



# **H**olistic **P**roject **M**anagement

How to add value by continuous improvement along the process chain

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# Saltigo – part of Lanxess Advanced Intermediates



Development and **production** of numerous products that are used as **intermediates** or **active ingredients** for **crop protection**, **pharmaceuticals** and other high quality **fine** and **specialty chemicals**.

Corresponding supply of services.

**saltigo**  
customized competence



A company of the  
**LANXESS**  
Group

**saltigo**  
customized competence

# AGENDA

- **Saltigo's Approach on Sustainable Processes**
- **Case studies:**
  - **Recycling of Acetonitrile from mother liquor**
  - **Save Energy by Increasing Productivity**
  - **How to remove salt from an aqueous value stream?**
  - **Improve materials and waste management**
  - **Doubling capacity without interrupting deliveries**

# Saltigo – a global leader in custom manufacturing

- **Saltigo...**

- ... supports customers throughout the entire life cycle of their products

- ... supplies premium chemicals and services

- ... protects intellectual property

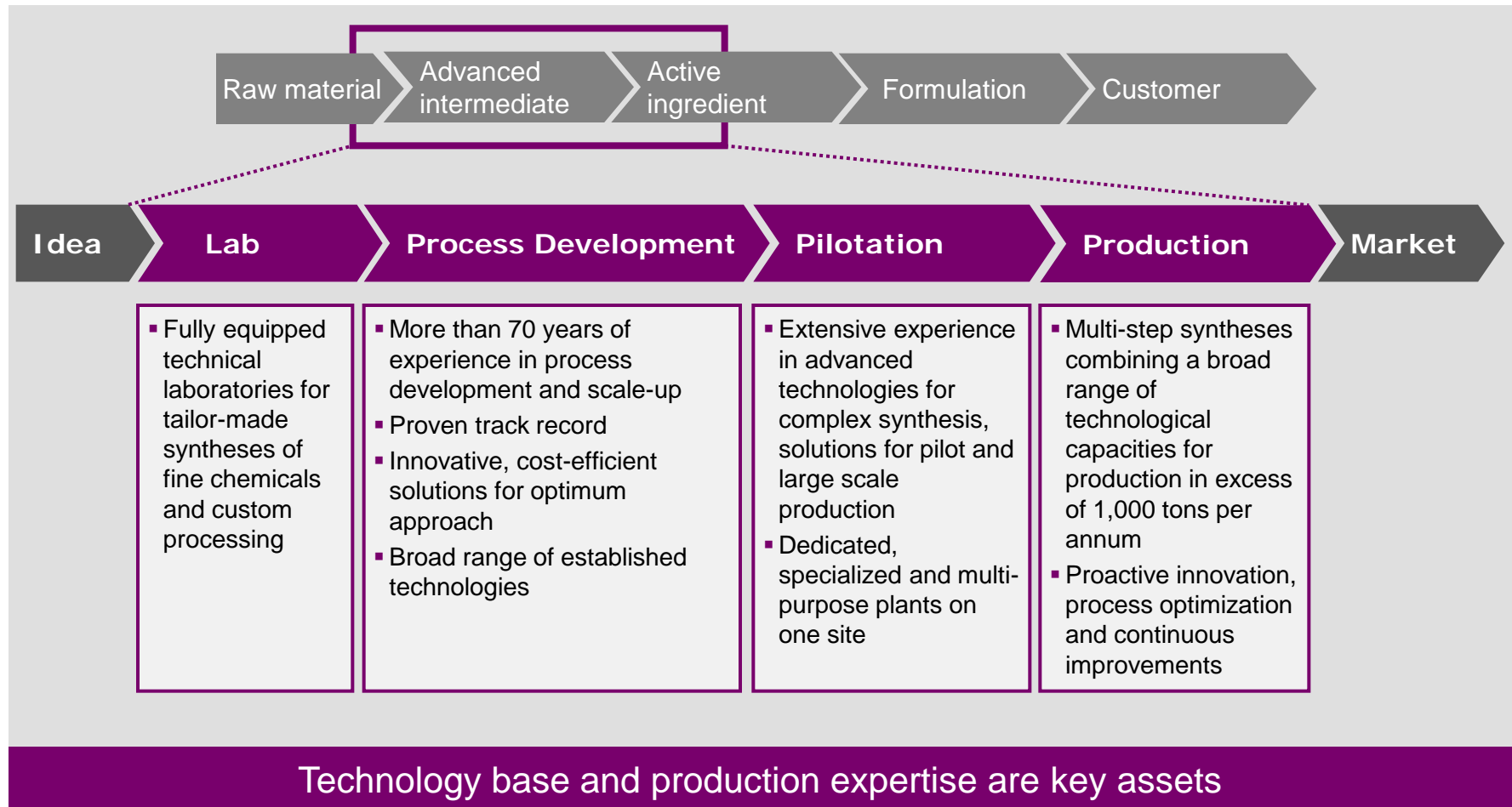
- ... targets cost driver optimization via continuous improvement of our processes and assets

- ... is devoted to the principles of sustainable development

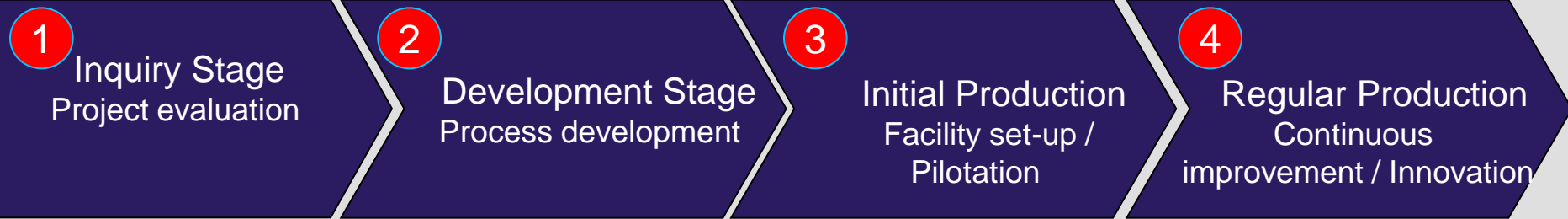
- As a Company of the LANXESS Group, Saltigo has the financial backing and stability for long-term partnerships



