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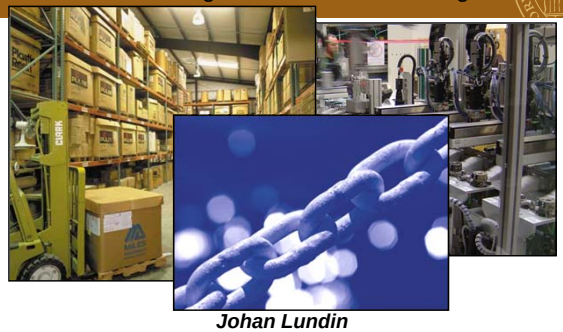
# L15 – Benchmarking

MTTN25 – Warehousing and Materials Handling



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***McKinsey & Company***
***2011-09-30***

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## Who am I? – Johan in short

- McKinsey & Company, Present
  - EMEA Operations practice
  - Stockholm office
- PhD Industrial Engineering, 2011
  - Lund University
- Fulbright scholar, 2008/2009
  - Georgia Tech, Atlanta, USA
- MSc Industrial Engineering, 2006
  - Lund University
- BSc Business & Economics, 2005
  - Lund University

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## Warehousing and Materials Handling

**Tools & Techniques**

- Optimization models: Pick-paths; Inclusion of SKU in FPA; Lane depth & slotting
- Layout: Location of receiving & shipping; Aisle configuration, Stack height; Forward Pick Area
- Activity Profiling: Measurement & statistical analysis of Warehouse activity / Data mining
- Benchmarking: Performance measurement — L15

**Processes**

Receiving → Put-away → Storage → Pick → Pack, Ship

**Resources**

- Equipment: Racks & Shelves; Handling & Transportation; Automation; Mobile picking
- Labor Management Scheduling: FT vs. Temps; Safety regulations; Union rules
- ISIT/WMS: Support the operation with space allocation, route planning, consolidated picking and statistics

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## Learning objectives

- Learn what performance measures that are suitable for benchmarking
- Learn how to measure the performance of activities in a warehouse operation
- Understand how to benchmark one warehouse with others; with whom to compare and how to improve

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## Agenda

- Benchmarking data
- Data collection
- Comparing different measurements

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## First of all, what is benchmarking? Furthermore, what is warehouse benchmarking?

Measuring and comparing performance between different units:
- Internally – on the processes within a single company
- Externally – on the same process in other industries or on the same process in competitors

Some questions arise:
- What to measure?
- With whom to compare?
- How to improve?

Performance measurement using a simple ratio (relative measurement):

Units of output achieved /
Units of input required

Example performance ratios:
- Operating costs, such as warehouse costs as a percentage of sales
- Operating productivity, such as pick-lines, orders, cartons, pallets handled per person-hour
- Response time, measured, for example, as order-cycle time (minutes per order)
- Order accuracy, measured, for example, as fraction of shipments with returns

Criteria for performance ratios (KPIs):
- Unbiased, customer-focused, and consistent with corporate goals
- Measure those activities or results that are important to successfully achieving your organization's goals

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## Data needed for warehouse benchmarking – What KPIs are important for your case companies?

| Type of data | Description |
|---|---|

- Receiving
- Put-away
- Storaging
- Picking
- Packing/ shipping

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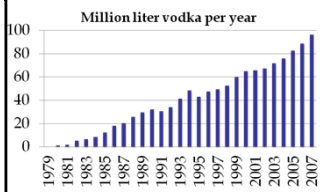
## Absolut in Åhus: One location, One well, One big wheat field, and One source

General facts:
- Manufacturing and global distribution of vodka to 126 countries (98% export)
- 96.6 million litres 2008 - 600 000 bottles each day (growing steadily with 3-4 million litres per year)
- Approximately 300 SKUs (flavours, 10 bottle sizes) - most bottles are 1 litre packed in cartons, 12 bottles in each




Warehouse operations:
- Pallets are automatically (un)loaded onto trucks using conveyors
- Large volume: AS/RS storage system
- Small volume: Manual picking
- Container shipments using slip-sheets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## Tetra Pak GTS: A warehouse for spare parts

Tetra Pak Global Technical Support AB (spare parts):
- 90+ full-time employees at the warehouse
- 200 000 storage locations
- 76 000 SKUs (possible to have 600 000 SKUs)
- 7 000 m²

