to acquire a client.

Research showed that chemicals are manufactured and used in various stages of the textiles value chain:

- Agrochemicals are used in the production of cotton, petrochemicals in the production of synthetic fibres;
- Solvents as well as organic/inorganic pigments, dyestuff, and additives for manufacturing printing inks and dyes, as many inks and dyestuff contain very hazardous substances
- Bleaches, acids, bases, oxidizers, surfactants, stabilizers, dyes (various types), inks, finishing polymer precursors and catalysts etc. used in the wet processing of textiles

In particular, research showed that the textiles value chain has many environmental and social impacts, making it a high-value target for eco-innovation. Below are some examples of these impacts

- The textile industry uses approximately 25% of all the world's chemicals (total life cycle including agrochemicals) many of which have known hazardous properties
- Some textile factories are known to employ children
- NPEOs (Nonylphenol ethoxylates) are used in the wet processing textile industry as scouring agents (e.g. for wool), wetting agents, emulsifier agents for dyes and printing inks. NPEOs degrade into nonyphenol in the environment which is a toxic to aquatic organisms and may cause harm to unborn children.
- Hazardous chemicals such as formaldehyde are found on textile products sold to consumers. Formaldehyde is often used to preserve textiles in transit and may cause cancer.
- Cotton, used to manufacture cotton apparel, is one of the most pesticide and water intensive crops (150 g pesticides and 2200 L water for one cotton shirt) and is often grown in (semi-)arid regions leading to water scarcity and/or salinization of the soil (degradation of ecosystems)

Furthermore, the regional market grew moderately strong over the past 3 years (approximately 4% per year) and some value chain pressures promoting sustainable business practices were identified for different customer (buyer) segments. In particular, some consumer segments are requesting fair and eco-labelled textiles, and many multinational brands are demanding that textile manufactures adhere to a Restricted Substances List (RSL).

PR.1 Evaluate potential markets

BACKGROUND INFORMATION

Eco-innovation in the chemical products' value chain is a process by which businesses integrate sustainability principles in their business strategies, which have a direct influence on their products (chemicals or services) and promote technological and operational innovations to improve business productivity, growth and competitiveness in the value chain. Applying sustainable chemistry principles can support the technical implementation of eco-innovation in the chemical products' value chain and create new opportunities or overcome barriers for companies serving this value chain.

Sustainable chemistry seeks to improve the efficiency with which natural resources are used to meet human needs for chemical products and services. It encompasses the design, manufacture and use of efficient, effective, safe and more environment-friendly chemical products and processes. Sustainable chemistry stimulates innovation across all sectors to design and discover new chemicals, production processes, and product stewardship practices that will provide increased performance and value while meeting the goals of protecting and enhancing human health and the environment (OECD, 2016).

Building on these principles and the methodology presented in the Eco-innovation Manual, this supplement provides chemical products' value chain-specific information to advance eco-innovation of companies within this value chain. It is complementary to the Eco-innovation Manual and not to be used as a stand-alone guide. Similarly to the Eco-innovation Manual, the supplement makes use of a learning case study of a fictional company in a developing country (Tip Top Textiles Co.) to illustrate practical examples of the methodology being presented.

Understanding the chemical industry

The chemical industry is a process industry consisting of companies that convert raw materials through synthesis or formulation processes into intermediate or finished chemical products.

The products of the chemical industry can be divided into the following subsectors:

Commodity chemicals consisting of:

- Petrochemicals
- Basic chemicals
- Polymers
- Specialty chemicals
- Fine chemicals
- Consumer chemicals

The manufactured chemicals are sold to industrial customers and consumers for direct consumption (e.g. solvents, detergents, cosmetics, etc.) or to other industries to be further processed into finished products (e.g. plastic components for the automotive industry, construction materials, etc.) which are then sold to end market consumers.

PR.1 Evaluate potential markets

Globally, the largest industrial end markets for chemicals include construction, electronics, household, paper and packaging, and automotive. Each end market can have different segments, for example paper and packaging can have different market segments, such as printing, plastic packaging, or toiletries – all of which could involve multiple chemical subsectors as value chain actors.

The chemical industry consists of several value-adding activities, which include Research and Development (R&D), master-batch formulation, packaging (for industry and consumers), logistics, customer prototyping, and optimisation of other industrial user processes (see Figure 1)

Value-Adding Activities	Research & Development	Design	Production	Logistics	Marketing	Services	Packaging and Labelling	Certification

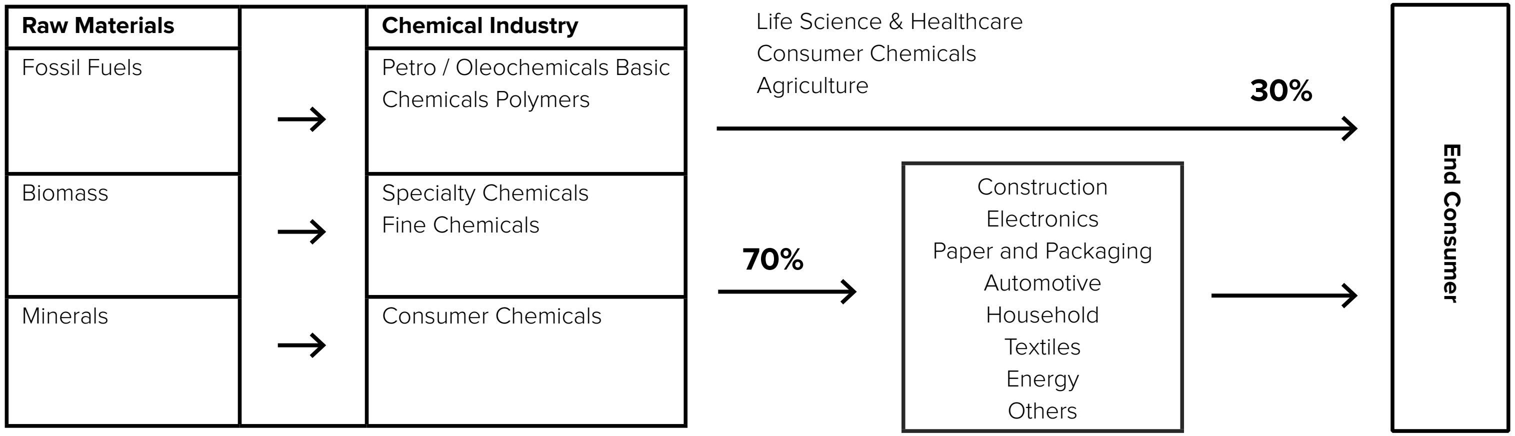

Figure 1. Simplified representation of the chemical products' value chain

Table 2. summarises some of the key features of commodity, specialty, and fine chemicals, such as chemical type (substance or mixture), production mode (continuous or batch), volume and price, and value proposition. You can use this table as a starting point to help you understand how subsectors and markets operate and how they deliver value to their clients.

PR.1 Evaluate potential markets

Table 2: Some key features of commodity, speciality, fine, and consumer chemicals (authors elaboration based on (Pollak, 2011)

Key features	**Commodity chemicals**	**Speciality chemicals**	**Fine chemicals**	**Consumer chemicals**
Chemical type	Single pure chemical substances, standardised	Mixtures of one or more fine chemicals	Single pure chemical substances, complex	Mixtures of one or more fine chemicals
Plant type	Produced in dedicated plants	Formulated, typically multi-purpose plants	Produced in multi-purpose plants by chemical or biotechnology processes	Formulated, typically separate plant lines for liquid, semi-solid, and solid products.
Production mode	Produced often in continuous	Produced normally in batch, variable reactor size	Produced in batch, median reactor size 4-6 m3	Produced normally in batch, variable reactor size
Volume and price	Large volume Low price (>US$1/kg), cyclic and fully transparent	Variable	Low vol. (<1000 Mtpa) High price (>US$10/kg)	Variable
Application	Many applications	Variable, also for consumers outside the chemical industry	Few applications	Exclusively for consumers
Examples	e.g. petrochemicals, basic chemicals, heavy organic and inorganic chemicals, (large-volume) monomers, commodity fibres, plastics	e.g. agrochemicals, dyestuff, food additives, enzymes, specialty polymers	typically patented, as drug or an active ingredient in an agrochemical or for further processing in chemical industry	e.g. household cleaning products, laundry detergents, anti-aging cream, make-up, shampoo.
Value proposition	Sold on specifications	Sold on performance properties "what they can do"	Sold on specifications (functional performance) "what they are"	Variable depending on market. Sold on cost, performance and brand image

PR.1 Evaluate potential markets

Eco—i Chemicals

Some chemicals are manufactured in continuous processes while others are produced in batch processes. The decision for operating in continuous or batch mode depends on many factors, mainly relating to economy of size.

Categorization of the chemical industry subsectors, markets and submarkets

The following provides a detailed categorization of markets in the chemical industry and can be used to help you identify potential markets for your eco-innovation services.

Commodity chemicals

Petrochemicals / Oleochemicals

- Olefins, polyolefins
- Aromatics
- Biofuels

Basic chemicals

- Petrochemical derivatives and solvents
- N-Inorganics, other inorganics
- Acids/bases
- Industrial gases

Polymers

- Commodity polymers
- Thermoplastics
- Engineering plastics
- Synthetic fibres

Specialty and Fine Chemicals

- Adhesives and sealants
- Agrochemical ingredients (F)
- API - Active pharmaceutical ingredients (F)
- Biotech chemicals (F)
- Catalysts:
    - Petroleum refining
    - Chemical processes
    - Emission control
- Construction chemicals:
    - Concrete and cement
    - Corrosion protection
    - Elastomeric roof coating
    - Exterior insulation and finish systems
    - Industrial nonwovens
    - Insulation
    - Roof and siding
    - Sealing and bonding
    - Waterproofing applications
- Cosmetic additives
- Electronic chemicals:
    - Semiconductors and IC processing chemicals
    - Printed circuit board chemicals
- Explosives
- Flavours and fragrances (F)
- Feed additives (F)
- Food additives (F)
- Imaging chemicals and materials
- Industrial and institutional cleaners for:
    - Commercial markets
    - Electronic components
    - Fabricated metal products
    - Food and beverage processing
    - Plastics processing

Notes: (F) denotes a market in the fine chemicals sector

PR.1 Evaluate potential markets

- Laboratory chemicals
- Leather chemicals
- Lubricants and lubricant additives
- Membrane material
- Mining chemicals
- Nonwoven fabrics
- Neutraceutical ingredients (F)
- Oil field chemicals
- Packaging and flexible packaging
- Paints and coatings:
  - Architectural
  - Automotive and transportation
  - Decorative
  - Industrial
  - Traffic coatings
- Paper chemicals
- Pesticides
- Plastic additives and plastic compounding
- Pharmaceutical intermediates (F)
- Polishing and plating chemicals (for metals and plastics)
- Printing inks
- Rubber and rubber processing chemicals
- Speciality coatings:
  - High performance anti-corrosion
  - Radiation curable coatings
  - Thermosetting powder
- Speciality polymers:
  - Engineering thermoplastics
  - High-performance thermoplastics
  - Specialty films
- (Specialty) Surfactants:
  - Water soluble polymers
- Textile chemicals and dyes
- Water management chemicals
- Wood treatment chemicals

Consumer Chemicals

<u>Household chemicals</u>

- Household cleaning products
- Dishwashing
- Laundry and fabric care

<u>Healthcare and life sciences</u>

- Prescription medicines
- Diagnostic testing
- Consumer health products:
  - Pain relief
  - Cough, cold, and fever relief
  - Health enhancers
  - Vitamins, minerals, nutrients

<u>Cosmetics</u>

- Skin products (e.g. skin care cream, cleansers, make-up, sun care, etc.)
- Hair and scalp products (e.g. shampoo, colouring, styling, etc.)
- Nail and cuticle products (e.g. nail polish, nail polish remover, etc.)
- Oral hygiene products (e.g. toothpaste, mouthwash, etc.)

PR.1 Evaluate potential markets

Benchmarks on environmental performance for selected chemical subsectors

The German chemical industry is one of the largest in Europe and its highly competitive on a global scale. The following tables provide the examples of benchmarks on environmental performance from German chemicals companies in various chemical manufacturing subsectors, specifically waste residue, solvent and halogen consumption, waste water emissions as well as greenhouse gas emissions. It is ideal to use benchmarks when evaluating environmental impacts of specific subsectors in the chemical industry. For example, as seen in Table 3 the manufacturing of pigments and dyes tends to have highest environmental impacts with respect to water consumption, whereas the manufacturing of pharmaceuticals is especially environmentally harmful in terms of solvent consumption. As a result, the highest ranking means that the subsector has the highest resource intensity and corresponding environmental impact for that category.

Table 3: Average amount of waste residue incinerated by German chemical companies in selected chemical subsectors (Steinbach, 2013)

Selected subsectors	Inorganic material [kg/t Product]	Organic material [kg/t Product]	Water [kg/t Product]
Pharmaceuticals	150	3,600	1,400
Pigments and Dyestuffs	1	100	5
Plant Protection	90	330	620
Specialty Chemicals	1	40	5
Commodity Chemicals	5	20	130

Table 4: Average amount of process wastewater treated in on-site wastewater treatment plants by German chemical companies in selected chemical subsectors (Steinbach, 2013).

Selected subsectors	Inorganic material [kg/t Product]	Organic material [kg/t Product]	Water [kg/t Product]
Pharmaceuticals	590	320	5000
Pigments and Dyestuffs	3600	480	72500

Plant Protection	630	160	8200
Specialty Chemicals	120	40	1400
Commodity Chemicals	1	20	1900

Table 5: Average amount of solvent consumption, water consumption, and halogen waste production by German chemical companies in selected chemical subsectors (Steinbach, 2013).

Selected subsectors	Solvent Consumption [kg/t Product]	Water Consumption [kg/t Product]	Halogen [Input, kg/t product; % Input as waste]
Pharmaceuticals	3200	5400	363 Kg; 78%
Pigments and Dyestuffs	700	71200	368 Kg; 88%
Agrochemicals	250	6400	364 Kg; 74%
Specialty Chemicals	100	1500	59 Kg; 75%
Basic Chemicals	0	1900	-

Table 6: Average amount of waste material conversion [kg/t product] excluding water (organic fraction in %) by German chemical companies in selected chemical subsectors (Steinbach, 2013).

Selected subsectors	By-products	Secondary raw materials
Pharmaceuticals	320 (ca. 99%)	60 (ca. 55%)
Pigments and Dyestuffs	50 (ca. 30%)	905 (ca. 40%)
Plant Protection	410 (ca. 55%)	35 (ca. 40%)
Specialty Chemicals	150 (ca. 40%)	20 (ca. 80%)
Commodity Chemicals	170 (< 10%)	5 (ca. 35%)

Table 7: Average carbon dioxide emissions from production and waste treatment [kg CO2/ t product] by German chemical companies in selected chemical subsectors (Steinbach, 2013).

Selected subsectors	Production (exhaust air)	Combustion of residue	Wastewater treatment	Total
Pharma-ceuticals	15	8620	550	9185
Pigments and Dyestuffs	10	210	920	1140
Agro-chemicals	50	660	270	980
Specialty Chemicals	15	120	105	270
Basic Chemicals	30	60	30	120

PR.1 Evaluate potential markets

Table 8: Average halogen input and output [kg/t product] for German chemical companies in selected chemical subsectors (Steinbach, 2013).

Selected subsectors	**Input Primary feedstock**	**Output Product**	**Waste**
Pharma-ceuticals	363	79	284; 78%
Pigments and Dyestuffs	363	43	325; 88%
Plant Protection	364	94	270; 74%
Specialty Chemicals	59	15	44; 75%

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PR.2

Building the right internal team

Eco—i Chemicals

PR.2 Building the right internal team

TIPS & TRICKS

BRING IN EXTERNAL EXPERTS FOR YOUR TARGET MARKETS

It is important to have expertise in your team for the chemical markets you are targeting. This will enable your team to accurately identify the most important sustainability impacts, feasible business opportunities and innovations. The chemical industry is complex and varies accoridng to subsector and you will likely need different experts (e.g. a paint expert is of limited use in the ink industry). Additionally, having experts with specific know-how for the target markets will provide you with credibility when approaching companies to market your services.

ENSURE TEAM HAS FUNDAMENTAL SKILLS FOR THE CHEMICAL SECTOR

In order to evaluate a company's performance and implement eco-innovation, the team should include some skills important for the chemical sector, such as proficiency in:

- The Globally Harmonized System of Classification and Labelling of Chemicals (GHS)
- Developing and/ or updating a good practice chemical inventory
- Plant safety risk assessments (Occupational Health & Safety and presentation of major accidents)
- Auditing companies manufacturing chemical products
- Implementing common business models and business practices in the chemical sector

Other skills could be of additional value depending on the eco-innovation opportunities identified, such as know-how on: Chemical Leasing business models, simple substitution of chemicals, and optimization of production planning and processes.

PR.3
Build the right external partnerships

Eco—i Chemicals

PR.3 Build the right external partnerships

Eco—i Chemicals

TIPS & TRICKS

IDENTIFY IMPORTANT VALUE CHAIN STAKEHOLDERS FOR NEW PRODUCT DEVELOPMENT

Consider the critical tasks to be done in the product's value chain and initiate contact with relevant stakeholders. For example, formulators developing a new environmentally friendly anti-corrosive paint may collaborate with suppliers of different pigments, manufacturers of specialty resins, corrosion experts, product quality, service providers and end market customers in order to understand the customer priorities and to perform field trials on new products.

Consider engaging different types of value chain stakeholders, such as:

- Customers: direct customers, end market customers, distributors
- Upstream and downstream manufacturers of chemical products
- End-of-life service providers such as recyclers, hazardous waste management companies, etc.
- Value chain actors from other industries
- Service and equipment providers
- Academia and public authorities

→ See more details and additional tips for each type of value chain actor and approaching companies to market your services in the section *'Background Information'*

CUSTOMER COLLABORATION CAN LEAD TO WIN-WIN BUSINESS DEVELOPMENT

According to the consultancy report by A.T. Kearney (2012), chemical manufacturer-customer collaboration is driven mostly by customer requests or jointly developed solutions to address emerging trends (e.g. new energy storage solutions, lightweight materials for mobility solutions, green buildings, etc.). Furthermore, both chemical manufacturers and their customers benefit through increased collaboration, most seeing an increase in sales of 2-4% and a reduction in costs by at least 2-4%.

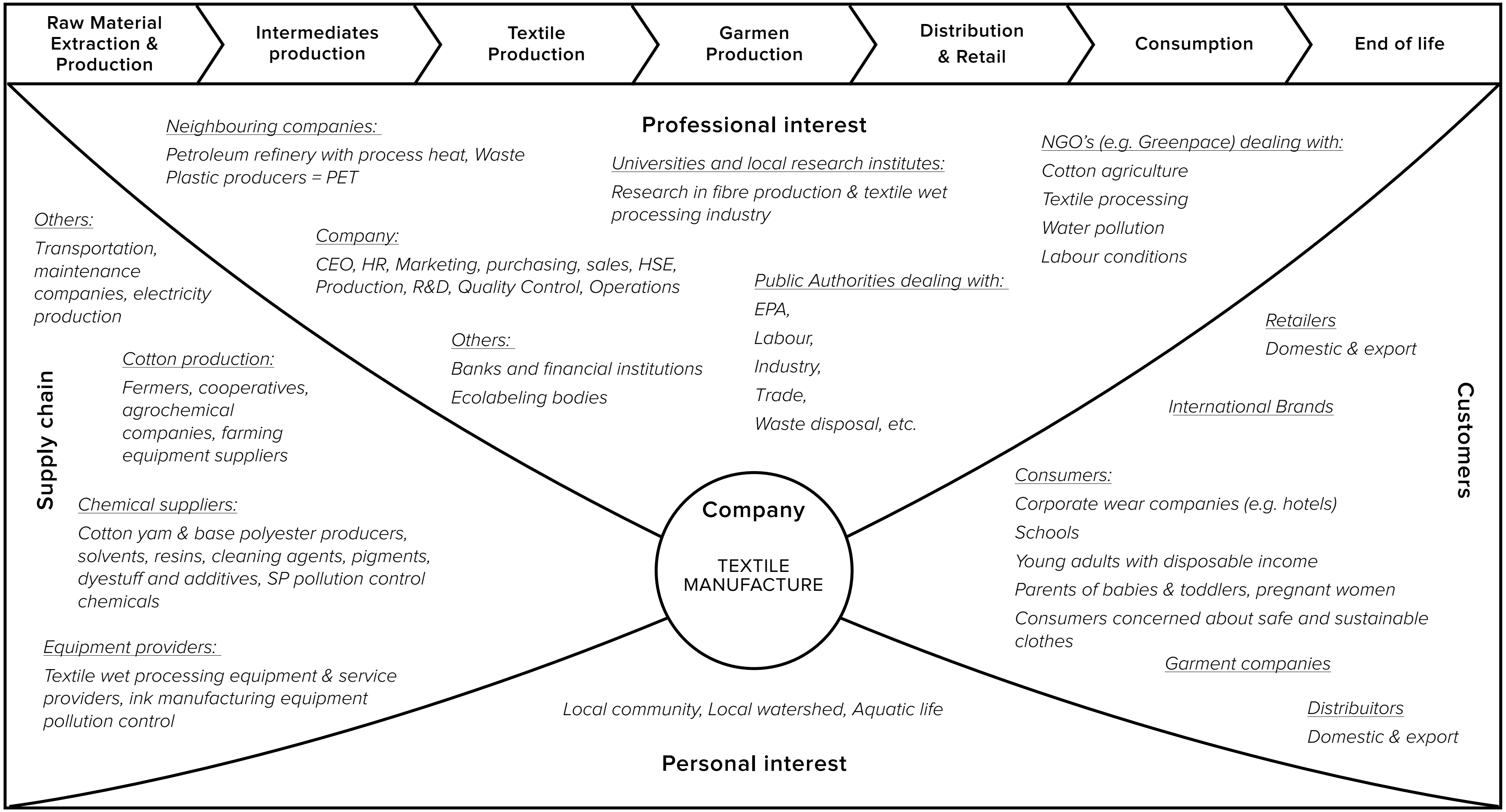
Approach end market leaders to identify the emerging trends they are facing and collaborate on win-win solutions addressing critical challenges.

You can also consider synergies between upstream and downstream companies – even with the same chemical subsectors – that may offer beneficial partnership opportunities such as sharing market information and customer service resources for similar products, as well as integrating production plans. Such partnerships may lead to proactive solutions for customers benefitting all parties.

PR.3 Build the right external partnerships

Eco—i Chemicals

LEARNING CASE STUDY OF LIFE CYCLE STAKEHOLDERS



PR.3 Build the right external partnerships

The following list describes how some stakeholders could potentially contribute to eco-innovation activities in the value chain:

- Chemical suppliers provide alternatives for scouring agents containing NPEOs (Nonylphenol ethoxylates) and eliminate its discharge into the aquatic environment
- Cotton producers source fair trade, organic cotton thereby minimizing environmental degradation and promoting better wages
- Eco-labelling bodies provide guidance on how to meet ecolabel criteria and market to new, higher revenue generating customer segments
- Waste plastic recyclers provide a secondary feedstock, which can be used for synthetic-based textiles
- International Brands partnerships for eliminating and replacing chemicals on a textile industry's Restricted Substances Lists

BACKGROUND INFORMATION

Collaboration intensity in commodity and specialty chemical markets

Collaboration along the value chain is a common practice in the chemical industry to increase competitiveness, particularly between chemical manufacturers and their customers with higher levels of collaboration typically taking place in the specialty chemicals markets and lower levels of collaboration in the commodity chemicals markets.

Types of partnerships in the chemical industry

Customers:

- Retailers of consumer chemicals, especially specialty stores (e.g. paints, health stores, etc.)
- Professional users of the final product (e.g. a high-performance resin manufacturer collaborates with paint contractors)
- Industrial users of chemicals (e.g. pollution control catalysts/ chemicals for manufacturing and power generation plants, wastewater treatment plants)
- End market customers (e.g. Original Equipment Manufacturer (OEM) automotive – hybrid lightweight materials, construction – corrosion protection, etc.)

