

# NORDISK KONFERENS OM ANALYS AV TURISM



## The Knowledge Destination – Customer-based Knowledge through Business Intelligence

**Prof. Matthias Fuchs**

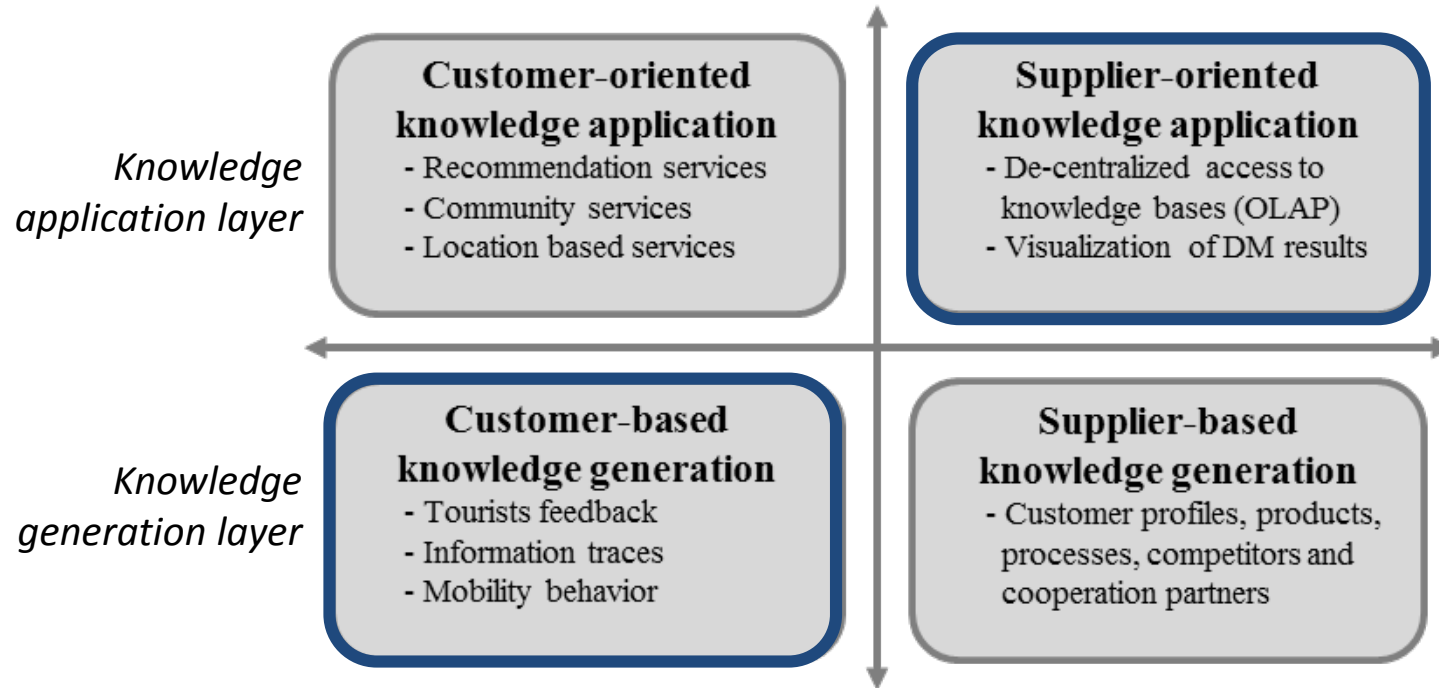
ETOUR Mid-Sweden University

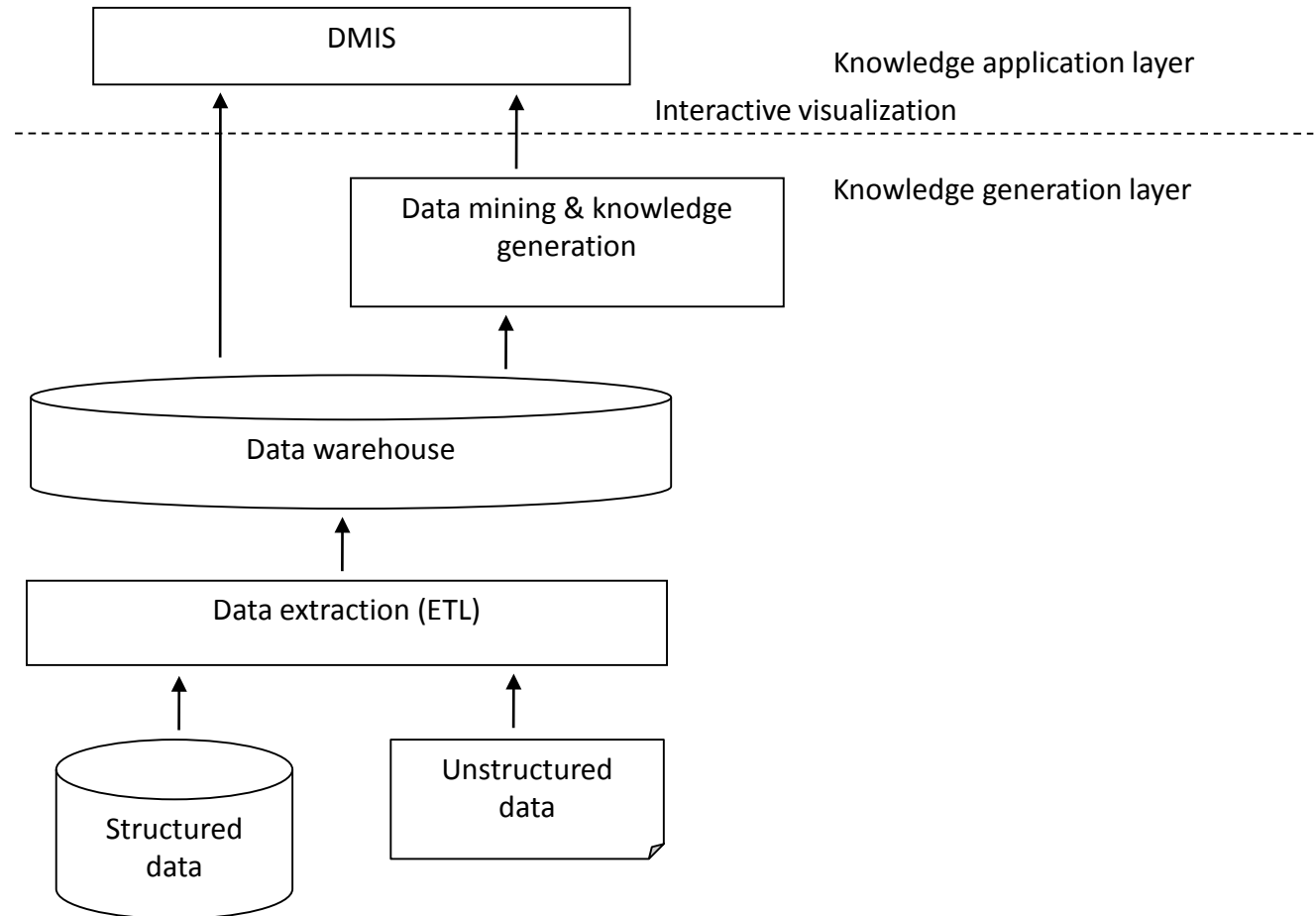
Östersund

- Knowledge Destination
  - Knowledge Destination Framework
  - Knowledge Destination Architecture
- BI-based Destination Management Information System
  - Destination Data Warehouse Model
  - Examples for Knowledge Generation
  - DMIS-Prototype
- Conclusion & Outlook

