Värdet av unik identifiering på förpackningar i svensk tillverkningsindustri

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Agenda

What is the value of uniquely labelled packaging?

Purpose

- Examines the use of unique identities applied to packages and load carriers in Swedish manufacturing industries
  - RFID technology, bar codes and ”human-readable” labels
- Investigate drivers behind the adoption, as well as the perceived improvements and visions for the coming 2-5 years
- Covers the use of different methods for reading the identities, locations of identification in the supply chain and how the acquired information is utilised

Respondents

- Directed at logistics managers in manufacturing companies in Sweden
- A systematic, stratified sample was used to avoid disequilibrium among the groups:
  - The companies were divided into three groups according to size; small, medium-sized, and large companies
  - All large companies were included in the sample
  - 40% of the medium-sized companies were systematically selected
  - Every one small company in four was systematically selected

Count

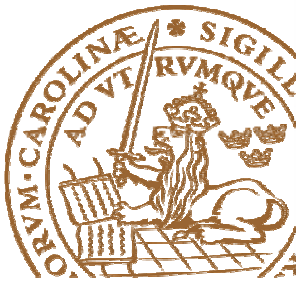
		No. of employees					
		100 - 199	200 - 499	Above 499	Responses	Sample	Population
Industry	Manufacture of chemicals and chemical products	3	9	5	17	32	83
	Manufacture of electrical equipment, computer, electronic and optical products	0	1	6	7	17	40
	Manufacture of fabricated metal products	8	17	10	35	82	202
	Manufacture of food products and beverages	4	4	14	22	43	83
	Manufacture of furniture and other manufacturing	2	3	2	7	14	37
	Manufacture of machinery and equipment	5	6	14	25	55	117
	Manufacture of motor vehicles, trailers, semi-trailers and other transport equipment	2	4	7	13	22	50
	Manufacture of pulp, paper and paper products	4	5	8	17	25	52
	Manufacture of rubber and plastic products	4	3	2	9	20	51
Responses		32	52	68	152	310	715
Sample		91	86	133	310		
Population		368	214	133	715		

Companies using unique identities

- It seems to be more common for large companies to use unique identities, compared to smaller ones
- The differences between the groups are statistically significant with 95% confidence

Count

		Unique labelling		
		Yes	No	Total
Company size (no. of employees)	Small (100 - 199)	16	16	32
	Medium-sized (200 - 499)	29	23	52
	Large (above 499)	50	18	68
Total		95	57	152



Packaging level identifiable and identification method

Packaging level uniquely identifiable	Unique identities
Primary packaging	71%
Secondary packaging	67%
Load carrier	66%

32% has unique identification on all three packaging levels

Identification method	Unique identities
“Human-readable” labels	56%
Bar codes	84%
RFID technology	7%

Data collection

- The data collection took place in February and March 2008
- The overall response rate is 49.0%
- The reason cited most often for non-response was lack of time, followed by company policy
- No statistically significant differences were found, which indicates the absence of non-response bias (Armstrong and Overton, 1977).

The survey instrument

- 14 question areas with 3 to 19 questions per area
- Type and registration location of unique identities on a nominal scale
- Five-point Likert scale covering:
  - Demographic data
  - Drivers
  - Results obtained
  - Visions
  - Information sharing
- From *strongly disagree* to *strongly agree*, with a neutral alternative in the middle

1. I vilken omfattning är produkter, gods och lastbärare märkta med unika identiteter?

Vilka ”förpackningsnivåer” är märkta med unika identiteter?	Märkning? Ja	Märkning? Nej	*Om ja*, hur är märkningen utförd? Siffror/bokstavs kombination	Streckkod	RFID
Enskild produkt eller dess primärförpackning	☐	☐	☐	☐	☐
Transportförpackning/sekundärförpackning	☐	☐	☐	☐	☐
Lastbärare (pall, container, etc.)	☐	☐	☐	☐	☐

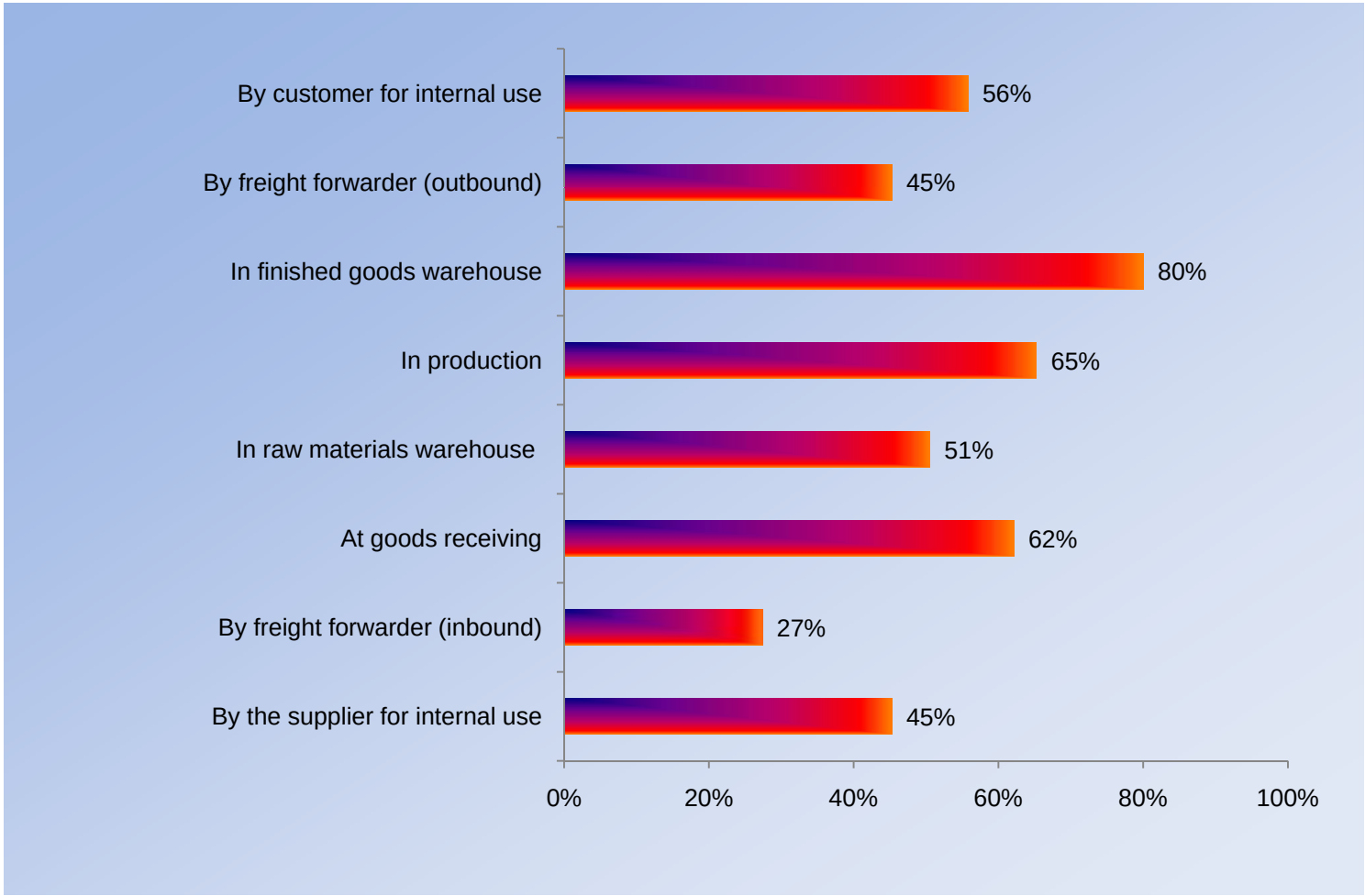
2. Var och på vilket sätt läses och registreras märkningen med unika identiteterna?

Var i logistikkedjan läses och registreras märkningen med unika identiteter?	Läses och registreras märkningen? Ja	Läses och registreras märkningen? Nej	*Om ja*, på vilket sätt läses märkningen? Manuellt	Streckkod	RFID	På vilken ”förpackningsnivå” läses märkningen? Enskild produkt/ primärförpackning	Transportförpackning/ sekundärförpackning	Lastbärare
Av leverantör för eget bruk	☐	☐	☐	☐	☐	☐	☐	☐
Av transportör i samband med inleveranser	☐	☐	☐	☐	☐	☐	☐	☐
I samband med ankomstrapportering	☐	☐	☐	☐	☐	☐	☐	☐
Vid in/utleverans råvarulager	☐	☐	☐	☐	☐	☐	☐	☐
Internt i produktionen	☐	☐	☐	☐	☐	☐	☐	☐
Vid in/utleverans färdigvarulager	☐	☐	☐	☐	☐	☐	☐	☐
Av transportör i samband med leverans till kund	☐	☐	☐	☐	☐	☐	☐	☐
Av kund för eget bruk	☐	☐	☐	☐	☐	☐	☐	☐

3. Vilka drivkrafter låg bakom införandet av märkning med unika identiteter?

Vilka drivkrafter låg bakom införandet av ert system för märkning med unika identiteter?	Stämmer inte alls	Stämmer ganska dåligt	Varken bra eller dåligt	Stämmer ganska bra	Stämmer helt och hållet
Förbättrad lagerstyrning	☐	☐	☐	☐	☐
Förbättrad leveransservice	☐	☐	☐	☐	☐
Förbättrad spårbarhet (track & trace)	☐	☐	☐	☐	☐
Förbättrad styrning av materialflöde *internt*	☐	☐	☐	☐	☐