Upstream and downstream actors in the chemical industry:

- Manufacturers and distributors of petrochemicals and oleo chemicals which could be of relevance for feedstock recycling (e.g. polymers)
- Manufacturers and distributors of basic chemicals, polymers, specialty chemicals and fine chemicals

PR.3 Build the right external partnerships

Eco—i Chemicals

Value chain actors from other industries:

- Equipment suppliers in associated value chains. For example, the metal processing and fabrication industries present many opportunities to collaborate with equipment providers to provide complete product-service offerings in the following: a) metal parts cleaning with solvent, b) metal polishing and finishing processes, and c) electroplating.
- Waste management service providers
- Supply chain management experts

Industry Associations and networks:

- Chemical industry associations and the Responsible Care network
- End market industry associations important to the chemical industry (e.g. building and construction, energy, automotive, health and medicine, packaging, etc.)
- Green Network for example the US E3's Green Suppliers Network is a group of suppliers improving their environmental performance
- Innovation hubs
- Coalitions such as the Sustainable Apparel Coalition or the Zero Discharge for Hazardous Chemicals initiative

Miscellaneous value chain actors:

- Inspection, verification, testing and certification companies could be potential partners when testing or auditing is required to obtain an ecolabel or a sustainability certification. For example, services could range from ISO certification to ecolabels for textiles, consumer electronics, and personal care products as well as for construction (e.g. LEED).
- Information and Communications Technology (ICT) service providers can help share information between value chain actors on important operational factor as sharing customer service resources, integrative production plans among intermediate chemical manufacturers, etc.

Actors outside of the value chain:

- NGO's
- Universities and research institutes chemistry, chemical engineering, biotechnology, ecotoxicology, green business, etc.
- Environmental protection agency (local, national, regional)

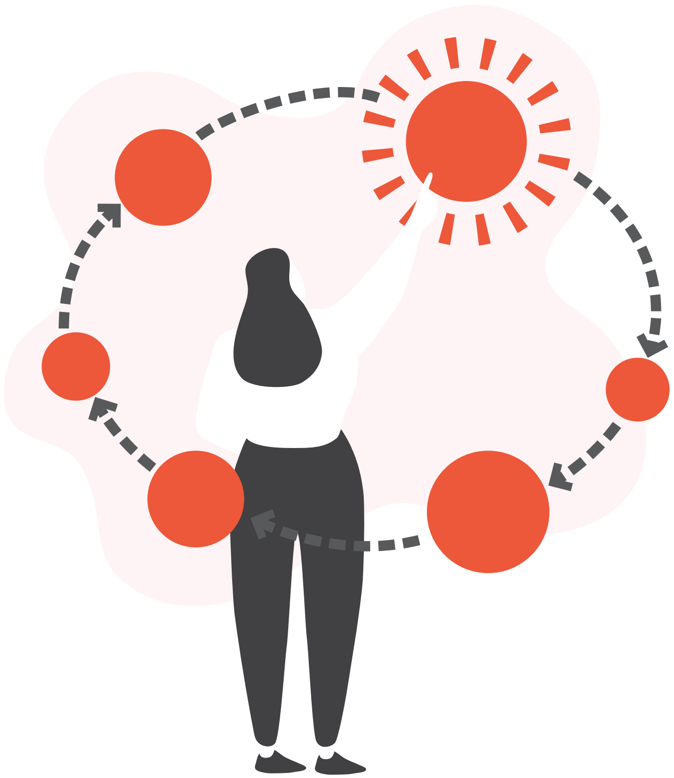
References

A.T. Kearney (2012). Collaboration: A New Mantra for Chemical Industry Growth. A.T. Kearney, Inc.

PR.4

Identify sustainability hotspots across the value chain

Eco—i Chemicals



PR.4 Identify sustainability hotspots across the value chain

Eco—i Chemicals

TIPS & TRICKS

USE CHEMICALS OF CONCERN LISTS TO IDENTIFY HEALTH AND ENVIRONMENT RELATED SUSTAINABILITY HOTSPOTS

Industry, NGO and public authority lists containing chemicals of concern or restricted substances, such as the CHEMSEC SIN (Substitute It Now!) list, California's Chemical of Concern list, or the Zero Discharge of Hazardous Chemicals (ZDHC) industry initiative Restricted Substances List (RSL) are being increasingly used as a basis for eliminating hazardous substances from a product's life cycle. Check legislation, standards and lists that apply to your region and value chain in order to identify chemicals that are sustainability hotspots and should be prioritized for action.

IDENTIFY HOW RESOURCE SCARCITY AFFECTS THE VALUE CHAIN

Scarcity in resources, including energy, water and rare earth minerals, can be a concern for companies. Chemical production is energy and water intensive. Rising energy prices may spur the sector to continue its efforts to improve energy efficiency. Higher energy prices and climate change concerns may also drive chemical companies to diversify their feedstock base away from fossil fuels. Recuperating valuable raw materials, known as urban mining, will be increasingly important in this context. The following case study demonstrates how resource scarcity can lead to eco-innovation in the value chain by working with partners to recover and chemically recycle valuable chemical feedstock from end-of-life material.

Industry example 1: Collection, recovery and chemical recycling of PTFE from end-of-life material

PTFE is a specialty high-performance thermoplastic polymer used in many end markets, e.g. in the automotive sector and in consumer goods, such as functional clothing and cookware. The PTFE value chain is typically linear: commodities production, polymerisation, usage in consumer goods, and end-of-life via incineration or disposal on landfills. However, it utilises non-renewable inputs (e.g. CaF_2) and consumes large amounts of energy. A new chemical recycling process developed by Dyneon, a 3M subsidiary specialised in fluoropolymer production, transfers the linear value chain into a circular one. PTFE at its end-of-life is collected, depolymerised and the monomers are used again to produce new PTFE. Recycling of PTFE led to significant reductions in materials, waste and energy demand, thereby alleviating resource scarcity and closing the value chain. For instance 1 ton of recovered monomer saves, amongst others, 5 tonnes chlorine, 2 tonnes sulphuric acid as well as 10 tonnes of CO_2 emissions and acid waste. Moreover, the energy demand can be decreased by 50% and the CaF_2 cycle is closed (3M Dyneon, 2013).

BUILD ON SUSTAINABILITY HOTSPOTS RESULTING FROM EMERGING TRENDS

Emerging trends in different regions and countries can provide insight on sustainability hotspots. For example, under the *trend human* health, a general hotspot related to the chemical sector could include increased knowledge of the adverse effects of hazardous chemicals.

→ Refer to '*Background Information*' for an overview of trends and generalized sustainability impacts.

PR.4 Identify sustainability hotspots across the value chain

LEARNING CASE STUDY OF LIFE CYCLE INVENTORY

Emissions	*GHG emissions, waste water, run-off residues, Cotton waste*	*GHG emissions, Dust, Fiber/ yarn waste*	*GHG emissions, waste water, caustic soda, heavy metals, organic waste*	*GHG emissions, waste water, salt, dyestuffs, tensides, VOC, pigments*	*GHG emissions, waste water, solid waste*	*GHG emissions, waste water, fabric waste, packaging waste*	*GHG emissions, damaged and unsold garments*	*GHG emissions, waste water*	*GHG emissions, waste garments*
Key activities and product outputs	*Cotton cultivation*	*Fabric production, spinning/ waeving*	*Pre-treatment: sizing, bleaching...*	*Dyeing and printing*	*Finishing*	*Garment manufacturing*	*Wholesale / retail*	*Use (washing and drying)*	*Disposal / recycling*
	Cotton	*Fabric*	*Pre-treated fabric*	*Dyed fabric*	*finished fabric*	*Garments*	*Sold garments*	*Canned tuna*	*Waste tuna*
Inputs	*Fuel, Water*	*Electricity, Lubricants*	*Sizing agents, caustic soda, Peroxide, fuel, electricity, stabilising agents, water*	*Salt, dyestuffs, tensides, solvents, pigments, water, fuel, electricity*	*Resins, catalysts, enzymes, softener, tensides, additives, water, fuel, electricity*	*Electricity, lubricants, packaging, preservatives*	*Electricity*	*Electricity, water, detergents, additives*	*Fuel*

Raw materials	**Production**	**Use**	**End-of-life**

*Grey faded used to visually set apart life cycle phases

PR.4 Identify sustainability hotspots across the value chain

Eco—i Chemicals

LEARNING CASE STUDY OF LIFE CYCLE THINKING

					Environmental impacts		Social Impacts			Economic impacts
Phase	**Activity**	**Inputs**	**Product outputs**	**Emissions**	**Resource use**	**Ecosystem quality**	**On workers**	**On consumers**	**On stakeholders**	**Profitability**
Materials	*Cotton cultivation*	• *Fuel (diesel)* • *Water* • *Pesticides* • *Herbicides*	• *Cotton* • *Polyester* • *Textile chemicals*	• *GHG emissions* • *Waste water* • *Run-off residues* • *Cotton waste*	• *Farming water and agrochemical intensive (150g pesticides and 220o L water for a shirt) (M)* • *Petrochemical feedstock for polyester is non-renewable (M)* • *Solvent waste and wastewater from pigment production (M)*	• *Agro-chemical intensive farming leads to soil degradation and polluted water sources (M)*	• *Farmers often lack protective equipment and are exposed to toxic herbicides and pesticides (M)* • *Cotton farmers leaving industry replaced with automation, higer wages (L)*			• *Rising costs of synthetic feedstock and cotton (H)* • *Revenue to cotton farmers (M)* • *Cost of lost cotton (M)*
Production	*Fabric production (speaning / weaving)*	• *Electricity (100% coal)* • *Cotton* • *Lubricants*	• *Fabric*	• *GHG emissions* • *Dust* • *Yarn/fiber waste*	• *Resource depletion - fossil fuels (L)* • *Waste fabric (L)*	• *Climate change (L)*				• *High electricity costs for fabric production (M)* • *Cost of fabric (L)*

					Environmental impacts		Social Impacts			Economic impacts
Phase	**Activity**	**Inputs**	**Product outputs**	**Emissions**	**Resource use**	**Ecosystem quality**	**On workers**	**On consumers**	**On stakeholders**	**Profitability**
Production	*Pre-treatment (sizing, bleaching, etc)*	• *Fabric* • *Agents* • *Sizing* • *Caustic* • *Soda* • *Peroxide* • *Stabilizing* • *Water* • *Fuel* • *Electricity*	• *Pre-treated fabric*	• *GHG emissions* • *Waste water* • *Caustic soda* • *Heavy metals* • *Organic waste*	• *Water consumption (M)*	• *NPEOs used in textile wet processing degrade into nonyphenol in the environment which is toxic to aquatic organisms and may cause harm to unborn children (H)*			• *NPEOs used in textile wet processing degrade into nonyphenol in the environment which is toxic to aquatic organisms and may cause harm to unborn children (H)*	
	Dyeing and printing	• *Pre-treated fabric* • *Salt* • *Dyestuff* • *Tensides* • *Solvents* • *Pigments* • *Water* • *Fuel* • *Electricity*	• *Dyed fabric*	• *GHG emissions* • *Waste water* • *Salt* • *Dyestuff* • *Tensides* • *VOC* • *Pigments*	• *Water consumption (M)*	• *High biochemical oxygen demand of wastewater effluent affecting local aquatic environment (M)*	• *Azo dyes which degrade to form listed aromatic amines (e.g. benzidime), many of which cause or are suspected to cause cancer (H)*		• *Azo dyes which degrade to form listed aromatic amines (e.g. benzidime), many of which cause or are suspected to cause cancer (H)*	
	Garment manufacturing	• *Garments* • *Electricity*	• *Sold garments*	• *GHG emissions* • *Damaged / unsold garments*			• *Textile value chain employs a large number of low-skill labourers (H)*			• *Cost of lost fabric (H)*

					Environmental impacts		Social Impacts			Economic impacts
Phase	**Activity**	**Inputs**	**Product outputs**	**Emissions**	**Resource use**	**Ecosystem quality**	**On workers**	**On consumers**	**On stakeholders**	**Profitability**
Production	*Finishing*	• *Dyed Fabric* • *Resins* • *Catalysts* • *Enzymes* • *Softener* • *Tensides* • *Additives* • *Water* • *Fuel* • *Electricity*	• *Finished fabric*	• *GHG emissions* • *Waste water* • *Solid waste*					• *Conflict with local communities over waste water and sludge production (L)*	• *Waste water treatment costs (M)*
Use	*Wholesale / Retail*	• *Garments* • *Electricity*	• *Sold garments*	• *GHG Emissions* • *Damaged / unsold garments*						• *Cost of lost / unsold garments (M)* • *Revenue to retailers (M)* • *Revenue to producers (M)*
	Use (wear, wash, dry)	• *Electricity* • *Water* • *Detergents* • *Laundry additives*	• *Used / damaged garments*	• *GHG emissions* • *Waste water*	• *Most clothes discarded after 2 years (H)* • *Electricity consumption (typically fossil fuel) (H)* • *High detergent consumption from washing clothes (H)* • *High electricity use for tumbler dryers (H)*	• *Micro-plastics from synthetic clothing released during drying affect marine life (L)* • *Eutro-phication (M)* • *Climate change (L)*	• *Growing market for sustainable manuf-acturing clothes (H)*	• *Formal-dehyde used to preserve textiles in transit found in textiles used by consumers and may cause cancer (H)* • *Concers over safety of chemicals used in textiles, especially for infants and toddlers (H)*		• *Cost of washing and drying (M)*

PR.4 Identify sustainability hotspots across the value chain

Eco—i Chemicals

					Environmental impacts		Social Impacts			Economic impacts
Phase	**Activity**	**Inputs**	**Product outputs**	**Emissions**	**Resource use**	**Ecosystem quality**	**On workers**	**On consumers**	**On stakeholders**	**Profitability**
End of life	*Disposal and recycling*	• *Used / Damaged garments* • *Fuel*	• *Waste garments*	• *GHG emissions*	• *Most clothes landfilled after use and not reused or recycled (H)*				• *Leachate from landfilled textiles can enter groundwater causing adverse health effects (L)*	

The sustainability hotspots for the textiles value chain described in the case study are:

- Raw material extraction through cultivation of cotton is resource intensive (water, chemicals), degrading land and exposing farmers to harmful pesticides and herbicides.
- Impact of chemicals used during production (and use), such as nonylphenol ethoxylates (NPEOs) used in wet textile processing are known to degrade in the environment to endocrine disruptors; and formaldehyde used as a preservative during transport is suspected of causing cancer.
- Use: high detergent and water use from washing clothes; high electricity use from tumble drying of apparel.
- End-of-life: textiles typically discarded after 2 years of use and thrown in landfill without reuse or recycling. Further environmental and human health effects resulting from the decomposition of clothing in landfills.

PR.4 Identify sustainability hotspots across the value chain

Eco—i Chemicals

BACKGROUND INFORMATION

General sustainability challenges related to the chemical industry

Table 9: Overview of trends relevant to the chemical industry and related sustainability challenges Deloitte, 2011; Grossman, 2013; A.T. Kearney, 2012; Population Reference Bureau, 2006)

Trends	Sustainability challenges and unmeet needs	General opportunities for eco-innovation
Globalization	• *Commonality trends (standardisation of parts and components in supply chain), integration of regional economies and cultures* • *Global impact of local events* • *Global markets, including capital; global supply chains* • *Global competition, effects of low-cost labour, shift of value chains* • *Growing chemical markets, e.g. China*	• *New business models* • *Closed material cycles based on a "cradle to cradle" thinking* • *New emerging markets*
Demographic *change*	• *Human population changes including size, age, gender, race, income, and location;* • *Growing middle class in developing and emerging economies* • *Population growth (in particular in Eastern, Middle, and Western Africa)* • *Aging populations (in particular in the developed world as well as in China and Latin America)*	• *Increased demand for other products (e.g. due to altered age structures)* • *Resource efficiency* • *Recycling* • *New business models*
Urbanization	• *More people living in cities and suburbs* • *Strong growth of megacities and supporting infrastructure and housing* • *Concentration of regional economies, knowledge, resource consumption and waste generation in urban areas*	• *Urban mining* • *Resource efficiency* • *New consumption models* • *More sustainable infrastructure*
Patterns of mobility	• *Increased movement of people and freight* • *Altered movement in terms of mode, distance, frequency, time in transit, and regions*	• *New business models* • *Light-weight solutions* • *More sustainable infrastructure*

Trends	Sustainability challenges and unmeet needs	General opportunities for eco-innovation
Natural Resource Scarcity	• *Availability and costs of natural resources (petroleum, minerals, rare earth metals), energy, clean water, food, and energy alternatives* • *Increasing prices of raw materials/petrochemicals*	• *Advanced technical solutions* • *Closed material cycles* • *Urban mining* • *Resource efficiency* • *Energy efficiency* • *Reduce, Reuse, Recover, Recycle Systems* • *Increased value of more sustainable and resource efficient solutions*
Environment and Sustainability	• *Impact of climate change (severe weather, land erosion, etc.)* • *Impact of increasing waste (e.g. e-waste) on ecosystems* • *Protection, preservation, and restoration of the environment, biodiversity and ecosystem functionality* • *Increasing awareness*	• *Emissions reduction* • *Renewable raw materials* • *Waste reduction* • *Recycling and reuse* • *Green chemistry*
Consumption Patterns	• *Major shifts in demand for goods and services, such as luxuries in China and India;* • *Growing middle class in developing markets; a wealthier developing world leading to increased consumption* • *Increasing demand for sustainable products and services*	• *Demand for greener products* • *Energy efficiency* • *Resource efficiency* • *Closed material cycles* • *New consumption models and solutions (sharing, product servicing, etc.)*
Technological Convergence and New Technology	• *Technologies in addition to information technology (IT) performing similar tasks* • *Technologies combining synergies for accelerated technological change* • *Demand for more open information and access to the internet*	• *Substitution of the use of hazardous chemicals* • *Optimization of the use of chemicals* • *Product centric recycling* • *New models of production and consumption* • *Leapfrogging opportunities* • *Bio-mimicry* • *Inherently safer processes*
Human Health	• *Increased knowledge of adverse effects of hazardous chemicals* • *Expanded and intensified health care, disease prevention* • *Self-management of health; consciousness about health issues;*	• *Biodegradable products* • *Renewable feedstocks* • *Non-hazardous chemical substances* • *Emissions reduction* • *Safer production*

PR.4 Identify sustainability hotspots across the value chain

Eco—i Chemicals

Trends	Sustainability challenges and unmeet needs	General opportunities for eco-innovation
Regulation, Activism, Public Perception	• *Increasing role of social media, potential global impact of local event fuelled by the age of access to open information through internet* • *Increase in regulations promoting sustainability, resource efficiency, and human health (e.g. REACH, WEEE, Stockholm, Basel, and Rotterdam conventions)* • *Increase in voluntary industry standards throughout value chain* • *Increased demand for transparency in sustainability reporting*	• *Emissions reduction* • *Closed material cycles* • *Energy efficiency* • *Resource efficiency* • *Substitution with safer chemicals* • *Safer production processes* • *Green chemistry* • *Financial mechanism that favour more sustainable solutions*

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PR.5

Identify the general opportunities and threats across the value chain

Eco—i Chemicals

PR.5 Identify the general opportunities and threats across the value chain

Eco—i Chemicals

TIPS & TRICKS

IDENTIFY OPPORTUNITIES RELATED TO LEGAL TRENDS IN THE TARGET MARKETS

Some chemicals can severely damage our health and the environment. Hence their use in different applications and products is regulated at international, regional or national levels. Countries around the world have chemical regulations that require public disclosure on the safety of chemicals and require substitution through a safer alternative.

→ Refer to *'Background Information'* for examples of International Conventions, International Models, Regional Chemical Regulation and National Chemical Legislation.

By identifying these legal trends with the *PESTEL* template, you can stay on top of legislative developments in your domestic and export markets so that you can provide potential clients with a competitive advantage for being ahead of regulations. Innovative business models can include services helping customers meet regulatory obligations thereby offering an advantage over competitors.

Industry example 2: Legislation restricting substances in coating
Many countries have introduced or are planning to introduce legislations limiting the emissions of Volatile Organic Compounds (VOC) due to the use of organic solvents in paints (e.g. decorative and vehicle refinishing) in order to prevent adverse environmental effects of VOC emissions. As a result, many paint manufacturers are shifting from producing solvent-based paints to alternatives, such as water-based paints, high-solids paints, or powder coatings for a variety of applications. Legislation can also target specific hazardous chemicals of high concern. For example, the United States Consumer Product Safety Commission banned lead paint in certain consumer products and also placed a limit of the lead content in paints for manufacturers (0.009% as of 2009). This also led to the development of new products and technologies to replace the functionality that lead-containing compounds provided in various paint types.

IDENTIFY OPPORTUNITIES RELATED TO MARKET TRENDS IN THE TARGET MARKETS

Consumers are increasingly concerned about toxic chemicals used in products and are asking for products that are produced in a more sustainable manner, including incorporating non-hazardous chemicals, renewable resources, recycled materials, as well as energy and water-efficient technologies. Aim to identify sustainability-driven market trends in your region.

Industry example 3: Cosmetics
In the case of the cosmetics market, you could target the anti-ageing trend – the dominant trend in cosmetics – and offer (certified) natural resins or extracts, which can add value to anti-ageing products. Refer to the CBI for more market trends: https://www.cbi.eu/About%20CBI/sectors/Natural%20ingredients%20for%20cosmetics/1858/
Industry example 4: coatings
In the case of the paint resins market, a resins manufacturer bundled environmental compliance with improved productivity of the paint contractors in its end market to achieve a significant price premium.

PR.5 Identify the general opportunities and threats across the value chain

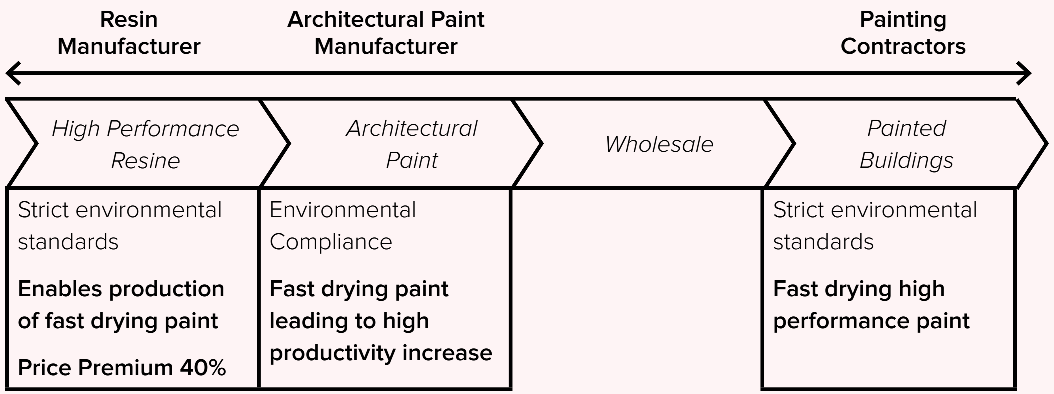
IDENTIFY THE VALUES AND NEEDS OF END MARKET CUSTOMERS

You may want to build a profound understanding of what makes a strong value proposition for companies in the chemical industry. Some factors that customers of the chemical industry typically value include product quality and performance, stability and reliability of supply, innovation that improves reliability/quality and reduces costs – and of course price.

Since many chemical products are near the beginning of the manufacturing value chain, chemical manufacturers are often not in close contact with the end consumer. Therefore, it can be important for chemical manufacturers to understand what the end market customer values and needs when forming a value proposition in the chemical industry, as illustrated in the following example:

Industry example 5: Engaging the value chain to provide value to direct and end market customers, (Harvard Business Review, 2006)

A leading manufacturer of speciality resins used in the formulation of architectural coatings responded to changing regulations by developing a more expensive high performance resin that would enable its customers (paint manufacturers) to meet the new stricter environmental standards. Despite the same high functional performance level, customers did not migrate to the new resin due to the higher costs – the customers of the paint manufacturers (commercial painting contractors) did not want to absorb the higher price, preferring cheaper but less effective alternatives from competitors.



Only when the resin manufacturer engaged its customer's end market (the painting contractors), did it discover that it could improve the painting contractors' productivity significantly by manufacturing a resin that enabled the paint manufacturers to manufacture a fast-drying, environmentally compliant paint. By demonstrating and communicating the environmental and productivity improvements, the resin manufacturer was able to obtain a 40% price premium over the traditional high performance resin.

THINK IN TERMS OF VALUE NETWORKS TO IDENTIFY DRIVERS AND OPPORTUNITIES FOR ECO-INNOVATION

Thinking in terms of 'value networks' (interconnected value chains) can be an innovative way to see and identify opportunities within and across value chains. Background Information contains an overview of drivers for eco-innovation and some possible examples of solutions for different value networks (life sciences, mobility, housing and infrastructure, digital life, energy) in the chemical industry.