- **Tourism destination: Strategic unit in Travel & Tourism**
  - **Competitiveness of destination** ↔ attractiveness, **potential to adapt to customer needs**
    - **Knowledge need** for innovation,... resource re-configuration, self-transformation...
- **Learning Tourism Destination**
  - **External knowledge to develop strategic options** ↔ inclusion of customer
  - Networked **ICT infrastructure** and **services collecting data for creating, applying and disseminating new knowledge**

- Majority of tourism information, transactions and communication processes **electronically**
  - Customer traces during all trip phases → **large quantity and variety** of **customer-based data** in destinations...
    - Transaction data, CRM data, survey data... [**Data bases**]
    - Navigation & search data, UGC,... [**Web Servers**]
  - ... large data amount remains **unused**
- **Solution: Business Intelligence-based knowledge infrastructure for destinations**
- **Business Intelligence** ⇔ **One of 10 technologies changing the world** (MIT Review 2008)
  - BI = {Data Warehousing + Data Mining} ⇔ *Data*: relaxed assumptions of AI → huge in amount
  - Explosive **growth of data flows/collection, storage capacity/computing power, decreasing storage/computing costs** → OS SW for AI Apps (e.g. *RapidMiner™*)





Höpken, W., Fuchs, M., Keil, D. & Lexhagen, M. (2011): The Knowledge Destination – A Customer Information-based Destination Management Information System, In: Law, R., Fuchs, M. & Ricci, F. (eds.), *Information and Communication Technologies in Tourism 2011*, Springer, New York: 417-429.

## Customer-based knowledge sources [DMIS Indicators] → DMIS Data Warehouse

- **1. Economic Performance**
  - Bookings
  - Overnights
  - Prices
  - Sales
- **2. Customer Behaviour**
  - A. Web Navigation & Search
  - B Booking & consumption Behaviour
  - C Customer Profiling
- **3. Customer Perception & Experience**
  - A Brand Awareness
  - B Perception of Destination Value Chain Areas
  - C. Value for Money & Customer Satisfaction
  - D Loyalty



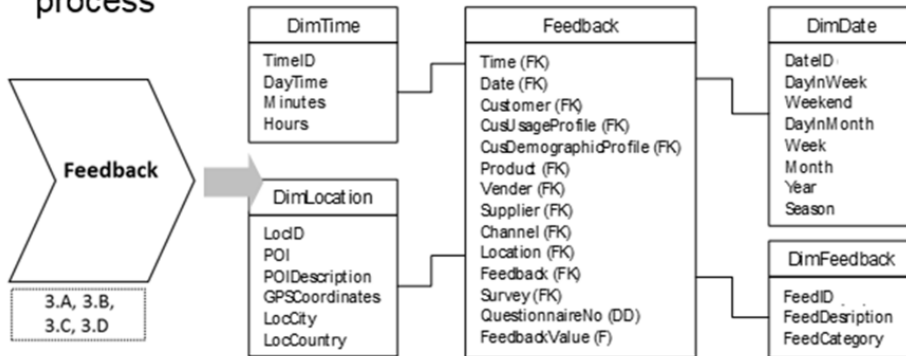
Business events  
generating data

Transaction & process-  
oriented structure

Multi-dimensional structure  
supports OLAP

Fact tables interlinked through  
shared dimensions ↔ **Cross  
Process Analyses**

DW composed of **fact & dimension tables** for each business process



Business Process	Fact Table	Dimension																		
		Time	Date	Customer	Customer Use Profile	Customer Demo Profile	Product	Vendor	Supplier	Channel	Location	Feedback	Var Feedback	URI	Event	Session	Referral	Survey	Marketing	Connectivity
Info Request	info request	x	x	x	x	x	x	x	x											
Web Navigation	click fact table	x	x	x	x	x	x	x												
Booking	session fact table	x	x	x	x	x														
Booking	booking	x	x	x	x	x	x	x	x	x										
Stay	stay		x	x	x	x														
Consumption	consumption	x	x	x	x	x	x	x	x	x										
Location Tracking	location poi	x	x	x	x	x														
Feedback	feedback	x	x	x	x	x	x	x	x	x	x	x	x							
Capacity (rooms)	capacity		x				x	x	x											
Marketing Activity	marketing activity		x					x	x	x	x									x

Business Process:  
**Feedback**

Fact-Dimension Table:  
**Feedback**

## Examples for knowledge generation through BI

### Web Usage Mining

[www.visitare.se](http://www.visitare.se)

Clustering ⇔ Log files Aug 2008 - Mar 2009 (92,035 user sessions)

- X-Mean Clustering ( $2 \leq x \leq 30$ ) by category change

	Cluster 1	Cluster 2	Cluster 3
<b>Size</b>	8.7% (7,989)	3.1% (2,839)	88.2% (81,143)
<b>Duration</b>	12.6 min	12.2 min	2.5 min
<b>Selection</b>	Accomm. (80% a/s 6.4) Program (29% a/s 1.9) To do (26% a/s 1.9)	Eating (100% a/s 8.4) To do (33% a/s 1.6) To see (21% a/s 0.8)	To do (28% a/s 0.7) Accomm. (27% a/s 0.5) To see (9.2% a/s 0.2)
<b>Actions</b>	Tourism (11.2%)	Brochure (7.6%) Congress (7.2%)	PDF (6.8%)
<b>Ext. Search</b>	Services (17.5%) Accomm. (10.5%) Activities (3.1%)	Eating (13.5%) Services (12.5%) Activities (2.1%)	Services (14%) Activities (6.6%) Accomm. (6%) Skiing (3.1%)
<b>Int. Search Used after</b>	3.4 min	3.8 min	1.3 min
	Accomm. (22%) Skiing (5.5%) Activities (5.1%)	Accomm. (17.7%) Eating (12%) Skiing (8.1%)	Accomm. (16%) Services (10.2%) Skiing (8%)
<b>Parametric Used after By</b>	5.1 min	4.3 min	1.5 min
	21% (a/s 4.4)	19% (a/s 4.9)	6% (a/s 1.9)

ÅRE  
DESTINATION

To do

- Aviation
- Bathing
- Bicycling
- Boating
- Canoeing
- Climbing

Accommodation

- Cabins
- Camping
- Farm living
- Fishing camps
- Flats
- Hotels/B&Bs
- Mountain cabins

Eating

- Cafés
- Fast food
- Food on the slopes
- Other food
- Restaurants

search_word(s)	requests
liftkort	151
karta	94
pistkarta	55
björnen	46
tännforsen	32
skiduthyrning	30
spa	27
bad	25
bio	24
brunkulla	24
skidskola	23
matthias+fredriksson	21
tegefjäll	21
systembolaget	21
åre+fjällby	20
after+ski	20
systembolaget	20
skoter	20
.....	18

a. Cluster 1  
accommodation accommodation afterski areturistbyrå areturistbyrå att bo boende camping OOM fiske fjällby fjällby göra händer holiday hotell hotel hyra in inni jämtland karta lägenhet lägenheter nattiv och övernattnig pensionat personer privatstugor ski stuga stugor turistbyrå turistbyrå turistinformation utbyres utgång vandrarhem vecka