Registration structure of uniquely labelled products and load carriers



Improvements obtained

	N	Median	Mean	Std. Deviation
Reduced inventory levels	90	3	2,66	1,291
Improved inventory turnover	90	3	2,68	1,305
Fewer inventory points	89	2	2,35	1,235
Less wastage	91	3	2,52	1,336
Less obsolescence	92	3	2,61	1,358
Reduced inventory space	91	3	2,88	1,373
Improved service levels	89	4	3,26	1,310
Reduced lead time	89	3	2,97	1,394
Reduced transition time	89	3	2,44	1,167
Improved capacity utilisation	90	3	2,37	1,185
Reduced labour costs	91	3	2,65	1,268
Elimination of duplication of work	91	3	3,10	1,309
Improved handling of product returns	91	3	2,86	1,261
Reduced delivery costs	91	3	2,68	1,163
Reduced delivery errors	91	4	3,62	1,162
Improved control of internal material flows	89	3	3,03	1,394
Co-ordination of material flows to customers	89	3	2,83	1,281
Co-ordination of material flows from suppliers	90	3	2,47	1,173
Improved information quality	91	4	3,58	1,292

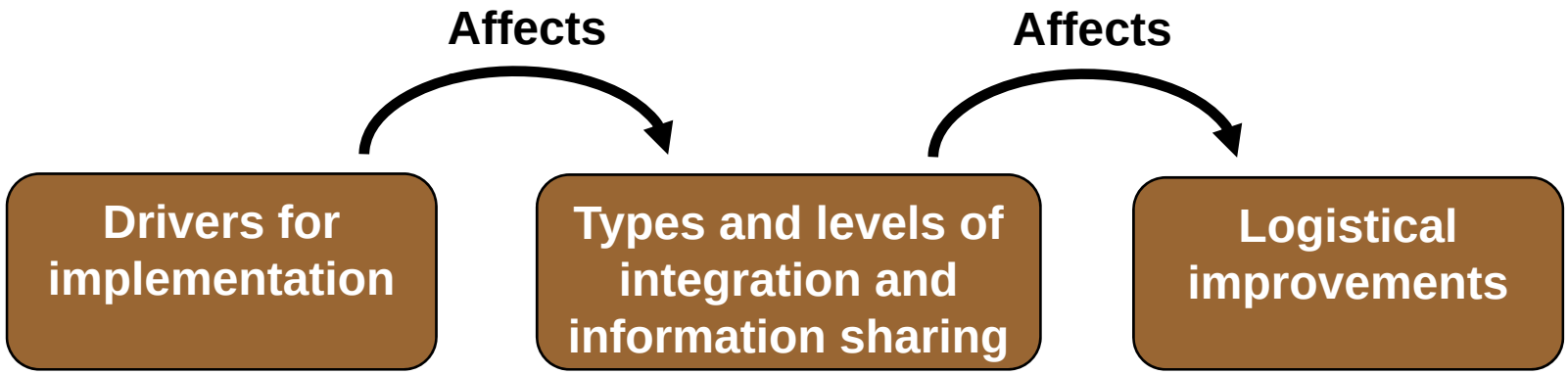
Impact of identification technology and identification points on logistics performance

- Auto-ID labelled goods have a significant positive influence on logistics performance compared to other types of labelling. **NO SUPPORT!**
- RFID-labelled goods have significant positive influence on logistics performance compared to other types of labelling. **SOME SUPPORT!**
- The number of identification points along the supply chain has significant positive influence on logistics performance. **SUPPORT!**

Impact of information sharing of tracking data on logistics performance

- The frequency of information sharing of tracking data has a significant positive influence on logistics performance. **SUPPORT!**
- The scope of information sharing has a significant positive influence on logistics performance. **SUPPORT!**
- Information sharing with customers is positively correlated to logistics performance. **SUPPORT!**
- Information sharing with suppliers is positively correlated to logistics performance. **SUPPORT!**

Links identified for drivers for implementation of unique identities



- Identified four distinct clusters with similar drivers for implementation. Based on cluster affiliation, different levels of integration and improvements have been obtained.

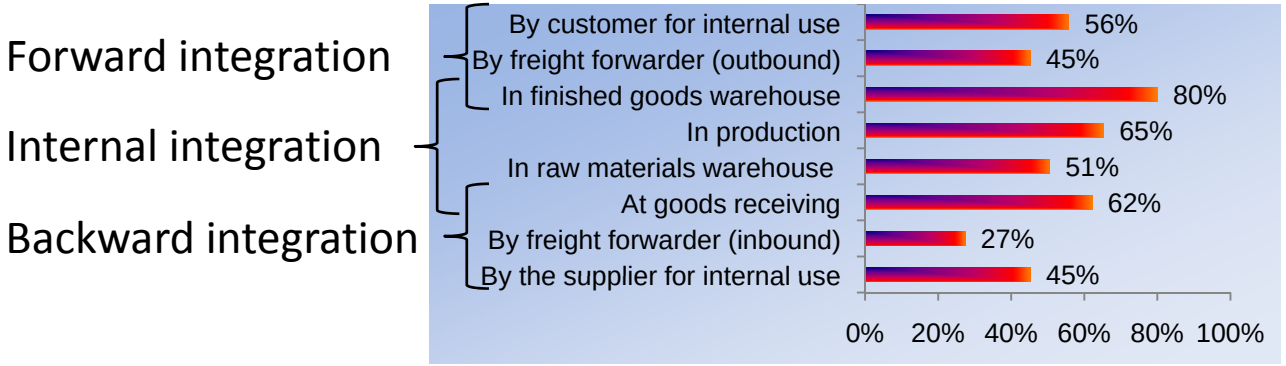
Cluster analysis

- To investigate whether the data include distinct groups with different drivers a cluster analysis is conducted

- Four distinct clusters are identified:
  1: Co-ordination of material flows
  2: Replanning and traceability
  3: External requirements
  4: Reduce counterfeiting or theft

Operationalisation of supply chain integration

- Assess the number of places in the supply chain where the unique identity is read and registered
- The notion is that the more places the same identity is used, the more integrated the supply chain



Level of integration for different clusters

Cluster	Backward integration	Internal integration	Forward integration
1: Co-ordination of material flows	High (3)	High (3)	High (3)
2: Replanning and traceability	Low (1)	Medium (2)	Medium (2)
3: External requirements	Low (1)	Medium (2)	Medium (2)
4: Reduce counterfeiting or theft	High (3)	High (3)	High (3)

Levels of integration
0: No integration
1: Low level of integration
2: Medium level of integration
3: High level of integration
4: Full integration

- A one-way ANOVA test shows that companies in the different clusters have obtained different levels of integration
- Multiple comparisons, using Tukey's honestly significant difference test, confirm significant differences between the clusters

Factor analysis of results variables

	Factor loading	Eigenvalue	% of variance	Cumulative %	Communality
Factor 1: Inventory management		9.40	49.47	49.47	
Improved inventory turnover	.852				.917
Reduced inventory levels	.847				.921
Reduced lead time	.699				.768
Fewer inventory points	.633				.772
Reduced inventory space	.608				.757
Improved service levels	.580				.625
Factor 2: Productivity		1.55	8.18	57.66	
Improved capacity utilisation	.830				.886
Reduced transition time	.788				.851
Improved control of internal material flow	.692				.767
Factor 3: Delivery quality		1.20	6.31	63.97	
Reduced delivery errors	.795				.747
Reduced delivery costs	.700				.683
Improved information quality	.687				.749
Factor 4: Co-ordination with customers and suppliers		1.08	5.68	69.65	
Co-ordination of material flows to customers	.793				.785
Co-ordination of material flows from suppliers	.677				.736
Improved handling of product returns	.625				.642
Factor 5: Inventory wastage and obsolescence		.96	5.05	74.70	
Less wastage	.794				.812
Less obsolescence	.781				.815
Factor 6: Labour costs		.68	3.59	78.29	
Reduced labour costs	.745				.808
Elimination of duplication of work	.731				.834

Extraction method: Principal component analysis.
Rotation method: Varimax with Kaiser normalisation.

Improvements for different clusters of companies

1. Co-ordinating material flows (cluster 1)
   Obtained more improvements in inventory management, delivery quality and productivity than the other companies

2. Companies aiming at improving replanning and traceability (cluster 2)
   A weak indication of improved delivery quality, but the companies in this cluster exhibit large variations regarding improvements

3. Companies with external requirements for implementing unique identities (cluster 3)
   Obtained the least number of improvements

4. Companies aiming at reducing counterfeiting or theft (cluster 4)
   Obtained the second highest number of improvements in inventory management, delivery quality and productivity

Frequency of information sharing

Cluster	Frequency of information sharing
1: Co-ordination of material flows	Daily
2: Replanning and traceability	Weekly
3: External requirements	In exceptional cases
4: Reduce counterfeiting or theft	Twice per month

