Supply Chain Digitization
Presentation to the ETH Zurich
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</table>
A. Introduction to Roland Berger
Let me introduce myself

Matthias Hanke,
Managing Partner, Zurich
Central European Head of consumer Goods & Retail

| > Born 1965 in Hamburg, living in Basel |
| > Married, two kids (20/22) |
| > Apprenticeship in steel trading (2 years) |
| > German Navy (2 years) |
| > Combined Master studies of Mechanical Engineering and Business Administration at Technical University Darmstadt (6 years) |
| > Junior Consultant to Senior Project Manager at RBSC (5 years) |
| > Executive Vice President "Network & Strategy" at Swissair, Crossair, Swiss (4 years) |
| > DHL Express (3 years) |
| > Partner with RBSC in Zurich (11 years) |
| > Key areas: Logistics/ SCM, Aviation, Tour Operating, Consumer Goods & Retail |

> **Mobile: +41 79 372 3945, e-mail: matthias.hanke@rolandberger.com**

Source: Roland Berger
Let me introduce Roland Berger consultancy

Our scope and global reach

Founded in 1967 in Germany by Roland Berger

50 offices in 38 countries, with 2,200 employees

About 210 RB Partners currently serving

~1,000 international clients

Source: Roland Berger
B. Introduction to basic terms in Logistics
In easy words: a company's supply chain manager is the customer of the logistics service provider – however borderlines are blurring

Cornerstones – SCM versus LSP – two different perspectives

The "shipper/ consignee" perspective – Supply Chain Management

- **Purchasing** of production material and logistics components
- **Inbound** logistics
- **Site/production** logistics
- **Production footprint management**
- **Distribution** logistics
- **Overall SCM optimization**

> Overall supply chain ownership and accountability for all actions conducted
> Actively managing cost & quality control
> Make or buy decisions
> Increasing demands for sophistication of logistics services

The "Logistics Service Provider" perspective

- **Transportation/haulier** Services
- **Forwarding** Services
- **Warehousing** Services (Contract Logistics)
- 'Special B2C logistics'
- **Value added services** along the supply chain
- Logistic **Solutions/ Consultancy/ SCM Services ... 4-PL services** (~SCM)

> Network capabilities, knowhow & value added services form strong USPs
> Sophisticated asset management and/or capacity purchasing
> Price-competitive offering

Source: Roland Berger
There is an evolution of job-shifts from SCM to LSP to be observed

Key differentiation of logistics business models

1PL

> No outsourcing at all
> Shipper or consignee for a given manufacturing/ transportation flow (owner of the cargo)
> Overall responsible for execution of logistics activities

2PL

> Companies operating assets to execute the physical transportation of goods
> Typical 2 PL players include airlines, shipping lines, trucking companies, and warehousing companies – asset heavy business models

3PL

> Service providers with a business model of consolidating and integrating multiple logistics services into a holistic door-to-door solution for customers
> Maintains very limited physical assets and relies on purchasing- or leasing capacity from 2PL’s (Forwarders)

4PL

> Independent actors/ consultants that are organizing and managing complete supply chains strategies for their customers
> Drive outsourcing decisions, supplier selection, cargo routing …to support SCM; this way also manage subcontracting with 3PLs and 2PLs