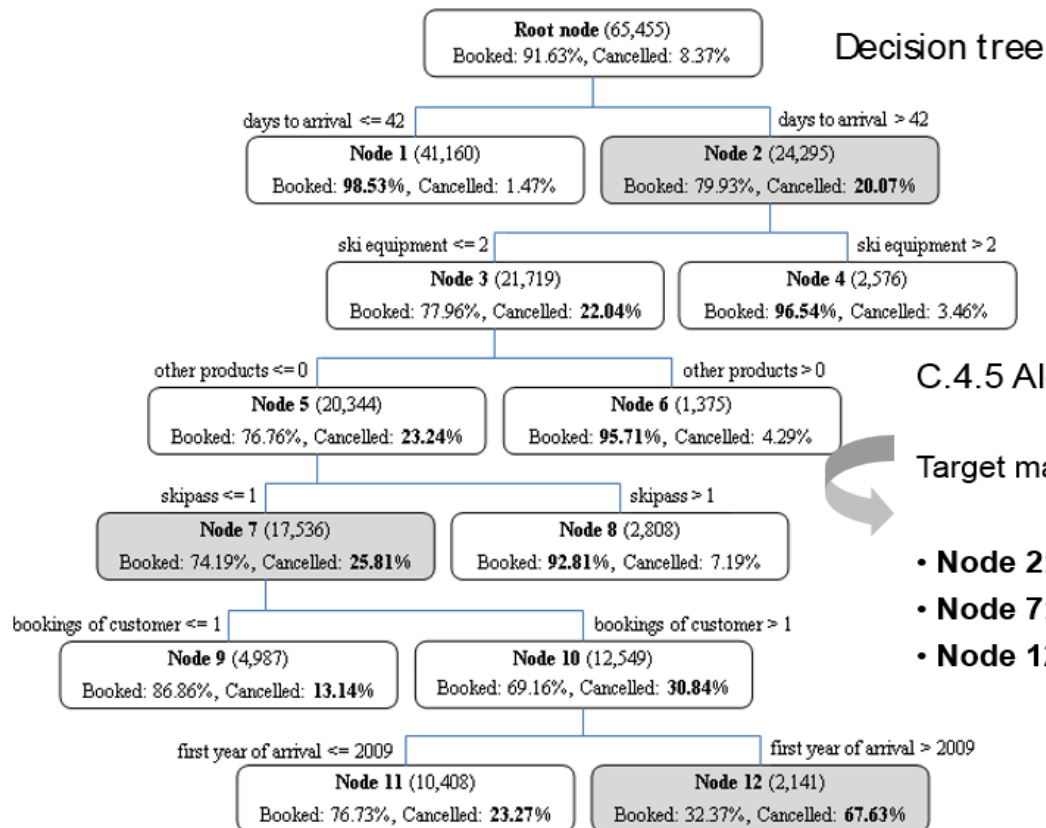
b. Cluster 2  
after amfheldts äta ar bar bistro black cafe club dahlboms döds fjällby göra helpension hotell ica janne julbord kabinbana kabinbanan karta knuten konditori krog mat meny morsel oliven pub restaurang restauranger skaffer sleep stormköket supper uniformer taxi vinterstuga toppstugan tu turistbyrå turistbyrå turistbyrå vandrarhem

c. Cluster 3  
anjans att bitstöd bo boende buss camping com fiske fjällby fjällstation från göra holiday höstmärnad hotell hotell hyra ica in islandshästar jämtland julfrände kabinbanakabinbanan karta kyrka lingdäckning lingdäck och öppetider på restaurang restauranger stop stugor skiduthyrning skoter skoterleder skoteruthyrning stuga stugor till transfer turistbyrå turistbyrå turistinformation vandrarhem vandring



## Examples for knowledge generation through BI

### Explaining cancellation behaviour



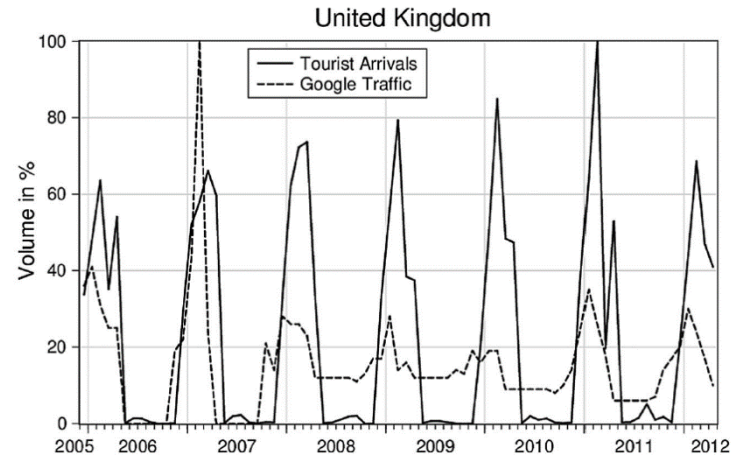
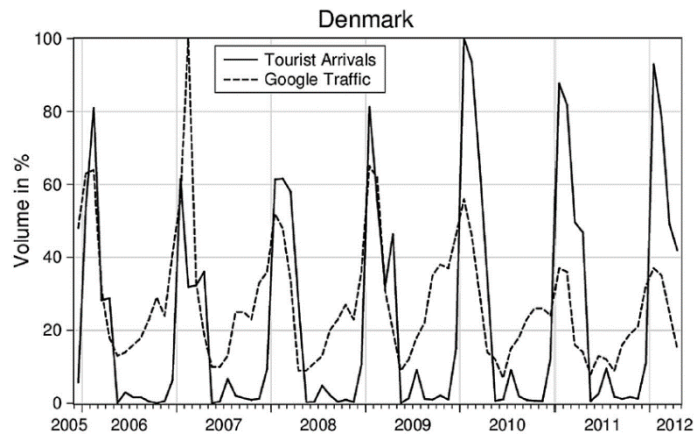
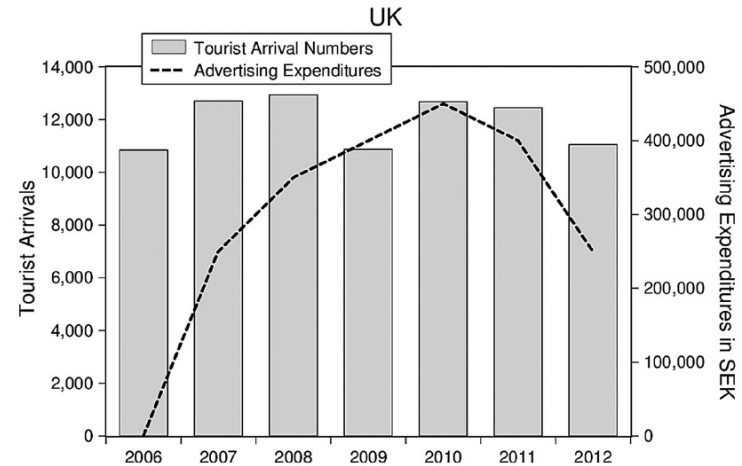
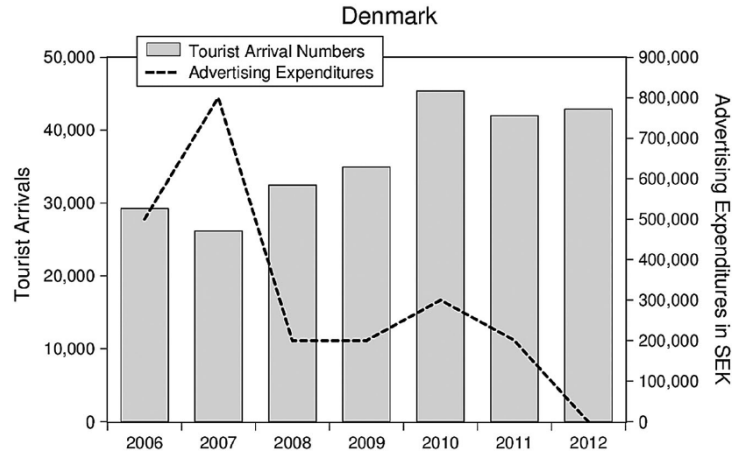
C.4.5 Algorithm (accuracy 94%,  $R^2$  .23)