Warehouse operations:
- Boxed items: conveyor band to a miniload and an AS/RS
- Shuttle system is feeding narrow aisle racks with palletized items
- Fast moving units: pallet pick area with regular racks
- Slow-moving SKUs: separate Paternoster
- Items from the mini load: 11 different pick-to-light stations
- Items from narrow aisle racks: 3 pallet pick stations
- Manual marrying of packages and pallets before shipment

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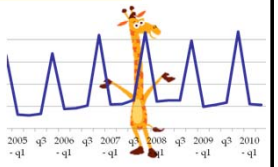
## Toys“R”Us: Facing the challenges of seasonal demand

Warehouse in McDonough, GA supporting 63 retail stores:
- 150-500 employees at warehouse (seasonal)
- 300 000 pallet locations, 7-high in bulk storage, 7 200 SKUs, 93 000 m2
- Peak season: approx. 400 % more arriving trucks, workers, shipments and conveyor load




Warehouse operations:
- Bulk storage in narrow-aisle racks (high rise lift trucks)
- Non-conveyable product is stored closest to shipping
- The fastest-moving cartons are picked to "belt"
- Product flows upward toward the cross-warehouse conveyor system.
- Conveyors merge into faster conveyors closer to shipping area
- A "shoe-sorter" pushes each carton onto the chute leading to its assigned trailer.

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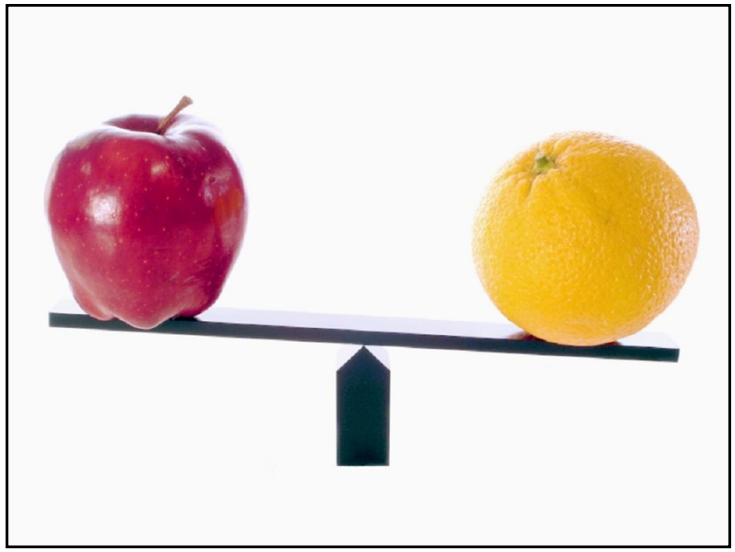

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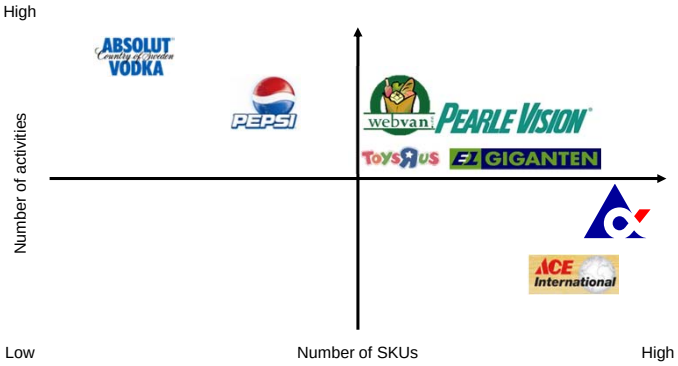
## Choosing among different KPIs: Number of activities vs. Number of SKUs

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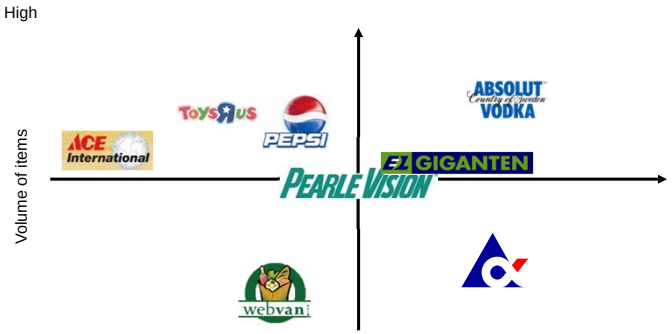
## Choosing among different KPIs: Volume of items vs. Cost of labor