# Unique technology base to support customer needs along the project lifecycle



# Project management - 4 phase model



## Inquiry Team

Interdisciplinary team of Experts

## Project Team

A project team is assigned which is responsible for the sustainable development of the project over its total life cycle

## Steering Committee

Interdisciplinary team of senior executives responsible for multi-project management, resource allocation, prioritization, portfolio development



# Directions of development within projects

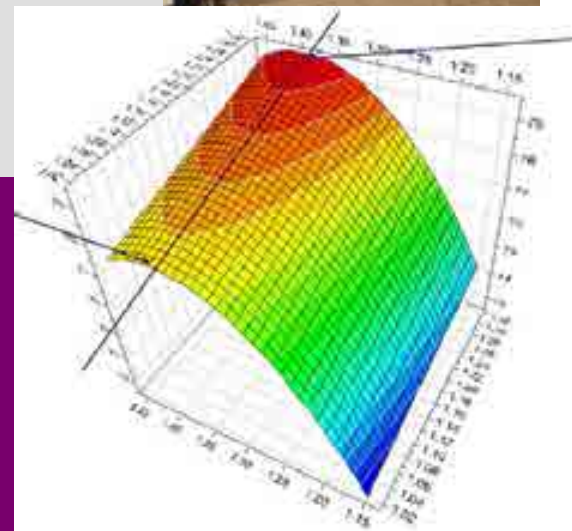
The „main process“ towards the target molecule is generally developed reasonably well (technical package)

Often **limited input** from customers or literature on **handling of material flow**

- **recycling** of solvents
- catalyst **cost**/recyclability
- **waste** treatment/avoidance options
- **alternative** processes
- **Energy efficiency** of a process

These areas are essential part of a **standard evaluation** during **inquiry assessment phase**

**2/3** of process development **efforts** at Saltigo are directed towards these topics



# Targeting cost drivers

Saltigo strives to maintain cost leadership in terms of process efficiency by continuous improvement of our chemical processes

Already in the bidding process it is essential to **identify „cost drivers“** and to **envision optimized processes**

## Solvent costs

range between 30 and 250 €/t  
⇒ improvement of recycling rate by 10% can save ~50 T€ in 100 t campaign in solvent cost spending

## Incineration costs

range between 200 and 800 €/t  
=> improvement of recycling rate by 10% can save ~20 T€ in 100 t campaign in avoided incineration cost

## Energy costs

cost increases by 70-100 % since 2009  
=> 20 % productivity improvement can reduce energy cost by ~30 T€



# Questioning technical process information

Choice of Solvent

Availability and cost of reagents

Reaction Temperature

Phase separation strategy

Process Safety evaluation

Recycling process

Catalyst

Quality determining operation

Reaction time











Choice of acids and bases

Waste

....

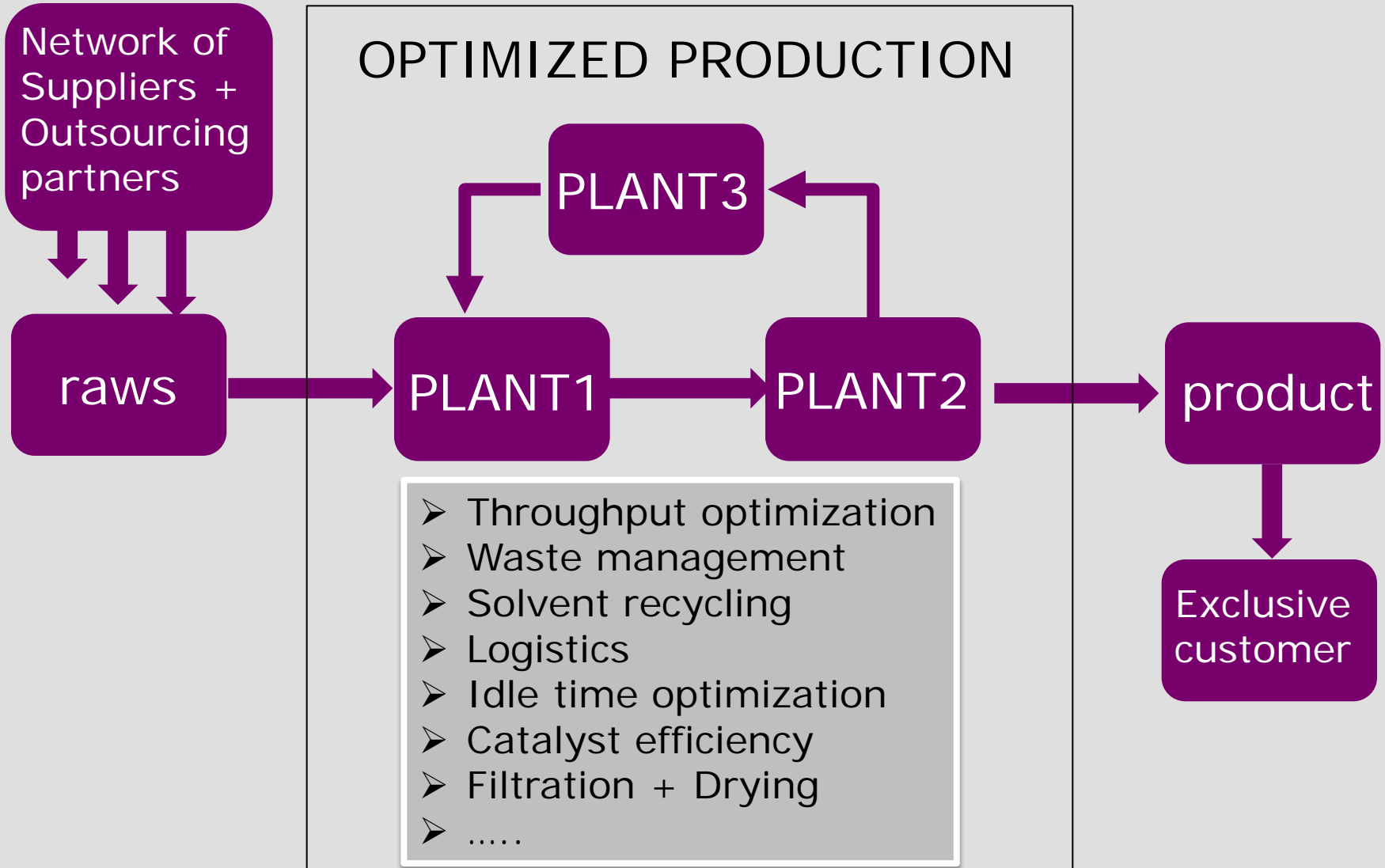
# Creating the right chemistry in our plants