PR.5 Identify the general opportunities and threats across the value chain

LEARNING CASE STUDY

Value adding activities								
	Research & Development	Design	Production	Logistics	Marketing	Services	Packaging and labeling	Certification

Inputs	Textile manufacturing	Garment production	Distribution and sales
Raw materials: *Cotton, oil and natual gas, petrochemicals*	**Yarn and fabric wholesale**	**Garment:** *Hosiery, flat knit, cut & sew, accessories, packaging*	**Wholesale**
Natural fibre: *Cotton* **Synthetic fibre:** *Nylon Polyesters*	**Yarn:** *Cleaning, spinning*		**Direct customers**
Chemicals: *Bleaching chemicals, finishing chemicals, solvents, pigments, dyestuffs*	**Fabric:** *Sizing (e.g. polyviyl alcohols), dyeing, weaving*		**Retailers**
Packaging and labeiing	**Ink**		
	Finished textile: *Pretreatment, dyeing, printing, finishing*		

Textile markets
Corporate wear
School uniforms
Babies / toddlers clothes
Shirts for young adults
Promotional apparel

PR.5 Identify the general opportunities and threats across the value chain

The following list provides a summary of the sustainability challenges and opportunities resulting from the *PESTEL* template, that has not been included here.

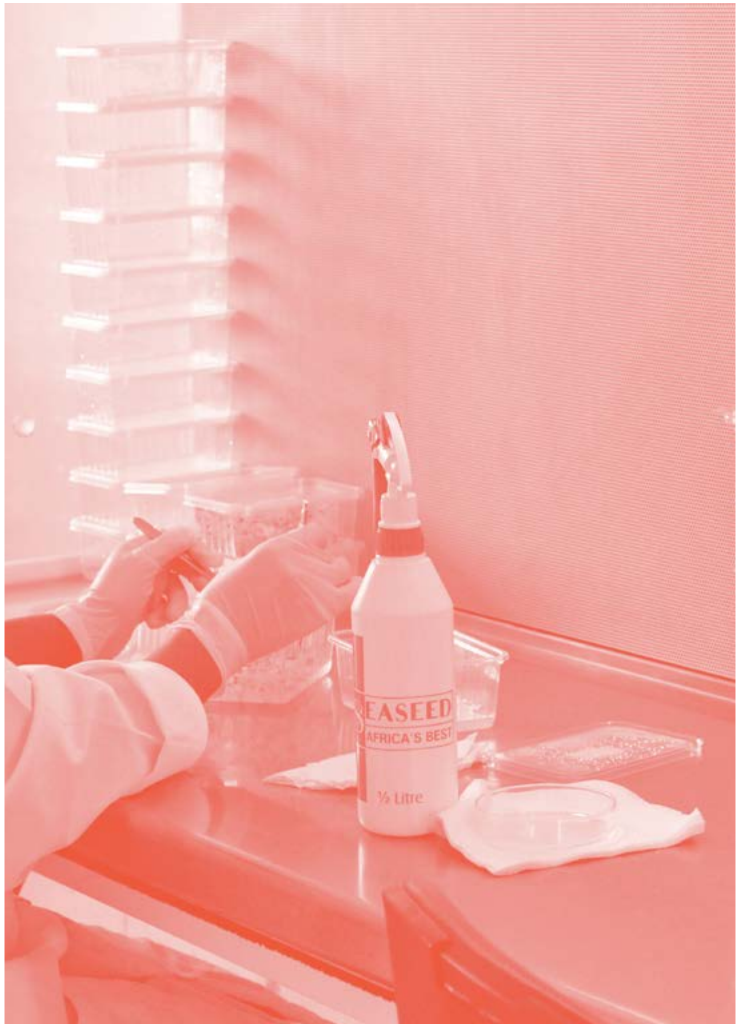
Challenges

International regulations and standards concerning hazardous chemicals become more stringent.

- Limited regional availability in high quality cotton and synthetic fibre feedstock and high prices
- Competition from low-cost regional and international companies putting pressure on the market share of domestic companies
- Women workplace participation in region is low since affordable day-care not available

Opportunities

- Consumers are becoming increasingly more aware of the risks associated with the chemicals used by the textile industry and want to ensure that the products they buy are sustainably sourced and manufactured responsibly
- Large international companies (Brands) are requiring suppliers in their supply chain to adopt best environmental practices and eliminate hazardous chemicals from the life cycle (e.g. ecolabels, social accountability, restricted chemicals list, etc.). The Zero Discharge of Hazardous Waste is one such value chain initiative



PR.5 Identify the general opportunities and threats across the value chain

BACKGROUND INFORMATION

Legal trends

The following provides examples of regulations related to the chemicals sector and may be relevant for your value chain.

Relevant international conventions

There are a series of conventions that address specific chemical issues often indirectly creating favourable conditions for innovation, including the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (signed: 1989, entering into force: 1992), the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides (signed: 1998, entering into force: 2004), the Stockholm Convention on Persistent Organic Pollutants (signed: 2001, entering into force: 2004), the Montreal Protocol on Substances that Deplete the Ozone Layer (signed: 1987, entering into force: 1989), and the Minamata Convention on Mercury (signed: 2013, not yet entered into force).

Example international model

United Nations Globally Harmonised System of Classification and Labelling of Chemicals (GHS) (date of adoption and implementation vary between countries) is expected to facilitate global trade and the harmonised communication of hazard information of chemicals and to promote regulatory efficiency.

Relevant Regional Regulation: European Union

In the European Union the Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) (EC Regulation 1907/2006) calls for the substitution of the most dangerous chemicals when suitable alternatives have been identified. It also pushes chemical companies and chemical industries to develop stronger relationships and better understanding how chemicals are used. The REACH complementing Regulation on Classification, Labelling and Packaging (CLP) (EC Regulation 1272/2008) aligns the European Union system of classification, labelling and packaging chemical substances and mixtures to the GHS.

Specific groups of chemicals in the EU specific groups of chemicals, such as biocides, pesticides, pharmaceuticals or cosmetics, are covered by their own legislation. These specific regulations aim to improve the function of the internal market in these products whilst ensuring a high level of environmental and human health protection since provisions on authorisation and placing on the market are prescribed.

The Waste Electrical and Electronic Equipment (WEEE) Directive (WEEE Directive 2012/19/EU) shifts the responsibility of the post-use phase of electronics to the producer and the Restriction of the use of Hazardous Substances (RoHS) Directive (RoHS recast Directive 2011/65/EU) restricts the use of certain substances in electrical and electronic equipment and requires substitution by safer alternatives.

By introducing the reduction scheme for emissions of Volatile Organic Compounds (EC Directive 2004/42/EC for VOCs in paints) EU companies using organic solvents in their processes were obliged to take measures to reduce emissions. This spur innovation related to substitution of solvents with less harmful substances, emissions reduction equipment, process optimisation, etc.

Ecodesign Directive (2009/125/EC, adoption 2009, stepwise implementation) aimed to encourage energy efficiency, is also enforcing other environmental considerations including materials use, waste issues and recyclability. These are specifically relevant for the cooling equipment of refrigerants (chemicals), therefore companies with innovative products that meet these standards will enhance access to EU export market, but also others with strict regulations. In addition, this is linked to the F-gas Regulation and the Montreal Protocol.

Example National chemicals related legislation: China

In June 2010, the Ministry of Environmental Protection in China adopted the Provisions on Environmental Regulations of New Chemical Substances, replacing a previous regulation from 2003. The 2010 regulations are similar to the EU's REACH and are known as "China REACH" (CBI,2015).

Table 10: Value networks with eco-innovation opportunities (Deloitte, 2011)

Value networks	Trends and Drivers		Selected unmet needs where the global chemical industry can contribute		

Life sciences:
End markets:
• Personal care
• Nutrition
• Pharmaceuticals
Supporting industry:
• Machinery
• Paper and packaging
• Agricultural products
	Demographics:
	• Aging population in developed countries
	Env./sustainability:
	• Eco-friendly packaging
	Human health/Regulation:
	• Increasing health consciousness and self-medication, self-monitoring
	• Shortage of nursing staff and doctors
	• Food safety packaging
	• Safer chemicals and processes
		Natural Resource scarcity:
		• Scarcity of food (competition with e.g., biofuel) and new patterns of consumption
		• Convenience food for developing countries
		• Private labels
		• Demographics
		• Increase of middle class causes shift towards eating meat
			Human health
			• Healthy cosmeceuticals or nutraceuticals
			• Agriculture:
			  • Genetically modified food crops with stress resistance and high yields for food and biofuel crops
			• Ingredients for geriatric medicine, chronic diseases, and oncology
			• Medical devices:
			  • Biometrics for everyday use
				• Telemedicine and remote monitoring systems
				• Nurse robots
				• Self healing materials
				• Medical devices carrying pharmaceuticals
				• Catalytic production of enantiomers
				Beauty and age
				• Anti-aging cosmeceuticals or nutracosmetics
					• Sustainable no waste products such as diapers, shampoo s or female products
					• Cosmetics for diverse ethnic groups or male grooming
					• Bio products with natural ingredients
					Food
					• Bio-based food production processes
					• Functional foods on nanoscale as next frontier

Value networks	Trends and Drivers	Selected unmet needs where the global chemical industry can contribute
		• Nutraceuticals and nutracosmetics • Genetically engineered designer foods • Disease preventing ingredients (biomedical basis) • Dietary supplements • Nutraceutical ingredients require suspension aids to preserve the original structure • Healthier, more nutritious, and allergy-free food • No waste processes • Bio-security: Good sensing, storage, and shipping • Bottles/packaging lighter and stronger, with better thermal tolerance and less gas absorption • New service-based business models (Chemical Leasing)
Mobility <u>End markets:</u> • Automotive • Transportation <u>Supporting industry:</u> • Machinery • Solar • Apparel, textile, and leather • Battery • Electronics • Mining and metal	**New patterns of consumption/Demographics** • Senior-friendly transport • Demand for inexpensive cars • Demand for quality, functionality, and comfort in emerging middle class • Web-enabled cars that are connected with house, office, and personal devices • Efficient urban goods and people transport **Env./Sustainability** • Demand for safe and green travel/transport • Reduced fuel and energy consumption • CO_2 reduction in production and product in use • Recycling of cars and materials **Information sensing, collecting, and presenting technological convergence** • E-mobility	**Power train** • Electric • Hybrid and fuel-cell cars **Pay-per-use business models drive standardization** • Proactive coatings **Mass and urban transport:** • Systems and materials (lightweight, no reinforced) • Packages indicating content temperature history **Cars** • Light-weight materials (plastic used as substitutes for metal under the hood and glazing) • Gluing instead of welding –Web connectivity • Energy generating vehicles/self-powered **Substitution of plastics by bioplastics tires** • High-performance tires/less abrasion • Improve recyclability • Tire sensing **Batteries** • Compact batteries in the future • Fast rechargeable batteries and systems • Nano-materials with large surface-to-mass ratios to increase battery capacity

Value networks	Trends and Drivers	Selected unmet needs where the global chemical industry can contribute
Housing and infrastructure End markets • Construction and infrastructure • Household appliances • Home furnishings Supporting industry • Machinery • Paper and packaging • Agricultural products	**New patterns of consumption:** • Demand for quality, functionality, and comfort in emerging middle class • Housing for developing countries • Easy life systems (smart houses; cleaning; etc.) **Urbanization:** • Need for infrastructure development **Env./Sustainability:** • CO_2 reduction in production and product in use • Recycling/biodegradability of materials • Energy efficient housing (passive house) **Demographics:** • Aging population in developed countries **Resource scarcity:** • Water	**Residential and commercial buildings:** • Proactive and protective coatings • Plastics with form memory • Wind energy self-powered buildings • Intelligent sensor networks • Smart energy management • Senior-friendly residential buildings/ solutions • Increasing use of wood instead of steel and cement • Glazing • Significantly increased glazing • Substitute glass for bioplastics that are resistant and energy efficient **Infrastructure** • Nano-steel or nano-aluminium with higher durability • Systems to renovate canalization **Substitution of plastics by bioplastics** • Bio-based, biodegradable, and no volatiles materials • Energy-efficient construction material (solar shingles, insulation, non-electric heating/cooling systems, etc.) **Gluing for adhesion** • CO_2 neutral • Autarkic cities **Household** • Bio-based and biodegradable cleaners • Cleaners with proactive functionality • Household appliances that reduced water and energy consumption
Digital life End markets • Electronics • Medical devices • Commercial printing Supporting industry • Machinery • Solar • Battery • Mining and metal	**Convergence of technologies:** • All-in-one products • Information sensing, collecting, and presenting • Mobile "offices" **Reduced energy consumption and resource scarcity:** • Rare earths and water **Env./Sustainability** • CO_2 reduction • Recycling/ biodegradability of materials **New patterns of consumption** • Demand for quality, functionality, and comfort in developing middle class groups • Easy life systems (smart phones, smart houses, etc.)	**Bio-based, biodegradable, and energy efficient use of material:** • Substitution of plastics by bioplastics • Energy-efficient products and production processes **Web connectivity everywhere** • Intelligent sensor networks • Home system management from a distance **Self-energized components** • Rare earth mineral substitutes • Rare earth recycling Proactive and protective coatings for electronics **Battery long life and storage materials** • Electrical polymers Materials with enhanced optical, heat, etc. properties • Metals modifiers and metals material composites

PR.5 Identify the general opportunities and threats across the value chain

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Value networks	Trends and Drivers		Selected unmet needs where the global chemical industry can contribute		
Energy End markets • Oil and gas • Solar/Wind/renewable • Energy/electric utilities Supporting industry • Machinery • Solar/Wind • Battery/Electronics	**Demographics** • Growth of world population **Increased per capita energy consumption** • Regulation/stimulus • Env./Sustainability • Desire for clean and safe energy • New renewables	**Resource scarcity** • Energy efficiency of renewables • Competition with food chain for land • Enough and clean water • Shale gas boom	**Alternative raw materials for chemical production** • Degradable drilling materials • No-waste processes • Energy use reduction materials such as insulation, electric transfer, weight, etc. • Bio refineries	**Long-term, cheap storage of electricity** • Solar • Bio-solar materials • Solar electric storage • Efficient and low cost cells • Batteries • Nanomaterials with large surface-to-mass ratios to increase battery capacity	• Batteries on organic basis without minerals and acids • Wind • Offshoring systems with more resistant materials and coatings to prevent corrosion and icing • Lightweight materials for larger wind blades

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PR.6
Develop a value chain vision

Eco—i Chemicals

PR.6 Developing a value chain vision

Eco—i Chemicals

LEARNING CASE STUDY OF VALUE CHAIN VISION

Threats and opportunities

- *Limited regional availability in high quality cotton and synthetic fibre feedstock and high prices.*
- *Competition from low-cost regional and international companies putting pressure on the market share of domestic companies.*
- *Women workplace participation in region is low since affordable day-care not available.*
- *Consumers are becoming increasingly more aware of the risks associated with the chemicals used by the textile industry and want to ensure that the products they buy are sustainably sourced and manufactured responsibly.*
- *Large international companies (Brands) are requiring suppliers in their supply chain to adopt best environmental practices and eliminate hazardous* chemicals from the life cycle (e.g. ecolabels, social accountability, restricted chemicals list, etc.). *The Zero Discharge of Hazardous Waste is one such value chain initiative.*

Vision

The textile industry is successful, profitable and growing strong in both domestic and international markets.

The overuse of agrochemicals in the cultivation of cotton for the production of cotton-based textiles and the corresponding impacts on environmental degradation and farmer health have been resolved through a switch to organic farming and best practice-based crop protection while providing fair wages and good working practices for the farmers.

All chemicals used for the production of textiles that are on Restricted Substances Lists have been eliminated and the criteria specified by the ZDHC initiative regarding permitted concentrations in wastewater have been achieved through cooperation between chemical suppliers, textile equipment manufacturers, international brands and wet textile manufacturers. Residual sludge from wastewater treatment is safely disposed of, such as in adequate cement kilns.

Cooperation between textile manufacturers, washing machines, and detergent suppliers have led to a significant decrease in water, electricity and detergent use for the cleaning of clothes.

The waste generated by textile products, especially garments, at the end of life has been significantly reduced through the introduction of new business models and technologies focusing on the collection and chemical recycling of synthetic fibres and using other waste sources as raw materials for textile production.

Partnerships

- *Chemical suppliers*
- *Textile equipment manufacturers*
- *International brands*
- *Wet textile manufacturers*

Clients

- *Consumers*
- *Retailers*
- *International brands*
- *Garment companies*
- *Distributors*

PR.6 Developing a value chain vision

Introducing TipTop Textiles Co.

At this point of the eco-innovation process, you have gathered all the necessary information on the target value chain and are ready to engage a company to offer your services as an eco-innovation service provider. From this point onwards in the supplement, we will use the hypothetical company TipTop Textiles Co. as a learning case study to provide practical examples of implementation of the eco-innovation methodology and selected templates at a company within the chemicals value chain.

You already provided Resource Efficient Cleaner Production (RECP) services to a local wet textile processing company, TipTop Textiles Co., and are therefore in a good position to acquire their business to provide eco-innovation services.

The family run medium sized company (120 employees) produces textiles for various purposes. The company only processes orders received from domestic and international customers with the domestic market constituting 85% of total sales.

The company manufactures synthetic fibre on-site from polymer chips and processes it into both polyester yarn for fabric manufacturing. The company also uses cotton yarn, which it receives from its suppliers. The natural and synthetic yarns are further processed to finished fabrics via different production steps including weaving or knitting, pre-treatment, dyeing and printing (optional steps), as well as finishing.

The textile products are a mixture of polyester, cotton, and polycotton based-materials. The main products are textiles for corporate wear (e.g. suits for hotels) and school uniforms. Clothes for babies/toddlers, T-shirts for young adults, and apparel for the tourism industry make up the rest of the sales.

The production steps at the company are: polyester fibre, yarn and thread production; warping, weaving or knitting; and textile finishing. Textile finishing is an energy and chemical intensive process including: singeing, desizing, washing, bleaching, dyeing and printing, and final finishing.

The company also manufactures ink for the printing phase. They have a local chemicals distributer supplying the required feedstock for the ink (pigments, solvent, additives, etc.). All the manufactured ink is produced and used internally (they started small as a family owned business manufacturing their own inks). They formulate the inks and dyestuffs in dedicated batch processing reactors.

The majority of the company's employees is involved in the production. In addition, there is the CEO, production manager, sales manager, purchasing manager, finance manager, IT support, environment and health officer, and R&D lab used for developing new inks and textile materials, as well as for quality control.


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SET STRATEGY

The aim of the SET STRATEGY phase is to use your knowledge of the company's strengths, weaknesses, opportunities and threats to propose a new business strategy that places eco-innovation at the core of the company's business strategy to ensure progress towards a sustainable future for the company

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ST.1

Plan my data gathering strategy

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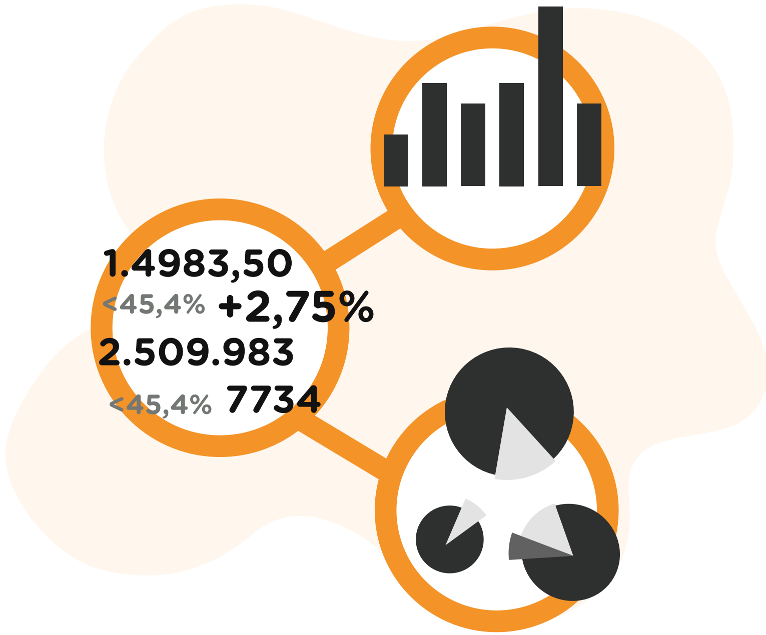


ST.1 Plan my data gathering strategy

TIPS & TRICKS

PRIORITIZE KEY PERFORMANCE INDICATORS FOR QUANTIFYING SUSTAINABILITY HOTSPOTS

You can use Key Performance Indicators (KPIs) in the chemical industry to identify and compare sustainability impacts across the life cycle. Some indicators of high relevance for the chemical industry are presented in the following table that guides you to key data you may want to gather from the company to understand their current situation.

Table 11. Examples of different indicators to measure sustainability in the chemical sector. Underlined elements indicate important KPI's for the chemical sector.

Group of indicators	Examples of indicators		
Financial indicators To track sales and costs	• EBITDA: earnings before interest, taxes, depreciation, amortization • ROI: Return on invested capital • COGS: Costs of goods sold • R&D: Research and Development expenditure (%)		
Business performance To gauge operational performance, market and marketing efforts	**Operational** • Overall Equipment Effectiveness • Lean metrics: batch cycle time, inventory days supply (IDS), process velocity...	**Market** • Market growth rate • Market share • Brand equity	**Customers relationships** • Customer satisfaction Index or the Net Promoters Score • Customer retention rate • Marketing effectiveness
Environmental indicators To measure the interaction with or impacts on the environment	**Inputs** • Restricted substances intensity • Recycled/reused content	**Operations** • Water/Energy intensity • Renewable production of energy • Residuals intensity • Air/water releases intensity	**Products** • Recycled/reused content • Restricted substances content • Recyclability • Energy consumption intensity • Water/Carbon/ Chemical footprint
Social indicators To account for the impacts on the society including employees	• Number and rate of employee turnover by age group and gender • Number of accidents related to unforeseen risks, injuries, lost days, absentee rates and fatalities • Staff value and satisfaction • Average hours of training per year per employee • Assessment and management of impacts of operations on communities		

ST.1 Plan my data gathering strategy

Furthermore, you can build indicators to represent important sustainability hotspots. For example, if you identify hazardous waste as a sustainability hotspot along a product's life cycle, you could build a KPI representing hazardous waste at each life cycle stage (e.g. kg hazardous waste in phase X per kg product sold to consumer).

Additionally, you may want to build KPIs that can be used to set strategic sustainability objectives, guide and monitor continuous improvement, and communicate sustainability performance to workers, key partners, and external stakeholders.

ST.2
Interview the CEO

Eco—i Chemicals

ST.2 Interview the CEO

Eco—i Chemicals

TIPS & TRICKS

DETERMINE IF THE COMPANY'S MAIN STRATEGY IS COST LEADERSHIP OR DIFFERENTIATION

There are two fundamental types of strategies that are commonly applied in the chemical industry: (1) Cost leadership strategy or (2) Differentiation strategy. The chosen strategy will affect the entire business operations including not only the composition of the product portfolio but also technology used, marketing strategies, and procurement activities.

The aim of cost leadership is to gain a cost advantage over the competition, especially in markets characterised by mass products and price competition, by establishing a competitive cost structure through low material and energy costs, efficient production technologies and practices, as well as geographical advantages. The differentiation strategy involves placing emphasis on accessing and shaping new market segments and expanding the application and characteristics of products. The differentiation strategy focuses strongly on product innovation and success involves having a knowledge advantage over competitors. An important success factor is the ability of companies to lead or react flexibly to market demands.

Understanding whether the company follows a cost leadership, a differentiation strategy or a combination of both provides insights into possibilities for eco-innovation activities at the company and in their markets.

ASK WHICH STRATEGIES THE COMPANY USES TO HANDLE VOLATILITY IN RAW MATERIALS

Many companies, especially in the commodities sector, have strategies to buffer against volatility in their raw materials, which are typically caused by variation in the business cycle. These strategies could involve measures to reduce risk by engaging in long-term contracts or production flexibility. Other measures to reduce risk could include a shift towards services, moving downstream towards segments with closer end-customer proximity, value pricing, and broadening the customer base.

ST.2 Interview the CEO

Eco—i Chemicals

LEARNING CASE STUDY OF CEO INTERVIEW

Vision

No vision statement defined yet.