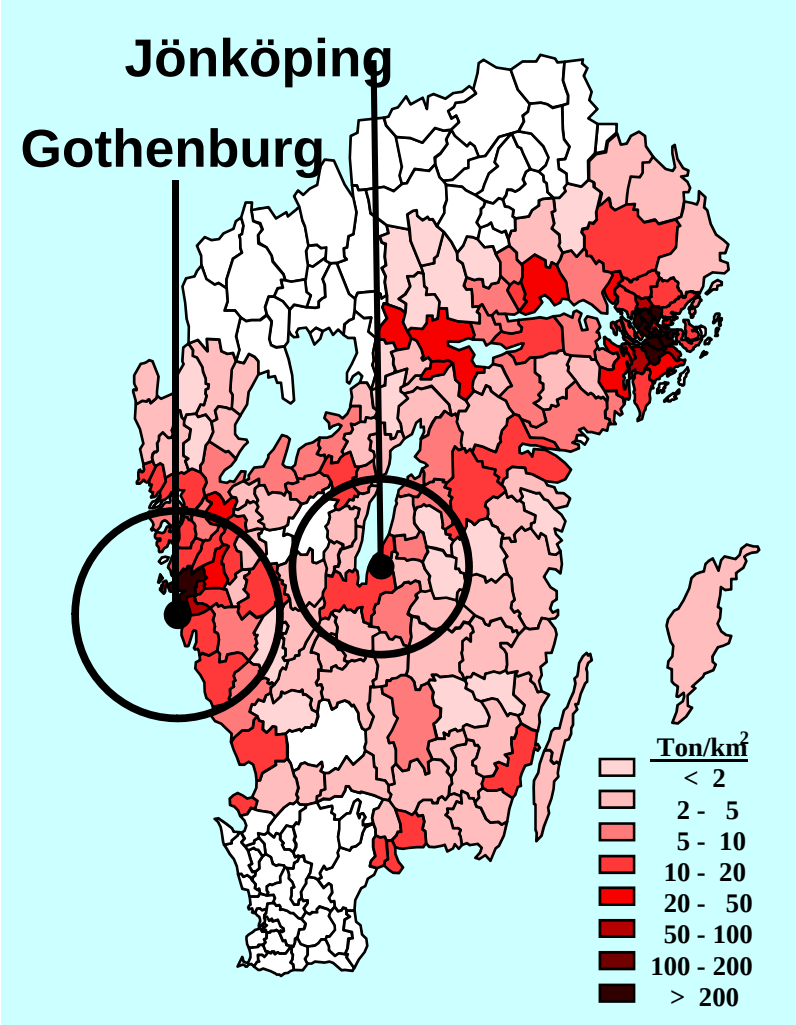
Conclusions

- Auto-ID labelled goods do not, in general, perform better than other types of labelling. Potential explanations:
  - Elementary analysis tools
  - Data utilisation may be more important
  - Different technologies in the concept of Auto-ID
- Some evidence that RFID-labelled goods perform better than the other identification technologies do
- Utilisation of tracking data more important than choice of identification technology
- Best-in-class firms:
  - Extensive sharing of tracking data upstream and downstream both in terms of frequency and scope
  - Several identification points in the supply chain
  - The more the integration and information sharing the respondents report, the more the improvements they state that they have obtained
- Organisational motivation (drivers) for implementing unique identities affects improvements obtained

Visions

- In the coming 2-5 years from 2008, the companies in the study expect to secure more improvements in unique identities
- Particularly, they aim to focus on backward integration
- However, to succeed in obtaining more improvements, the companies need to increase their level of information sharing with suppliers and customers

Arla Foods



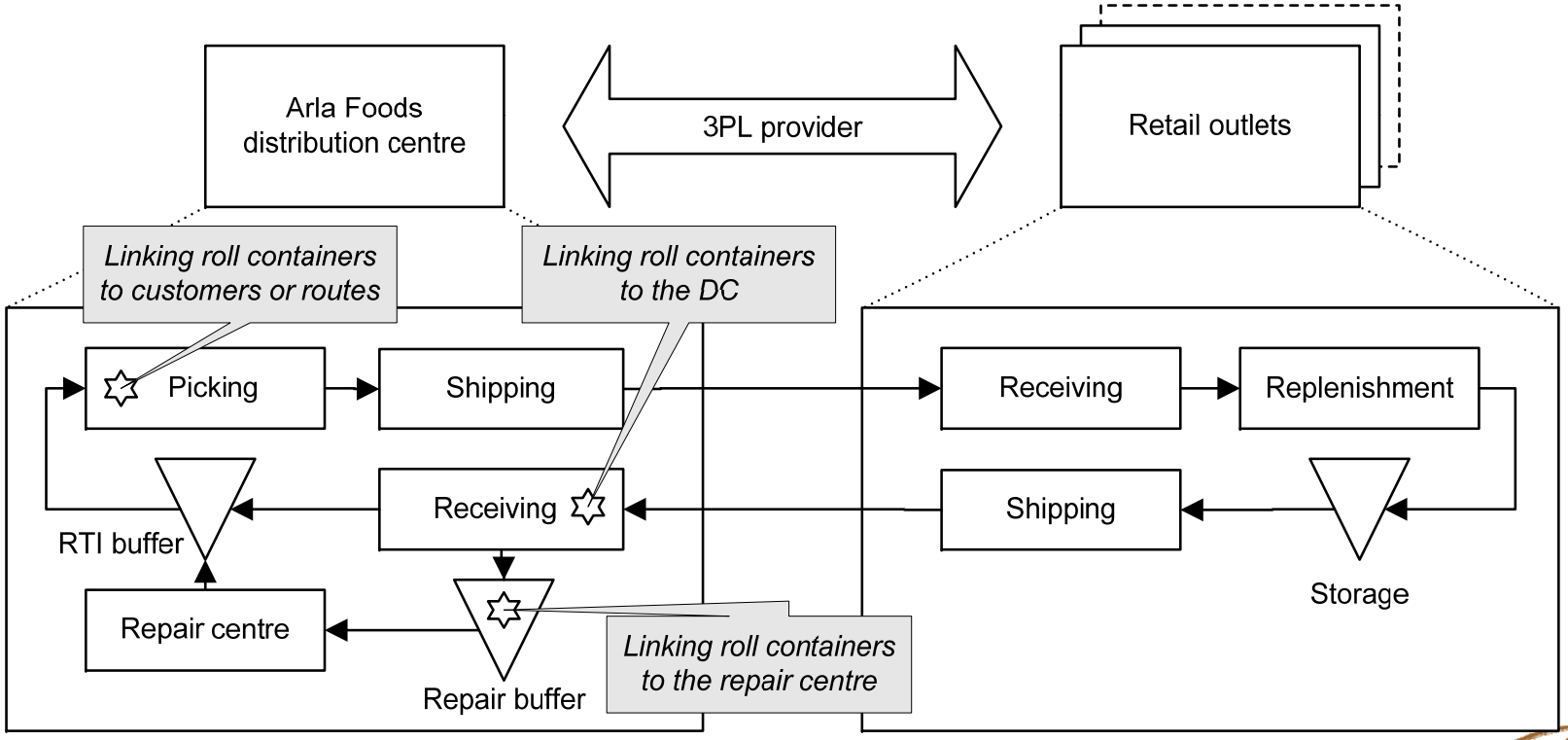
Logistics facts

- Direct distribution to 14000 delivery points
- Customer lead-time between 4-24 hours
- DCs operate 24/7
- >120’000 roll containers

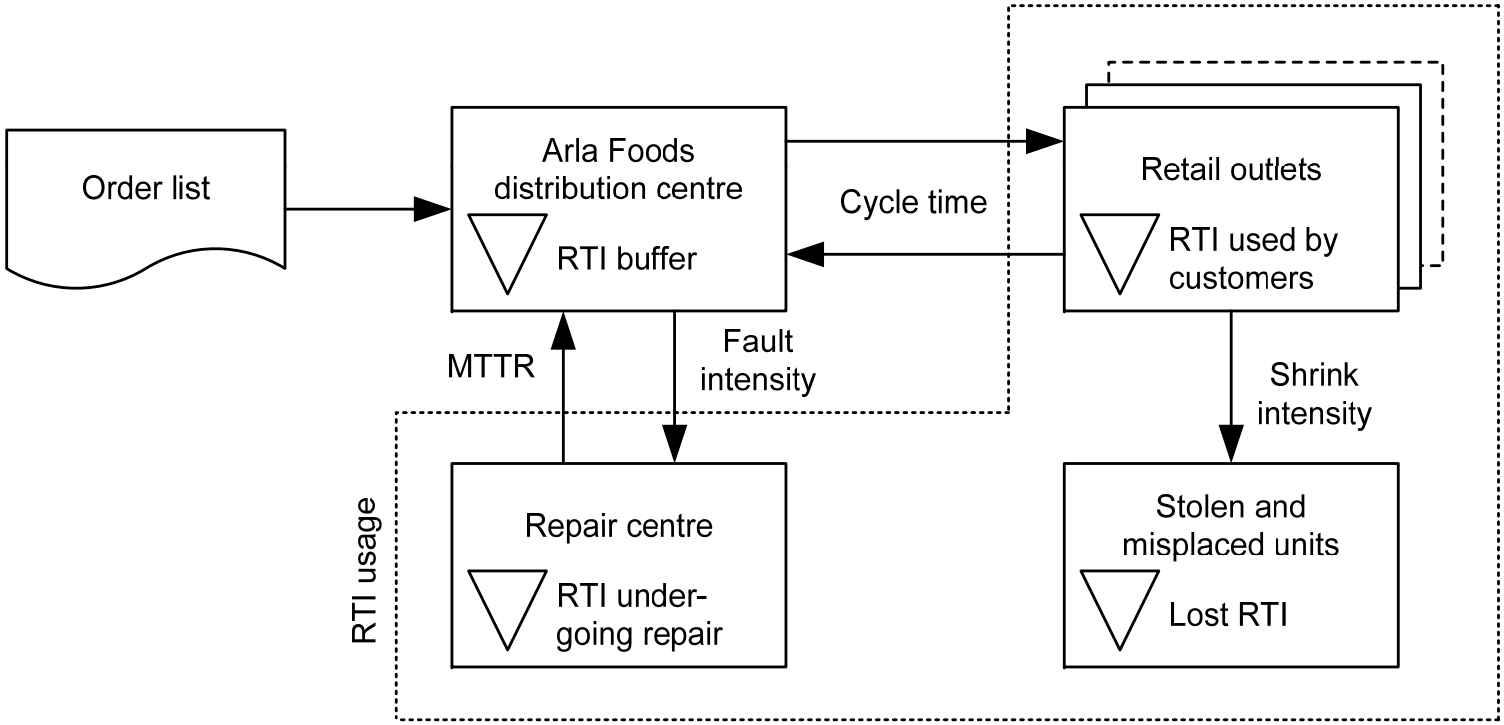

Klämrisk


Klämrisk

Rotation of roll containers



Simulation model



Based on actual tracking data including more than 340’000 transactions over 8 months time