Target marketing to prevent cancellation

- **Node 2:** Days to arrival > 42 days (2.4 ↑)
- **Node 7:** Booking ski pass < 1 day (3.1↑)
- **Node 12:** First year of arrival > 2009 (8 ↑)

## Examples for knowledge generation through BI

### Explaining tourist arrivals



Kronenberg, K., Fuchs, M., Salman, K., Lexhagen, M. & Höpken, W. (2015). Economic Effects of Advertising Expenditures – A Swedish Destination Study of International Tourists. *Scandinavian Journal of Hospitality & Tourism Research* (in print).

## Examples for knowledge generation through BI

$$Y_{jT} = \beta_0 + \beta_1 \text{GDP}_j + \beta_2 \text{EX}_{Sj} + \beta_3 \text{EX}_{Aj} + \beta_4 \text{Jet Fuel} + \beta_5 \text{Advertising}_j + \beta_6 \text{Advertising}_{(jt-i)} + \beta_7 \text{Online}_j + \beta_8 \text{WorldChampionship} + \beta_9 \text{Winter} + \beta_{10} Y_{jt-i} + e,$$

**Table 5.** Summary of estimated coefficients of Åre destination's major sending countries.

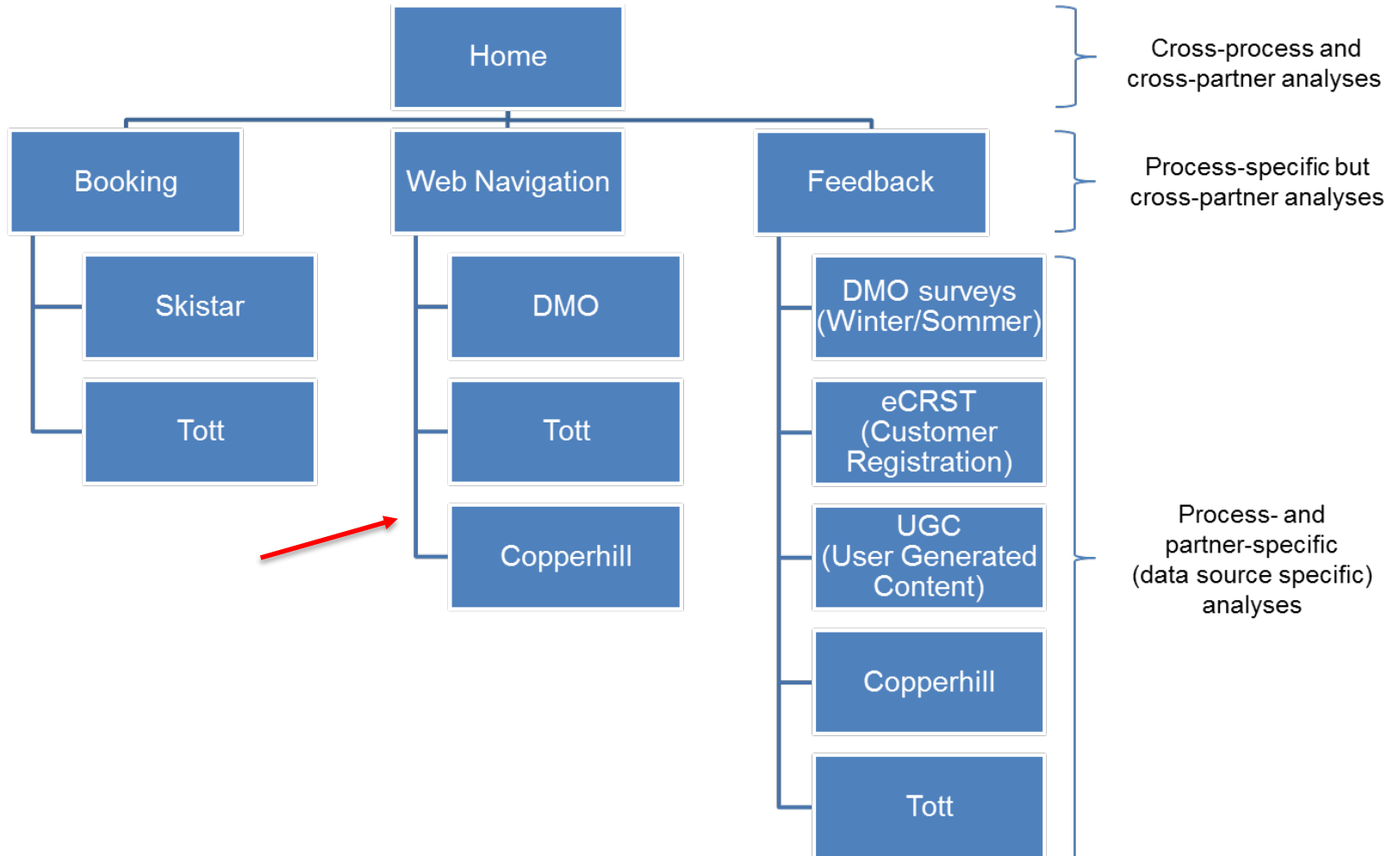
Variables	Denmark	Russia	Norway	UK	Finland
GDP	14.882	41.051	17.412	5.830	-3.814
EX <sub>S</sub>	1.681*	10.482	-0.141	-0.001	.090
EX <sub>A</sub>	-99.483*	-43.907	.0174	.071	-.379*
Jet Fuel	-2.682	19.844	4.164	-2.292	.541
Advertising	-13.911*	20.623	2.237	8.201*	11.632
Advertising <sub>(jt-i)</sub>	2.748	53.401*	10.814*	-2.071	-24.129*
Advertising <sub>(jt-k)</sub>	3.582	82.573*	11.480*	1.232	-
Online	33.612	-114.582*	33.276	10.031	272.858*
WorldChampionship	-4940.242*	-3298.392	-5590.943*	-1029.890	-16754.219*
Winter	6984.531*	3537.121*	4357.733*	907.501*	1283.411
Y <sub>(jt-i)</sub>	-.0401*	-.210*	.031	.443*	.201
Model Statistics					
F-statistics	67.292	8.456	8.794	44.753	19.188
Prob. (F-statistics)	.000	.000	.000	.000	.000
Durbin-Watson	1.712	2.168	1.907	2.382	2.001
R <sup>2</sup>	.932	.628	.645	.901	.779

Note: \*Significance level < .05;

Lag-periods for the lagged advertising variables Advert<sub>(jt-i)</sub> and Advert<sub>(jt-k)</sub>: Denmark (i = 3; k = 6), UK (i = 3; k = 6); Norway (i = 6; k = 10); Russia (i = 1; k = 9); Finland (i = 9).