Market

- *Currently, the TipTop Textiles Company focuses primarily on the domestic market with their main products being corporate wear for hotels and school uniforms. The total sales for last year was US$10.2 m.*
- *Domestic market: Corporate wear and school uniforms are the largest, but clothes for babies/toddlers, T-shirts for young adults, and apparel for the tourism industry are also supplied to this market. The domestic market accounts for 85% of the company's total sales with a profit margin of 10%.*
- *Exports: The only products exported are textiles for corporate wear and school uniforms and accounts for 15% of total sales with a profit margin of 15%.*

Product

- *Corporate wear suits and blouses for hotels, material: polycotton*
- *trousers, skirts, shirts, and blouses, material: polycotton*
- *Babies/toddlers clothes material: cotton*
- *Shirts for young adults material: cotton*

Selling points

- *Speed, low cost, customization*
- *Low cost, durability*
- *Comfort for baby, appearance*
- *Low cost, fashionable, unique*

Strategic goals

- *Increase export business by 25% within 5 years. The profit margins are higher in the export sector and marketing became easier during the last years due to the internet. Expanding this business requires a sales department and improved language skills of the sales manager.*
- *Triple sales of shirts for young adults within 3 years. A growing young middle class with disposable income in emerging economies demands fashionable shirts.*
- *Triple sales for babies and toddlers clothes within the next 5 years (domestic) Currently, the company holds a small market position. Recent problems with the quality of the competitor's products may soon lead to more orders. However, cheaper imported products present an increasing challenge. However, parents are becoming more concerned about chemicals in textiles.*
- *Hold position in top 3 for domestic providers of corporate wear and school uniforms. The growing eco-tourism industry in the country leads to more (upper-class) hotels that require corporate wear. The market for school uniforms is not expected to grow significantly and there is fierce competition from local rival textile mills.*

ST.3

Capture the current business model

Eco—i Chemicals

ST.3 Capture the current business model

Eco—i Chemicals

TIPS & TRICKS

CLASSIFY CURRENT BUSINESS MODELS TO BETTER UNDERSTAND HOW THE COMPANY OPERATES

By classifying the business models currently being used by the company according to those shown in the *'Background Information',* you can better understand the business models' key elements and how the company interacts with its customers and end markets as well how it differentiates its products in the marketplace (e.g. low-cost or differentiation).

LEARNING CASE STUDY OF BUSINESS MODEL CANVAS

TipTop Textiles' direct customers are the local garment factories that sews the fabrics provided by TipTop Textiles Co. to finished apparel, as well as the distributors and retailers ordering the textiles from the company. Downstream the value chain, the end customers are for instance hotels and schools, requiring corporate wear and school uniforms, respectively. Furthermore, parents of infants and toddlers, tourists, and young adults buy the goods produced by TipTop Textiles Co.. The company delivers high-quality textiles made from polyester, cotton or polycotton and as they produce their own synthetic yarn and ink, they are able to rapidly fulfil the orders and have competitive prices. They communicate with their customers via an integrated customer relationship management (CRM) system. In addition, they have dedicated key-account managers that maintain B2B relationships. TipTop Textiles Co.'s revenues are generated through selling the textiles they produce.

To produce their goods, TipTop Textiles Co. requires certain key resources, which include an IT integrated system for orders, production and inventory control, flexibility, production speed, an R&D department, quality control, all the necessary production equipment, and a strong financial position (good cash flow and reserves).

With these resources, the company produces synthetic yarn from polyester fibres, manufactures ink for printing, weaves or knits, and finishes the fabrics, which includes chemical processing steps such as bleaching, washing, dyeing, printing, and finishing.

In addition, the company treats the wastewater they generate and maintains good relationships with its customers. When it comes to partners, the most important ones are the local garment companies, the distributors of the textiles, and the chemicals and raw materials suppliers.

In addition, the costs for labour, raw materials, energy and the machinery needed to produce the goods are also generated by waste disposal and wastewater treatment. Additional external costs are caused by impacts on the society or the environment. These impacts include emissions from hazardous chemicals during the production process and the effects on the workers as well as impacts on climate change and local air quality.

ST.3 Capture the current business model

LEARNING CASE STUDY OF BUSINESS MODEL CANVAS

Key Partners

Local partner garment company

Distributors

Chemical suppliers (ink feedstock, textile chemicals)

Textile raw material suppliers (cotton and polyester pellets)

Key Activities

Customer relationship management

Purchasing of resources

Polyester fibre production

Ink manufacturing

Textile manufacturing: weaving or knitting and textile finishing including dyeing and printing

Wastewater treatment

Key Resources

Raw materials (cotton, polyester, chemicals)

IT integrated system for orders, production and inventory control

R&D department

Quality Control

Production equipment

Strong financial position (cash flow)

Value Propositions

High quality textiles made from cotton, polyester or polycotton at Locally competitive prices

Integrated textile mill offering ink production, polyester fibre production, weaving, textile finishing, as well as thread production

Fast fulfilment of orders

Customer Relationships

TIntegrated Customer Relationship Management System

Dedicated key-account managers for strategic B2B customers (includes interviewing customers)

Channels

Integrated Customer Relationship Management (CRM) system for sales, delivery, payment, and post-sale feedback

Sales force

Trade conventions

Newsletters to customers on new product offerings

Customer Segments

Direct customers:

Local garment company

Distributors (domestic and export)

Retailers

End customers:

Corporate wear (e.g. hotels)

Schools

Parents of infants and toddlers

Tourists buying promotional apparel (e.g. I love Kenya)

Young fashion-conscious adults

Cost Structure

Technical facilities
Textile raw materials: cotton, polyester
Ink and dye raw materials
Textile wet processing chemicals
Hazardous waste disposal
Wastewater treatment
Logistics and transportation costs for products

Revenue Streams

Sales of textiles (mostly corporate wear, school uniforms)

ST.3 Capture the current business model

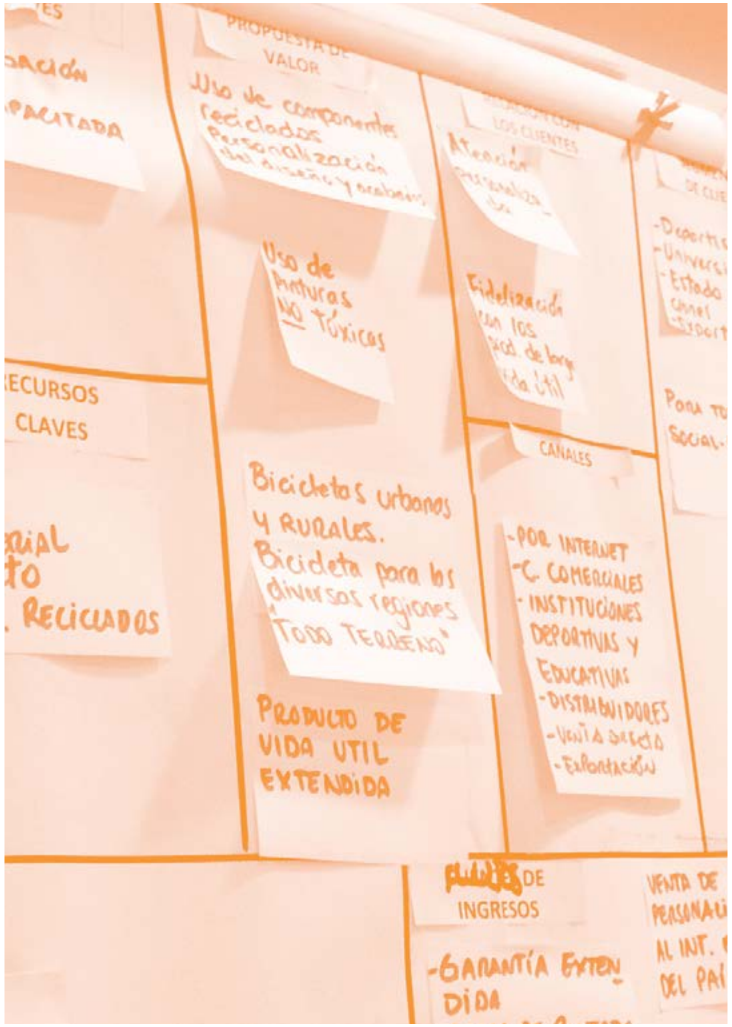
BACKGROUND INFORMATION

Common business models used in the chemical industry

The chemical industry provides a variety of products and services that differ with respect to price, functionality and availability, which is reflected in the business model. For example, a commodity chemical supplier will have a business model with a focus on cost, reliability, and product quality, whereas a specialty chemical supplier may have a business model with a focus on innovative custom design with a high degree of customer intimacy. While performing the preliminary assessment, it may be useful to classify the business model(s) used by the company in order to highlight the key elements of the business model. The following figure illustrates key elements of various business models commonly encountered in the chemical industry. The business models differentiate themselves according to customer or end market proximity and product classification (i.e. low-cost or differentiation).

References

Deloitte. (2011). End market alchemy - expanding perspectives to drive growth in the global chemical industry. Deloitte Global Services Limited.



ST.3 Capture the current business model

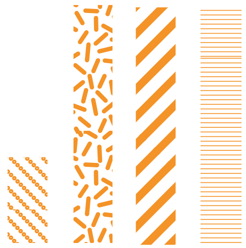
Eco—i Chemicals

Supply Chain differentiation/integration · Industrial marketing · Collaborative Innovation · Value pricing · Supply-demand pricing

End market intimacy — High

Low-cost, extended supply chain integration

This model is similar to the low-cost, supply chain integration model and extends the entire supply chain to an end market. Value-selling skills are required to bring together various participants in the supply chain and collaborative innovation is essential for success due to the structural change in the value chain.



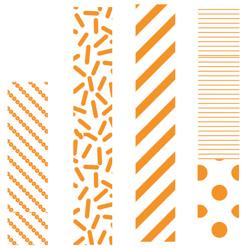
Innovation of exyended custom design

This business model has most of the same characteristics as innovation of custom design but extends collaborative R&D and marketing to the end markets. It emphasizes the value of product/process innovation with downstream.

Customer Intimacy — High

Low-cost, supply chain integration

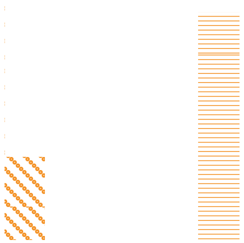
This model has all the same characteristics as the low-cost, reliable supplier model, but in it a high degree of customer intimacy requires more advanced industrial marketing to identify opportunities. Some value-selling skills are required for negotiations.



Innovation of custom design

Building on the same characteristics as the innovation of superior trends-based products, this business model incorporates a high degree of customer intimacy with selected customers and a focus on supply chain integration.

Customer Intimacy — Low



Low-cost, reliable supplier

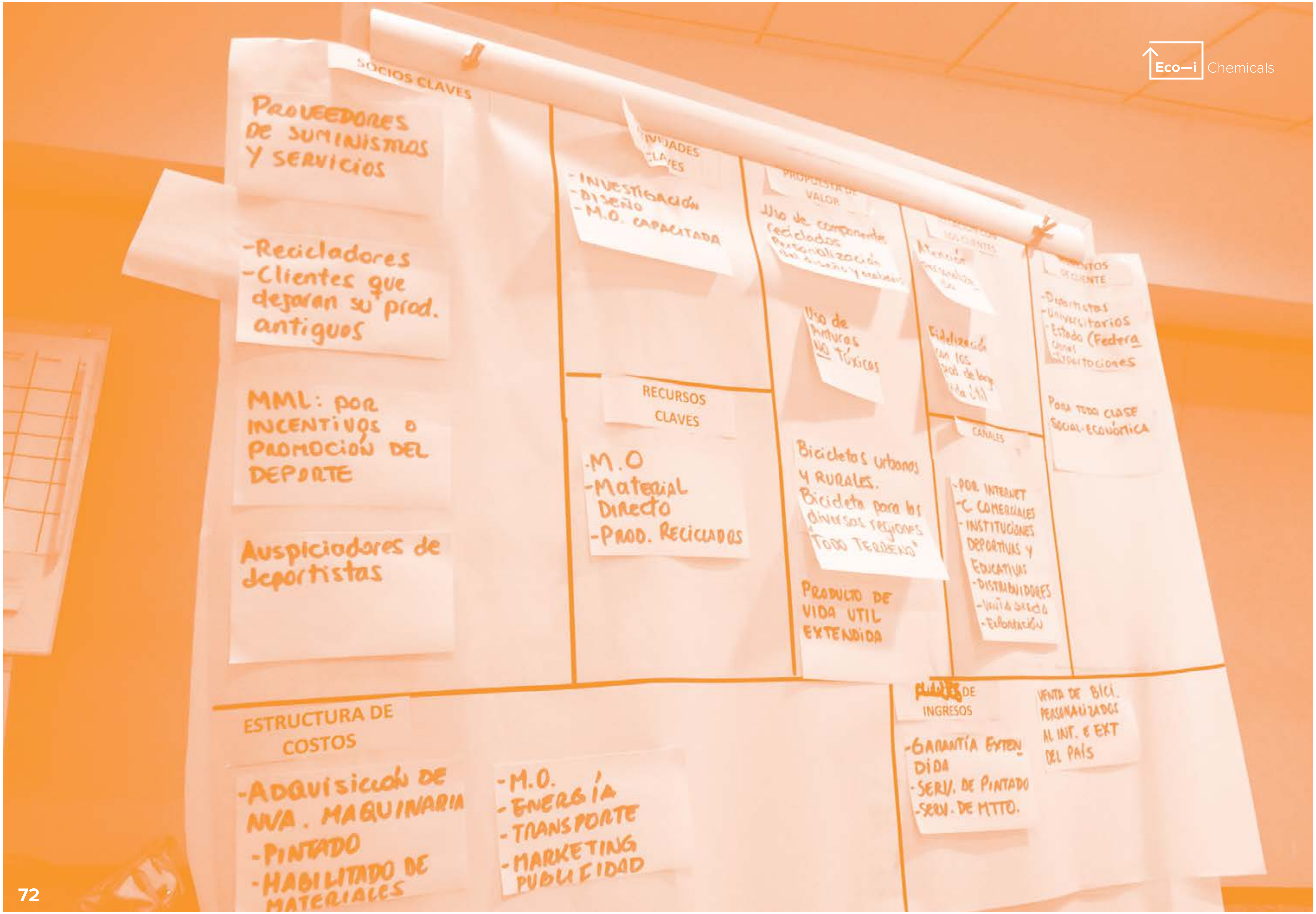
This model requires operations that are streamlined to produce and deliver products at the lowest cost. The products manufactured tend to be basic chemicals. In addition, this model bases purchasing decisions almost exclusively on specifications. Thus, monitoring and supply chain network optimisation are essential competences.

Innovation of superior trends-based products

The focus lies on developing superior products but acting independently from specific customers and other paricipants in the industry chain. Value-pricing skills as well as significant industrial matrketing and market research, combined with R&D, are required to create innovative new products or processes.

Low cost	Differentiation
Strategic intent	

Figure 2. Overview of different typical business models in the chemical industry and their major features based on (Deloitte, 2011)


SOCIOS CLAVES
PROVEEDORES DE SUMINISTROS Y SERVICIOS
-Recicladores
-Clientes que dejaran su prod. antiguos
MML: POR INCENTIVOS O PROMOCIÓN DEL DEPORTE
Auspiciadores de deportistas
-INVESTIGACIÓN
-DISEÑO
-M.O. CAPACITADA
RECURSOS CLAVES
-M.O
-Material Directo
-PROD. RECICLADOS
VALOR
Uso de pinturas NO Tóxicas
Bicicletas urbanas y RURALES.
Bicicleta para los diversos regiones
"TODO TERRENO"
PRODUCTO DE VIDA UTIL EXTENDIDA
CANALES
-POR INTERNET
-C. COMERCIALES
-INSTITUCIONES DEPORTIVAS Y EDUCATIVAS
-DISTRIBUIDORES
-Deportistas
-Universitarios
PARA TODO CLASE SOCIAL-ECONÓMICA
ESTRUCTURA DE COSTOS
-ADQUISICIÓN DE NVA. MAQUINARIA
-PINTADO
-HABILITADO DE MATERIALES
-M.O.
-ENERGÍA
-TRANSPORTE
-MARKETING PUBLICIDAD
INGRESOS
-GARANTÍA EXTENDIDA
-SERV. DE PINTADO
-SERV. DE MTTO.
VENTA DE BICI. PERSONALIZADOS AL INT. E EXT DEL PAÍS

ST.4
Do a Walk-Through Audit

Eco—i Chemicals

ST.4 Do a Walk-Through Audit

Eco—i Chemicals

TIPS & TRICKS

USE A CHEMICAL INVENTORY TO SCREEN FOR CHEMICALS OF CONCERN

The first step in identifying chemicals of concern that should be prioritized for elimination, substitution or protective control measures, is to establish and then screen an up-to-date and accurate chemical inventory.

If a chemical inventory is not available, you can offer your services to the company to develop an actionable chemical inventory. Information on hazards and safety precautions are typically found on the Safety Data Sheets (SDS). If the SDS is not up-to-date, you can use the CAS # and find the harmonized hazard classification and other information on the chemical on the European Chemicals Agency's website 'Information on Chemicals': http://echa.europa.eu/information-on-chemicals

Use this safety information to help you understand and identify safety related issues, but also to ensure human health and safety along the value chain (transporters, customers, communities).

USE VALUE STREAM MAPPING TO IDENTIFY AREAS FOR PRODUCTIVITY IMPROVEMENT

Value Stream Mapping can be a useful tool to characterize the whole business process and identify areas for productivity improvement. You can use the audit and Value Stream Mapping to identify added-value techniques to improve their current operational deficiencies. Such techniques are typically low-cost and result in a better bottom-line. You can find out more about Value Stream Mapping on the US EPA's website: http://www.epa.gov/lean/environment/toolkits/environment/ch3.htm#introduction

LEARNING CASE STUDY

During the walkthrough audit and a workshop conducted at the company with key personnel, you identified the strengths and weaknesses of TipTop Textiles Co.'s current operations.

An audit of the company showed that material consumption is the highest cost element of the company followed by personnel costs. The cost for materials is mainly attributed to bleaching agents, dyestuffs, pigments, finishing agents, textile auxiliaries (e.g. lubricants) and basic chemicals (e.g. solvents). See Figure 3 for further details.

ST.4 Do a Walk-Through Audit

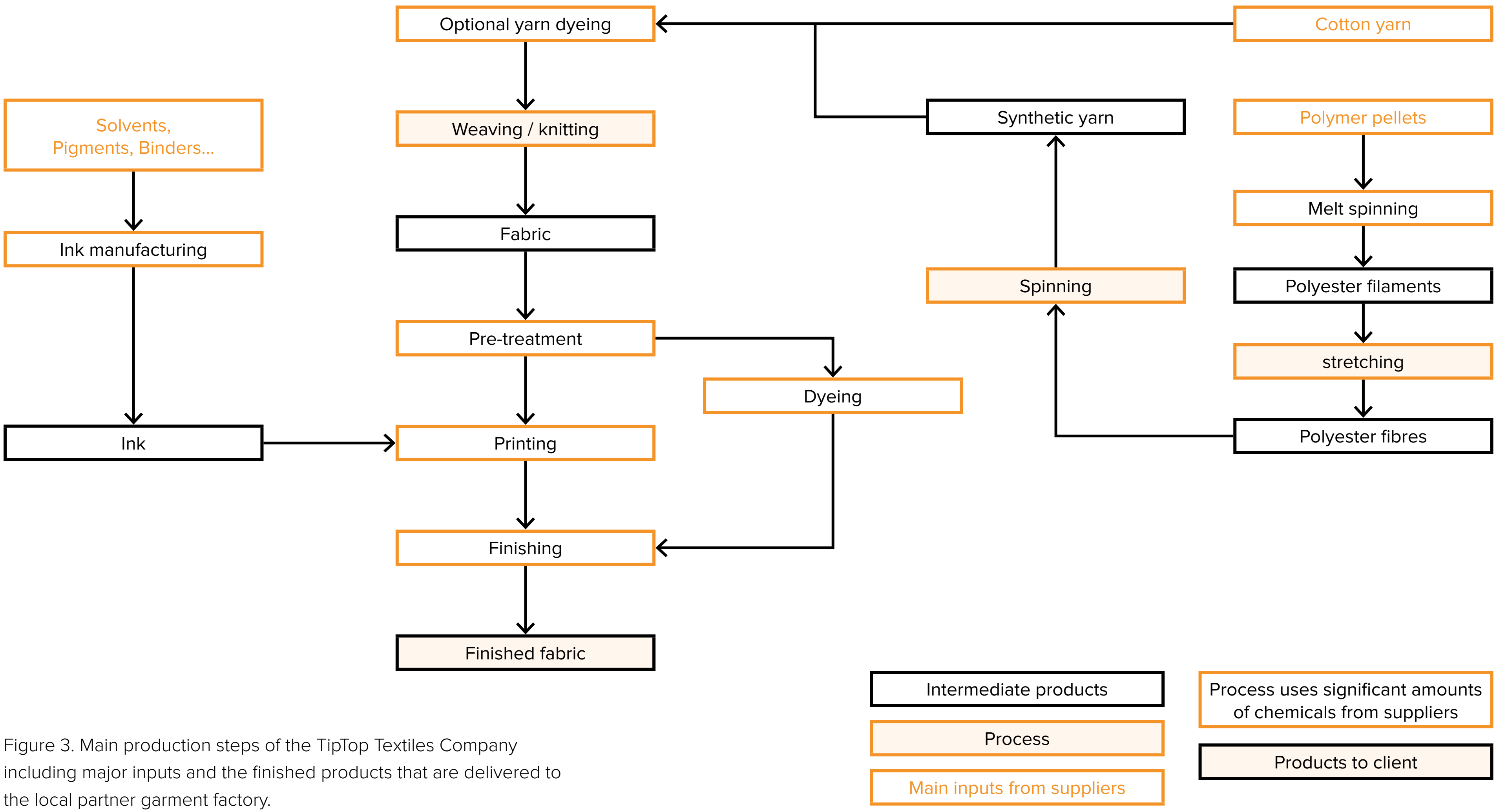


Figure 3. Main production steps of the TipTop Textiles Company including major inputs and the finished products that are delivered to the local partner garment factory.

ST.4 Do a Walk-Through Audit

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The walk-through audit and discussion with responsible TipTop Textiles Co. staff revealed the following major internal strengths and weaknesses:

Operational strengths

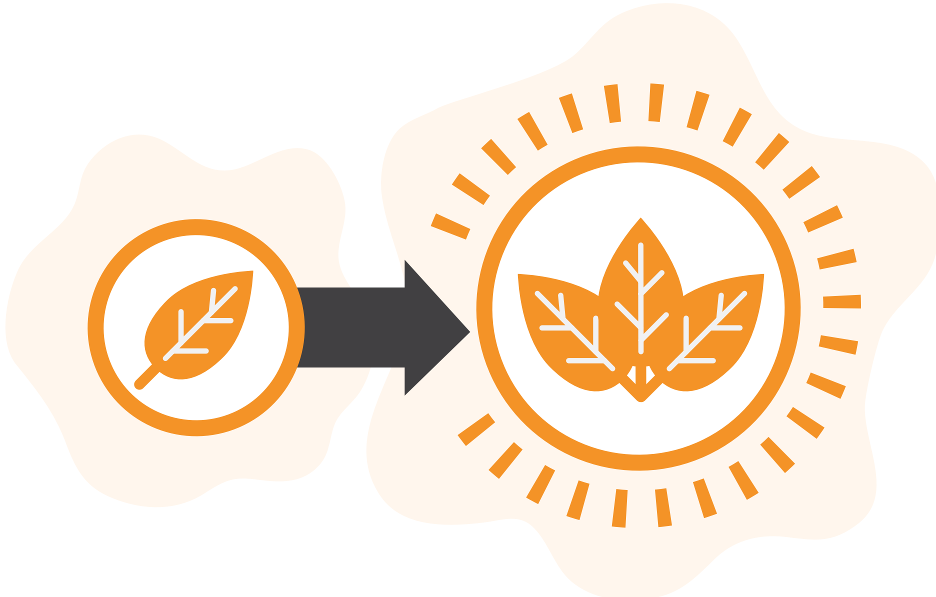
- High quality finished textile with little off-spec material and quick and on-time delivery
- High quality dye and ink due to own manufacturing by chemists and engineers; quick adaptations are possible
- Well-equipped R&D/Quality Control (QC) lab with experienced personnel and line operators (polyester fibre production, ink manufacturing, textile finishing)
- Effective, innovative and adaptable sales and marketing team
- IT-based Customer Relationship Management (CRM) system for integrating marketing, sales, production, delivery, and payables
- Good customer relations with local garmenting industry, corporate wear customers, and school customers
- Strong financial position (good cash flow and reserves)
- Existing cooperation with local university

Operational weaknesses

- Fluctuating raw material prices, especially cotton and polyester pellets suppliers
- High energy and water costs due to non-optimised equipment and batch processes including water removal, heating (and recovery), and liquor ratio
- Large amount of (hazardous) waste produced, especially in ink manufacturing leading to expensive disposal costs
- Occupational health issues related with the production and use of printing inks as well as the cleaning of printing equipment (e.g. printing rolls and related equipment are cleaned using solvents in open cleaning machines) in different parts of the facility
- Insufficient wastewater treatment: Large amounts of wastewater from the textile finishing process are released to local river impacting local communities and river quality through releases Local communities rely on the river for fishing and field irrigation.