Source: Roland Berger

PL = ‘party logistics’
3PL (and 2PL) LSPs can be divided into four groups

Logistics Service Providers

<table>
<thead>
<tr>
<th>Key characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overland Transportation</strong></td>
</tr>
<tr>
<td>&gt; Mainly <strong>trucking</strong>; growing share of rail</td>
</tr>
<tr>
<td>&gt; Forwarders often exercise &quot;Selbsteintrittsrecht&quot; and &quot;operate&quot;</td>
</tr>
<tr>
<td>&gt; Operation consists of <strong>carriage</strong> plus <strong>terminal operation</strong> for LTL business (groupage)</td>
</tr>
<tr>
<td>&gt; &quot;Mama and Papa business&quot; – low USPs ... <strong>low entry hurdles</strong></td>
</tr>
<tr>
<td><strong>Global Forwarding</strong></td>
</tr>
<tr>
<td>&gt; Core business is <strong>sea and air</strong> intercontinental transportation</td>
</tr>
<tr>
<td>&gt; <strong>Asset-light/trading business</strong> (capacity brokerage) plus <strong>value added services</strong></td>
</tr>
<tr>
<td>&gt; <strong>Low margins</strong> (RoS; don't mix up with RoC)</td>
</tr>
<tr>
<td>&gt; <strong>Interfaces</strong> with Overland Transportation and Contract Logistics</td>
</tr>
<tr>
<td><strong>Contract Logistics</strong></td>
</tr>
<tr>
<td>&gt; <strong>Coordination of parts of the supply chain</strong> on behalf of the customer</td>
</tr>
<tr>
<td>&gt; <strong>Warehousing and Distribution</strong> are elements of core business</td>
</tr>
<tr>
<td>&gt; Contract duration over a <strong>longer period</strong> (~5 years) with dedicated <strong>investments</strong></td>
</tr>
<tr>
<td>&gt; <strong>IT integration/interfacing</strong> with customer is key</td>
</tr>
<tr>
<td><strong>Integrators; Express Logistics</strong></td>
</tr>
<tr>
<td>&gt; <strong>Door-to-door</strong> service, self operated (P&amp;D, domestic linehaul, intl. linehaul, terminals)</td>
</tr>
<tr>
<td>&gt; Standing <strong>network</strong> – given fix-cost (flight gets operated ... full or empty)</td>
</tr>
<tr>
<td>&gt; <strong>Day-definite</strong> and <strong>Time-definite</strong> delivery plus even <strong>courier-services</strong></td>
</tr>
<tr>
<td>&gt; <strong>High-cost</strong> proposition</td>
</tr>
</tbody>
</table>

Source: Roland Berger
C. Ready for take-off? …
Supply Chain 4.0
E-commerce in combination with mobile devices and digitization are the major challenges for LSPs – the value chain is likely to change based on new demand profiles and on new entrants.

Evolution of logistics solutions

- **Business challenges**
  - Subcontracting
  - Globalization
  - Just in time
  - E-commerce
  - Digitization

- **LSP\(^1\) positioning**
  - 1PL Subcontractor
  - 2PL Carrier or LSP
  - 3PL Logistics operator
  - 4PL Supply chain optimizer

- **Solutions**
  - Planning
  - Containers
  - Warehouses
  - Routing
  - Distribution centers
  - Logistics platforms
  - IT
  - Cross-docking
  - Bundling
  - Lean
  - SCM
  - Pooling
  - Advanced pooling

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1) Logistics Services Providers

Source: Roland Berger
Digitization takes effect on logistics industry via four levers

'Industry 4.0'

> **Digital data availability**: Capturing, processing and analyzing digital mass data allows better predictions and decisions to be made

> **Availability of new Automation solutions**: Combining traditional technologies with artificial intelligence is increasingly giving rise to systems that work autonomously and organize themselves. This reduces error rates, adds speed and cuts operating costs

> **Connectedness across the value chain**: Interconnecting the entire value chain via mobile or fixed-line high-bandwidth telecom networks synchronizes supply chains and shortens both production lead times and innovation cycles

> **Digital customer access**: The (mobile) internet gives new intermediaries direct access to customers to whom they can offer full transparency and completely new kinds of services

'Logistics 4.0'

Source: Roland Berger, joint study with BDI on effects of Digitization
Supply chain digitization is a multi-lateral and multi-procedural question – there is not ONE solution but rather HUNDREDS

The Turf (Internat. Supply Chain; focus on logistics – SOP\(^1\)) / Production not covered

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**SUPPLY CHAIN**

**Vendor(s)**
- raw material
- components

**Producer (Shipper)**
- various product. sites

**Intercont shipment**
- road, air, sea

**Wholesaler, Importer (Consignee)**

**Retailer**

**Customer**

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**LOGISTICS REQUIREMENTS**

- **Shipping/ Trucking**
- **Warehousing**
- **Order management**
- **JiT delivery**
- **Control tower**
- **Intra logistics**

- **Warehousing**
- **Forwarding**
- **Documents**

- **Customs**
- **Trucking**
- **Handling**
- **Warehousing**
- **‘Shipping’**

- **Retail inbound logistics**
- **Stockholding**
- **Unpacking**
- **Shelf replenishment**
- **@ home delivery/ e-comm.**
- **Retour logistics**