Lag-periods for the lagged dependent variable Y<sub>(jt-i)</sub>: Denmark (i = 11), UK (i = 12); Norway (i = 10); Russia (i = 10); Finland (i = 9).

# DMIS Prototype



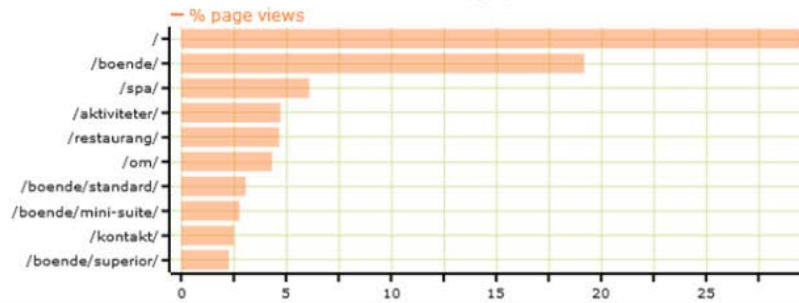
Home Booking Web Navigation Feedback

- Web navigation | Dashboard | OLAP clicks | OLAP sessions | choose another data pool here:

## Website statistics

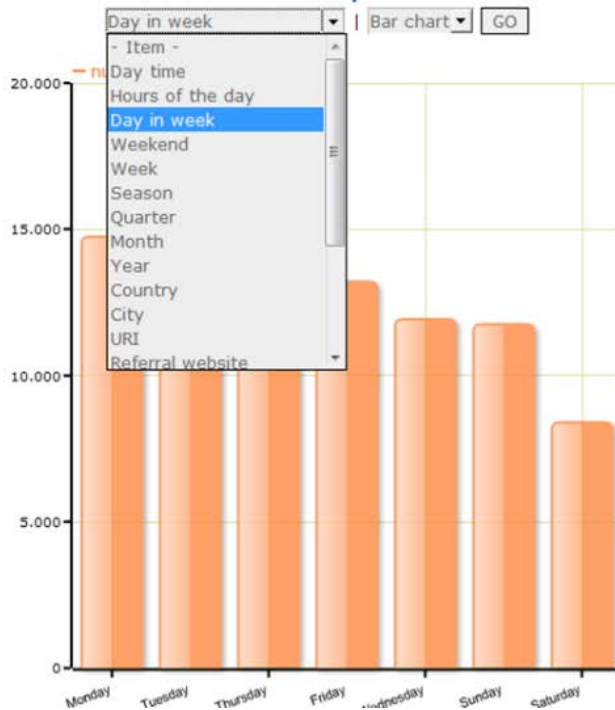
indicator	value
total visits (sessions)	28802
unique visitors	16058
total page views	87372
average pages per visit	3.034
average visit time in seconds (session length)	87.665
average time on single page in seconds	26.292

## TOP10 - visited webpages

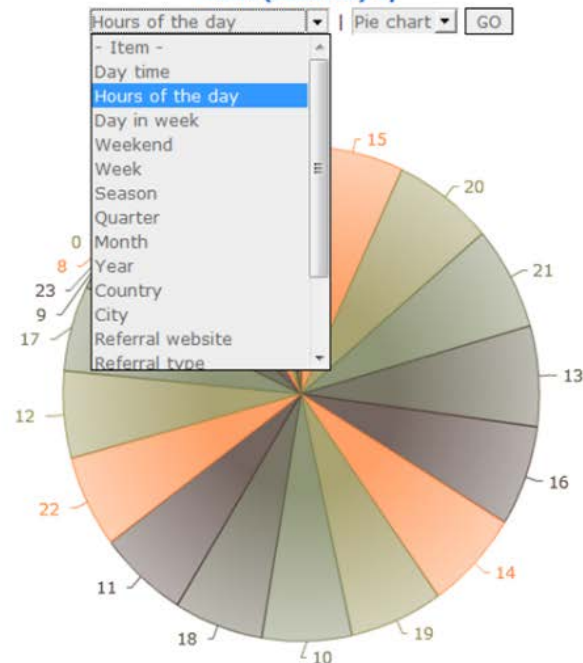


## details on clicks and sessions

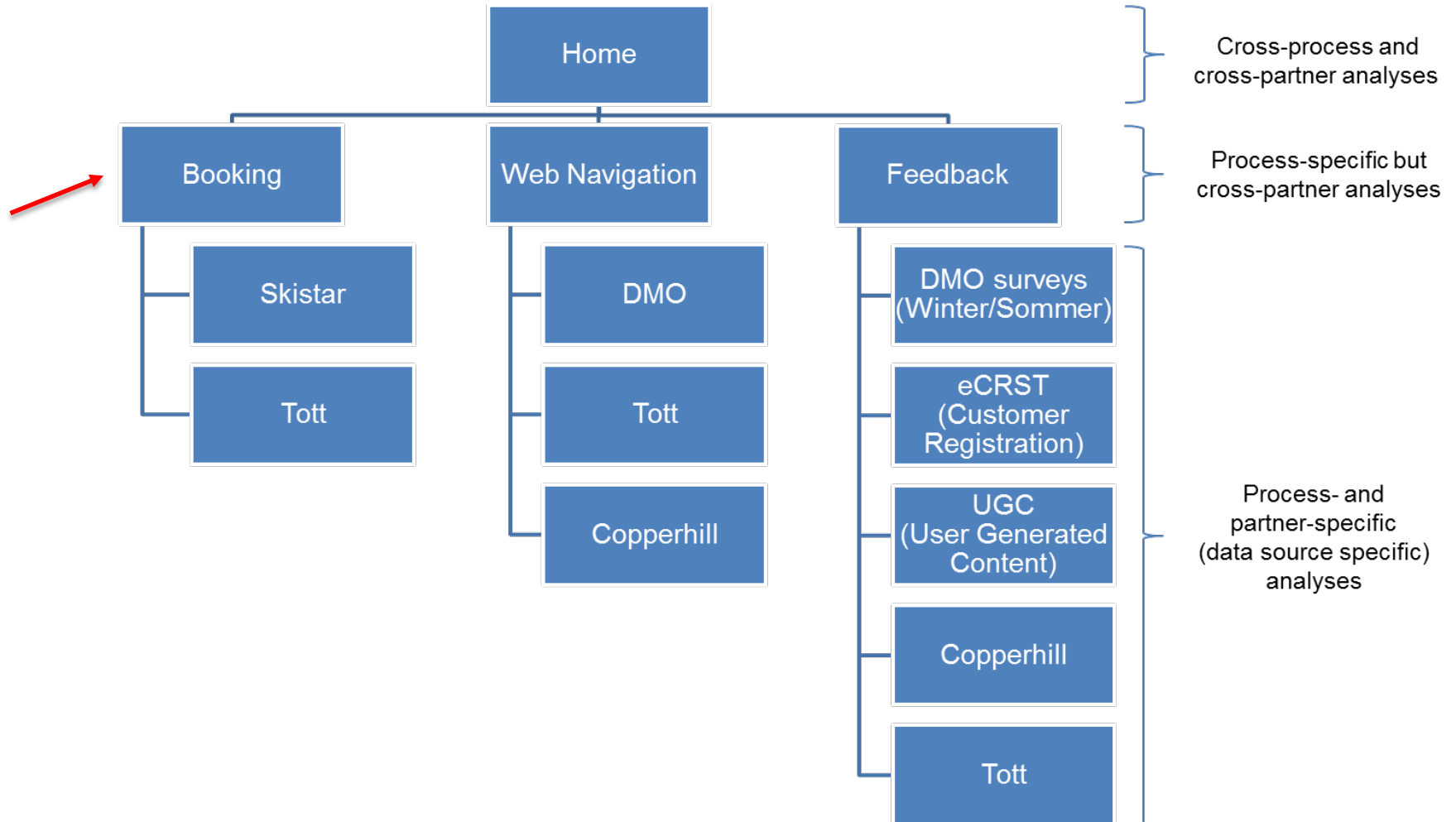
### Clicks by



### Visits (sessions) by



# DMIS Prototype







The destination management information system in tourism

[Home](#) [Booking](#) [Web Navigation](#) [Feedback](#)