ST.6

Update the sustainability hotspots



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ST.6 Update the sustainability hotspots

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LEARNING CASE STUDY OF LIFE CYCLE THINKING

					Environmental impacts		Social Impacts			Economic impacts
Phase	**Activity**	**Inputs**	**Product outputs**	**Emissions**	**Resource use**	**Ecosystem quality**	**On workers**	**On consumers**	**On stakeholders**	**Profitability**
Materials	*Cotton cultivation*	• *Fuel (diesel)* • *Water* • *Pesticides* • *Herbicides*	• *Cotton* • *Polyester* • *Textile chemicals*	• *GHG emissions* • *Waste water* • *Run-off residues* • *Cotton waste*	• *Farming water and agrochemical intensive (150g pesticides and 220o L water for a shirt) (M)* • *Petrochemical feedstock for polyester is non-renewable (M)* • *Solvent waste and wastewater from pigment production (M)*	• *Agro-chemical intensive farming leads to soil degradation and polluted water sources (M)*	• *Farmers often lack protective equipment and are exposed to toxic herbicides and pesticides (M)* • *Cotton farmers leaving industry replaced with automation, higer wages (L)*			• *Rising costs of synthetic feedstock and cotton (H)* • *Revenue to cotton farmers (M)* • *Cost of lost cotton (M)*
Production	*Fabric production (speaning / weaving)*	• *Electricity (100% coal)* • *Cotton* • *Lubricants*	• *Fabric*	• *GHG emissions* • *Dust* • *Yarn/fiber waste*	• *Resource depletion - fossil fuels (L)* • *Waste fabric (L)* • ***Polyester fibre waste from off-spec operation (L)***	• *Climate change (L)*				• *High electricity costs for fabric production (M)* • *Cost of fabric (L)* • ***Cost of lost polyester fibre (M)***

					Environmental impacts		Social Impacts			Economic impacts
Phase	**Activity**	**Inputs**	**Product outputs**	**Emissions**	**Resource use**	**Ecosystem quality**	**On workers**	**On consumers**	**On stakeholders**	**Profitability**
Production	*Pre-treatment (sizing, bleaching, etc)*	• *Fabric* • *Agents* • *Sizing* • *Caustic* • *Soda* • *Peroxide* • *Stabilizing* • *Water* • *Fuel* • *Electricity*	• *Pre-treated fabric*	• *GHG emissions* • *Waste water* • *Caustic soda* • *Heavy metals* • *Organic waste*	• *Water consumption (M)*	• *NPEOs used in textile wet processing degrade into nonyphenol in the environment which is toxic to aquatic organisms and may cause harm to unborn children (H)*			• *NPEOs used in textile wet processing degrade into nonyphenol in the environment which is toxic to aquatic organisms and may cause harm to unborn children (H)*	
	Dyeing and printing	• *Pre-treated fabric* • *Salt* • *Dyestuff* • *Tensides* • *Solvents* • *Pigments* • *Water* • *Fuel* • *Electricity*	• *Dyed fabric*	• *GHG emissions* • *Waste water* • *Salt* • *Dyestuff* • *Tensides* • *VOC* • *Pigments*	• *Water consumption (M)* • ***Waste ink and solvent from ink production and ink printing (cleaning of equipment) (M)***	• *High biochemical oxygen demand of wastewater effluent affecting local aquatic environment (M)*	• *Azo dyes which degrade to form listed aromatic amines (e.g. benzidime), many of which cause or are suspected to cause cancer (H)* • ***VOC fugitive emissions impacting workers health due to lack of control technologies and PPE (M)***		• *Azo dyes which degrade to form listed aromatic amines (e.g. benzidime), many of which cause or are suspected to cause cancer (H)*	• ***Cost of waste ink and solvent from ink production & printing (M)***

					Environmental impacts		Social Impacts			Economic impacts
Phase	**Activity**	**Inputs**	**Product outputs**	**Emissions**	**Resource use**	**Ecosystem quality**	**On workers**	**On consumers**	**On stakeholders**	**Profitability**
Production	*Garment manu-facturing*	• *Garments* • *Electricity*	• *Sold garments*	• *GHG emissions* • *Damaged / unsold garments*			• *Textile value chain employs a large number of low-skill labourers (H)*			• *Cost of lost fabric (H)*
	Finishing	• *Dyed Fabric* • *Resins* • *Catalysts* • *Enzymes* • *Softener* • *Tensides* • *Additives* • *Water* • *Fuel* • *Electricity*	• *Finished fabric*	• *GHG emissions* • *Waste water* • *Solid waste*					• *Conflict with local communities over waste water and sludge production (L)*	• *Waste water treatment costs (M)* • ***Disposal hazardous materials (M)***
Use	*Wholesale / Retail*	• *Garments* • *Electricity*	• *Sold garments*	• *GHG Emissions* • *Damaged / unsold garments*						• *Cost of lost / unsold garments (M)* • *Revenue to retailers (M)* • *Revenue to producers (M)*

ST.6 Update the sustainability hotspots

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					Environmental impacts		Social Impacts			Economic impacts
Phase	**Activity**	**Inputs**	**Product outputs**	**Emissions**	**Resource use**	**Ecosystem quality**	**On workers**	**On consumers**	**On stakeholders**	**Profitability**
End of life	*Disposal and recycling*	• *Used / Damaged garments* • *Fuel*	• *Waste garments*	• *GHG emissions*	• *Most clothes landfilled after use and not reused or recycled (H)*				• *Leachate from landfilled textiles can enter groundwater causing adverse health effects (L)*	

The *Life cycle Thinking* template just presented is completed for the TipTop Textiles Co., with the new, company-specific impacts in bold. The sustainability hotspots for the textiles value chain described in the case study are the same as those identified in the PREPARE phase:

- Raw material extraction: Cultivation of cotton is resource intensive (water, chemicals), degrades land and exposes farmers to harmful pesticides and herbicides
- Impact of chemicals used during production (and use): Nonylphenol ethoxylates (NPEOs) used in wet textile-processing are known to degrade in the environment to endocrine disruptors and formaldehyde used as a preservative during transport is suspected of causing cancer
- Use: High detergent and water use from washing clothes and high electricity consumption from tumble-drying of apparel
- End-of-life: Textiles typically discarded after 2 years of use and thrown in landfill without reuse or recycling. Further environmental and human health effects resulting from the decomposition of clothing in landfills

ST.6 Update the sustainability hotspots

Below are some sustainability hotspots for the TipTop Textiles Co. listed along with examples of stakeholders and their possibilities to address the relevant hotspot.

Table 12: Selected sustainability hotspots for TipTop Textiles Co. and possibilities on how to address them

Sustainability hotspot	Stakeholder and how they could help
Impact of chemicals used during production (and use): nonylphenol ethoxylates (NPEOs) used in wet textile processing are known to degrade in the environment to endocrine disruptors; formaldehyde used as a preservative during transport is suspected of causing cancer.	International Brands: partnerships for eliminating and replacing chemicals on a textile industry's Restricted Substances Lists. Chemical suppliers - provide alternatives for NPEO-containing scouring agents and therefore eliminate discharge to aquatic environment.
Cultivation of cotton is resource intensive (water, chemicals), degrading land and exposing farmers to harmful pesticides and herbicides.	Cotton producers - source fair trade, organic cotton thereby minimizing environmental degradation and promoting better wage
End-of-life: textiles typically discarded after 2 years of use and thrown in landfill without reuse or recycling.	Waste plastic recyclers - provide a secondary feedstock, which can be used for synthetic-based textiles.

ST.7
Do a SWOT analysis

Eco—i Chemicals

ST.7 Do a SWOT analysis

Eco—i Chemicals

LEARNING CASE STUDY OF SWOT

	Helpful to becoming more sustainable	Harmful to becoming more sustainable
Internal origin **(attributes of the company)**	**STRENGTHS** • *High quality finished textile products delivered quickly and on time* • *High quality ink and dye manufacturing capability for tailored solutions* • *Well-equipped and talented R&D / QC department as well as line operators* • *IT-based CRM integrated system (marketing, sales, production, delivery, etc.)* • *Good customer relations* • *Strong financial position* • *Existing cooperation with local university*	**WEAKNESSES** • *High energy and water costs due to non-optimised equipment and batch processes* • *Significant hazardous waste from ink production and printing processes (high VOC content)* • *Fugitive VOC emissions (operation/cleaning) causing worker complaints* • *High amount of wastewater causing concerns in nearby local community*
External origin **(attributes of the environment)**	**OPPORTUNITIES** • *Consumers demand high quality and sustainably produced textiles* • *Corporations looking to demonstrate sustainability practices* • *Governments promoting Green Public Procurement policies (e.g. school uniforms)* • *Technologies exist for chemical recycling of synthetic fabrics or manufacturing from renewable resources* • *Certain markets looking for sustainable solutions to necessary but little-used clothing (e.g. parents of infants/toddlers)* • *Large multinational brands pushing for zero discharge of hazardous substances throughout the supply chain (especially wet textile processing)* • *Large amounts of waste PET bottles in region that could serve as an alternative raw material for textiles*	**THREATS** • *Cheap imports driving down profit margins* • *Raw material price volatility, especially relating to polyester and pigment materials* • *Quick turnover of clothes produce large amount of waste leading to environmental and health challenges* • *Increasing electricity and fuel (Diesel, NG) prices* • *Large multinational brands pushing for zero discharge of hazardous substances throughout the supply chain (especially wet textile processing)* • *Lack of public day-care and healthcare obstacle for women to participate in workforce*

ST.8
Develop a vision for the company

Eco—i Chemicals

ST.8 Develop a vision for the company

Eco—i Chemicals

LEARNING CASE STUDY OF COMPANY VISION

SWOT

Value chain vision

Company vision for TipTop Textiles Co.

TipTop Textiles Co. is the leading manufacturer of apparel textiles in the region providing sustainably sourced and manufactured textiles to the domestic and export markets.

We work closely with cotton farmers to ensure a stable and cost-effective supply of organic cotton produced under safe working conditions, which is fairly compensated.

Also, we promote the cooperation with our direct customers for corporate and school wear to reclaim used textiles and to close the loop as much as possible through reuse or recycle of the end-of-life textiles.

We have a good and intense relationship with innovative chemical suppliers, international brands and quality assurance specialists to ensure only chemicals placed on the ZDHC Restricted Substance List are not used intentionally or inadvertently in the manufacturing process and do not end up as residue on sold clothing. Approved chemicals are used in manufacturing high-quality textile products.

Furthermore, we work with Eco-label certifiers using only chemicals on positive lists in the manufacturing of selected value-add textile products for niche and higher value products.

Feedback

ST.9

Define the strategic goals

Eco—i Chemicals

ST.9 Define the strategic goals

Eco—i Chemicals

TIPS & TRICKS

CONSIDER STRATEGIES THAT IMPROVE ENVIRONMENTAL AND ECONOMIC PERFORMANCE IN END PRODUCTS

Strategies to improve environmental and economic performance in end products where sustainability provides added value:

- Solutions for light-weighting in automotive products (e.g. reinforced polycarbonate fenders)
- Solutions for improving fuel efficiency in transportation vehicles (e.g. additives for reducing friction in tires to improve fuel economy)
- Solutions for green buildings during production and use phase: i) Energy-efficient building materials such as high-performance insulation based on porous polyurethane, coatings protecting against corrosion, heat-insulated windows, etc. ii) Self-powered houses such as solar shingles
- Solutions enabling energy efficiency in end products (e.g. multi-layer films offered by 3M that enable less energy use of many devices, see case study below).

Industry example 6: 3M

3M produces a range of multi-layer films that draw their inspiration from nature, particularly the glittering blue wings of the Morpho butterfly that are created without the use of colour pigment. By combining films in layers similar to those of a Morpho butterfly's wings, 3M has produced multi-layer films that reflect in the same way, whatever the light angle.

3M recognises that it is not the technology itself that is important but its commercial application. To date, applications for these films include LCD displays, so increasing screen brightness, reducing screen glare and providing viewing privacy. The brighter screen means energy efficiency and smaller batteries, enabling smaller equipment. Examples include: screens in laptop computers and personal digital assistants (PDAs) - and extend to fast growing, exciting applications such as the latest coloured mobile phones, car navigation displays and rear-projection televisions.

Working as a focused team in the UK, the Enterprise Growth Team identified two specific new applications for multi-layer films which are delivering strong sales growth:

- 3M Thin Sign Technology. By combining three different types of multi-layer film, 3M has created a new display solution, with the advantages of the latest 'edge lit' sign technology at a price more consistent with traditional lower-cost, back-lit alternatives. The new technology also means the illuminated signs use less energy and generate less heat, thus reducing air conditioning costs when used, for example, in stores.
- Decorative applications on luxury goods. The film creates an attractive colour effect, helping to differentiate the product and add value. Uses include CD covers, perfume packaging, greeting cards, and even designer lampshades.

3M's eco-innovative approach involved a strategy finding end market products that could be retrofitted, thus enabling technologies and products to be more efficient (i.e. to use less energy). This provided a whole new product line to existing products.

ST.9 Define the strategic goals

CONSIDER DEVELOPING AND MARKETING "GREEN PRODUCTS"

Develop and market "green products" making use of:

- Less hazardous substances (e.g. heavy-metal free paints)
- Renewable feedstock (e.g. bio-based polylactic acid as a polymer feedstock) or natural ingredients (e.g. cosmetics provided by Natura, see following case study)
- Recycled material (e.g. collection and mechanical/chemical recycling of end-of-life polymers)

ONSIDER STRATEGIES THAT IMPROVE ENVIRONMENTAL AND ECONOMIC PERFORMANCE IN INDUSTRIAL USERS OF CHEMICALS

Consider strategies to improve environmental and economic performance in industrial users of chemicals. For example, offering Chemical Leasing services to manufacturers using solvents to clean parts, such as those for cleaning high precision metal parts for the aerospace or medical industry, can improve both the economic and environmental performance of the industrial user of chemicals. For more information on Chemical Leasing, visit: http://www.chemicalleasing.com/

TURN VALUE CHAIN CHALLENGES INTO BUSINESS OPPORTUNITIES

Think about the main sustainability hotspots faced by customers and users in the value chain. Current or potential customers may have a common problem or challenge that you can improve by developing a new product offering. For example, some companies have a negative-value by-product (e.g. hazardous waste), which could be upgraded to a sellable product, or some companies may face resource efficiency challenges that the company can improve through new products and services.

ST.9 Define the strategic goals

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LEARNING CASE STUDY OF STRATEGIC GOALS

STRATEGIC GOAL #1	
What hotspot or other SWOT issue does the goal help to address?	*The wet-textile process consumes significant amounts of hazardous chemicals, significant amounts of water, and generates much wastewater affecting the local water supply and community.*
What is the desired change?	*Eliminate chemicals on the ZDHC Restricted Substances List (RSL) through a combination of substitution and technological improvements*
How will you know if the goal has been achieved?	*All chemicals in the chemical inventory will be updated and screened against the ZDHC RSL. All new replacements will be screened against the ZDHC RSL. A KPI will be established to monitor the number of chemicals on the RSL.*
When will the change be achieved?	*Within two years*
Final formulation of the goal:	*We will eliminate all chemicals used in production which are on the ZDHC Restricted Substances List (RSL) within two years through a combination of substitution and technological improvements*

ST.10

Generate ideas for new products, markets and selling points

Eco—i Chemicals

ST.10 Generate ideas for new products, markets and selling points

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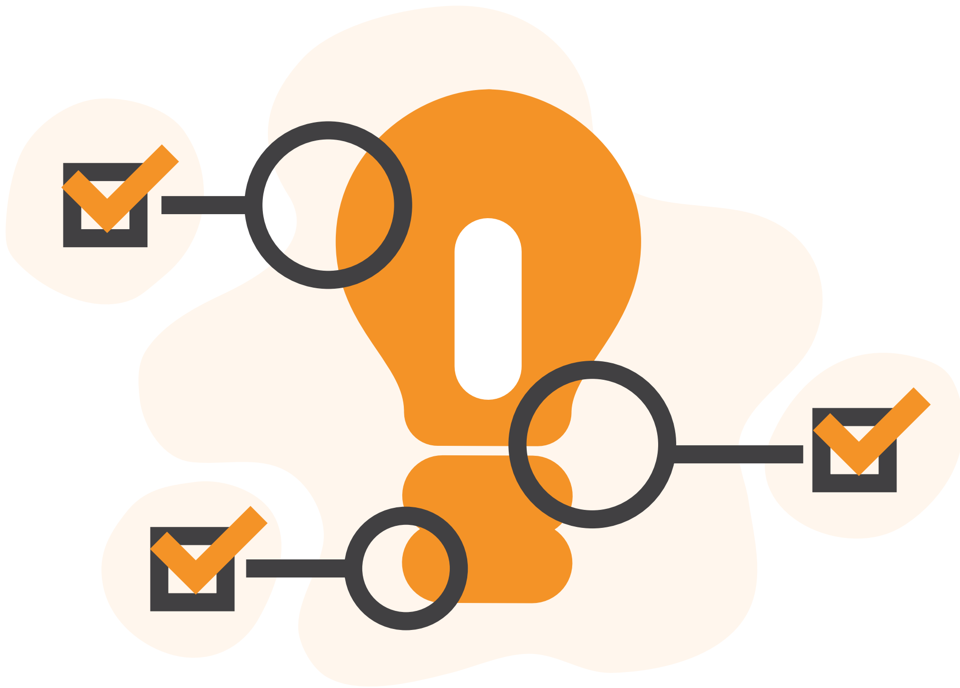
LEARNING CASE STUDY OF STRATEGY IDEA EVALUATION

Idea title: Use organic cotton and sustainability as a selling point for existing products		
Type of benefit	**Description**	**Fit with goals**
Economic	*Estimated total available market of US$ 500k-1MM growing at 10% per year.*	*Contributes to the goal of becoming the leading local supplier of sustainably sourced and manufactured processed textiles for corporate wear customers*
Environmental	*Reduces the amount of agrochemicals used in cotton production by 100% and eliminates the use of all toxic chemicals on the ZDHC RSL.*	*Contributes to the elimination of all chemicals used in production which are on the ZDHC Restricted Substances List (RSL) within two years*
Social	*Will protect the health of workers in the supply chain by eliminating their exposure to toxic chemicals.*	*Reduce the chemical footprint of toxic chemicals in the value chain by 15% within 3 years.*

ST.11

Evaluate ideas for new markets, products and selling points



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ST.11 Evaluate ideas for new markets, products and selling points

LEARNING CASE STUDY OF STRATEGY IDEA EVALUATION

Idea title: Use sustainability as a selling point for existing products			
Type of risk	**Description**	**Existing or new?**	**Risk score**
Product	*Corporate wear and infant clothing*	*Existing*	*0*
Market	*Domestic and export markets with a strong interest in sustainability*	*New*	*1*
Selling point	*Sustainability (organic cotton, safe chemicals used in production)*	*New*	*1*
		Total	*2*
		Risk rating	*High*

ST.13

Do an individual/ group review of the business strategy proposal

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ST.13 Do an individual/group review of the business strategy proposal

Eco—i Chemicals

LEARNING CASE STUDY OF BUSINESS STRATEGY

Vision

TipTop Textiles Co. is the leading manufacturer of apparel textiles in the region providing sustainably sourced and manufactured textiles to the domestic and export markets.

We work closely with cotton farmers to ensure a stable and cost-effective supply of organic cotton produced under safe working conditions that is fairly compensated.

We work closely with our direct customers for corporate and school wear to reclaim used textiles and to close the loop as much as possible and reuse or recycle the end of life textiles.

We work closely with innovative chemical suppliers, international brands and quality assurance specialists to ensure only chemicals placed on the ZDHC Restricted Substance List are not used intentionally or inadvertently in the manufacturing process and do not end up as residue on sold clothing. approved chemicals are used in manufacturing high quality textile products

Furthermore, we work with ecolabel certifiers using only chemicals on positive lists in the manufacturing of selected value-add textile products for niche, higher value products.

Market

Domestic corporate wear and school wear market segments

Domestic market for sustainably produced apparel

Regional export corporate wear market segment

Product

Corporate wear

School uniforms

Infant clothing

Shirts for young adults

Selling points

LOW COST	SERVICE
QUALITY	INNOVATION
SPEED	*SUSTAINABILITY*

Strategic goals

- *We will eliminate all chemicals used in production which are on the ZDHC Restricted Substances List (RSL) within two years through a combination of substitution and technological improvements*
- *We will reduce chemical footprint of toxic chemicals between raw material extraction and use by 15% in 3 years.*
- *We will manufacture sustainably-sourced and biodegradable printing ink within 2 years while maintaining the same performance quality*
- *Reduce polyester based products sold by the company from ending up in landfill by 25% within 2 years and by 75% within 4 years.*
- *Increase sales by 25% in three years while increasing productivity by 15%.*
- *Increase sales by 25% in three years while increasing productivity by 15%.*
- *To become the leading local supplier of sustainably sourced and manufactured processed textiles for corporate wear customers.*

SET BUSINESS MODEL

Defining a new business model
to deliver the business strategy

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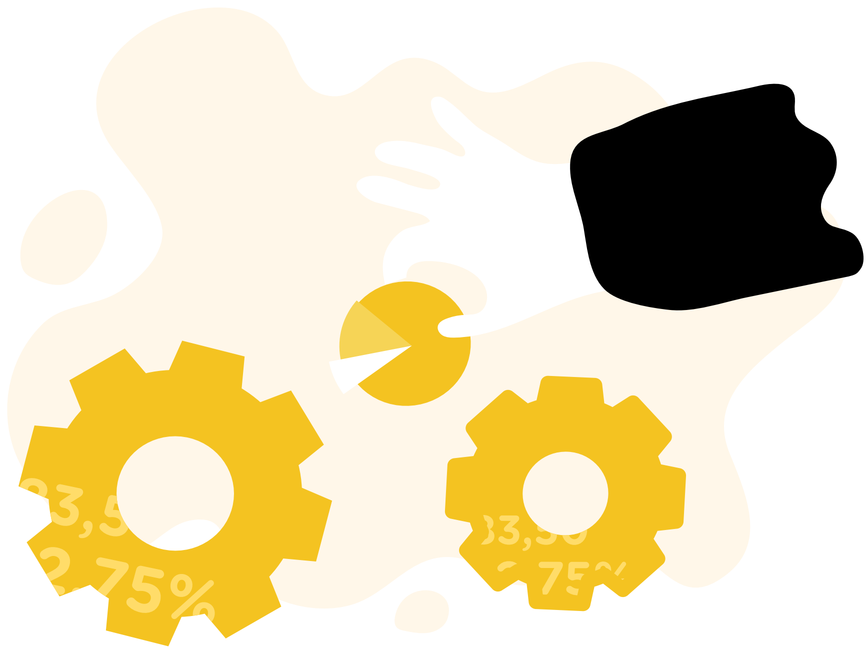
BM.3
Gather additional data on operational performance



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BM.3 Gather additional data on operational performance

TIPS & TRICKS

PRIORITIZE FLAGSHIP PRODUCTS FOR LCA STUDY
Since chemical sector companies typically offer multiple products and product lines, such as different types of architectural paints, you can maximize the cost-to-benefit by performing a LCA on a "flagship" product because the results can often be applied to other product lines as well. Furthermore, a LCA of a "flagship" product will serve as a platform for communicating the company's sustainability approach to stakeholders.

USE CHEMICAL FOOTPRINTING TO QUANTIFY AND MONITOR USE OF CHEMICALS OF CONCERN IN YOUR PRODUCTS' VALUE CHAIN
Chemical footprinting is an emerging trend in the chemical industry. According to the Clean Production Action (Clean Production Action, 2016): "Chemical footprinting is the process of evaluating progress away from chemicals of high concern to human health or the environment to chemicals that have a lower hazard profile than the ones they replace". You may consider calculating the chemical footprint of products and using it as a KPI to measure your sustainability performance.

RE-EVALUATE AND UPDATE KPIs PRIORITIZED IN ACTIVITY 10
An overview of different KPIs was provided in Activity 10, which could be used to characterize sustainability hotspots. It is a good idea to revisit the selected KPIs and evaluate if new ones should be included or any existing ones are no longer important. At this point, it is helpful to ensure the underlying data is accurate and reliable. Refer to the '*Background Information*' in Activity 1 for examples and ranges of environmental performance indicators for selected chemical subsectors.