2500 m<sup>3</sup> stirred reactor volume

Plant 1	 <p><b>Phosgenation Plant</b></p> <ul style="list-style-type: none"><li>▪ Multi-purpose plant</li><li>▪ units 8-20 m<sup>3</sup></li></ul>	<p><b>Multi-purpose herbicide plant</b></p> <ul style="list-style-type: none"><li>▪ High potency herbicides</li><li>▪ units 8-16 m<sup>3</sup></li></ul>		Plant 3
Plant 2	 <p><b>Chlorination Plant</b></p> <ul style="list-style-type: none"><li>▪ Cl<sub>2</sub>, PCI<sub>3</sub>, POCl<sub>3</sub></li><li>▪ GLS units 12-25 m<sup>3</sup></li></ul>	<p><b>The Multi-Purpose Plant</b></p> <ul style="list-style-type: none"><li>▪ agro &amp; fine chemicals</li><li>▪ units 8-16 m<sup>3</sup></li></ul>		Plant 5
	 <p><b>Distillation + packaging plant</b></p> <ul style="list-style-type: none"><li>▪ 25-120 plates</li><li>▪ units 12-40 m<sup>3</sup></li></ul>	<p><b>ZeTO 1: Pilot to Production</b></p> <ul style="list-style-type: none"><li>▪ Flexible plant concept</li><li>▪ Units 0,1 – 6 m<sup>3</sup></li></ul>		
Plant 4	 <p><b>High-pressure hydrogenation</b></p> <ul style="list-style-type: none"><li>▪ 3 lines Hydrogenation + Alkylation</li><li>▪ Units 3-5 m<sup>3</sup>, conti, batch</li><li>▪ Reactions up to 200 bars, 300 °C</li></ul>	<p><b>ZeTO 2: Synthesis Competence</b></p> <ul style="list-style-type: none"><li>▪ From Grignard to Fluorination</li><li>▪ Units 4–12 m<sup>3</sup></li></ul>		Plant 5
	 <p><b>Multi-purpose fungicide plant</b></p> <ul style="list-style-type: none"><li>▪ Multi-step actives synthesis</li><li>▪ units 6-16 m<sup>3</sup></li></ul>	<p><b>cGMP-plant for pharma actives</b></p> <ul style="list-style-type: none"><li>▪ modules 2,5-8 m<sup>3</sup></li></ul>		