Scenarios

A. Expected
How Arla Foods anticipated the system to work prior to introducing the new roll container and the tracking system

B. Actual
How the Arla Foods system actually works based on the collected data from the tracking system

C. Potential – Asset visibility
How the Arla Foods system could work if asset visibility is accompanied by proper management actions

Investment costs

		Scenarios		
		A	**B**	**C**
Investment costs	Roll containers	348,000	348,000	149,400
	Tracking system*	0	18,750	18,750
Total investments		348,000	366,750	168,150

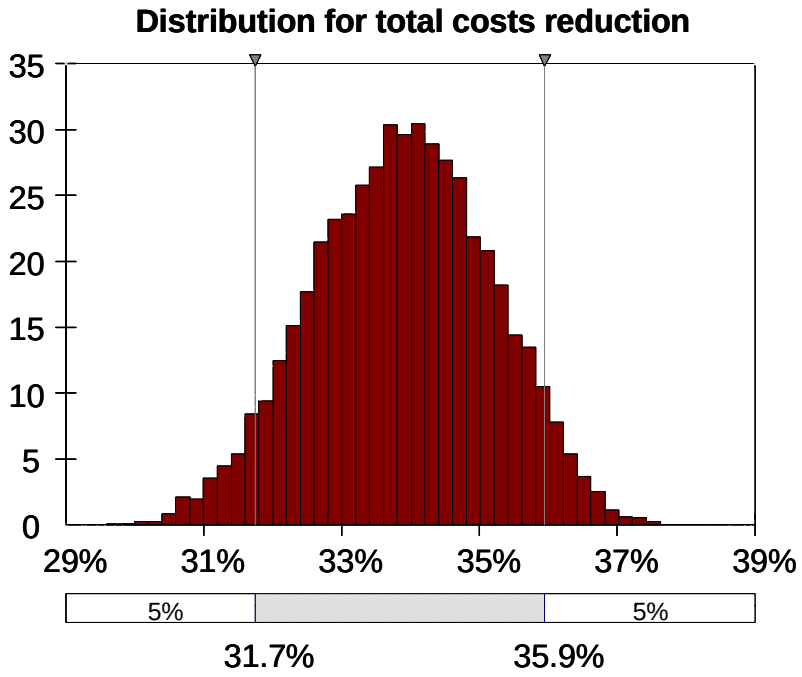
52% reduction in investments

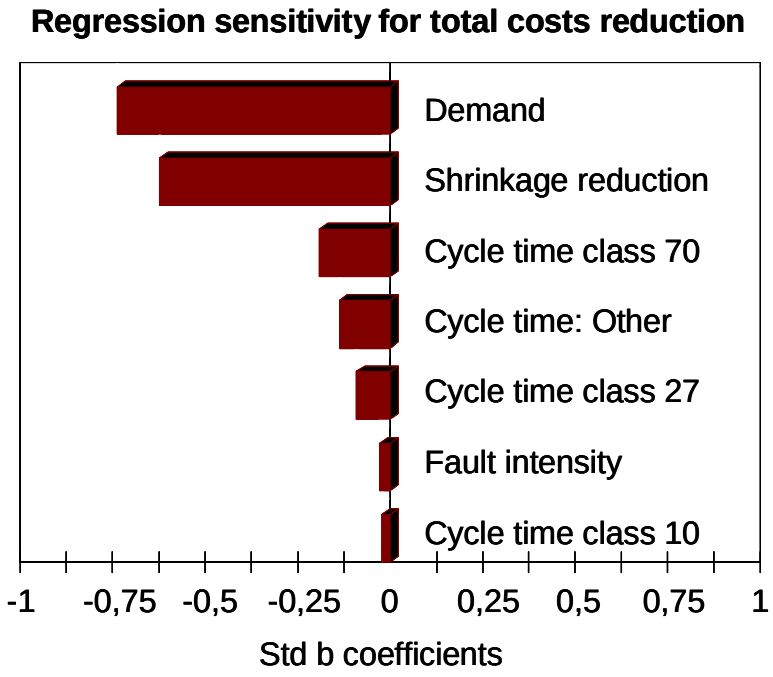
Total costs

		Scenarios		
		A	**B**	**C**
Operating costs	Replacement	69,600	51,504	17,784
	Repair and maintenance	7,371	7,371	7,371
	Warehousing and handling	89,651	89,651	89,651
	Tracking system*	0	2,500	2,500
	Depreciation	55,680	59,299	26,323
Total		222,301	210,324	143,628
Non-operating costs	Cost of capital	34,800	36,675	16,815
Total costs		257,101	246,999	160,443

34% total costs reduction

Risk assessment





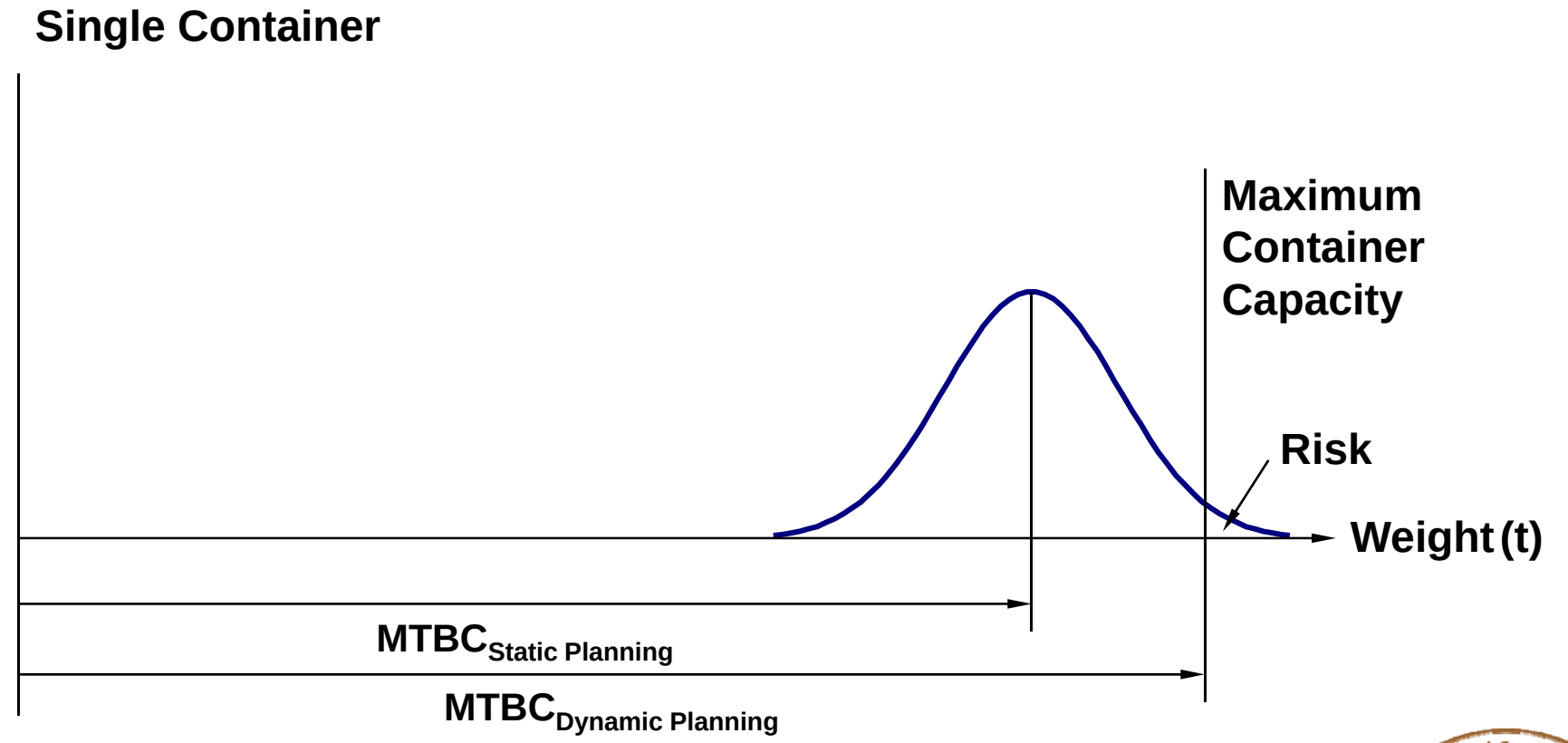
Conclusions

- Managerial insights
- Fleet sizing
- Cost reductions
- Risk identification and assessment