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**DIGITIZATION**

- **autonomous trucking**
- **Digitized supply chain planning**
- **digitized market places**
- **shortened value chain (no retailer)**
- **fleet management**
- **tender platforms**
- **GDS\(^1\)-Freight**
- **shipment platforms**
- **online shopping**
- **O-2-O\(^1\) shops**
- **prime-now**
- **AI-purchasing**
- **industry 4.0**
- **3-d printing**
- **demand forecasting**
- **digitized LSP\(^1\) processes**
- **robots in retail and warehousing**
- **automated warehousing**
- **route optimization**
- **IT supp. order management**
- **e-cargo**
- **crowd logistics**
- **drone transports**

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1) SOP= Sales and operations Planning, GDS= Global Distribution Systems, O-2-O= Online to Offline and v.v., LSP= Logistics Service Provider

Source: Roland Berger
Monitoring of recent start-ups and innovative companies in the logistics area gives a good impression on the value chain dynamics.

<table>
<thead>
<tr>
<th>1</th>
<th>Business intelligence and data</th>
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</thead>
<tbody>
<tr>
<td>2</td>
<td>Freight marketplaces</td>
</tr>
<tr>
<td>3</td>
<td>Niche logistics operations</td>
</tr>
<tr>
<td>4</td>
<td>Automation</td>
</tr>
<tr>
<td>5</td>
<td>Green Technology</td>
</tr>
</tbody>
</table>

Source: Roland Berger
D. Digital Supply Chain Planning
Supply Chain Planning (SCP) – Digitization and system integration promises significant benefits

A  Outdated SCP practices

Business environment

- Volatility
- Uncertainty
- Complexity
- Ambiguity

Supply Chain Planning practices

- Inefficient Processes
- Inconsistent Organization
- Incapable Systems

B  Future state of SCP

Vision for SCP 4.0

End-to-End integrated Systems

Lean Processes

Process-led planning Organization

C  Benefits\(^1\) of SCP 4.0

- Short-Term Planning changes
- Forecast accuracy: +20%
- Slow-moving and obsolete: -20%
- Days of inventory: -7%
- Payback: 2-4 y

1) Variations may occur depending on the digital maturity of a company

Source: Roland Berger
Current SCP practices are not adapted anymore to the VUCA business environment, leading to operational inefficiencies

Misalignment between VUCA and SCP practices

**VUCA business environment**

- **Volatility**
  - Fast-changing consumer needs
  - Shortening of production life-cycles

- **Uncertainty**
  - Globalization of demand and supply
  - Financial pressure on margins
  - Uncertain politics and regulations (e.g. Brexit)

- **Complexity**
  - Sophistication of technologies (e.g. Internet of Things, 3D printers, deep learning, etc.)
  - Proliferation of SKU variants
  - Overflow of consumer-related data

- **Ambiguity**
  - Fading boundaries between markets in the digital age
  - Demand for tailor-made solutions

**Operational inefficiencies in SCP practices**

- **Process**
  - **Silo thinking** between production planning processes
  - **Demand sensing/ forecasting**: No effective alignment between demand and supply
  - **Manual** processes
  - No real time view of supply chain
  - No standardized processes and low adherence discipline

- **Organization**
  - **Heterogeneous** planning organizations
  - High churn of planners and no-harmonized incentive systems
  - No strategic positioning of SCP organization set-up

- **Systems**
  - Different IT systems and system breaks
  - No overall data integrity, transparency and traceability
  - Insufficient system functionalities

Source: Roland Berger
We foresee a best-in-class digital, optimized and interconnected landscape to drive the SCP transformation

Vision of the future Supply Chain

SUPPLY CHAIN PLANNING 4.0 USE CASES

Source: Roland Berger
To underpin this change, the company's vision for SCP need to be defined to derive the future processes, orga. and IT system landscape.

Supply Chain Planning of the future - Framework

Supply Chain Planning 4.0 vision

> Enhanced customer-centricity via Big Data capabilities
> Agile SCP organization in phase with VUCA\(^1\) business environment
> End-to-end visibility from suppliers to point-of-sales

1) Volatile, Uncertain, Complex, Ambiguous

Source: Roland Berger
E. Digitization of LSP and Forwarders in particular
Online survey: almost 95% of participants share the opinion that digitization will partly or completely change their industry.