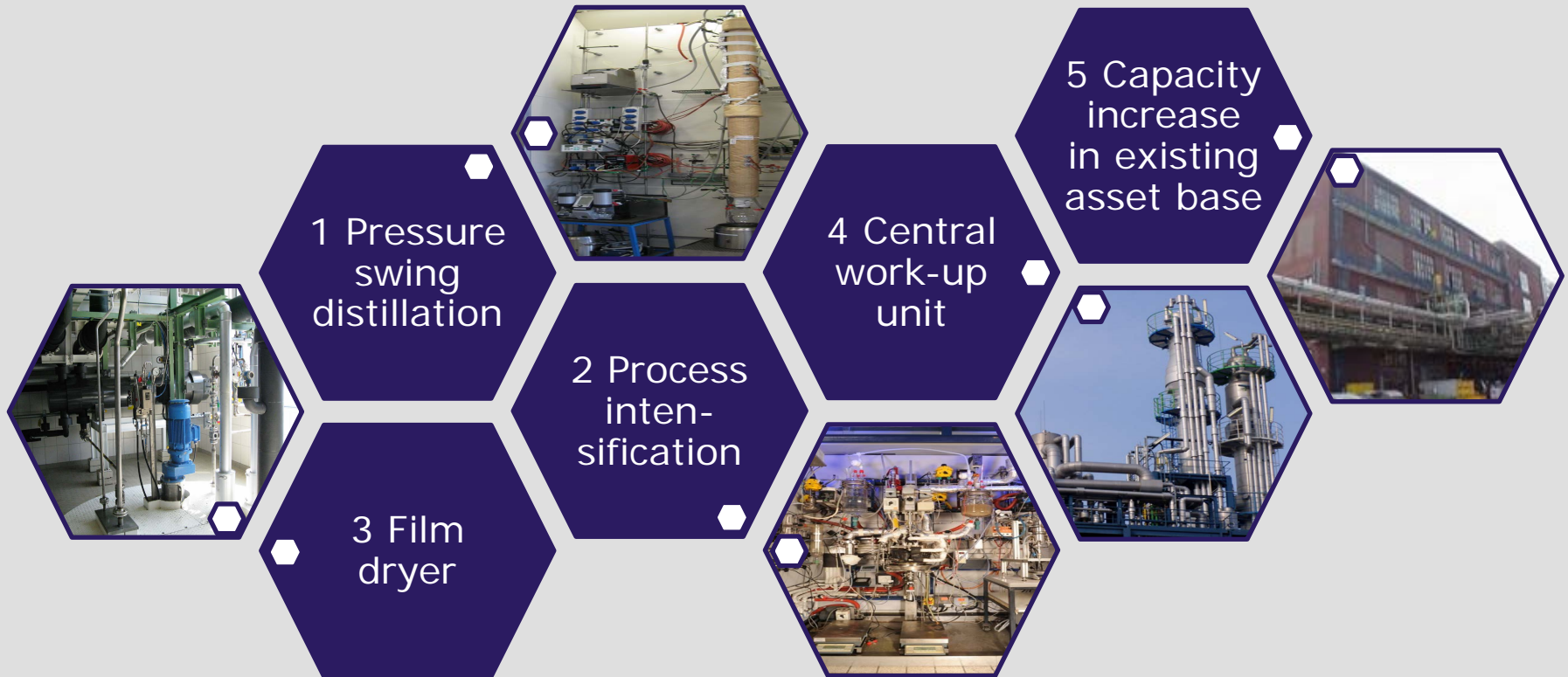
# Value addition

## Effecting Total Cost of Goods



# Value addition – five case studies

## Technology and performance driven process solutions



# Case study 1 – Recycling of Acetonitrile

>1000 t/a of 50% **acidic** aqueous **acetonitrile mother liquor** to be efficiently recycled

## Handling of mother liquor


Limited availability of acid resistant column at source of ACN mother liquor

Transport issue (corrosive material)

### Short term solution

Neutralization with caustic - aqueous phase contains high level of AOX

### Mid term solution

„acidic“ transport in 1 m<sup>3</sup> containers 

## Selection of distillation partner


External partner would have issues with residual waste streams

In-house distillation in SGO plant network  
⇒ Azeotropic distillation of acidic ML in Saltigo **chlorination** plant ! 

## Selection of „azeo breaking“ process

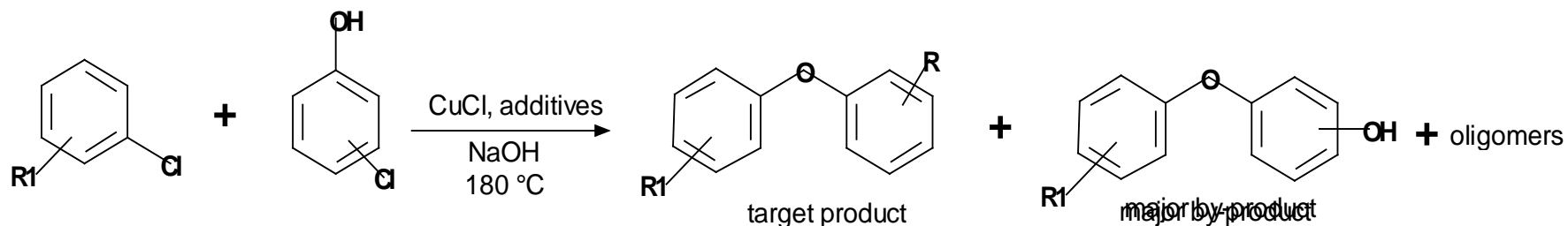
### Short-term solution

Addition of CaCl<sub>2</sub> (manual operation, large brine quantities to be handled)

**Sustainable long term solution**  
Investment into **pressure swing distillation** 

## Case study 2 - Save Energy by Increasing Productivity

A copper catalyzed Ullmann reaction is conducted on >1000 t/a scale  
**Productivity** had to be increased by **factor 2**, cost position improved



### Selectivity and yield influenced by

- excess chloroarene (phenole concentration)
- reaction conditions
- additives and catalyst

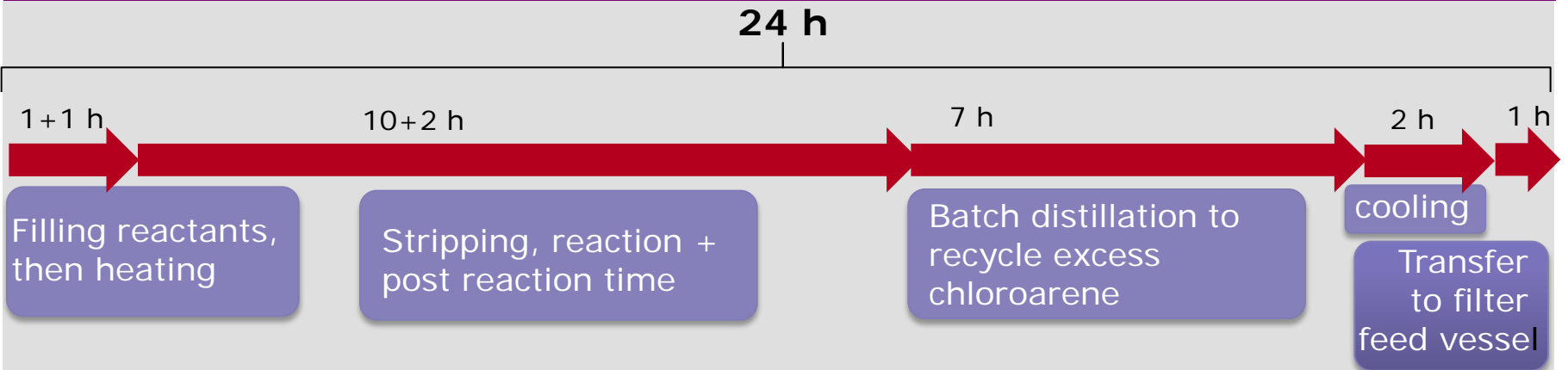
### Productivity influenced by

- reactant concentration (= excess chlorobenzene)
- filtration efficiency
- water content of rxt mixture