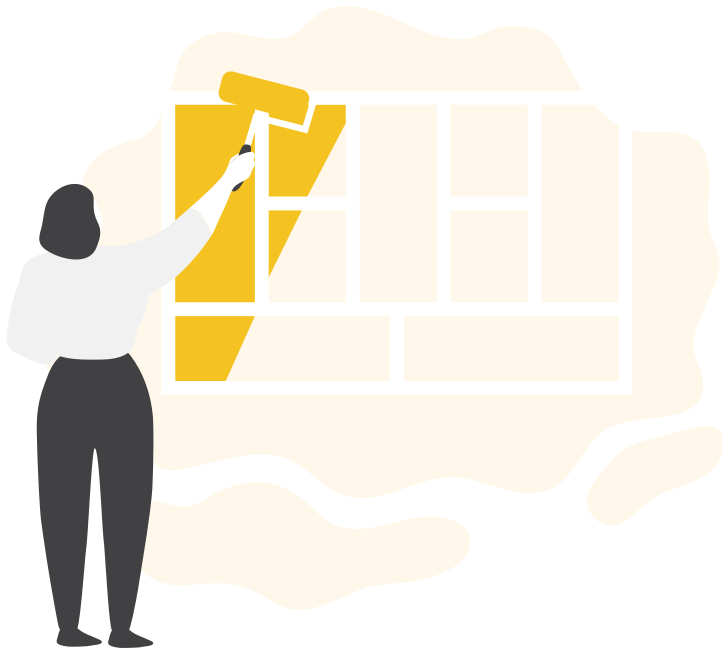
BACKGROUND INFORMATION

References and resources:

- Clean Production Action. (2016). Improve Your Chemical Footprint. [ONLINE] Available at: http://www.cleanproduction.org/programs/chemical-footprint [Accessed 4 July 2016]

BM.4
Generate business model concepts at the big picture level

Eco—i Chemicals



BM.4 Generate business model concepts at the big picture level

Eco—i Chemicals

TIPS & TRICKS

ASSESS AND DESIGN PRODUCTS FROM A LIFE CYCLE PERSPECTIVE

In Belgium, the small manufacturer of ecological cleaning products, Ecover, made a shift to a more radical eco-innovative path and set eco-innovation at the core of their long-term business strategy. In particular, Ecover started considering the entire value chain of its products and introduced innovations across all dimensions of the business: from a new business model to supply chains and sourcing strategies in order to respond to market demand ahead of competitors. This led to their big expansion in the market of ecological cleaning products.

Ecover used their Diamond Model sustainability assessment technique to identify product innovation potentials across the whole life cycle of the product, such as extraction phase, usage phase, and environmental absorption phase. The product innovations that were introduced helped the company to achieve substantial business benefits and growth with added-value by producing a sustainable product free of harmful substances and effective with a cold water wash, thereby addressing a key hotspot in the life cycle of detergents: hot water use.

Furthermore, Ecover introduced innovations through open source collaboration (involving partners and scientific institutions) in all processes including manufacturing and distribution channels by promoting dispensing machines with retailers and online purchases.

You can use a similar approach to identify and improve your products' life cycle impacts.

PROVIDE YOUR PRODUCT AS A SERVICE

The 'product as a service' business model pattern introduced in the Eco-innovation Manual has been applied in the chemical sector in the form of "Chemical Leasing". "Chemical Leasing" has the potential to combine resource efficiency and sustainability performance with profit generation and competitive advantage.

When implementing "Chemical Leasing", users and chemical suppliers work together more closely and share knowledge in order to optimise the production processes. The business model implies that the unit of payment is changed, from quantity-based to service-based. Through optimised processes and a common interest of all actors, the quantities of chemicals are reduced, which benefits the environment and human health. Due to the changed unit of payment, all partners gain economic benefits from the reduced amount of chemicals. You can find an example for improvements resulting from the implementation of the "Chemical Leasing" business model in the case study below.

In Egypt, about 95% of the companies of the industrial sector are SMEs, a large share of that is made up by chemical companies. In fact, the "Chemical Leasing" business model was applied by a solvent supplier. The hydrocarbon solvent supplier supervises the application of the solvent in the process of cleaning equipment at General Motors Egypt and receives payment per vehicle produced instead of solvents sold. When the cleaning process is completed, the supplier takes back the solvent waste for recycling at its plant. This model has achieved cost reductions of 15% related to the reduction of solvent consumption from 1.5L per vehicle to 0.85L per vehicle. Other economic benefits cited by partners include sharing liability and benefits as well as the creation of a long-term business relationship (Chemical Leasing, 2016)

BM.4 Generate business model concepts at the big picture level

LEARNING CASE STUDY

Business Model #1: Fibre Leasing business model

After following the steps outlined in the Eco-innovation manual, a new "Fibre Leasing" business model has been proposed for TipTop Textiles Co. and is captured using the business model canvas. Several value propositions are shown in the business model canvas. However, only the first one will be described in detail, as it is the core of the "Fibre Leasing" business model.

In this closed loop business model, the fibres used in the making of garments for corporate wear customers are owned by TipTop Textiles Co. and are leased for the garment production and use. This enables TipTop Textiles Co. to take back the used wear and recover the fibres through a chemical recycling process. By working with suppliers and customers in the value chain, TipTop Textiles Co. will prolong the life of leased corporate wear and then chemically recycle textiles at their end-of-life in order to lower the amount of chemical-based products on land-fills.

The value proposition is the leasing of high-quality polyester-based textiles with a customized functionality (durability, wrinkle-free, low temperature washable, etc.) that is chemically recycled from used wear. Revenue from this value proposition is acquired via a leasing contract that is negotiated based on the type of material, required functionality, and the number of employees belonging to the serviced client.

In order to improve sustainability performance across the value chain, an additional value proposition is offered to customers: a web-tool. The online web-tool helps customers evaluate the life cycle impacts of their textile design decisions. For example, the tool will allow the customers to compare different types of textile properties on type of material, colour, functionality, etc.. An additional service fee is charged to aid customers for special requests to adapt their design and to produce the life cycle impact in order to communicate the product's sustainability performance with their end market.

The key activities include the operation of a collection, repair and recycle system in which it is first evaluated, whether the clothes can be re-used without chemically recycling the waste material to new polyester. The technical sales team will also provide training to corporate-wear customers on how best to use the products to avoid damage, including the optimum washing procedures (e.g. best temperature, amount and type of biodegradable detergent). In addition to providing a stable revenue stream and by diversifying the company's portfolio, the new business model will result in the elimination of chemicals on the Zero Discharge of Hazardous Chemicals Restricted Substance List (e.g. endocrine disruptors) and thus minimizing adverse environmental and human health effects from their products.

BM.4 Generate business model concepts at the big picture level

Eco—i Chemicals

LEARNING CASE STUDY OF BUSINESS MODEL CANVAS

An alternative value proposition to the "Fibre-leasing" business model is indicated in brackets.

Key Partners

Chemical suppliers (ink and dye feedstock)

Local university

Textile raw material suppliers (cotton and polyester pellets)

Local partner garment company

Corporate wear (e.g. eco-tourism) and school uniform customers:

Suppliers organic fibres

Distributors of sustainable textiles

Design team of clients

Key Activities

Collection and chemical recycling of corporate wear products

Ink manufacturing

Textile manufacturing: weaving or knitting and textile finishing, including dyeing and printing

Key Resources

Logistics (for delivery/retrieval) of used textiles

R&D Department

Quality Control Department

Value Propositions

High quality polyester textiles based on recycled polyester fibres [1]

High quality organic cotton textiles meeting eco-label requirements [2]

Safe and renewable based inks for the textile industry [3]

Web portal for brand designers to show customers the life cycle impacts of their choices for design (including fibre choice, colour, finishing properties) [4]

Customer Relationships

Integrate customer brand information with production (e.g. printing label information)

Source of information related to textile sustainability

Provide data for eco-labels in integrated form

Channels

Integrated ordering system (CRM)
Trade conventions, Trade magazines
Newsletter on emerging sustainability and regulatory trends
Sustainability awareness raising seminars in schools and companies
Facebook site
Web stores
Technical sales team trained on sustainability issues
Technical support to garment companies

Customer Segments

Direct customers

Other textile and printing mills [3]

Local garment company

Distributors (domestic and export)

End customers

Corporate wear consumers concerned about sustainability (e.g. eco-tourism outfits, large companies with GRI reporting, etc.)[1]

School uniforms [1]

Parents of infants and toddlers [2]

Young adults (18-30) from growing middle class [2]

Cost Structure

Labour
Electricity
Diesel Fuel for process heating
Technical facilities
Textile raw materials: cotton, polyester
Ink and dye raw materials
Textile wet processing chemicals
Hazardous waste disposal
Waste Water treatment
Taxes

Revenue Streams

Clothes leasing contracts for polyester-based textiles
Sales of eco-labelled cotton products
Sales of "sustainable" ink to other textile and printing companies with trademark
Service fee for user of LC design website portal for non-clients and a top-up service fee for customers

BM.4 Generate business model concepts at the big picture level

BACKGROUND INFORMATION

Alternative business model #2

Manufacture and sell "Sustainable Ink" to domestic and export markets. The new business model will focus on developing "Sustainable Ink" for textile printing based on safer chemicals primarily produced from local renewable resources. The "Sustainable Ink" will be sold to customers interested in accessing the growing market for sustainably produced clothing. This business model idea is an example of the "Circular supplies" business model pattern introduced in the Eco-innovation Manual.

References:

- Chemical Leasing. (2016). Cleaning equipment with hydrocarbon solvent. [ONLINE] Available at: http://www.chemicalleasing.com/sub/pilot/solvents.htm. [Accessed 4 July 2016].


IMPACTS OF DDF & LOCAL PLATFORMS
• BRINGING STAKEHOLDERS TOGETHER TO SOLVE COMMON PROBLEMS AND DRIVE DAIRY DEVELOPMENT
• INFLUENCE INFORMATION SHARING
• STRATEGIC ROLE AT NATIONAL
FOR POLICY DIALOGUE & ADVO
• STAKEHOLDER PARTICIPATIO
COULD BE IMPROVED

BM.5
Generate ideas for the customer segments block

Eco—i Chemicals

BM.5 Generate ideas for the customer segments block

Eco—i Chemicals

TIPS & TRICKS

USE CUSTOMER SEGMENTATION TO HELP IDENTIFY CUSTOMER GROUPS TO TARGET FOR SUSTAINABLE PRODUCT OFFERINGS

The chemical industry is progressively focusing on the customer and many companies have launched customer-segmentation initiatives in order to categorize their customers to help align the company's marketing and sales approach to the values of the customer and improve their meet their demand both in terms of value and price.

You can define customer segments in the chemical industry in several ways. These include:

- Chemical category: as mentioned in the PREPARE phase, there are 3 broad categories of chemicals – commodity, fine, or speciality chemicals. Commodity chemicals are typically destined for mass-market distribution and decision-making is typically price-driven, whereas fine and speciality are normally tailored for niche markets and decision-making is typically results-driven.
- Position in supply chain: the chemical can be an intermediate or an active ingredient to be later incorporated in an end product (e.g. TiO2 used as a photocatalytic biocide agent), an end market product (e.g. anti-aging cream, anticorrosive paints), or an auxiliary chemical for industrial users of chemicals (e.g. solvents or acids for surface cleaning, dyestuff for wet textile processing).
- Customer values: different customers place different values on the product relative to price. For example, buyers of the chemical products rank product quality and performance, innovation that improves reliability/quality, and reliability of supply ahead of price (Erhardt, 2011).

It could be useful to categorize the company's customers in a way that reflects their values in order to help align the company's marketing and sales approach to the values of the customer. Customers valuing product quality and performance may be more open to eco-innovative business models and value chain collaboration.

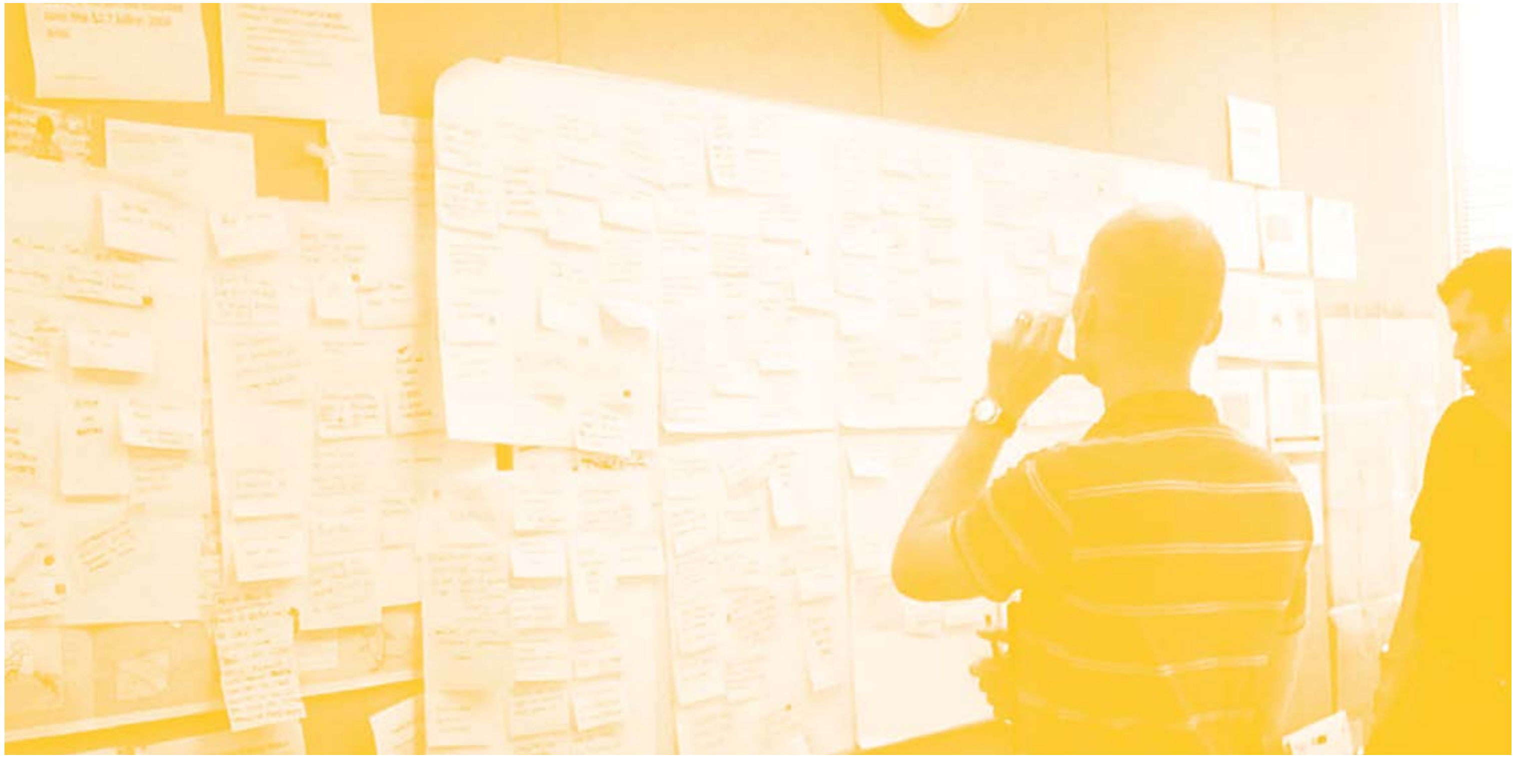
BM.5 Generate ideas for the customer segments block

LEARNING CASE STUDY

For example, the TipTop Textiles Co. recognizes that its corporate wear customers value sustainable sourced products, reliability of supply and speed of service and are therefore open to a fibre-leasing concept with bundled services including support for prolonging product life and minimizing washing costs, such as water and energy consumption, during use.

BACKGROUND INFORMATION

Erhardt, G. (2011). Aligning Customer Segmentation with Industry Realities to Achieve High Performance in the Chemical Industry. Accenture.




Höhere Standards überfordern kleine mittlere Betriebe

BM.6
Generate marketing ideas for the value proposition block

Eco—i Chemicals

BM.6 Generate marketing ideas for the value proposition block

BACKGROUND INFORMATION

Erhardt, G. (2011). Aligning Customer Segmentation with Industry Realities to Achieve High Performance in the Chemical Industry. Accenture.

BM.7
Generate technical ideas for the value proposition block

Eco—i Chemicals

BM.7 Generate technical ideas for the value proposition block

TIPS & TRICKS

SOME EXAMPLES OF ECO-INNOVATIVE VALUE PROPOSITIONS IN THE CHEMICAL PRODUCTS' VALUE CHAIN

The value proposition can consist solely of a product, a service, or a combination of both depending on the business model and customer values. Some innovations in terms of value proposition in the chemical sector could include:

- Improvement of existing value propositions by providing additional services such as chemicals management, optimisation of chemical use by industrial customers (e.g. "Chemical Leasing"), operation of non-core processes (e.g. surface cleaning and coating services), etc.
- Prototyping support (e.g. materials based on carbon nanotubes)
- Developing chemicals that enable final product recycling (e.g. flame retardants in plastics that do not prevent plastics recycling due to toxic properties)
- Designing chemical processes that enable more efficient recovery of chemicals (e.g. adding stabilizing-additives to solvent mixtures to allow easier separation by vacuum distillation)
- Being beyond compliance with export regulations or industry best practices. Some examples could include: tributyltin oxide-free anticorrosive paints, lead-free paints, VOC-free cleaning agents, etc.
- Eco-labels for consumer products (e.g. EU eco-label for textiles) or consumables (e.g. eco-labels for paints, industrial and institutional cleaners) can also add value to the chemical as well as the end product alongside to other certificates

A STRONG VALUE PROPOSITION REFLECTS THE CUSTOMERS' VALUES AND NEEDS

A strong value proposition addresses the customers' values and needs. A report by Erhardt (2011) shows that surveyed customers of the chemical industry value the following as much if not more than price: product quality, performance, reliability of supply, and quality of complaint resolution.

BM.7 Generate technical ideas for the value proposition block

Eco—i Chemicals

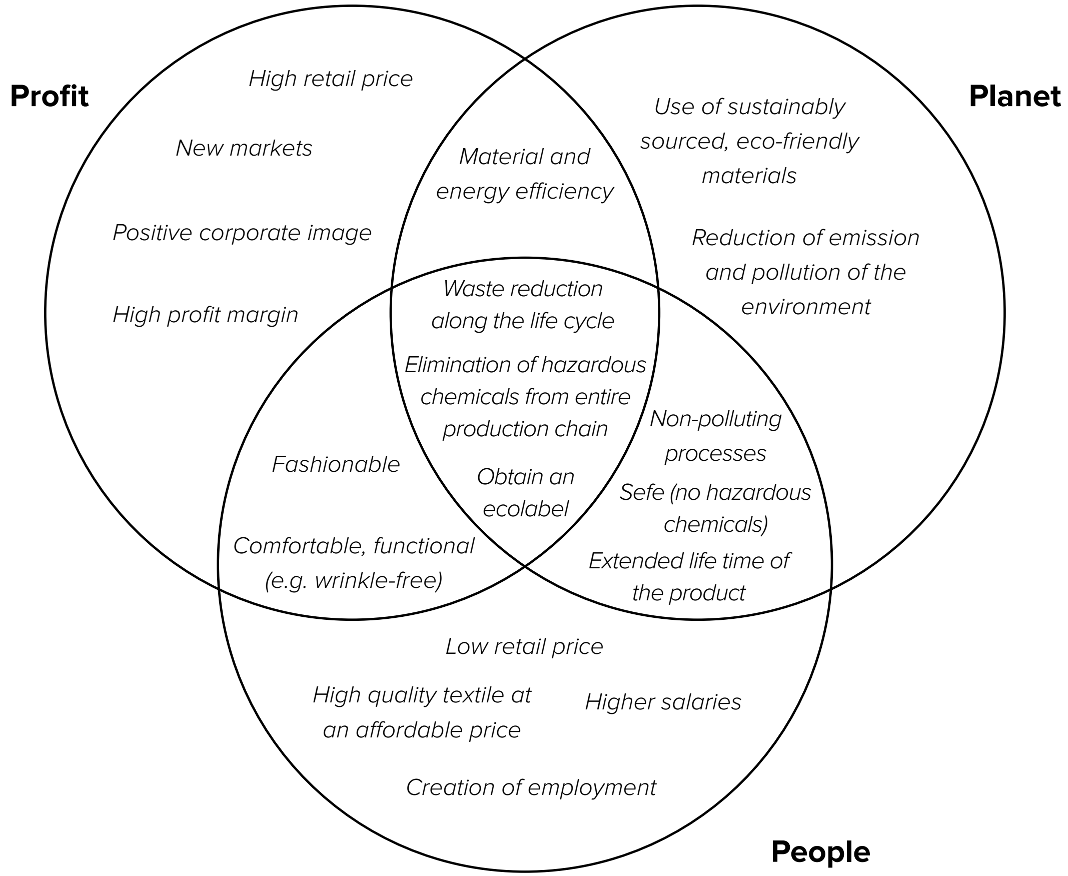
LEARNING CASE STUDY OF PEOPLE, PLANET, PROFIT

Taking the textile industry as an example, the Zero Discharge of Hazardous Chemicals (ZDHC) initiative ensures that participating textile brands issue and enforce a Restricted Substances List (RSL) in their supply chain. Keeping abreast of such developments can help companies take advantage of new emerging opportunities. For example, due to the ZDHC initiative, suppliers of textile chemicals (e.g. bleaching, dyes, finishing) and auxiliary chemicals (lubricants, catalysts) are able to provide solutions to key challenges faced by textile companies required to eliminate and replace the commonly used chemicals on the RSL (e.g. Nonylphenol ethoxylates, Azo dyes and pigments).

Use the PPP diagram to generate value proposition ideas

The *People, Planet, Profit diagram* shown below for the TipTop Textiles Co. illustrates that waste reduction along the life cycle and elimination of hazardous chemicals from the value chain are product requirements that would create benefits for business, the environment, and the customer at the same time.

One specific idea that emerges from applying the PPP diagram is that TipTop Textiles Co. could enhance their value proposition by obtaining an eco-label certification for their synthetic textiles, such as OEKO-TEXT STeP or the Bluesign Standard. This would benefit 'People' including customers, who would be assured that the product is sustainably produced and the workforce exposure to hazardous chemicals is lowered. It would benefit the 'Planet' as it requires the company to implement environment-friendly practices, such as using a chemicals positive list for suppliers, increasing product testing, and integrating the eco-label requirements into supplier contracts. Implementing these practices would require TipTop Textiles Co. to work closely with suppliers and value chain partners to help the company meet the eco-label requirements but would ultimately benefit the company ('Profit') as it would help to differentiate their product from their competitors and perhaps enable them to charge a premium price for the eco-labelled product range.



BM.8
Generate ideas for the channels block

Eco—i Chemicals

BM.8 Generate ideas for the channels block

Eco—i Chemicals

TIPS & TRICKS

CONSIDER THE COSTS AND VALUE OF DIFFERENT CHANNELS WHEN DEVELOPING A BUSINESS MODEL
When streamlining the business model, it is important to consider the costs of the various channels and decide which customer segments should be allocated to the more expensive channel offerings. It is important to keep in mind that different customer segments (e.g. quality vs. low-cost, large vs. small volume customers) might have different pricing mechanisms – see the Revenue Streams building block for further details. Some examples of different channels in the chemical industry include creating a low-cost customer interface for cost conscious customers or using a product distributor to reach low-volume buyers. On the other hand, a well-trained and experienced technical sales team is often necessary for business models with a close customer relationship and product customisation. For example, eco-innovative service-based models (e.g. "Chemical Leasing") could provide added value by providing service engineers to commission, maintain and optimise the new process.

ASK HOW CHANNEL INNOVATION CAN CONTRIBUTE TO SUSTAINABILITY IN THE VALUE CHAIN
When developing the new eco-innovative business model, you may want to consider the following questions:

- Can existing or new channels be used to implement a closed-loop model?
- Can an eco-label be used to communicate value to specific customer segments?
- Can JIT or integrated CRM systems be implemented throughout the value chain to reduce significant waste?
  → Refer to '*Background Information*' for more details.

COMMUNICATING VALUE
Communicating value is an essential component of marketing products to customers. It is good practice for chemical manufacturers to communicate the health and environmental hazards, possible exposure scenarios, and the correct use of the chemical to downstream users via a GHS-conform Safety Data Sheet (SDS). Eco-labels are both a value proposition and a marketing tool for communicating value to direct customers and possibly end market customers.

SAME COMPANY, DIFFERENT CHANNELS
It is also common to have different channels for different products at the same company. For example, Dow Corning (Dow Corning, 2009) sells a commodity polymer produced in a continuous facility with a low price that can be ordered online. The same company also offers a specialty polymer based on the commodity polymer, but tailored to customer requirements. This niche product is produced in batch mode and involves prototype testing together with close cooperation with the customer.