Changes in the logistics industry caused by digitization:

*Digitization will change the industry...*

> According to the vast majority of respondents, digitization will change the logistics industry completely (59%) or at least partly (36%) in the coming years.

> Changes are possible in many areas and will especially affect market transparency and collaboration between different (new) market participants.

Source: Roland Berger online survey "2016 logistics study on digital business models" developed in cooperation with TU München.
Online survey: Participants more concerned about data security than about disruption of current business models …

Risks of digitization

How could digitization threaten your business model?

Every option was assessed individually

<table>
<thead>
<tr>
<th></th>
<th>#1 Data security breaches</th>
<th>1</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>67</td>
<td>59</td>
<td></td>
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<tr>
<td>2</td>
<td>22</td>
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<td>4</td>
<td></td>
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<table>
<thead>
<tr>
<th></th>
<th>#2 Increased complexity of competition</th>
<th>1</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60</td>
<td>69</td>
<td></td>
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<tr>
<td>2</td>
<td>27</td>
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<table>
<thead>
<tr>
<th></th>
<th>#3 Increased price transparency</th>
<th>1</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>60</td>
<td>75</td>
<td></td>
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<tr>
<td>2</td>
<td></td>
<td>40</td>
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<td>4</td>
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<thead>
<tr>
<th></th>
<th>#4 Increased quality transparency</th>
<th>1</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>29</td>
<td>60</td>
<td></td>
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<tr>
<td>2</td>
<td></td>
<td>60</td>
<td></td>
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<td>4</td>
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</tbody>
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<table>
<thead>
<tr>
<th></th>
<th>#5 Business model becomes irrelevant</th>
<th>1</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>4</td>
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</tr>
</tbody>
</table>

1 – Big risk | 4 – No risk

> Data security is seen as a risk across all industries and company sizes
> Fully one third of participants believe current business models could become irrelevant
> Especially participants with a contract logistics background (~45%) and those from larger companies see this as a risk

> Numerous examples confirm disruption in other industries:
  – AirBnB vs. hotels
  – Uber vs. taxi companies
  – Expedia vs. travel agencies
  – Amazon vs. retail companies
  – Netflix vs. video rental stores
Online survey: despite high awareness, the major hurdle for change is lack of know-how and lack of stakeholder support

Challenges preventing from 'digital fitness'

**What challenges do you face when ...**

<table>
<thead>
<tr>
<th>... implementing digitization measures?</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>&quot;Don't know&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of know-how</td>
<td>77</td>
<td>17</td>
<td>17</td>
<td>130</td>
<td></td>
</tr>
<tr>
<td>Lack of stakeholder support</td>
<td>44</td>
<td>54</td>
<td>21</td>
<td>117</td>
<td></td>
</tr>
<tr>
<td>Lack of strategic decisions</td>
<td>46</td>
<td>50</td>
<td>26</td>
<td>106</td>
<td></td>
</tr>
<tr>
<td>Lack of resources</td>
<td>43</td>
<td>59</td>
<td>48</td>
<td>94</td>
<td></td>
</tr>
<tr>
<td>Lack of support from management/employees</td>
<td>41</td>
<td>64</td>
<td>28</td>
<td>71</td>
<td></td>
</tr>
</tbody>
</table>

Source: Roland Berger online survey "2016 logistics study on digital business models" developed in cooperation with TU München

> Small companies have to cope especially with a lack of resources, whereas bigger firms consider a lack of know-how and lack of support from management and employees to be a major factor impacting implementation
Hypotheses on 'digital end-games' leave only limited space for legacy forwarders

Surviving players in the logistics industry (endgame scenarios)

1) Booking & optimization platforms (BOP)
   - Independent platform for the management of logistics transactions
   - Route and cost optimization capabilities

2) Carrier, terminal operators, trucking companies (CTO)
   - Asset holders and operators performing logistics tasks
   - High asset and cost efficiency
   - Either specialized or standardized

3) Supply chain specialists (SCS)
   - Solution provider for complex or industry-specific tasks
   - Deep understanding of industry-specific supply chains

4) Service providers (SP)
   - New players, hardware providers and existing online players
   - Provision of support services for logistics companies

New players in services (especially in BOP)

Stronger specialization of the players (asset-heavy vs. asset-light)

Profit pool shift away from the business of traditional freight forwarders

Increasing number of large freight carriers & trucking companies vs. supply chain specialists

1) Active in multiple industries

Source: Market experts, Roland Berger
Especially the 'commodity business' (low USP, high degree of standardization) will be subject to business model disruption.