 Overall | [Dashboard](#) | OLAP | choose another data pool here:   

### indicators

 number of indicators:  0  1  2  3  total amount of bookings | select year, if desired: 
 
 

### sorting

 disabled  enabled

 sort by: 

 sort function: 

### grouping

select the characteristics the final result should be gr

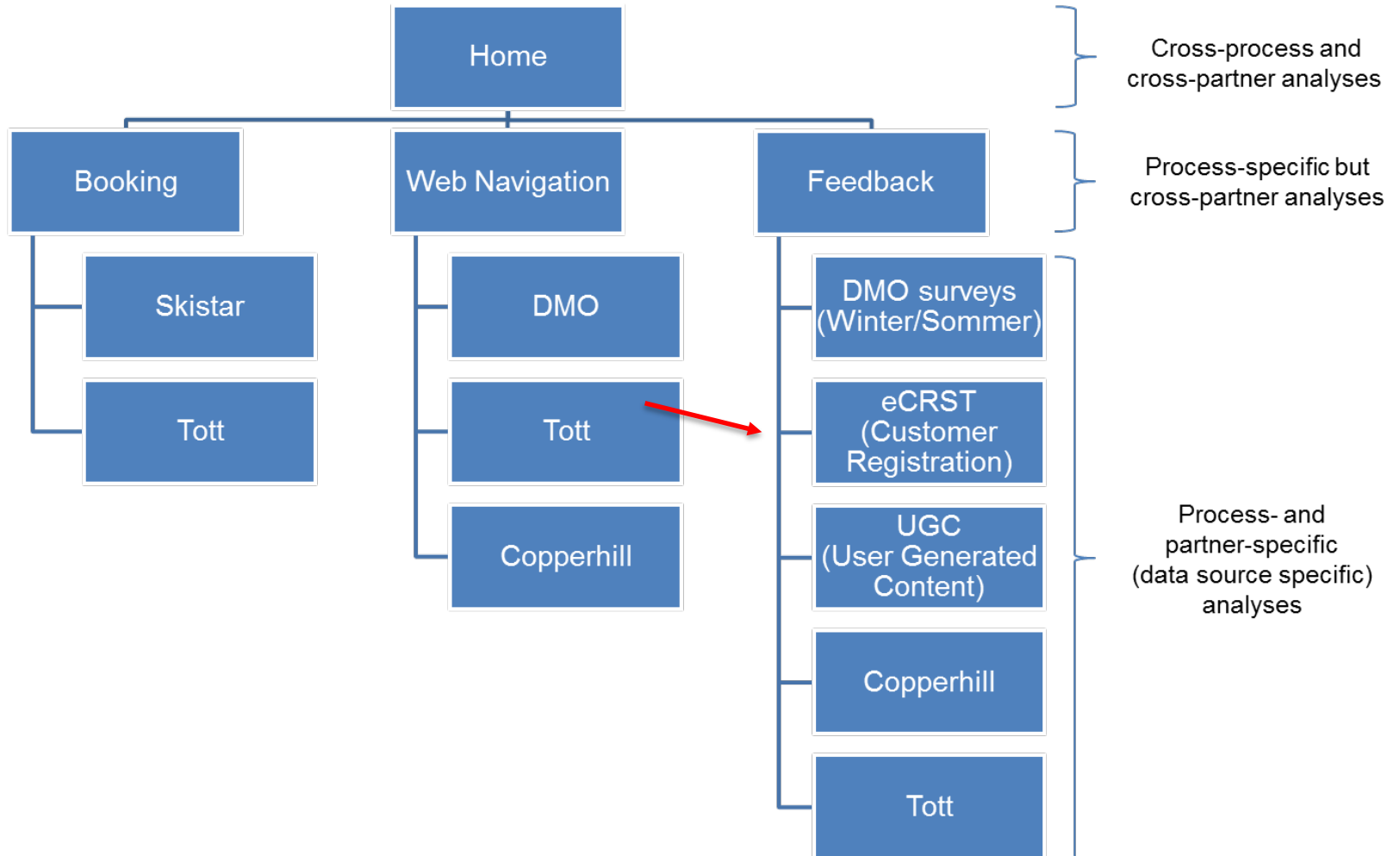
 
 |  | 

### execute


CusCountry	CusProTravelGroup	CusDemoAgeRange	sum_of_BookPrice	average_of_BookPrice	Total
Sweden	TravelGroup	40-49	3293794	5967.018	612
Sweden	Family	40-49	2937892	5971.325	493
Sweden	TravelGroup	50-59	2318377	6084.979	430
Sweden	TravelGroup	20-29	2141149	4517.192	476
Sweden	TravelGroup	30-39	2055898	5026.645	414
Sweden	TravelGroup	N/A	1162040	5030.476	722
Sweden	Couple	40-49	1116896	3415.584	330
Sweden	Couple	50-59	1056648	3475.816	306
Norway	TravelGroup	30-39	1051938	5339.787	202
Norway	TravelGroup	20-29	995890	4367.939	229
Norway	TravelGroup	N/A	907490	4384.010	249
Norway	TravelGroup	40-49	863690	5432.013	160
Sweden	Family	50-59	662525	5968.694	111
Sweden	Couple	30-39	662131	2916.877	230
Sweden	Couple	20-29	651336	2669.410	244
Sweden	Family	30-39	556316	4002.273	139
Sweden	Couple	N/A	546709	3273.707	243

# DMIS Prototype





## e-Customer Registration & Survey Tool

- Customer profile
- Information about visit
- Ad-hoc r feedback



How would you describe the motive for your visit to Åre? \*

- Main reason for the trip
- An important stop on a longer trip
- Quick stop on a longer trip

Which of the following activities have attracted you to Åre this summer?

- Aviation
- Bicycling
- Climbing
- Events
- Fishing
- Golf
- Guided tours
- Hiking
- Horse riding
- Mountain biking
- Riding the cable car
- Shopping
- Sightseeing
- Spa and pool
- Sunbathing and swimming
- Water sports
- Other

Would you like to tell us about your experience stay in Åre?

Positive experience

(Maximum characters: 160)

You have 160 characters left.

Negative experience

(Maximum characters: 160)

You have 160 characters left.