BM.8 Generate ideas for the channels block

BACKGROUND INFORMATION

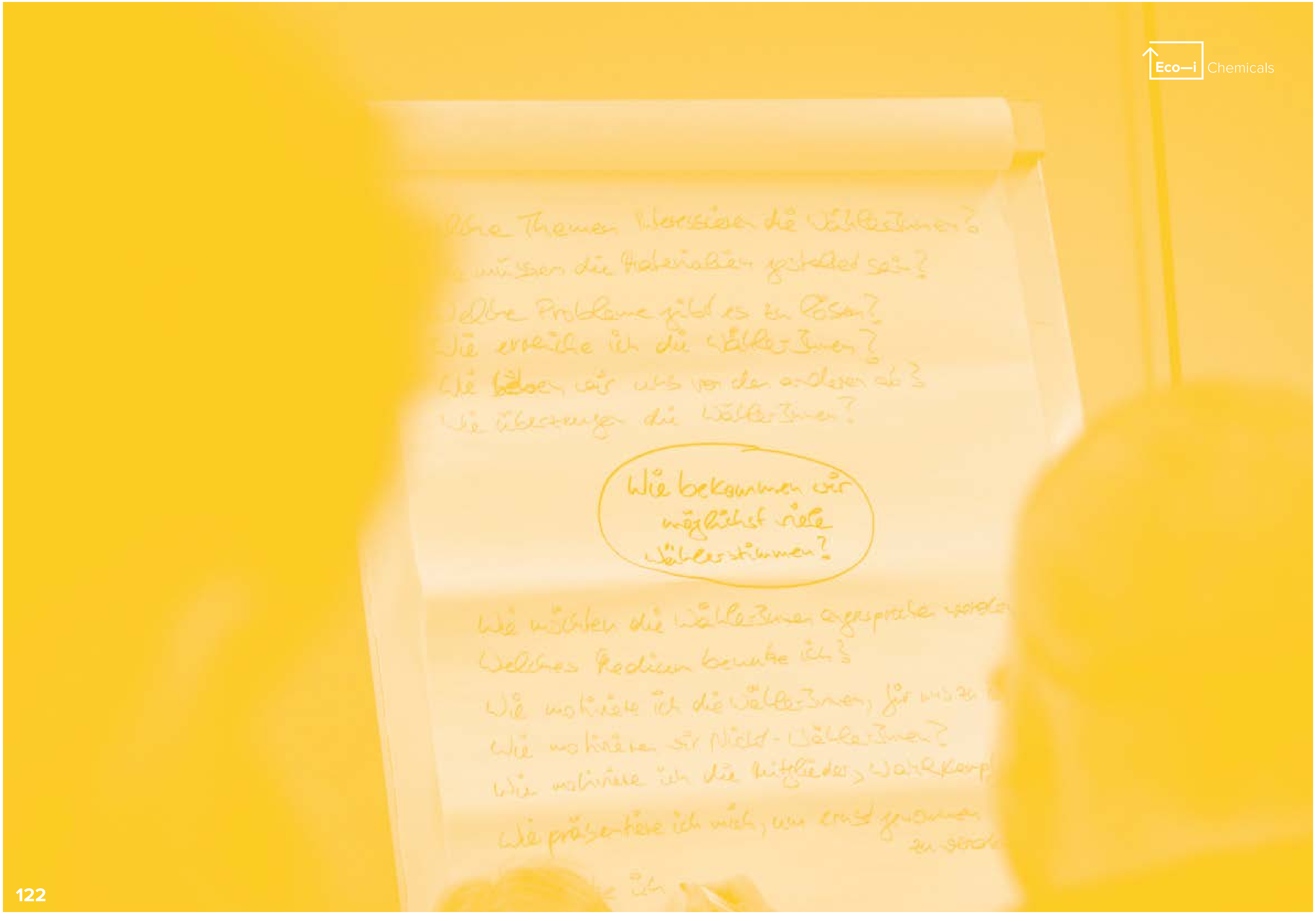
Communicating and delivering the value proposition to customers is an important component of the business model in the chemical sector. Chemical companies typically provide their products through a broad range of channels and mostly to other chemical companies or to companies in other industries: direct sales, e-commerce, customer service, technical support, and third party distribution.

However, many chemical companies commonly include value-added technical services and sales support within their current value propositions at complimentary basis to companies, regardless whether the services have been required (e.g. high-level customer service, product customisation, R&D support, training, know-how transfer, risk prevention measures, installation and commissioning of equipment, technical improvements to processes, etc.).

A common way of interfacing with customers in the chemical industry is via an integrated customer relationship management (CRM) system. A CRM system can consist of a channel strategy (marketing and sales) and customer service - see '*BM.9 Generate ideas for the customer relationships' block'* for further details. A CRM system integrating custom orders and "Just-in-time" (JIT) operations can increase customer satisfaction, reduce the customer's orderings costs by streamlining order specifications, and minimize the likelihood of off-spec customized products being produced leading to a reduction in chemical waste and an increase in operating profit.

References

Dow Corning. (2009). Harvard Business Review Features XIAMETER® Business Model. [ONLINE] Available at: http://www.dowcorning.com/content/news/XIAMETER_businessmodel_featured_in_HBR.asp. [Accessed 4 July 2016].


Wie bekommen wir möglichst viele Wählerstimmen?

BM.9
Generate ideas for the customer relationships block

Eco—i Chemicals

BM.9 Generate ideas for the customer relationships block

LEARNING CASE STUDY

In the case of the new business model for TipTop Textiles Co., an important component of customer relationships is a web-tool that customers can use to understand the sustainability impacts of their design decisions across the product's life cycle.

BACKGROUND INFORMATION

A survey including 130 chemical executives by Accenture indicated that over 50% of return on sales was explained by Customer Relationship Management (CRM) capabilities – CRM capability can significantly impact profitability. The report listed 5 specific capabilities, which accounted for 80 % of the total potential customer service impact (as measured in return on sales) that one could consider when investing into CRM software in the chemical industry:

- Leveraging information technology to enable easier customer contact (highest priority)
- Fairly compensating and rewarding personnel
- Building flexibility into information systems/technology
- Using customer service to generate sales
- Effectively developing service skills

References

Accenture (2011), Aligning Customer Segmentation with Industry Realities to Achieve High Performance in the Chemical Industry

BM.10
Generate ideas for the revenue streams block

Eco—i Chemicals

BM.10 Generate ideas for the revenue streams block

TIPS & TRICKS

CONSIDER THE STRATEGIC IMPORTANCE OF HIGH REVENUE CUSTOMERS
The 20/90 rule applies to many chemical companies with respect to customer performance – 20% of customers account for 90% of the company's profit margin. Considering the strategic importance of high revenue customers and the overriding importance of pricing on profit, many chemical companies use key account management for their priority customers – See '*BM.9 Generate ideas for the customer relationships' block*' for further details.

BACKGROUND INFORMATION

Selling a product is typically a major source of revenue in the chemical industry. However, sales are often accompanied by technical support. The price mechanism can be either a fixed price, dependent on volume or customer segment.

The sales price has the largest impact on profitability (see *'BM.14 Generate ideas for the cost structure block*) so you could consider different approaches to pricing differentiation, which could include transaction pricing (determining the exact price for each customer transaction), product/market strategy (determining what price yields the optimum position in each market relative to competitors), and industry strategy (determining supply and demand and highly volatile raw materials affect overall price levels).

The chosen channel (e.g. e-sales, distribution, technical sales and support) and pricing mechanism is usually allocated to specific customer segments according to what they value – see '*BM.9 Generate ideas for the customer relationships' block'* for further details.

Other forms of revenue streams are leasing systems that are often found in "Chemical Management Systems" or in "Chemical Leasing"; here, the functional unit of service can be expressed as $/part cleaned or $/operating hour.

BM.11
Generate ideas for the key resources block

BM.11 Generate ideas for the key resources block

LEARNING CASE STUDY

In the case of TipTop Textiles Co., a key resource in the new business model is the logistics system for retrieving used textiles and delivering new textiles. For this customer segment, high value would be placed on timely delivery of products in the volumes required.

BACKGROUND INFORMATION

The following is a list of key resources typical of the chemical industry to help you think about how to generate new eco-innovative business models:

- Raw materials: price, volatility, availability – importance of procurement principles
- Customer Relationships: marketing, sales, channel offerings
- Physical equipment: move towards multi-functional and modular plants (e.g. F3 factory project).
- Process intensification: can lead to smaller, more compact and reliable plants reducing the ecological footprint of production.
- Staff: Marketing and Sales, R&D, Environmental Health and Safety (EHS), procurement
- IT-based CRM or customer interface (depending on business model)

BM.12
Generate ideas for the key activities block

Eco—i Chemicals

BM.12 Generate ideas for the key activities block

BACKGROUND INFORMATION

Typical key activities in the chemical industry are:

- R&D, Customer Relationship Management (CRM) (channels, sales, and marketing) are key activities for successful chemical companies
- Procurement
- Production
- Quality control
- (Hazardous) Waste prevention and treatment
- Environmental, Health and Safety (EHS)
- Product Stewardship along the product's life cycle

BM.13

Generate ideas for the key partnerships block

Eco—i Chemicals

BM.13 Generate ideas for the key partnerships block

LEARNING CASE STUDY

For the case of TipTop Textiles Co., a key partner is the corporate wear customer since they are also suppliers of feedstock for the recycled clothing – cooperation will be required to handle and store used textiles in order to enable the efficient chemical recycling of polyester textiles. Partnerships with textile chemical suppliers and equipment suppliers are necessary for technical implementation of the chemical recycling of polyester.

BACKGROUND INFORMATION

Typical key partnerships in the chemical industry are:

- Technology service providers such as equipment suppliers (core processes as well as supporting processes), IT data management, process optimisation experts, etc.
- Suppliers of raw materials and active ingredients (e.g. fine chemical industry is highly integrated with the pharmaceutical industry)
- Distributors and wholesalers
- In some cases (e.g. "Chemical Leasing"), the customers (industrial users of chemicals) themselves also become a key partner – some variations of chemical leasing also bring in a technology supplier in order to provide advanced solutions that no one could achieve alone
- National and local competent authorities, especially for pollution control, chemical hazard management, such as occupational health and safety and accident prevention and preparedness. In many countries industry and competent authorities work together to ensure a sustainable private sector.

BM.14
Generate ideas for the cost structure block

Eco—i Chemicals

BM.14 Generate ideas for the cost structure block

TIPS & TRICKS

BETTER RAW MATERIAL RISK MANAGEMENT CAN IMPROVE PROFITABILITY

Measures to improve the risk management of raw material could include:

- Using a cost-plus pricing mechanism which passes increasing costs of feed-stocks on to the customer;
- Having a balanced port-folio of suppliers, thereby allowing flexibility and providing the option shift volumes from one supplier to another
- Avoiding risk by back-ward integration and taking ownership of supply sources
- Using non-depleting resources such as using secondary raw materials or bio-based materials as raw materials (e.g. poly-lactic acid derived from renewable resources)

BACKGROUND INFORMATION

It is common practice to calculate KPI's representing the total manufacturing cost (total $/kg product) and identify areas for improvement, where the total cost includes the costs of raw materials, labour, equipment, waste disposal, etc. Raw materials are typically the most cost significant elements for chemical companies. Therefore, raw material procurement and material efficiency are important strategies to increase profit margins. Table 13 provides indicative values of the cost structure for a fine chemicals company.

The cost structure of chemical companies depend to certain degree on the type of production and operating schedule, both of which are linked: e.g. a continuous production process which is typical for commodity chemicals or a (semi-)batch process typical for fine and specialty chemicals as well as for formulated chemicals. One way to maximize material productivity and overall equipment efficiency is to use KPI's that are common across different functional departments such as sales, purchasing and production as well as to manage customer delivery dates and production schedules.

References

Pollak, P (2011). Fine Chemicals: The Industry and the Business, 2nd Edition. John Wiley & Sons Inc., Hoboken, New Jersey.

Table 13: Cost structure for a fine chemicals company (Pollak, 2011).

Cost Elements			**Details**	**Share**
Raw Material			Including solvents	30%
Conversion cost	Plant Specific	Utilities and Energy	IElectric power, steam, brine	4-5%
		Plant labour	Shift and daytime work	10-15%
		Capital Cost	Depreciation and interest on capital	15%
		Plant Overhead	QC, maintenance, waste disposal, etc.	10%
		Research and Development	Inclusive pilot plant	8%
	Marketing and Sales		Inclusive Promotion	5%
	General Overhead		Administra-tive services	15%
Total			(Exclusive taxes)	100%

BM.15
Evaluate the benefits

Eco—i Chemicals

BM.15 Evaluate the benefits

LEARNING CASE STUDY

For the case of the TipTop Textiles Co., some benefits of the new "Fibre Leasing" business model include:

- Long-term contracts with customers providing long-term stability
- Increased revenue by 10% through value-added services
- Reduction of end-of-life polyester textiles by 90%
- Elimination of chemicals toxic to human health and the environment contained on the ZDHC Restricted Chemicals List.

BM.16
Evaluate the costs

Eco—i Chemicals

BM.16 Evaluate the costs

LEARNING CASE STUDY

In the case of the TipTop Textiles Co. new "Fibre Leasing" model, there are significant costs associated with piloting and upscaling the chemical recycling of end-of-life textiles from their customers including technologies for ensuring recycled material purity as well as product quality.

Furthermore, the business model requires significant monetary and labour investments in logistics and servicing the corporate wear customers.

BM.17
Evaluate the risks

Eco—i Chemicals

BM.17 Evaluate the risks

BACKGROUND INFORMATION

The following figure can be used as a benchmark to help you evaluate the business case for eco-innovation by providing success rates, time to commercialisation, relative increase in profit margin, and internal rate of return. This information can be incorporated into the *Risk Register* template already provided in the Eco-innovation Manual.

Degree of market familiarity (Low ↑ — ↓ High)

Market development: Product / service extensions into new markets		**Differentiation:** New product/service launches in new markets	
Success rate[1]: 30-40%	On-top margin[3]: 0-10%	Success rate: 15-20%	On-top margin: 0-60%
Time to commercialisation[2]: 2-7 years (average 5)	Average IRR[4]: 20-25%	Time to commercialisation: 8-19 years (average 14)	Average IRR: 8-12%
Market penetration: Product /service extensions into existing markets		**Product development:** New product/ service launches in existing markets	
Success rate: 40-50%	Success rate: 40-50%		
Time to commercialisation: 2-5 years (average 4)	Average IRR: 18-23%	Success rate: 30-40%	On-top margin: 0-10%
		Time to commercialisation: 6-15 years (average 11)	Average IRR: 13-18%

High ← **Degree of technology familiarity** → Low

Figure 4. Matrix providing success rates, time to commercialisation, relative increase in profit margin, and internal rate of return for different categories of product innovations (based on Miremadi et al, 2013).

BM.17 Evaluate the risks

Eco—i Chemicals

[1]Success rate presents the portion of projects in a given quadrant that created a positive return on a net present value (NPV) basis, using the innovator's cost of capital (with no risk adjustment).

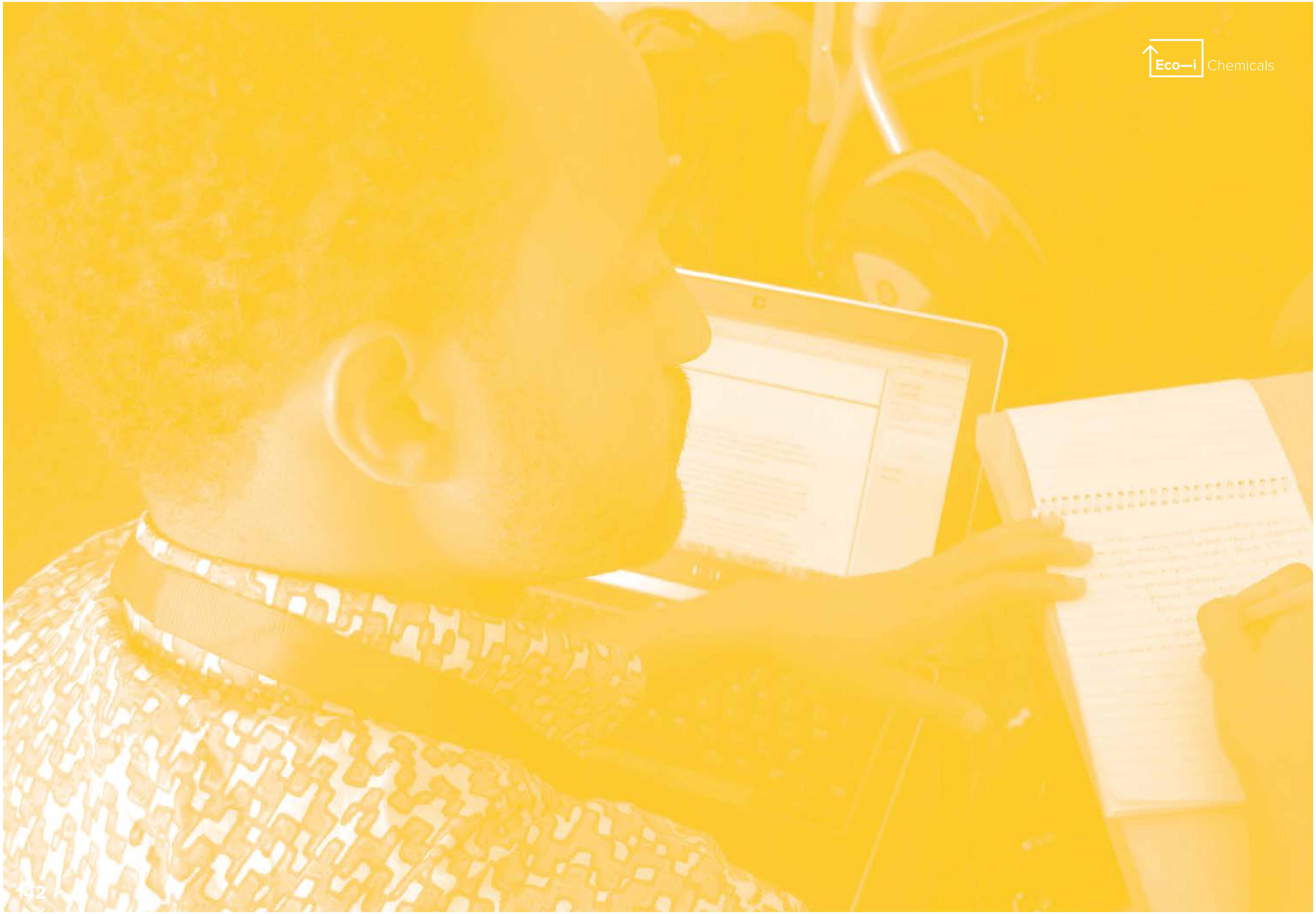
[2]Time to commercialisation is defined as the elapsed time between formal project initiation and the point at which the project's annual sales equal the total R&D investment in it.

[3]On-top margin is defined as the differential between the internal rate of return (IRR) of a new product based on innovation and the IRR of an incumbent product in the market that it replaces, net of cannibalisation.

[4]IRR: The internal rate of return is the cost of capital at which the net present value equals 0 percent.

References

Miremadi, M., Musso, C., Oxgaard, J. (2013). Chemical innovation: An investment for the ages. McKinsey & Company



BM.18

Integrate all the evaluations and make the final selection

Eco—i Chemicals

BM.18 Integrate all the evaluations and make the final selection

Eco—i Chemicals

LEARNING CASE STUDY OF BUSINESS MODEL EVALUATION

In the course of the phase *'Set Business Model'* you will develop several possible business models from which the company can choose. An evaluation summary is one way of comparing the different business models.

TipTop Texiles Co. found all 3 options as viable business models to help them achieve their goal of becoming a market leader in what they perceive to be a high-growth market in the future. Based on the business model evaluation summary above, the TipTop Textiles Co. management team has decided to pursue the "Fibre Leasing" business model (option 1), as it offers the highest potential to improve environmental and social performance across the life cycle, while offering the highest potential on profitability. The company estimated that the payback time of 5 years for the "Sustainable Ink" business model (option 2) was too high. Furthermore, the "Eco-label" business model did not offer a large enough domestic market potential and there is a lack of technological expertise to meet the stringent eco-label criteria.

	Metric	Current situation	Fibre Leasing	Sustainable Printing Ink	Ecolabel
Benefits	*Energy intensity*	*2*	*4*	*3*	*3*
	Material and water intensity	*2*	*5*	*3*	*4*
	Human health and toxicity	*2*	*5*	*3*	*5*
	Other social issues	*2*	*4*	*3*	*4*
	Profitability	*2*	*5*	*3*	*4*
	Job creation and security	*2*	*4*	*3*	*3*
Risks	*Long term risk (after mitigation actions and successful implementation)*	*2*	*4*	*3*	*4*
	Implementation risk (High/Medium/Low)	*Medium*	*Medium*	*Low*	*Medium*
Costs	*Upfront capital investment (state cost estimate)*	*(none)*	*€ 150,000*	*€ 85,000*	*€125,000*
	Implementation effort (High/Medium/ Low)	*(none)*	*High*	*Medium*	*High*

Legend: 0=100% worse than the current situation; 2= same as current situation. 5=75% better than current situation.


Discussion Questions
a) Opportunities
b) Challenges
c) The way forward
ZHANG Danrong

BUILD ROADMAP

Defining a new business model
to deliver the business strategy

Eco—i Chemicals


ROAD MAP
BENEFITS
RISKS
Cost
Material Water
CURRENT SITUATION
€125,000
Energy
Job creation
Capital Investment

BR.1
Prepare for the roadmapping workshop

Eco—i Chemicals

BR.1 Prepare for the roadmapping workshop

TIPS & TRICKS

IDENTIFY QUALITY ASSURANCE REQUIREMENTS AND FACTORS TO PROMOTE MARKET ACCEPTANCE OF NEW PRODUCT OFFERINGS

What quality assurance requirements are required or valued by existing and future customers?

- What additional factors could prevent acceptance of the product? What are the trade-offs or negative consequences (e.g. appearance, texture, smell, etc.)?
- How should you adjust or change your existing marketing, sales, and purchasing structure to account for this?

CONSIDER AND MANAGE UNEXPECTED IMPACTS FROM THE NEW PRODUCT OFFERINGS

Consider if there could be any unexpected impacts from the planned innovation, such as a significant increase in energy consumption for drying waterborne paints compared to solvent-based paints or more water required for a biodegradable cleaning agent than a solvent-based degreaser, etc. Be sure to investigate such impacts and integrate measures to address them in the roadmap.

DEVELOP PRIORITY KPIs TO MEASURE SUSTAINABILITY PERFORMANCE

Define KPIs and implement them to measure and monitor the environmental, social, and economic impact of the new business model. Consider the information or data that is required to properly calculate the KPIs and ensure their availability and accuracy.

IDENTIFY EXPERTISE REQUIRED TO DEVELOP AND EXECUTE THE NEW BUSINESS MODEL(S)

Consider what expertise is available in-house and what is required:

Is outside expertise required for product development?

Can universities, technical institutes, suppliers, and customers support product development?

Do you have sufficient R&D and production capacity and budget to perform the necessary steps and tasks? What can you do in-house and what should or could be subcontracted?

IDENTIFY PROTOTYPING AND TESTING REQUIREMENTS FOR NEW PRODUCT OFFERINGS

Consider the main steps to commercialize new product offerings:

- What prototype tests are required?
- What analytical equipment is required? It is common to select a trusted and cooperative customer to perform trials of the new/modified product in order to confirm its performance.
- What period is feasible? For example, the development of new mixtures (formulation) can take between 6-36 months, whereas the development of new substances (synthesis) can take between 2-5 years.