Market outlook – Driving forces of new business models

- Booking platforms are expected to attract most of forwarders' standardized business, aiming at grabbing their margin.
- As a result, forwarders' business models need to be transformed.

<table>
<thead>
<tr>
<th>Forwarding air/sea</th>
<th>Forwarding land</th>
<th>Contract logistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>~80%</td>
<td>~70%</td>
<td>&lt;5%</td>
</tr>
</tbody>
</table>

- Demand for personalized products expected to grow.
- Supply chain specialists expected to offer product personalization.
- As a result, contract logistics market expected to grow ~9% p.a.
- Digitization might boost growth as demand for tailored solutions increases.

Source: Market experts, Roland Berger
Forwarders should rethink their portfolio into two directions: Focus on asset ownership & operation of focus on SCM and VAS services

Hypotheses on 'digital end game' – slightly provocative

Challenges
> Cost efficiency will be key
> Financing will be a challenge

Challenges
> Business transformation and IT development will require sufficient financing
> Cost base to be efficient to increase operational CF
Based on research and interviews, different platform types can be distinguished – Different functions and foci

Statements on Business optimization platforms

> **Platform** foci are **diverse**; the field is not yet fully sorted

> **Upcoming structure of platforms** might be clustered into (1) Legacy solutions, (2) Tender platforms, (3) Carrier distribution systems, (4) Freight exchange broker platforms and (5) virtual forwarders supported by instant quote service providers:

  - **Tender platforms** provide a service for shippers and provide transparency on competing offers
  - **Carrier distribution systems** collect and manage carrier and service provider information as well as capacity in a central system
  - **Freight exchange broker platforms** sell single components, but negotiate own carriers and services
  - **Virtual forwarders** automatized their sourcing process and provide value added services to the shipper
  - **Instant quote service providers** manage quotes of individual carriers/ service providers and combines quotes to door-to-door packages

> All models might have a sustainable value proposition and might **diminish** the position of **legacy forwarders**
'Virtual forwarders' and 'dynamic production models' are about to come – legacy forwarders will lose market share

Joint study result – Future platforms in forwarding

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<table>
<thead>
<tr>
<th>Carriers and services</th>
<th>Supply management</th>
<th>Demand management</th>
<th>Shipper/Consignee</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Legacy LSPs</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>1 Legacy solutions</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Offering services on own webpage</td>
<td></td>
<td></td>
<td>Own sourcing web-page</td>
</tr>
<tr>
<td>Supply chain optimization and visibility tools (forwarder internal e-operations)</td>
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<tr>
<td>Partial automation of the legacy value chain</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>New entrants</th>
<th>1) Carrier distribution systems</th>
<th>4) Freight exchange broker platforms</th>
<th>5a) Virtual forwarders</th>
<th>2) Tender platforms</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; Distribution of sailing schedules, contract and rate information</td>
<td>&gt; Sales of single components</td>
<td>&gt; Sell door-to-door packages</td>
<td>&gt; Provide a service for shippers</td>
<td></td>
</tr>
<tr>
<td>&gt; Bundled and standardized access to carriers</td>
<td>&gt; Negotiate own carriers and services</td>
<td>&gt; Provide VAS</td>
<td>&gt; Provide transparency on competing offers</td>
<td></td>
</tr>
<tr>
<td>&gt; Sales of FWD packages</td>
<td>&gt; Use automated sourcing/ best price and instant quotes</td>
<td>&gt; Manage quotes of individual carriers and service providers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5b) Instant quote service providers</td>
<td>&gt; Combine quotes to door-to-door packages</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

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1) Including warehousing, customs clearance, trucking etc.