To what extent are you satisfied with your recent stay in Åre? \*

1 2 3 4 5

Not satisfied at all      Highly satisfied

Type of accommodation \*

- Hotel
- Camping
- Rented cottage
- Own cottage
- Rented apartment
- Own apartment
- Accommodation owned by relatives or friends
- Other

Accommodation area

- Åre village
- Björnen
- Tegefjäll
- Duved
- Other

Name of accommodation / service provider

## Survey registration

Particulars of your stay

Date of arrival \*

 /  / 

month day year

Date of departure \*

 /  / 

month day year

Number of adults in your travel group

Gender \*

- Male
- Female

Number of children in your travel group

Year of birth \*

Country of residence \*

- Denmark
- Estonia
- Finland
- Germany
- Latvia
- Lithuania
- Netherlands
- Norway
- Poland
- Russia
- Sweden
- UK
- Other country

**VI BEHÖVER DIN HJÄLP!**

REGISTRERA DIG på Åres gästundersökningspanel genom att besöka denna webbsida. Dina erfarenheter och uppfattningar om ditt besök är mycket viktiga för Åres utveckling.

Du kan vinna fina priser!

[www.are360.com/survey](http://www.are360.com/survey)

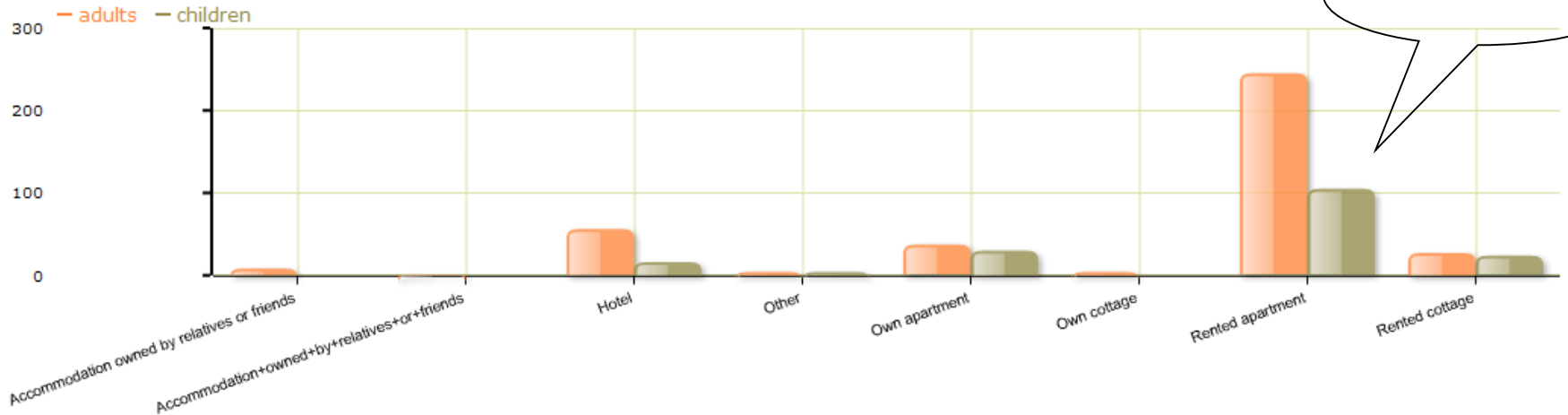




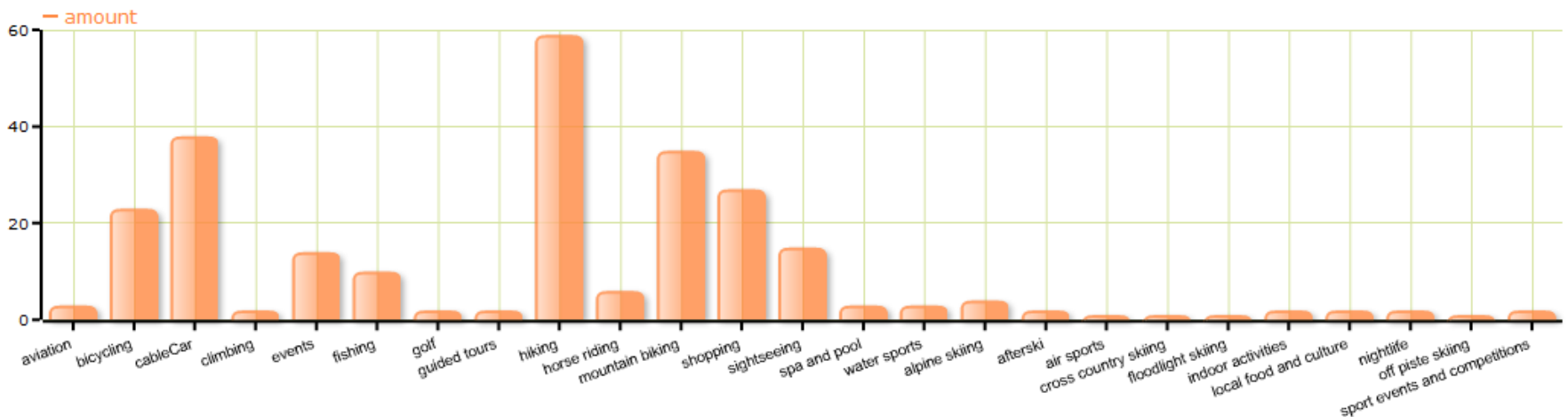

Home Booking Web Navigation Feedback

DMO - eCRST | Dashboard | OLAP | choose another data pool here: - Data -

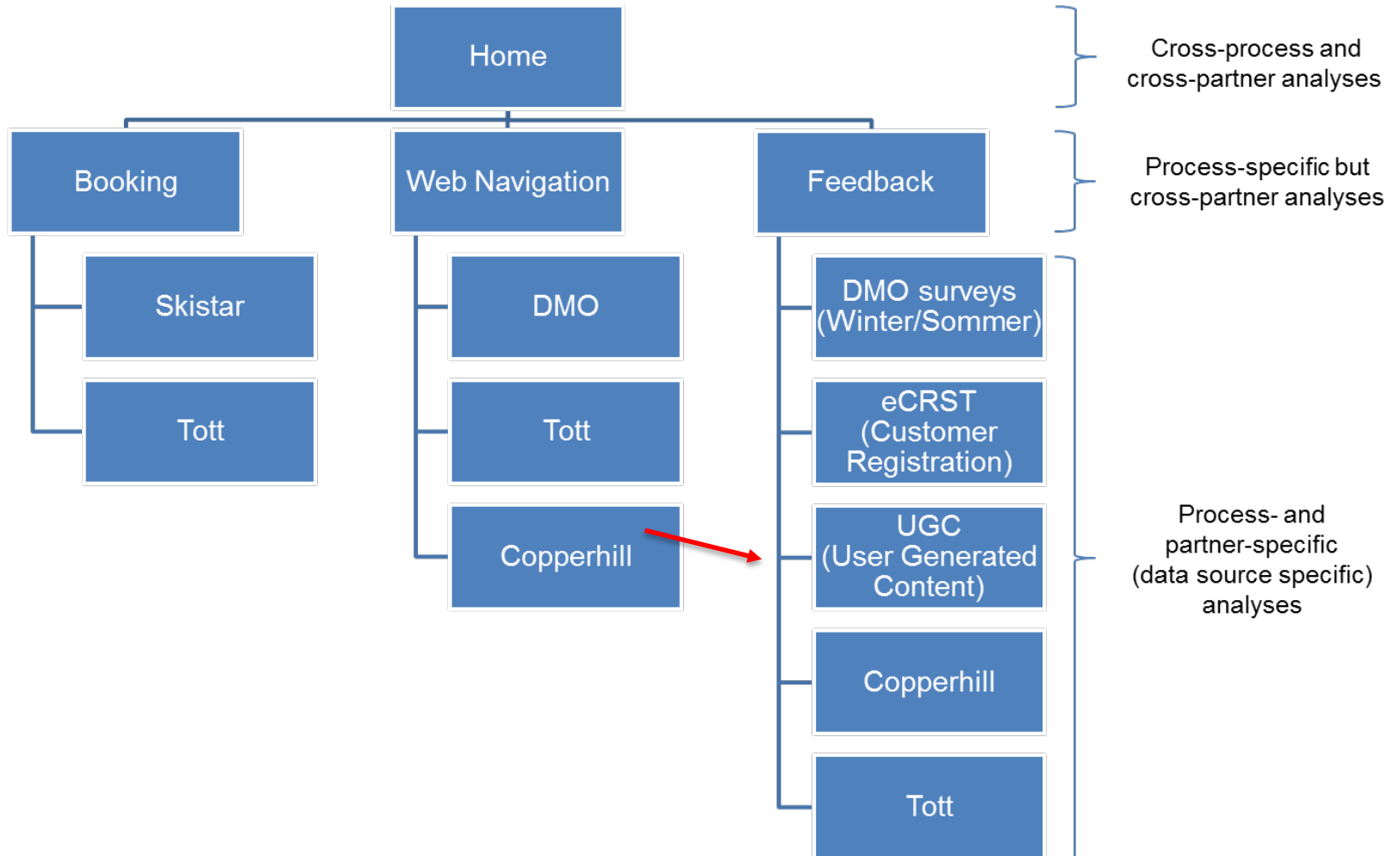
guest summary - total guests | by accommodation type  travel motivation - please select -