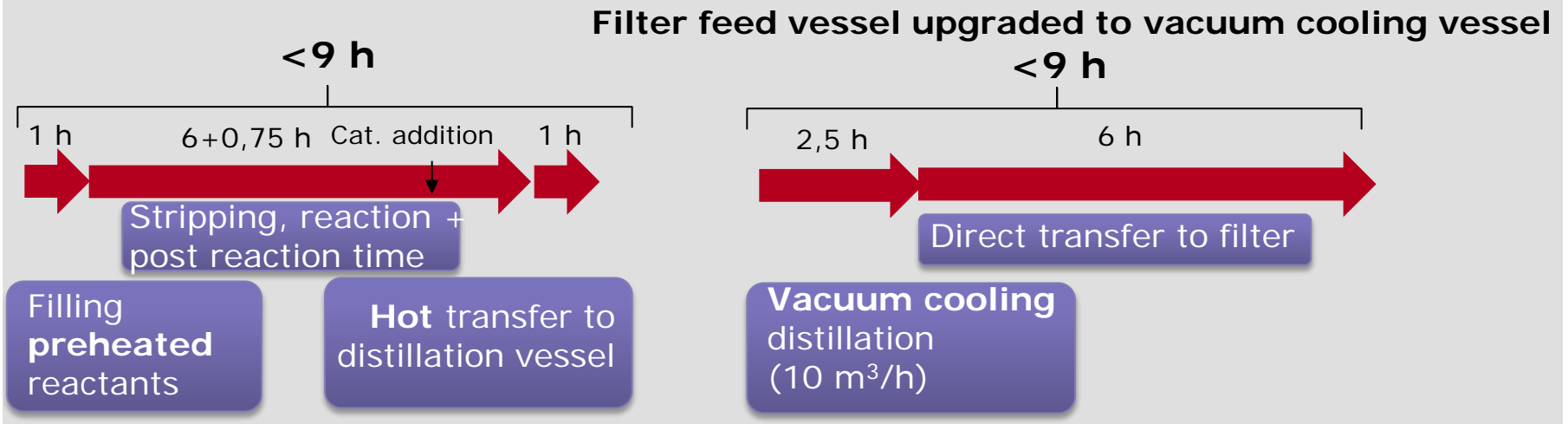


# Case study 2 - Save Energy by Increasing Productivity

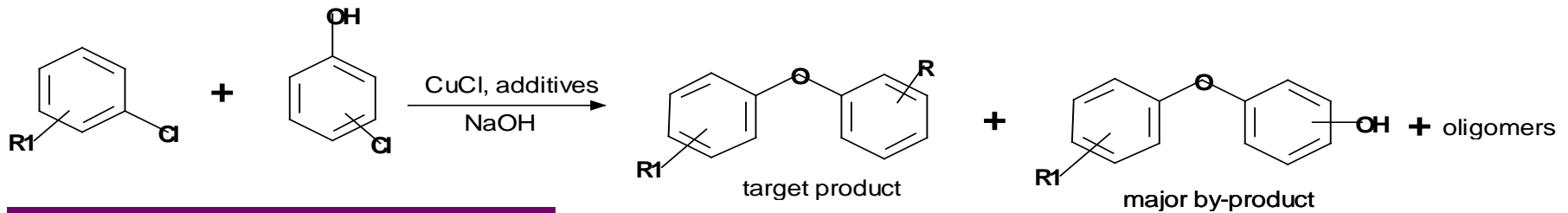
## Original process



## Optimized process (approx. 100 process modifications...)



# Case study 2 - Save Energy by Increasing Productivity



## Effects on productivity

- **Conversion increased** from 95 to >99%, isolated yield increase by 4,3%
- **Cycle time reduced** from 24 h to 9 h => 2,5 fold productivity increase

## Effects on variable cost

- Reduction of incineration residues **by 10 %**
- Reduced energy consumption by **combination** of distillation and cooling
- Reduced steam and coolant consumption by allowing **hot transfer** (avoid re-heating)
- Reduced steam consumption by **avoiding to strip** the waste water streams (complete phenole consumption makes WW extraction unnecessary)
- Significant **specific energy savings** by > doubled throughput

# Case study 3 –

## How to remove salt from an aqueous value stream ?

Economic Requirement: Recycling of precious amine

Type of reaction

Chlorine-  
Amine  
exchange

Organic  
water-soluble  
functionalized  
amine used in  
excess

Reactant

Neutralization  
with caustic

Amine-  
Hydrochloride

By-Product

Separation of  
water-soluble  
amine from  
brine solution

Task1

Strategy1

Boil down  
to  
„dryness“

Task2

Separate  
amine from  
water

entrainer  
distillation

Strategy2

Challenge:

Realization of Task1 lab-type strategy on >1000 t scale

# Case study 3 – How to remove salt ?

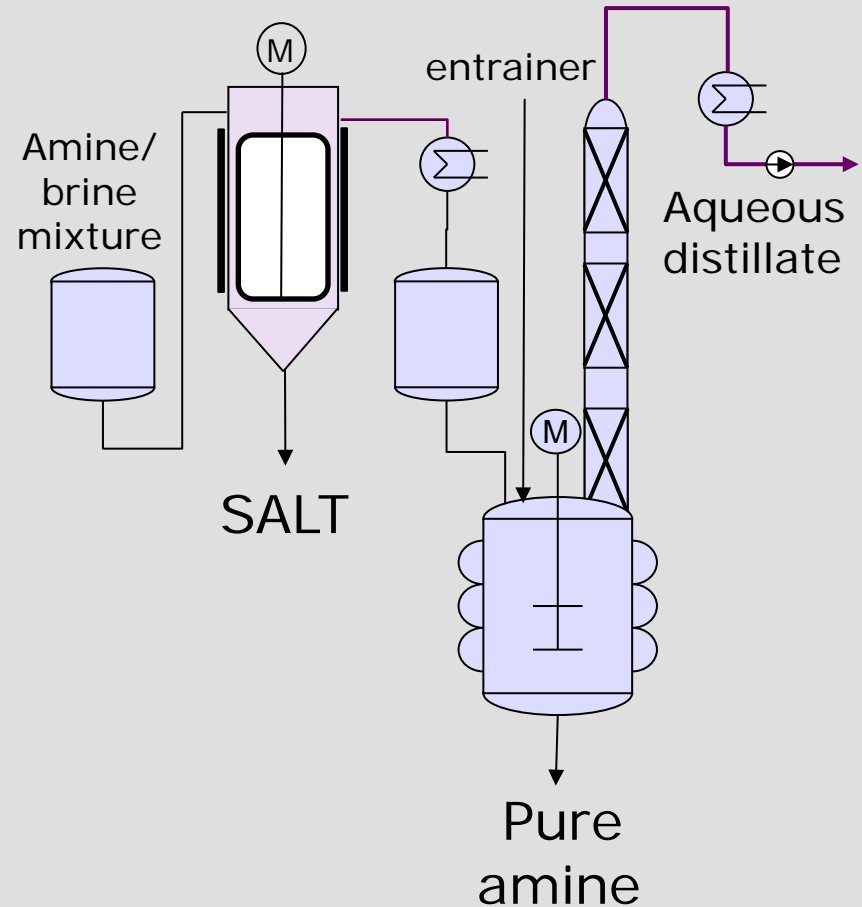
## Installation of a vertical film dryer