Source: company websites, Roland Berger
F. Robotics and automation in logistics
Robots are becoming affordable – In many cases, robots are becoming cheaper than human operators (example: Netherlands)

Hourly minimum salary in Netherlands vs. hourly costs of robots [EUR/hour]

Major cost impact drivers

- Increase in the length of the lifespan of robotic solutions
- Drop in robotic equipment prices
- Increase in the productivity of robotic solutions
- Continuous rise of labor costs

Resulting in an ROI of less than 3 yrs. for many robotic solutions

Source: IFR; INSEE; Eurostat; gemiddeld-inkomen.nl; Companies; Roland Berger study
The mass arrival of robots in logistics is no longer a question – the real question is how soon and how to better prepare for it.

**ROBOTIC SOLUTIONS**

Though solutions are not entirely comparable, their price evolution highlights the change in the scale of robotics solutions designed for order-preparation operations.

**EXAMPLE OF THE PRICE EVOLUTION OF LOGISTIC ROBOTS**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Price Evolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willow Garage’s</td>
<td>PR2</td>
<td>USD 400,000</td>
</tr>
<tr>
<td>Unbounded Robotics</td>
<td>UBR-1</td>
<td>USD 35,000-50,000</td>
</tr>
<tr>
<td>Rethink Robotics</td>
<td>Baxter</td>
<td>USD 22,000</td>
</tr>
</tbody>
</table>

**IMPACT ON EMPLOYMENT**

The comparison between logistic and automotive robotics reveals that a little over 1.5 million direct jobs (40%) would be destroyed in the Eurozone over the next ten years.

**PROPORTION OF ORDER PREPARATION STAFF AND WAREHOUSE WORKERS/TOTAL JOBS [in millions ~ 2013]**

- **EU-28**: 4.4
- **EU-15**: 3.6
- **Netherlands**: 0.2
- **Spain**: 0.3
- **Italy**: 0.3
- **France**: 0.5
- **Russia**: 0.6
- **Germany**: 0.8

In France nearly 225,000 direct jobs and almost as many indirect jobs would be destroyed over ten years.

Source: Roland Berger
Robots are moving "downstream" in logistics – Robotic developments in order picking and delivery are taking off

Robotization in the logistics sector

<table>
<thead>
<tr>
<th>Handling</th>
<th>Transport</th>
<th>Warehousing</th>
<th>Order Picking</th>
<th>Delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stationary robots</strong></td>
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<tr>
<td>Packaging</td>
<td>Automated container handling</td>
<td>Automated storage and retrieval</td>
<td>Automated order picking</td>
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<tr>
<td><strong>Automated guided vehicles</strong></td>
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<tr>
<td>Automated truck/ship delivery</td>
<td>Automated forklift</td>
<td>Moving shelves</td>
<td>Delivery vehicles</td>
<td></td>
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<tr>
<td><strong>Drones</strong></td>
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<tr>
<td>Surveillance/monitoring drones</td>
<td>Inventory drones</td>
<td>Delivery drones</td>
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</tr>
</tbody>
</table>

Source: Company website; Roland Berger
Robots are becoming more intelligent – Robots can handle more complex tasks in less controlled and less predictable environments

Development of robotic solutions

1960
First industrial robot
> Spot welding
> Extracting die castings

1970
Small part assembly robots
> Feedback from touch and pressure sensors
> Arm controlled by a minicomputer

1980
Direct drive arm robots
> Motors installed directly into the joints of the arm
> Faster and much more accurate handling

1990
Handling robots
> Part selection, transferring, packing, palletizing, loading and unloading, machine feeding or disengaging
> Controlled and structured environment

2000
Today's robots
> Lightweight & easier to relocate
> Work in semi-structured environments

2010
Future robots
> Amazon picking challenge: autonomous picking objects in unstructured setting: different shapes, colors, sizes and positions
> Use of 3D camera with visual recognition
> At-home delivery by AGV or drone

1960
First industrial robot

1970
Small part assembly robots

1980
Direct drive arm robots

1990
Handling robots

2000
Today’s robots

2010
Future robots

Traditional large market players

KUKA
ABB
MOTOMAN
FANUC
NACHI

Start-ups & research initiatives

Swisslog (KUKA)
YuMi® (ABB)
Baxter (Rethink)
Delft Robotics
Magazino (Siemens)
KIVA (Amazon)
Matternet (Mercedes)
Bastian
(x) shareholder/owner

Source: Manufacturers