The ”intelligent” recycling container

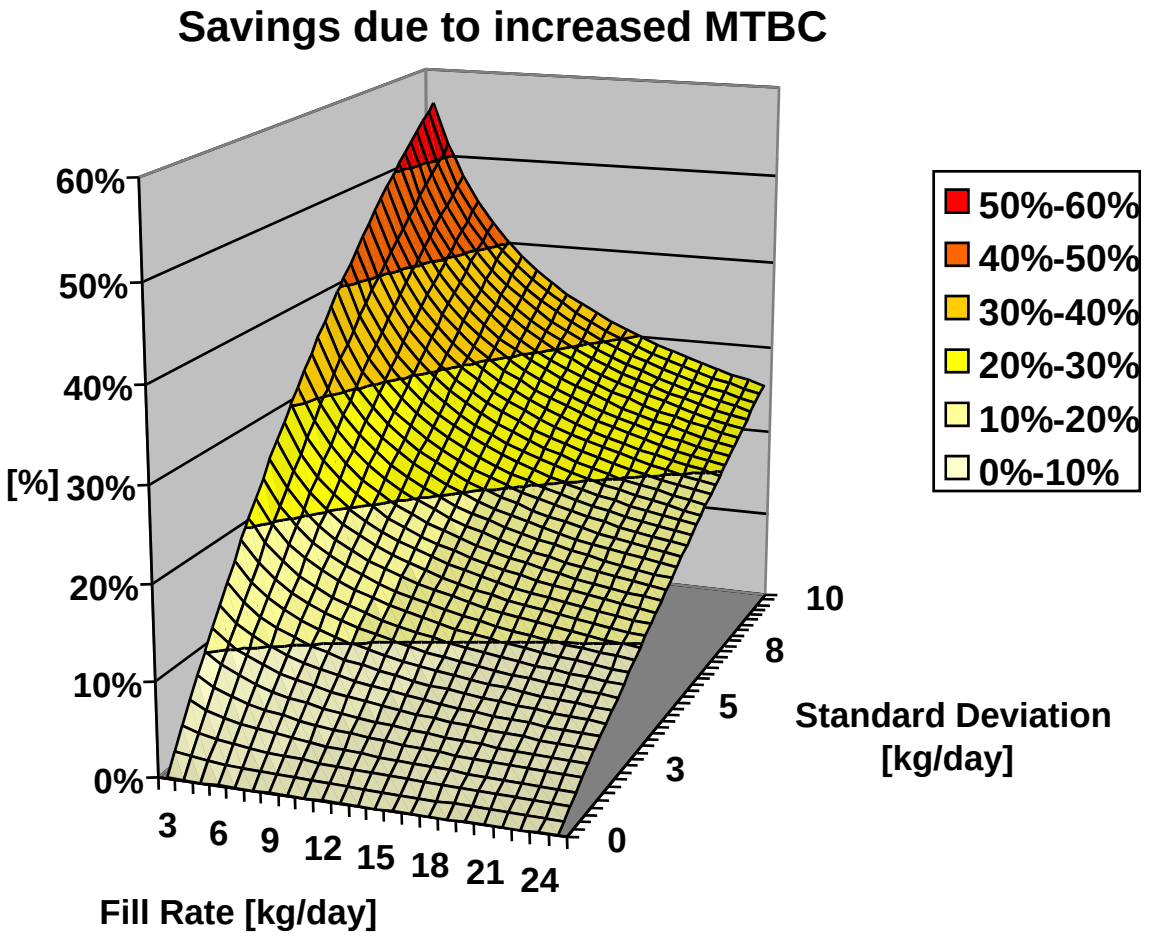
- Fitted with a level sensor and telecommunication equipment
- 3’300 units in operation
- 71 recycling points in Malmö
- Nine recycling points in the inner city with 16 “intelligent” containers for carton and corrugated board

Theoretical model

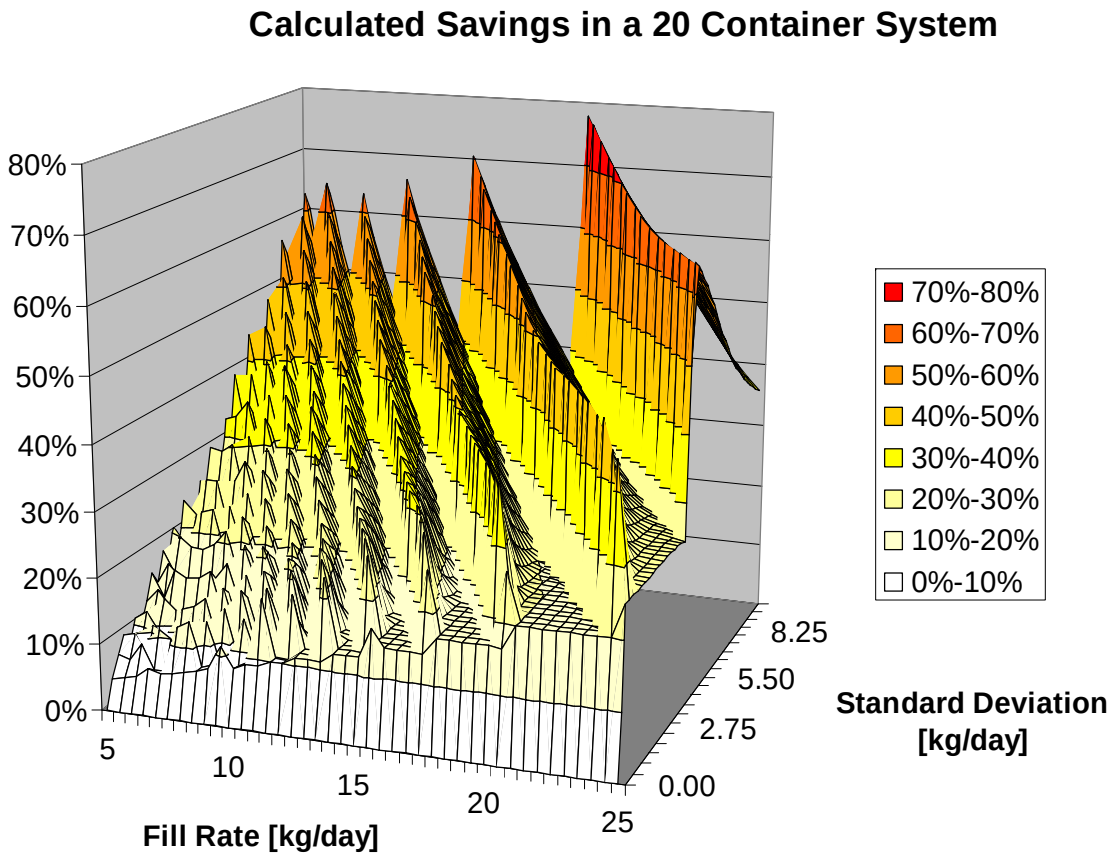


MTBC = Mean Time Between Collection
Increased MTBC ➡ Potential for Savings

Theoretical model (single container)

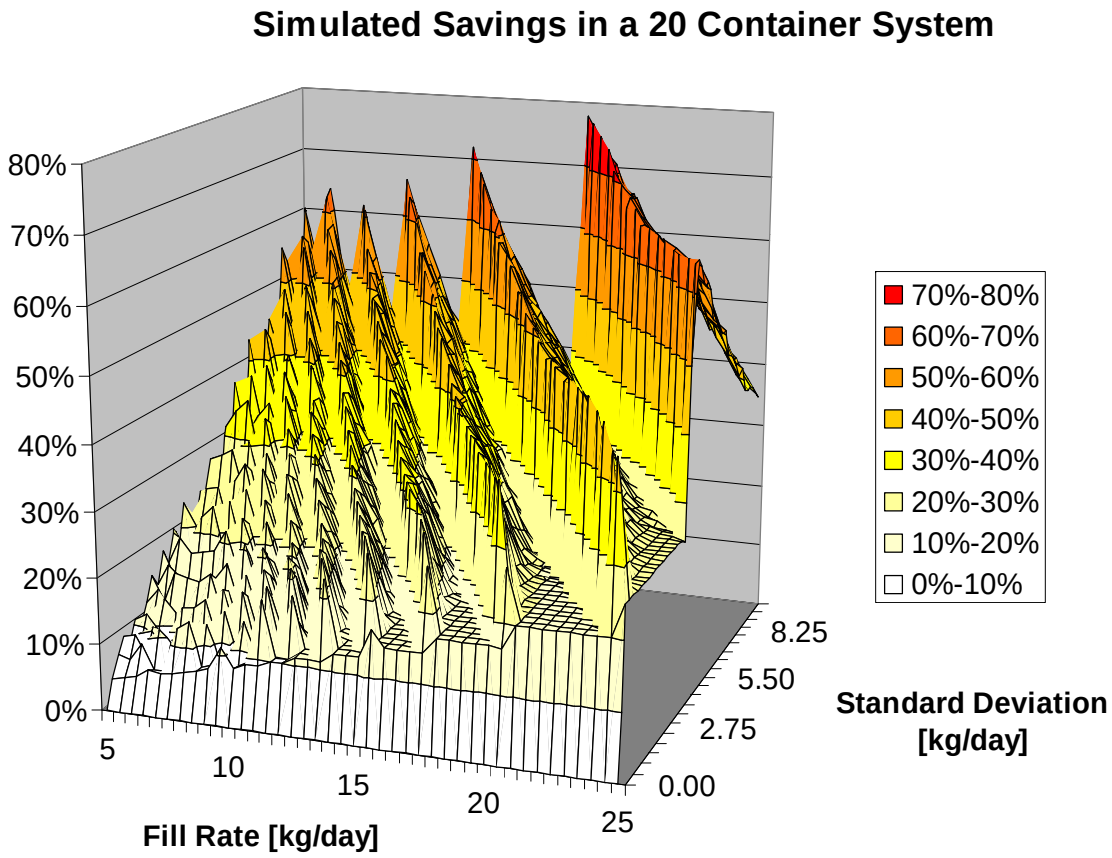


Theoretical time-discrete model (20 containers)