Distillation of aqueous brine solution of amine on film dryer to dryness

Sodium chloride separated and continuously discharged via rotary valve

Water/amine distillate is further processed

Drying via alcoholic entrainer by distillation

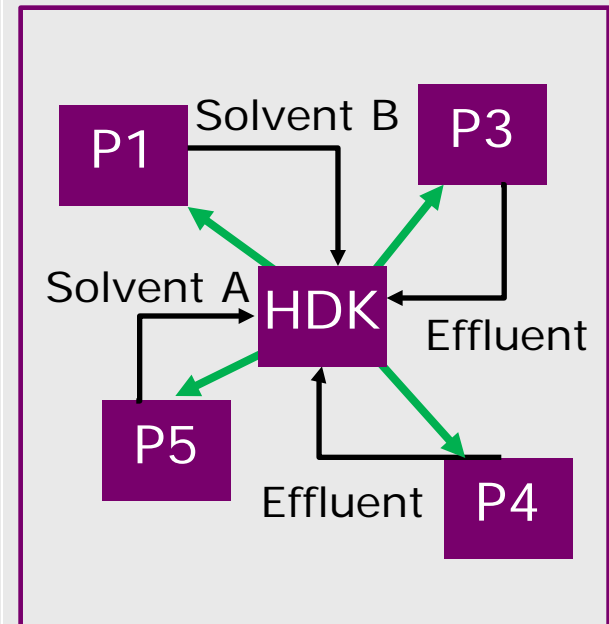


# Case study 4 - Improved materials and waste management - Logistics

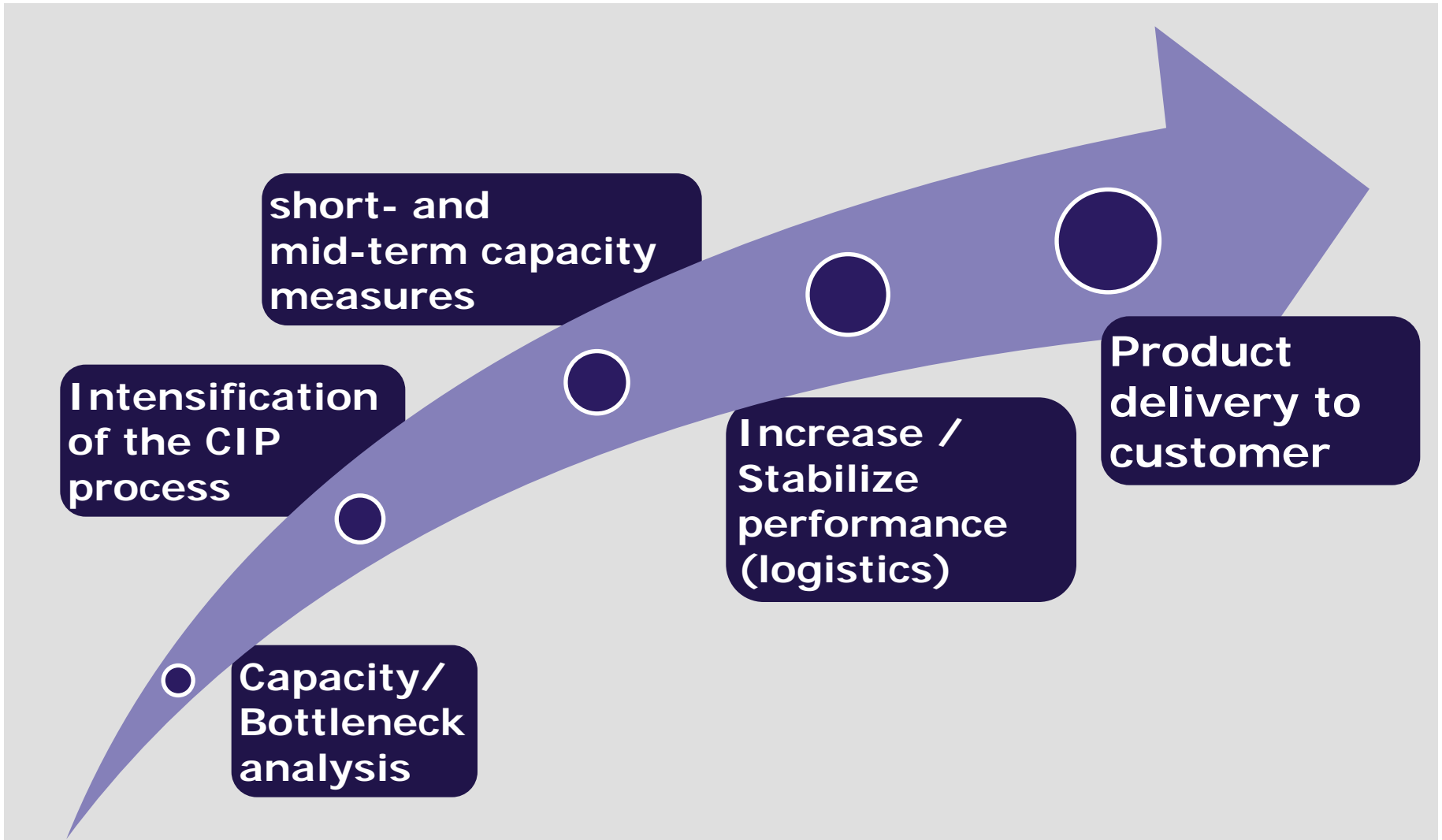
Recycling of various solvent streams at Leverkusen site contributes to significant reduction of environmental impact of our production

Distillation plant (HDK) plays a key role with regard to waste management

- Various material streams can be handled at the same time in the plant
- Solvent recovery allows reuse of solvent and reduces the amount of organic waste which requires incineration
- Distillation of aqueous sewage streams allows to increase product yield and facilitates disposal via the waste water treatment plant (WWTP)