BR.1 Prepare for the roadmapping workshop

Eco—i Chemicals

LEARNING CASE STUDY OF ROADMAP DEVELOPMENT MATRIX

Innovation idea title	**Benefits**	**Capital costs [US$]**	**Implementation effort [Person Months, PM]**	**Implementation risk (High/ Medium/Low)**	**Scheduling considerations**
Value mapping of all process steps	*Identification priority improvement areas: waste time, material, equipment utilisation* *KPI to measure manufacturing and business performance*	*1,000*	*1 Person Months*	*Low*	*Need specialist training course on Value mapping*
Lean Manufacturing practices	*Increase process cycle efficiency* *Reduction in lead time from customer order to product delivery* *Reduce waste time, materials, equipment usage*	*5,000-20,000*	*3 Person Months*	*Low*	*Need results of value mapping*
Green procurement policy for all chemical ingredients	*Immediate reduction in brand risk* *Immediate reduction in occupational health risks*	*0*	*2 Person Months*	*Medium*	*Need to find trusted suppliers and balance purchasing portfolio*
"Sustainable Ink" product development at lab-scale	*Reduction of occupational health risks* *Elimination of chemicals hazardous to human health and the environment* *Decouple dependency on non-renewable raw materials* *Higher profit margin due to selling price*	*5,000-10,000*	*5 Person Months*	*Medium*	*Detailed product development plan must be made including screening, sourcing, process modification*

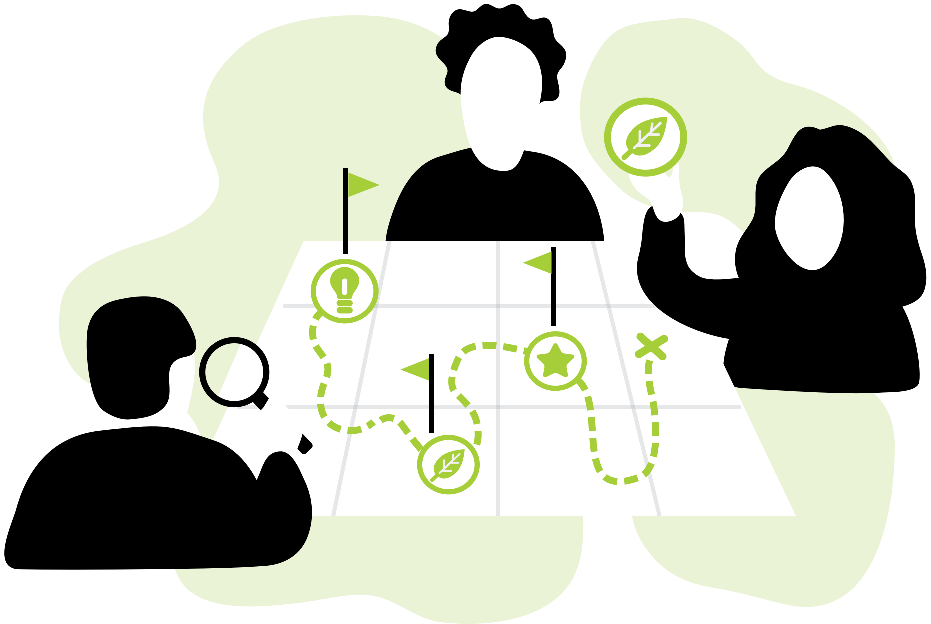
BM.4 Generate business model concepts at the big picture level

Eco—i Chemicals

Innovation idea title	Benefits	Capital costs [US$]	Implementation effort [Person Months, PM]	Implementation risk (High/ Medium/Low)	Scheduling considerations
Reduction and substitution of hazardous wet textile processing chemicals	*Immediate reduction in brand risk* *Immediate reduction in occupational health risks* *Provides added value and possibility to obtain ecolabel certification*	*15,000-35,000*	*10 Person Months*	*Medium*	*Detailed screening of all chemicals used required.* *Processed textiles and wastewater to be analysed for Restricted Substances*
Screen technologies for chemical recycling of polyester	*Provides economic and technical data to determine feasibility of concept*	*0*	*1 Person Months*	*Low*	*none*
Pilot test chemical recycling of returned polyester material	*Immediate reduction of raw material costs* *Proof-of-concept for customers* *Regional market leader in the chemical recycling of polyester fibres*	*50,000-125,000*	*5 Person Months*	*Medium*	*Critical for implementation of Fibre Leasing business model*
Develop web-based LCA tool to help customers (designers) reduce chemical footprint of designs	*Potential to significantly decrease hazardous chemicals and improve sustainability performance of the entire value chain* *Provides customers with the ability to improve their sustainability performance*	*15,000-25,000*	*4 Person Months*	*Low*	*The finished LCA tool is part of the business model value proposition and should be combined with marketing of the new Fibre Leasing business model.*

BR.2
Do a roadmapping workshop with input from value chain partners

Eco—i Chemicals



Eco—i Chemicals

BR.2 Do a roadmapping workshop with input from value chain partners

LEARNING CASE STUDY OF ROADMAP

Strategic goal	**Time** — *6 months* / *12 months* / *18 months* / *24 months*
Reduce chemical footprint between raw material extraction and use by 15% in 3 years	*Value mapping of all process steps in company* → *Train suppliers on value mapping and chemical footprinting techniques* → *Develop web-based LCA tool to help customers (designers) measure their product’s environmental footprint*
Manufacture sustainably-sourced and biodegradable printing ink within 2 years while maintaining the same performance quality	*Introduce green procurement standards for ink ingredients* → *Use GHS Column Model to screen and compare alternative chemicals* → *Pilot test new link ingredients*
Reduce polyester based products sold by the company from ending up in the landfill by 25% within 2 years and by 75% within 4 years	*Screen most technologies for the chemical recycling of end of life polyester* → *Develop logistics system for Fibre Leasing* → *Pilot test chemical recycling of returned material frm different customers*
Eliminate hazardous chemicals listed by the ZDHC initiative in 2 years through a combination of substitution and technological improvements	*Reduction & substitution of hazardous wet textile processing chemicals* → *Prepare a chemical inventory and identify priority restricted substance* → *Pilot test substitute chemicals for quality preformance*
Increase sales by 25% in three years while increasing productivity by 15%	*Implement Just-in-Time delivery for speciality chemicals* → *Implement Lean Manufacturing techniques*
To become the leading supplier of sustainably sourced and manufactured processed textiles for corporate wear costumers	*Develop Fibre Leasing concept with key corporate wear customers. Communicate added value* → *Begin marketing Fibre Leasing corporatewear* → *Switch to new Fibres Leasing Business Model*

BR.3

Define and prioritise the requirements of the first project

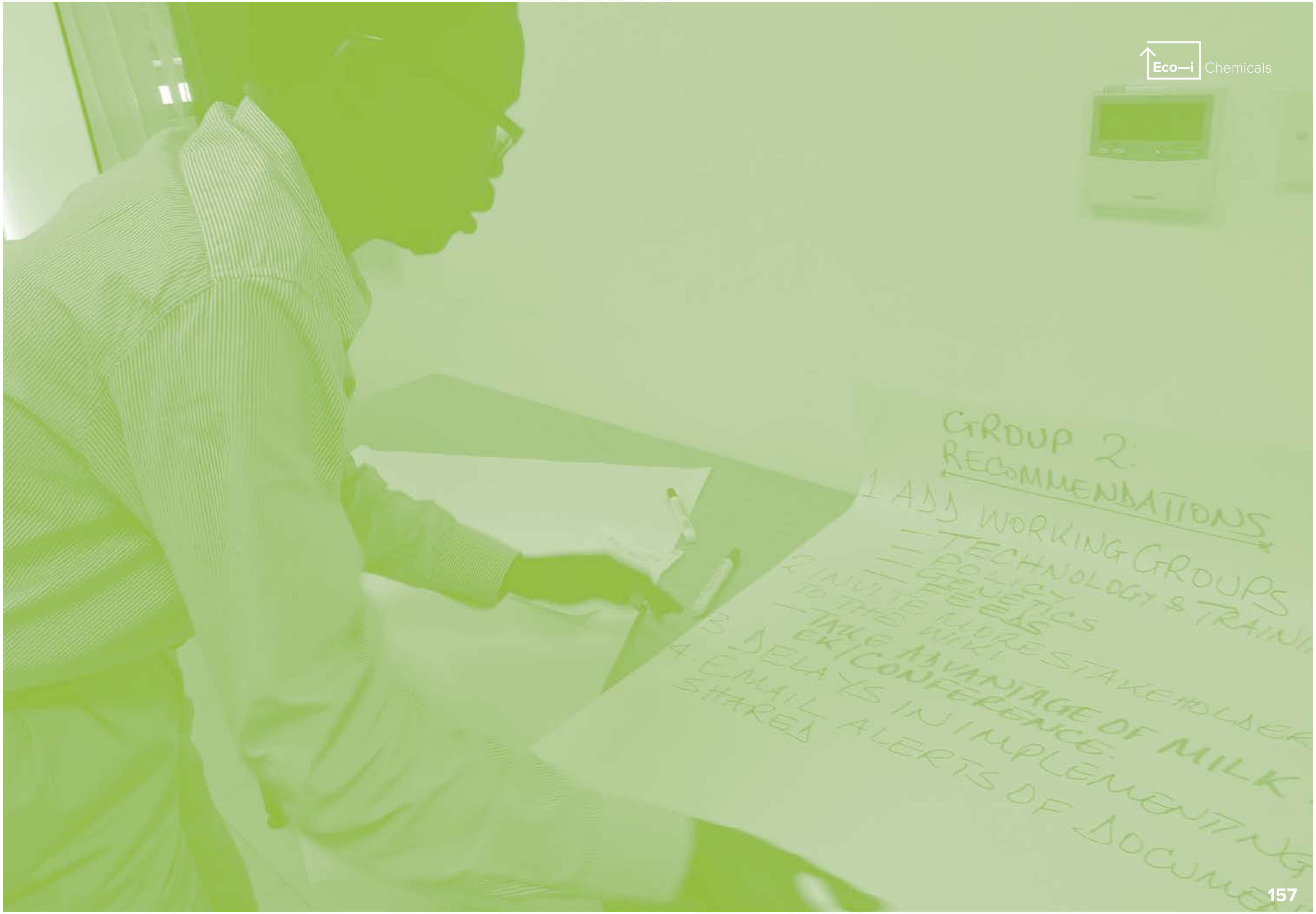
Eco—i Chemicals

BR.3 Define and prioritise the requirements of the first project

Eco—i Chemicals

LEARNING CASE STUDY OF REQUIREMENTS SPECIFICATION

Requirements specification for TipTop Textiles Company **Reduction and substitution of hazardous wet textile processing chemicals**					
Number or code	**Requirement**	**Comments**	**Priority (MSCW)**	**Review date (Project Month)**	**Reviewed / Approved (All Managers)**
Req01	*Determine essential properties and characteristics required for textile processing to product and customer segment (e.g. strength, comfort, colour, wrinkle-resistant, etc.)*	*Important to confirm the priorities for different customer segments*	*M*	*1*	*Technical Sales, Quality Control, Production, Marketing*
Req02	*Screen industry Restricted Substances List (RSL) and other relevant ecolabel RSL (e.g. Oekotext 100 RSL) and cross-reference with the company's chemical inventory and SOP's*	*Currently NPE's and formaldehyde are used in the process and are on most RSL issued by brand names*	*M*	*3*	*Quality Control, Production, Purchasing*
Req03	*Introduce counter current scouring and rinsing processes*	*Potential to reduce chemical and water consumption and decrease variable costs*	*S*	*5*	*Production, R&D*
Req04	*Obtain contractual commitment from chemical suppliers to ensure compliance with Restricted Substances List*	*Important to work with suppliers in a transparent way to guarantee compliance.*	*S*	*7*	*Quality Control, Production, Purchasing*
Req05	*Pilot test substitute chemicals for quality performance*	*E.g. melamine is used in the finishing stage to reduce wrinkling and shrinkage of corporate wear. One solution would be to switch from Formaldehyde to a formaldehyde-free cross-linkers*	*M*	*8*	*Quality Control, Production, R&D*
Req06	*Replace chemicals on Restricted Substances List in commercial scale-up*	*E.g. replace NPEO surfactant ingredient with sodium lauryl sulphate (complies with RSL).*	*M*	*12*	*Quality Control, Production, R&D*


GROUP 2:
RECOMMENDATIONS
1 ADD WORKING GROUPS

IMPLEMENT

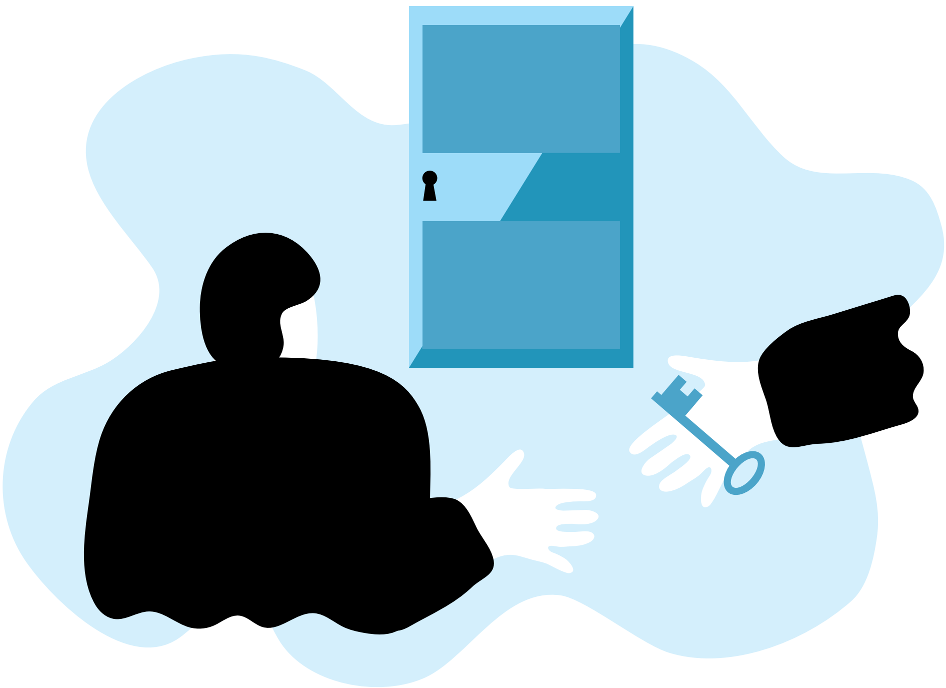
Implementing the first project for eco-innovation that will help to realise the new business strategy and business model

Eco—i Chemicals


Overview of the West Kenya platform
Stakeholder platforms to guide N2Africa business clusters in Tanzania

IM.3
Provide guidance and solve problems

Eco—i Chemicals



BACKGROUND INFORMATION

Additional tools can support the company in implementing specific technical projects in the chemical industry (e.g. developing a new chemical process, optimising existing production, or formulating a new and safer chemical product). The following is a list of selected technical tools and resources to support the implementation of technical projects in the chemical industry:

Chemical substitution and product formulation

- SIN List and SINIMILARITY Tool
  - What it is: You can search your chemicals and identify if they are on the CHEMSEC SIN (Substitute It Now) List. If not, the SINIMILARITY tool can tell you if they are similar to the SIN listed chemicals. The chemicals on the SIN List have been identified by CHEMSEC as Substances of Very High Concern based on the criteria established by the EU chemicals regulation REACH. There are substitution options listed for a limited number of chemicals, depending on application and on the SIN List website.
  - Further information: http://sinlist.chemsec.org/
- ECHA's Information on Chemicals portal
  - What it is: You can search your substances and find out their hazard classification and associated hazard and precautionary statements according to the CLP regulation (the EU's implementation of GHS). You can also access REACH dossiers for all registered substances.
  - Further information: http://echa.europa.eu/information-on-chemicals
- The Substitution Support Portal
  - What is does: Support your efforts in substituting hazardous substances by providing a repository of information on substitution methods, substances of concern, restricted substances, case studies, and substitution tools.
  - Further information: http://www.subsport.eu/
- OECD Substitution and Alternatives Assessment Toolbox (SAAT)
  - What it does: The OECD SAAT is a compilation of resources relevant to chemical substitution and alternatives assessments.
  - Further information: http://www.oecdsaatoolbox.org/
- Guide on sustainable chemicals
  - What it is: A decision tool for substance manufacturers, formulators and end uses of chemicals. Case studies are available for reference.
  - Further information: http://www.umweltbundesamt.de/en/publikationen/guide-on-sustainable-chemicals
- GHS Column Model
  - What it is: A simple tool allows for the comparison on chemicals/substances or materials/mixtures based on six hazard endpoints according to GHS classification.
  - Further information: http://www.dguv.de/ifa/Praxishilfen/GHS-Spaltenmodell-zur-Substitutionspr%C3%BCfung/index-2.jsp
- Cleangredients
  - What it is: A subscription-based online database that helps cleaning product formulators identify environmentally friendly ingredients and allow manufacturers to showcase their ingredients.
  - Further information: http://www.cleangredients.org/home

IM.3 Provide guidance and solve problems

Process modelling

- Aspen Plus
  - What it is: Aspen Plus is a license-based chemical process optimisation software used by commodity, fine and specialty chemical industries for the design, operation, and optimisation of safe and profitable manufacturing facilities
  - Further information: http://www.aspentech.com/products/aspen-plus.aspx
- HSC Chemistry
  - What it is: HSC Chemistry is an equilibrium thermochemical software with a flow sheet simulation mode used for chemical reactions and equilibrium calculations.
  - Further information: http://www.outotec.com/en/Products--services/HSC-Chemistry/
- PIUS Practice Tools
  - What it is: PIUS Practice Tools is a website with free Cleaner Production tools, such as VOC balance calculator and a solvent cleaning tool.
  - Further information: http://www.pius-info.de/en/pius_info_pool/tools/

Plant safety in the chemical industry

- Chemical hazard management: UN Environment's Responsible Production Toolkit
  - What it is: The Responsible Production toolkit provides a step-by-step guidance on identifying and understanding the hazards and risks related to the company products and operations and on developing a plan to address these and chemical safety issues. The Responsible Production Guidance and Toolkit is primarily targeting SMEs' managers and safety officers, but can also be used by local authorities and government officials in their planning and inspection activities.
  - Further information: http://www.unep.org/responsibleproduction/
- Process safety: Chemical Reactivity Evaluation Tool (RMT)
  - What it is: (RMT) can be used as an aid in identifying and evaluating chemical reactivity hazards so that they may be effectively avoided or controlled. It targets engineers, chemists, and management in SMEs responsible for process safety. It facilitates the (1) identification of most chemical reactivity hazards associated with their chemical processing and support operations; and (2) direction to the Centre for Chemical Process Safety (CCPS) documentation and other references of the best chemical engineering practices for the identification of reactivity hazards.
  - Further information: http://www.aiche.org/ccps/resources/tools/reactivity-management-tool
- Occupational Health & Safety: Control Banding using COSHH Essentials
  - What it is: An online tool providing advice on controlling the use of chemicals for a range of common tasks, e.g. mixing, or drying.
  - Further information: http://www.hse.gov.uk/coshh/essentials/

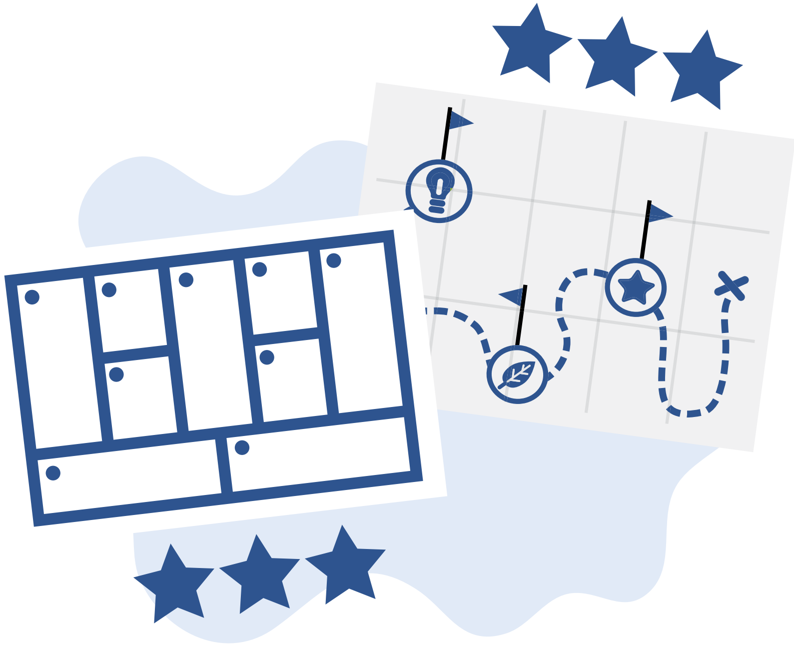
REVIEW

Review the performance of the first project
for eco-innovation and update your plans for the future

Eco—i Chemicals


A prospectus for an environmental research and educational facility for Africa

RE.3
Review the business model and roadmap



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RE.3 Review the business model and roadmap

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TIPS & TRICKS

EVERY END IS A NEW BEGINNING

When reviewing the performance of the business model and the roadmap progress, you can consider revisiting the PREPARE phase to keep abreast of recent development in the chemical sector with respect to potential regulations in domestic and export markets, voluntary initiatives or supply chain pressures (e.g Restricted Substances Lists), new value-adding marketing tools (e.g. eco-labels), as well as new and innovative business techniques to improve supply chain management, value chain engagement and business performance. By offering such services, you may be able to develop a long-term business relationship with key clients.

Glossary of key terms

Business model

Describes how a company does business. It is the translation of strategic issues, such as strategic positioning and strategic goals into a conceptual model that explicitly states how the business functions. The business model serves as a building plan that allows designing and realizing the business structure and systems that constitute the company's operational and physical form. (Osterwalder et al, 2005).

Business strategy

Describes the long term goals of the company and the markets in which the company will operate (i.e. vision and mission) (adapted from Andrews, 1997).

Gender

Describes the roles, behaviours, activities, and attributes that a given society at a given time considers appropriate for men and women. These attributes, opportunities and relationships are socially constructed and are learned through socialization processes. They are context/time-specific and changeable. (UN Women)

Gender discrimination

Describes any distinction, exclusion or restriction made on the basis of sex which has the effect or purpose of impairing or nullifying the recognition, enjoyment or exercise by women, irrespective of their marital status, on the basis of equality of men and women, of human rights and fundamental freedoms in the political, economic, social, cultural, civil or any other field (Art.1 CEDAW, 1979).

Gender equality

Refers to the equal rights, responsibilities and opportunities of women and men and girls and boys. Equality does not mean that women and men will become the same but that women's and men's rights, responsibilities and opportunities will not depend on whether they are born male or female. Gender equality implies that the interests, needs and priorities of both women and men are taken into consideration, recognizing the diversity of different groups of women and men. Gender equality is not a women's issue but should concern and fully engage men as well as women. (UN Women)

Gender-sensitive

Rescribes an attempt to redress existing gender inequalities when designing and implement development projects, programs or policies.

Life cycle

Consecutive and interlinked stages of a product (good or service), from the extraction of natural resources to the final disposal (adapted from ISO 14040:2006).

Life cycle assessment

It is a systematic set of procedures for compiling and examining the inputs and outputs of materials and energy and the associated environmental impacts directly attributable to the functioning of a product throughout its life cycle (adapted from ISO 14040:2006).

Life cycle thinking

It is a mostly qualitative approach to understand how our choices influence what happens at each of the stages of the life cycle of an industrial activity: from raw material acquisition through manufacture, distribution, product use and disposal. This approach is needed in order for us to balance trade-offs and positively impact the economy, the environment, and society (UN Environment, 2004).

Glossary of key terms

Marketing

It is the set of activities that are designed to help the company to understand the type of product it should offer to a market and communicate the benefits and value of the product to the targeted consumer. Marketing focuses on the product, promotion, price and distribution channels.

Market analysis

It is the activity of gathering information about the size, growth, profitability, target groups and existing products of a market, which is used to inform decision making at a strategic level. This specific activity would fall under the broader umbrella of marketing activities.

Organization structure

It refers to the range of activities and key resources (human and financial) within the company, in addition to those relating directly to production, that are dedicated to supporting the business model. These include procurement processes, distribution, key partnerships, customer relationships and interfaces, research and development, internal communication, and revenue generation.

Partners

It refers to parties in the value chain that provide or receive value including suppliers, outsourced workers, contractors, customers, consumers, clients, members, and others (ISO 26000:2010).

Roadmap

It is a planning tool used to support the implementation of strategies. It is made-up of a series of projects that will help to progress the organization from the company's current position towards fulfilling the organization's goals (adapted from Phaal R et al, 2007).

Stakeholder

It s any group or individual who can affect, or is affected by, an organization or its activities. Also, any individual or group that can help define value propositions for the organization (Stakeholder Research Associates Canada Inc., United Nations Environment Programme, AccountAbility: Stakeholder Engagement, 2005).

The supply chain

It is a system of organizations, technology, activities, information and resources involved in moving a product or service from supplier to customer (Michael Porter 1985) are the most significant impacts in the value chain or the life cycle of a product or service system, which can be used to identify impact improvement opportunities and to prioritize impact reduction actions (UN Environment/SETAC, 2014).

Value

It is understood to involve creating economic value (the revenue that a firm gets in return for its goods or services) in a way that also creates positive Outputs for society by addressing its needs and threats, taking into account economic, environmental and social considerations (adapted from Porter & Kramer, 2011).

A value chain

It is the entire sequence of activities or parties that provide or receive value in the form of products or services (e.g. suppliers, outsource workers, contractors, investors, R&D, customers, consumers, members) (ISO 14001 CD2, 2013). See also Partners definition above.

Value proposition

It refers to the products or services that an organization offers to a specific market segment that the organization believes will create value for that specific market segment.

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