Model is made time-discrete by allowing collection during normal working hours on weekdays only

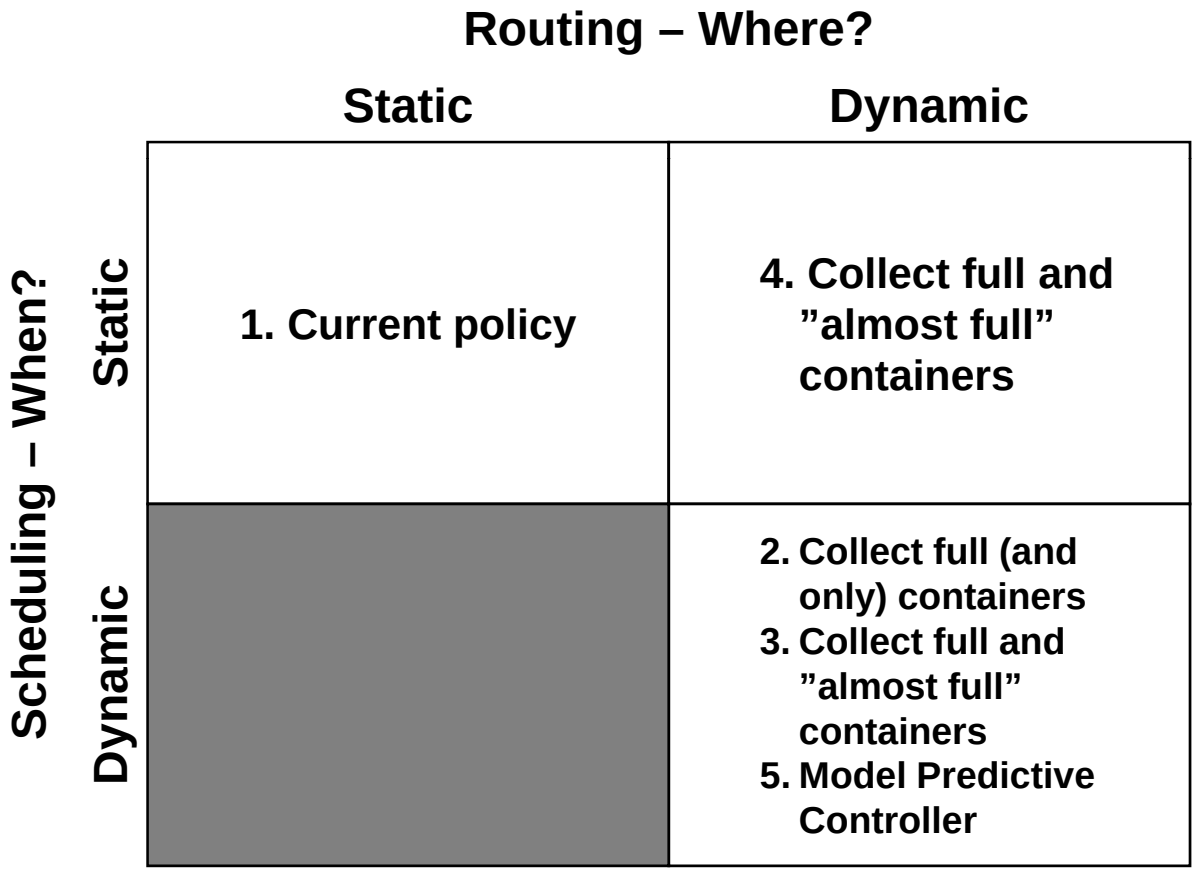
Simulated time-discrete model (20 containers)



MAPE (Mean Average Percent Error) between calculated and simulated savings less than 0.14%

➡ **Simulation model validated**

Planning policies



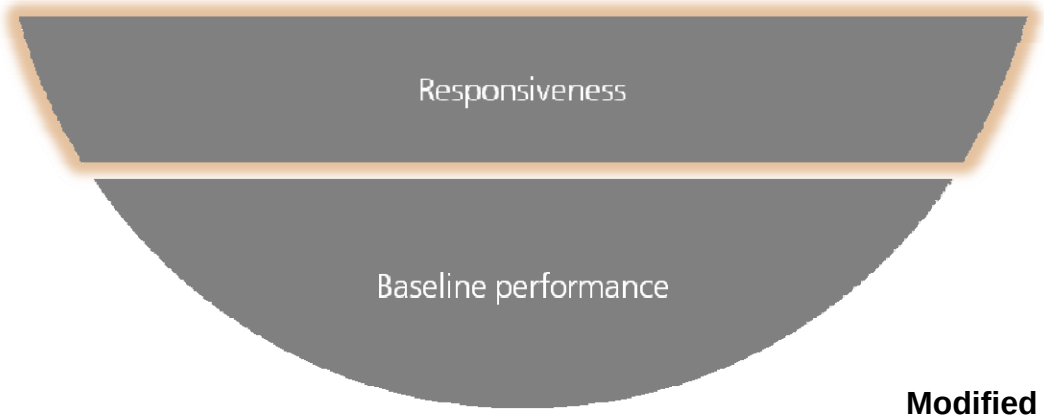
Conclusions

- Dynamic scheduling and routing has the highest potential to decrease cost at small and irregular demand
- The basic dynamic scheduling and routing policy is the optimal solution for large and dense systems. However, there are no benefits for small or distributed systems
- “Smarter” dynamic policies and mixed policies increase the benefits for smaller systems
- Theoretical and simulation model results are coherent and consistent with experiences from practitioners

Framework

Modified from Ketzenberg *et al.*, 2007.

Framework



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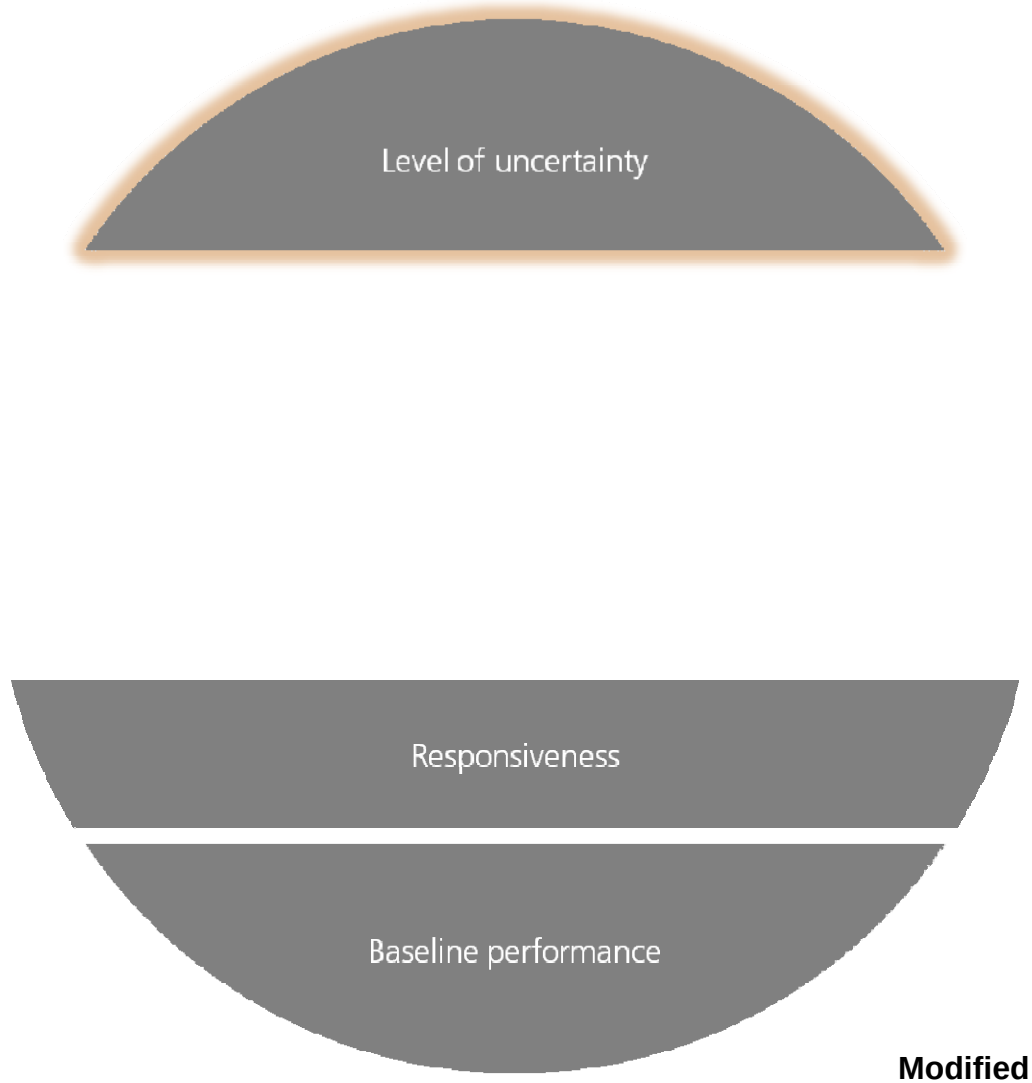