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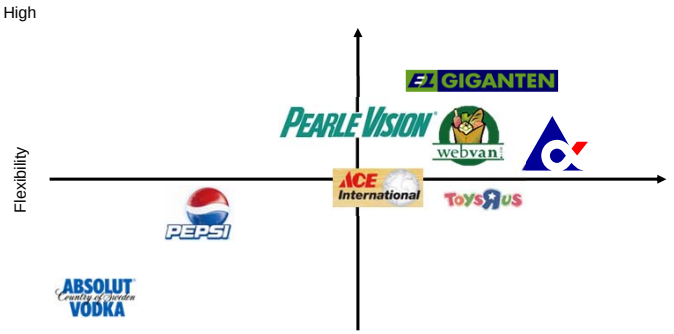
## Choosing among different KPIs: Flexibility vs. Demand volatility

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## Ratio-based benchmarking

- Collection of KPI's for three warehouses
  - KPIs scaled to lie within [0,1]
  - With 1 being the best possible
  - Which of these warehouses are performing "best"?

| | KPI1 | KPI2 | KPI3 |
|---|---|---|---|
| Absolut | 0.75 | 0.25 | 0.50 |
| Tetra Pak GTS | 0.50 | 0.75 | 0.25 |
| Toys"R"Us | 0.25 | 0.50 | 0.75 |

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## Ratio-based benchmarking

- Problems with simple, ratio-based performance indicators:
  - Represents a limited and therefore possibly misleading point of view
  - No wholly satisfactory model or structure to combine the measures of productivity into some integrated view
  - Sophisticated methods of aggregating KPIs result in paradoxical outcomes

| | KPI1 | KPI2 | KPI3 |
|---|---|---|---|
| Absolut | 0.75 | 0.25 | 0.50 |
| Tetra Pak GTS | 0.50 | 0.75 | 0.25 |
| Toys"R"Us | 0.25 | 0.50 | 0.75 |

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## Aggregate benchmarking

- In systems-based benchmarking, we take an aggregate point of view and consider, not single inputs or outputs, but entire portfolios of inputs and outputs.

| | Labor (hrs*10^3) | Capital ($M) | Annual pick-lines (M) |
|---|---|---|---|
| Absolut | 100 | 1.0 | 1.6 |
| Tetra Pak GTS | 110 | 1.1 | 2.2 |
| Toys"R"Us | 90 | 0.9 | 2.0 |

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## Aggregate benchmarking

- Consider the following three warehouses:
  - Which is the most efficient?
  - Scale the warehouses to the same output
  - Reveals inefficiencies of Absolut

| | Labor (hrs*10^3) | Capital ($M) | Annual pick-lines (M) |
|---|---|---|---|
| Absolut | 100 | 1.0 | 1.6 |
| Tetra Pak GTS | 110 | 1.1 | 2.2 |
| Toys"R"Us | 90 | 0.9 | 2.0 |

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## Data Envelopment Analysis

- Technique to study the efficiency of complex economic systems
- Handles multiple inputs and multiple outputs
- Allows for multi-dimensional comparison with a community of other warehouse

| | Labor (hrs*10^3) | Capital ($M) | Annual pick-lines (M) |
|---|---|---|---|
| Absolut | 100 | 1.0 | 1.6 |
| Tetra Pak GTS | 110 | 1.1 | 2.2 |
| Toys“R”Us | 90 | 0.9 | 2.0 |

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## Data Envelopment Analysis

- We can synthesize a benchmark warehouse that can be compared with any warehouse and reveal weaknesses.
- Indicates an efficiency score in the range [0,1]
- Evaluation is done by linear programming

| | Labor (hrs*10^3) | Capital ($M) | Annual pick-lines (M) |
|---|---|---|---|
| Absolut | 100 | 1.0 | 1.6 |
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| Toys“R”Us | 90 | 0.9 | 2.0 |

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## Data Envelopment Analysis

- Computes the relative efficiency of warehouse A in comparison to a collection of i = 1, … , n other warehouses
- Using a simple model with two inputs (Labour and Capital) and one output (Annual pick-lines)
- Suppose that warehouse A uses CA capital and LA labor to produce output OA.
- Similarly, warehouse i uses Ci capital and Li labor to produce output Oi.

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## Data Envelopment Analysis

- The efficiency score of warehouse A may be determined by solving the following linear program:

$$\min \theta \text{ subject to}$$

$$\sum_{i=1}^{n} O_i \lambda_i \geq O_A$$

$$\sum_{i=1}^{n} C_i \lambda_i \geq C_A \theta$$

$$\sum_{i=1}^{n} L_i \lambda_i \geq L_A \theta$$

$$\lambda_i \geq 0$$

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