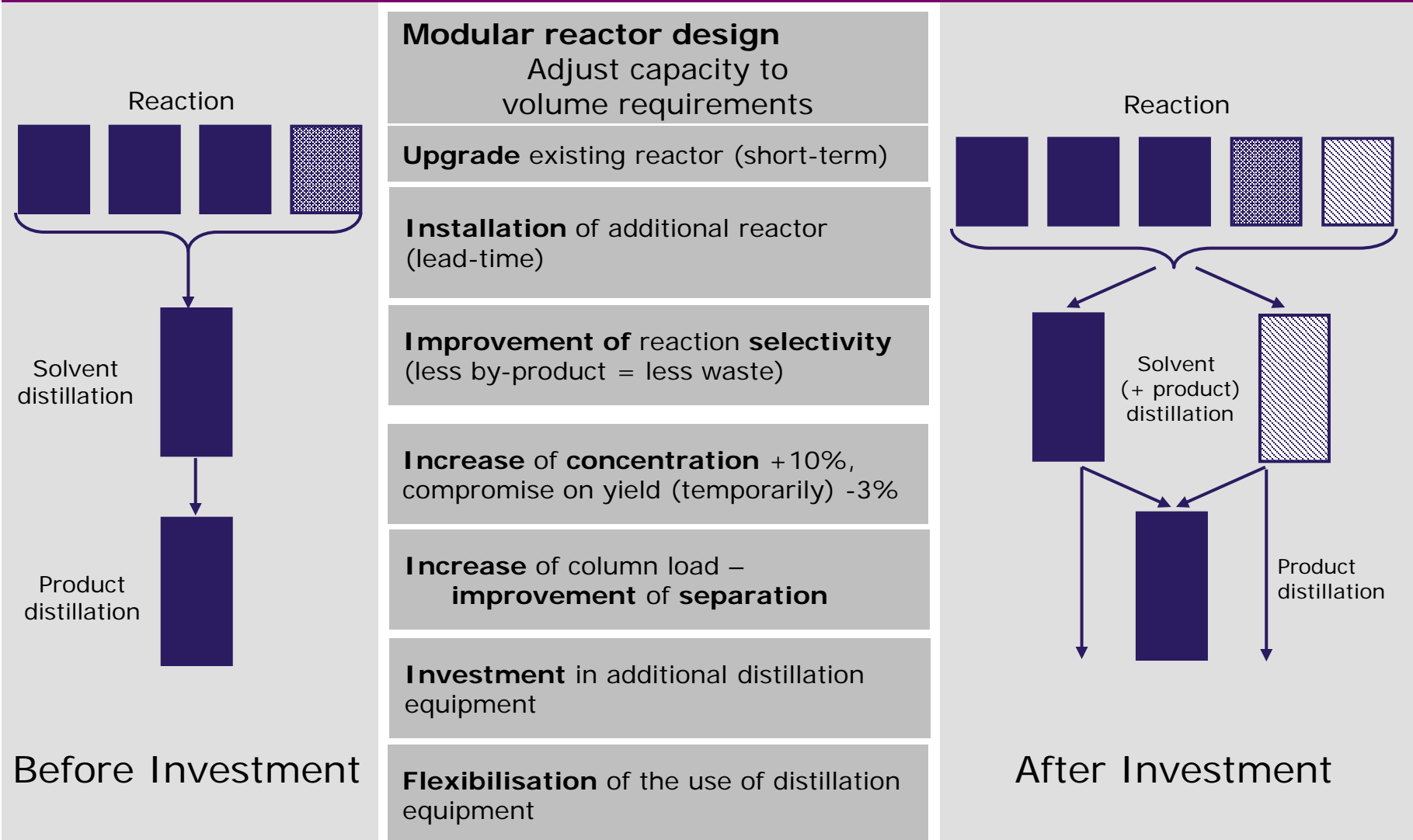
# Case study 5 - Capacity Increase





# Doubling capacity without interrupting deliveries

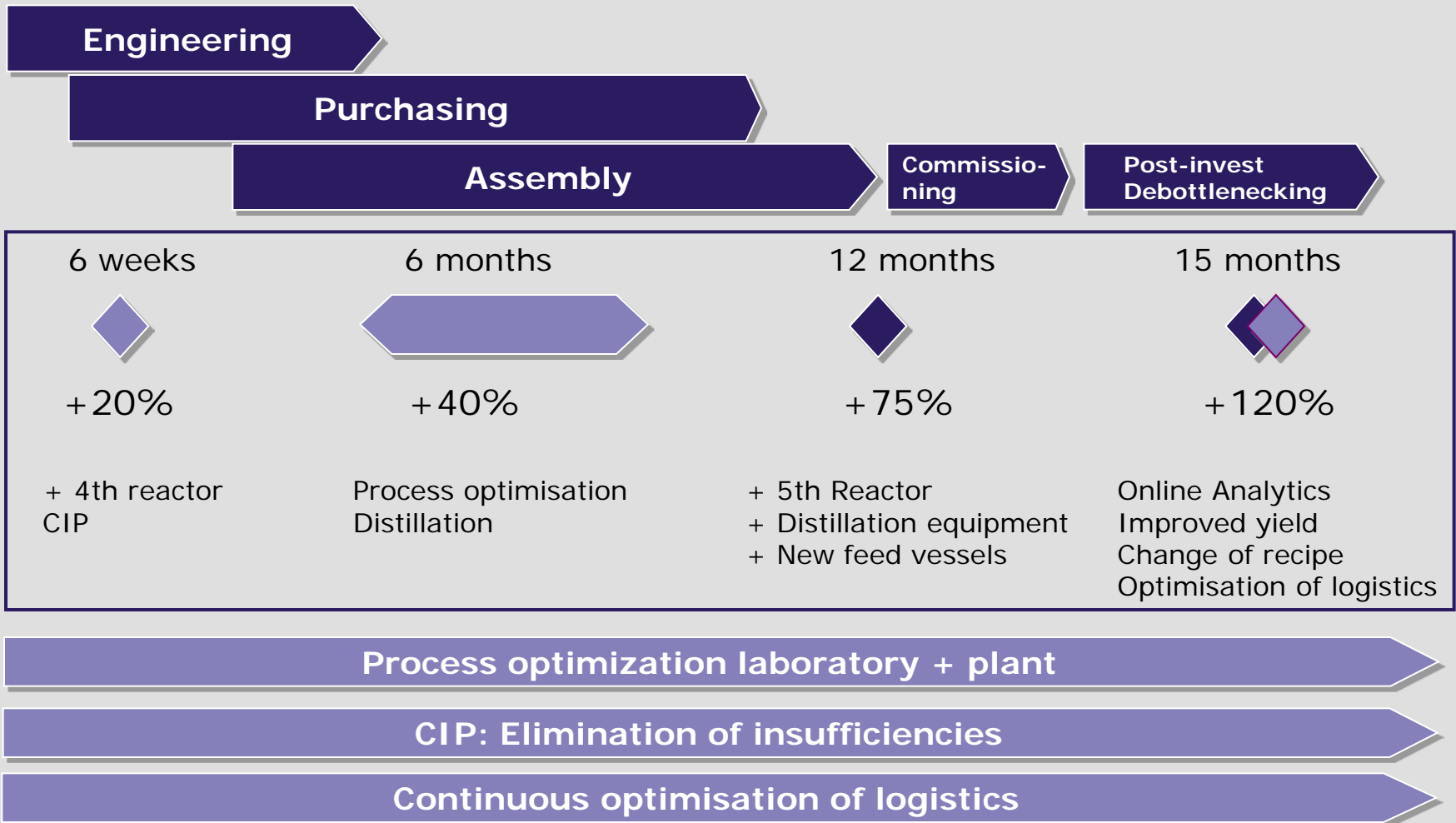
## Bottleneck a) reaction throughput and b) solvent distillation



Group

customized competence

# Simultaneous measures require holistic PM within interdisciplinary teams



# Summary - the Saltigo advantage

Our customers benefit during entire project life-cycle from our single-site CMO organization. Key success factors are integrated production planning and holistic project management within Saltigo

## All parts of the Saltigo organisation concentrated at one-site

- 9 manufacturing plants with a mix of technological specialities and multi-purpose equipment
- phosgenation plant in near vicinity (25 km)
- Production, Project management, Process development, Analytics, Marketing, Sourcing, Regulatory affairs...

## Holistic interaction of organisation throughout entire project life-cycle

- Customer benefits:
  - Reliable **response times** to customer requests
  - Short **time-to market** for individual projects
  - Flexible **adaption to customer project needs**
  - Effective **continuous improvement processes**

# Continuous improvement process

Custom solutions tailored  
to customer requirements

...focused on efficiency

...improved sustainability

... "greener" custom  
manufacturing