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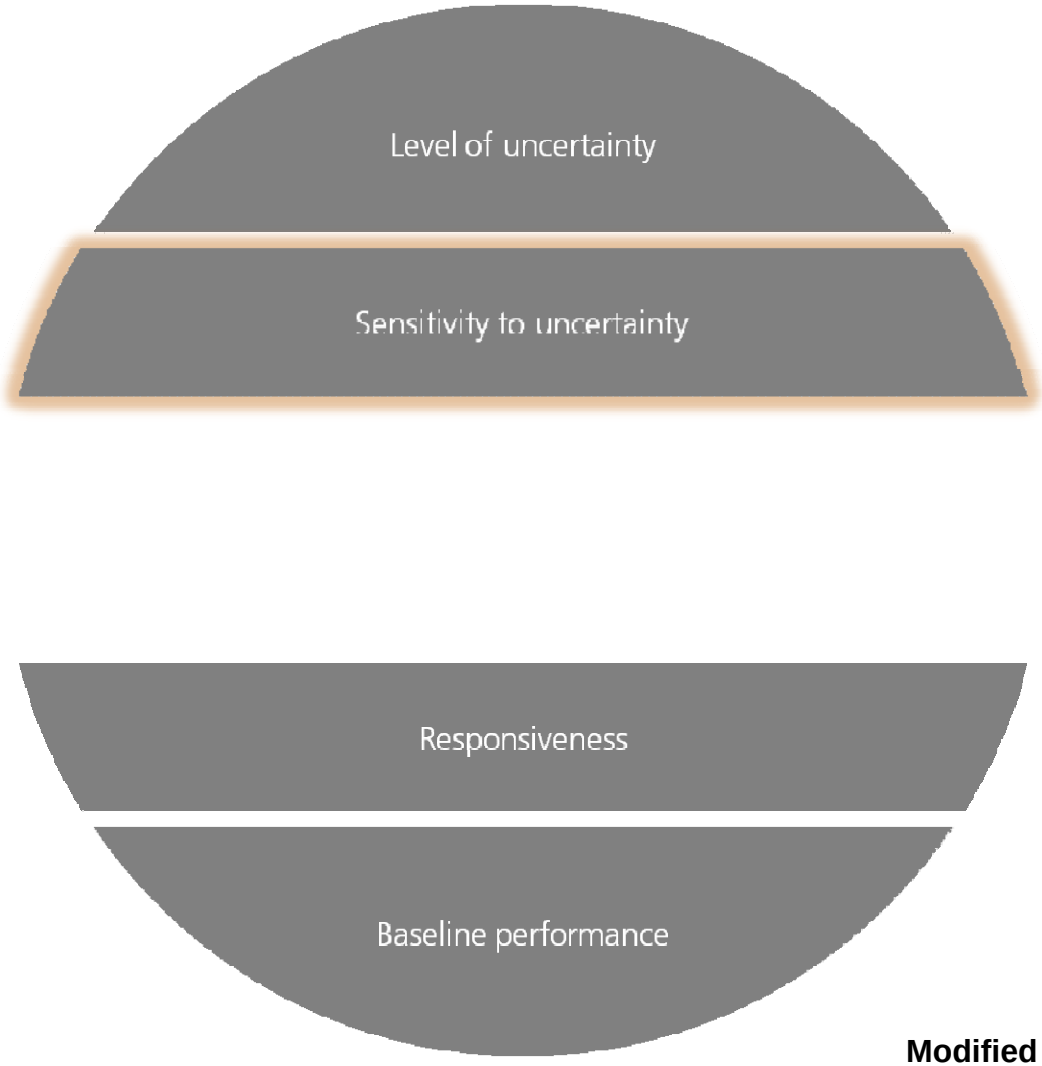

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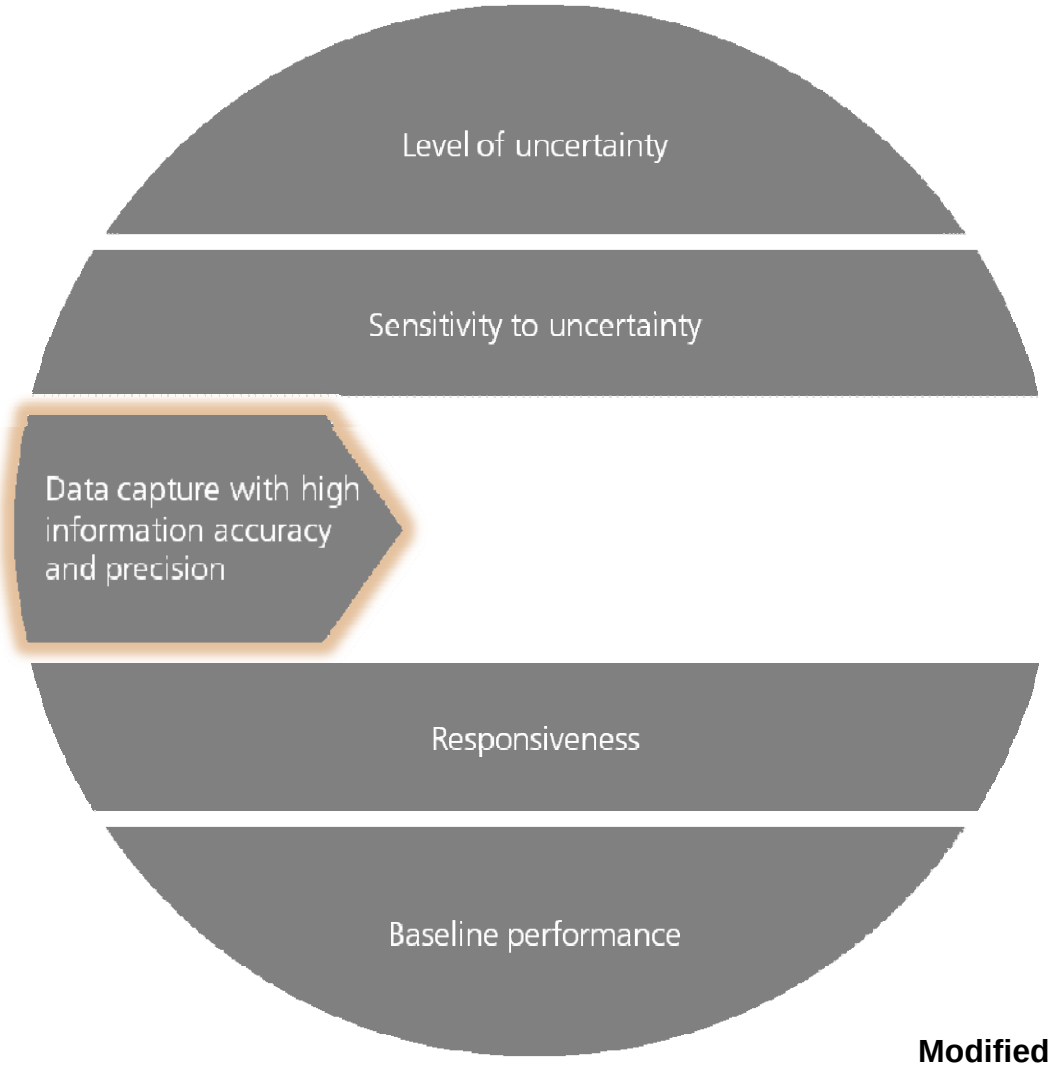

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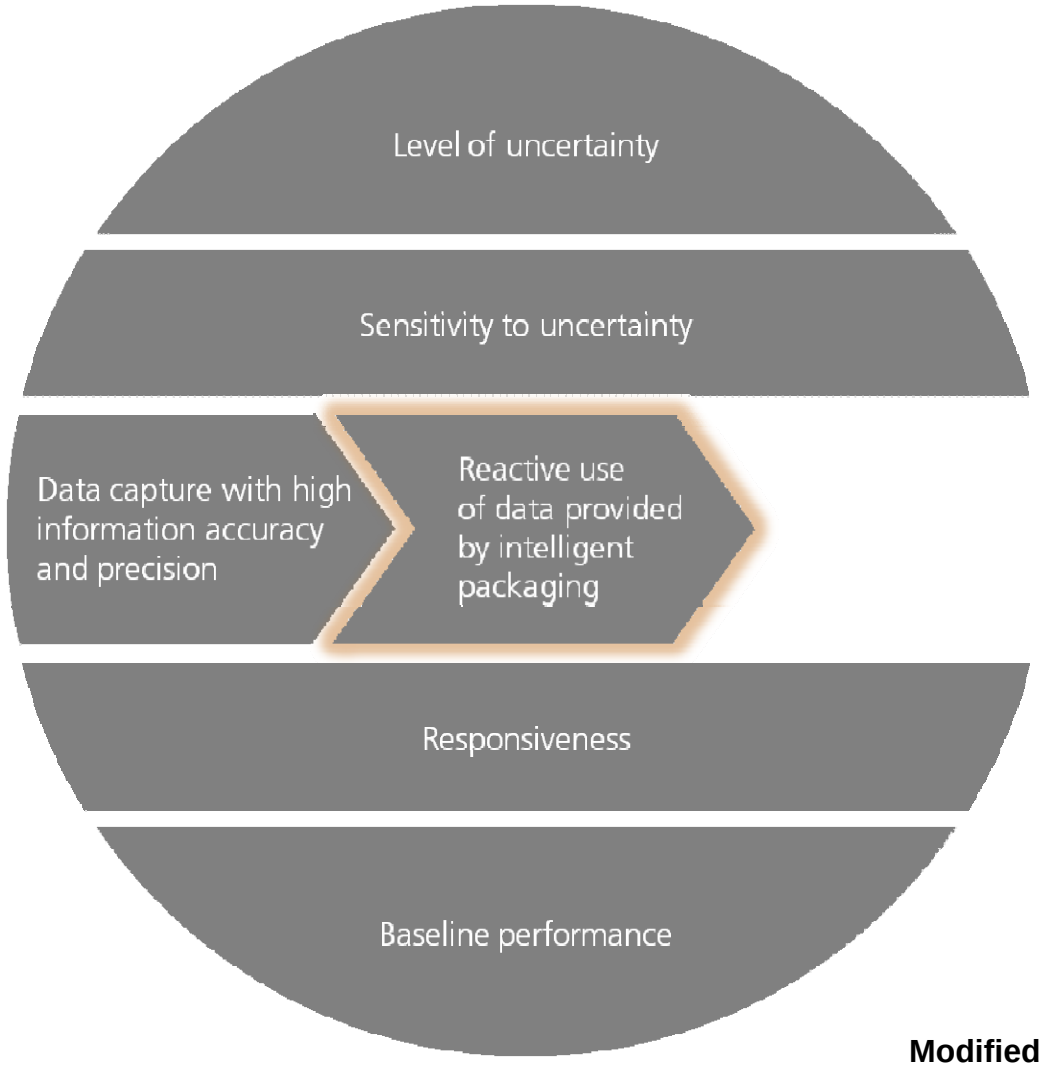

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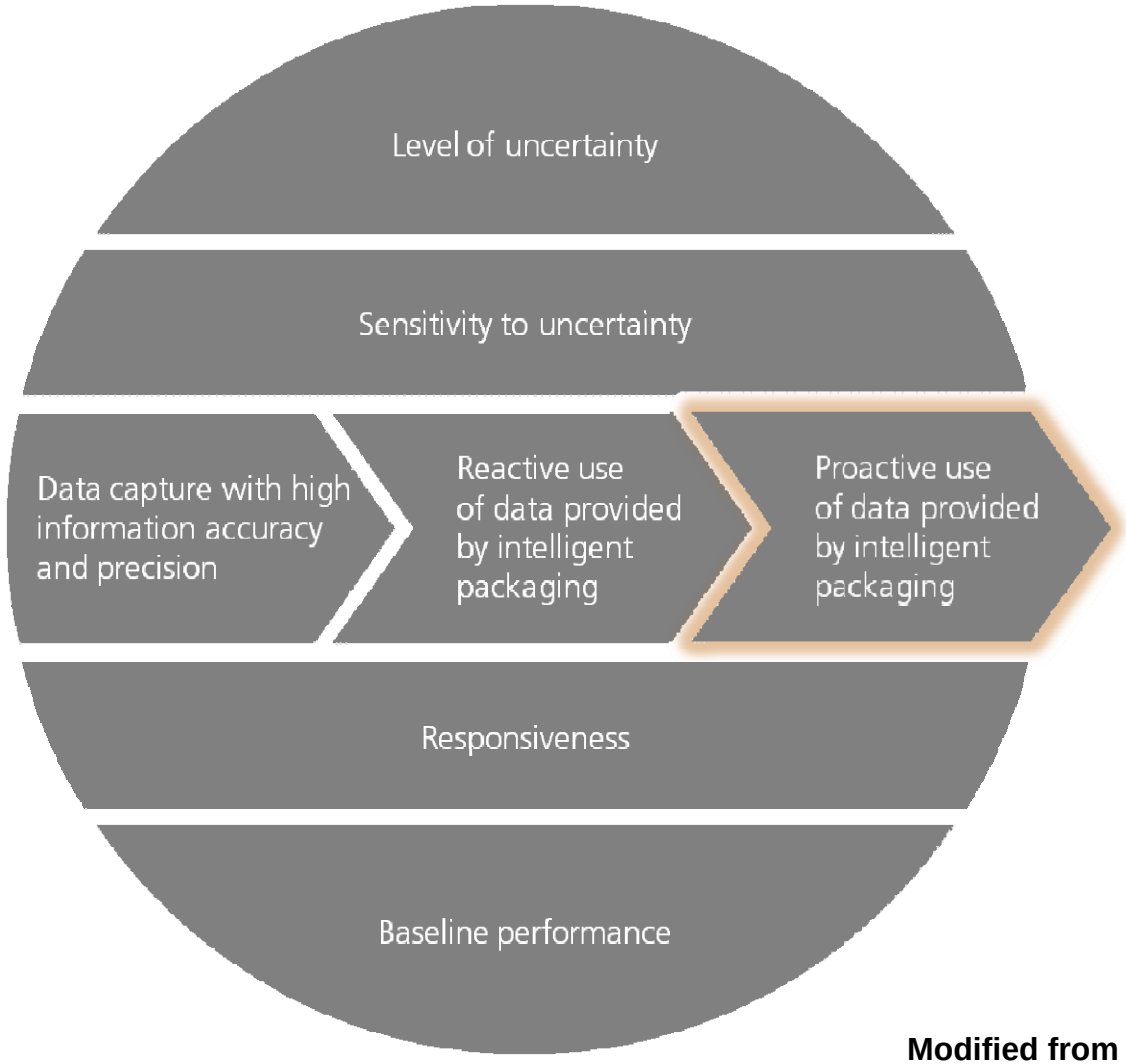

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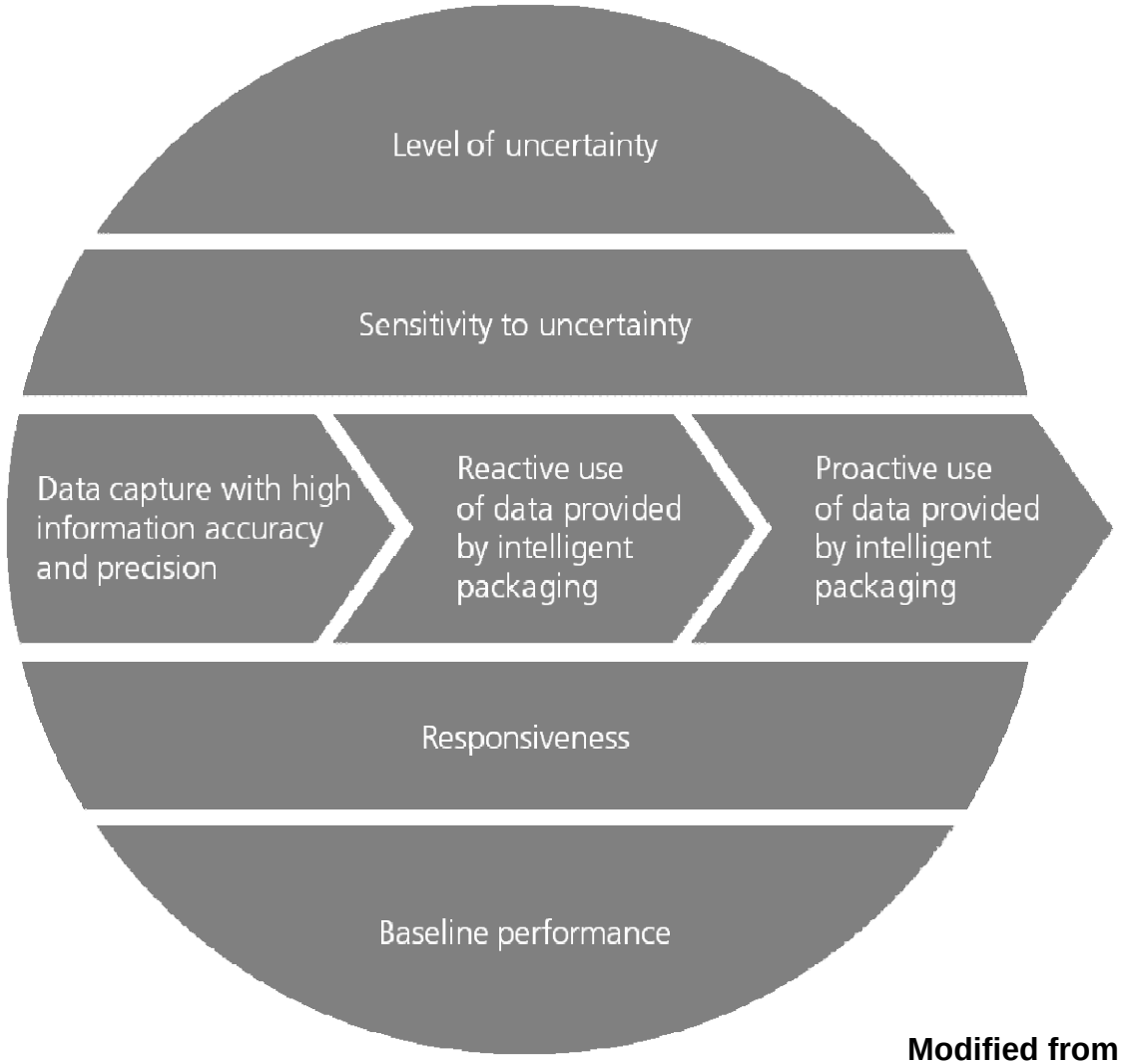

Modified from Ketzenberg *et al.*, 2007.

Conclusions

- The use of intelligent packaging is rare
- Intelligent use of intelligent packaging is potentially even more rare
- The lack of understanding how to use intelligent packaging may explain the slow adoption rate
- However, intelligent packaging supports practices shown to improve logistics performance
- The framework provides a starting point for understanding when and how to use intelligent packaging