guest summary - total guests | by - please select -  travel motivation activity overview




# DMIS Prototype



## Text data mining → opinion mining (polarity)


### 1) Document selection ⇔ Are hotels on leading review portals

	No. of Hotels	No. of e-reviews
Tripadvisor.com	10	248
Booking.com	17	1193

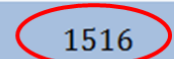


### 2) Document Processing

- **Extract review texts** from HTML documents
- Remove reviews with no text, filter **English texts only**
- Generate **single statements**



	No. of reviews	No. of statements
tripadvisor.com	127	1296
booking.com	81	220
<b>Total</b>	208	<b>1516</b>



## 3) Mining

### Machine Learning (*Naïve Bayes*, *SVM*, *k-NN*) ⇔ Dictionary-Based

- **Property recognition** ⇔ 100 training data/method, 7 classes
- **Subjectivity recognition** ⇔ 300 training data/method, 6,800 opinion words (Liu 2008)
- **Sentiment recognition** ⇔ 250 training data/method; 2,000 pos., 4,800 neg. words

## 4) Evaluation

Method	Accuracy
<b>Property recognition</b>	
SVM (with POS tagging)	72.36%
Naïve Bayes (with POS tagging)	49.72%
k-NN (with k = 8)	57.08%
Dictionary-based	71.28%
<b>Subjectivity recognition</b>	
SVM	65.50%
Naïve Bayes	60.67%
k-NN (with k = 5)	55.50%
Dictionary-based	82.63%
<b>Sentiment recognition</b>	
SVM (with bigrams)	76.80%
Naïve Bayes (with trigrams)	69.80%
k-NN (with k = 8)	69.60%
Dictionary-based	71.28%

← Part of speech tagging for parsing

←

← ⇔ 2 adjacent words  
→ 1 word



The destination management information system in tourism


Home Booking Web Navigation Feedback

UGC | Dashboard | **OLAP** reviews | **OLAP** statements | choose another data pool here: - Data - select

guest feedback full reviews select

February, 2013	tripadvisor.com	Tott Hotell	This is a perfect hotel both with or without kids. We arrived on a saturday morning, parked outside minutes. The afterski at Fjellgården nearby is tremendous and downtown Åre is just a walk or a sh
February, 2013	tripadvisor.com	Tott Hotell	I stayed for a 4 day ski week end. I had a family room, a bit pricy but very comfortable and conve style and ideally located, ttruely speaking ski on ski out, with a convenient Ski shop where you ca booking by internet very useful). Hotel is at 5 min walk from the village. Restaurant and bars are C international cusine. Yes, a place to recommend, not for a romantic week end but, definitely yes f
February, 2013	tripadvisor.com	Tott Hotell	I've been there during company conference - it's probably a great spot for skiers I'm not one of th center of Are. Rooms quality was quite good; service has some problems with talking in English (I disadvantage of this place (excl breakfasts) - it was cold so many times that I started to thing th cold meals!
February, 2013	tripadvisor.com	Tott Hotell	The situation is perfect. Rooms are ok, small kitchenette was nice surprise. The spa is very nice fc also. The hotel staff was very helpful. I'll stay here next time.
February, 2013	tripadvisor.com	Holiday Club Hotell	Excellent resort with plenty of options for wintersports. Holiday club excellent for families as it is c and sauna complex to chill out, sports bar and reception bar rather characterless. Large general ai indoor link to shopping mall. Food excellent quality and choice. Good service to meeting rooms. Ro fold out bed with curtain - great for sharing. Views from rooms better on higher floors. Storgae are arriving mv room was not available ans sent away - kinder to offer somewhere for luagaae and ent



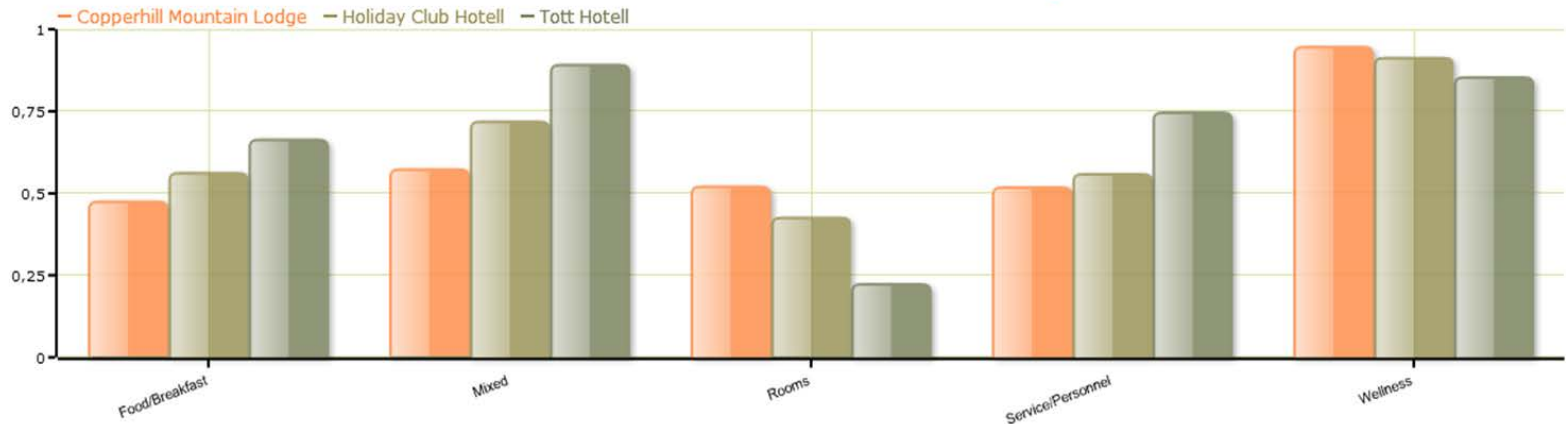


Home | Booking | Web Navigation | Feedback

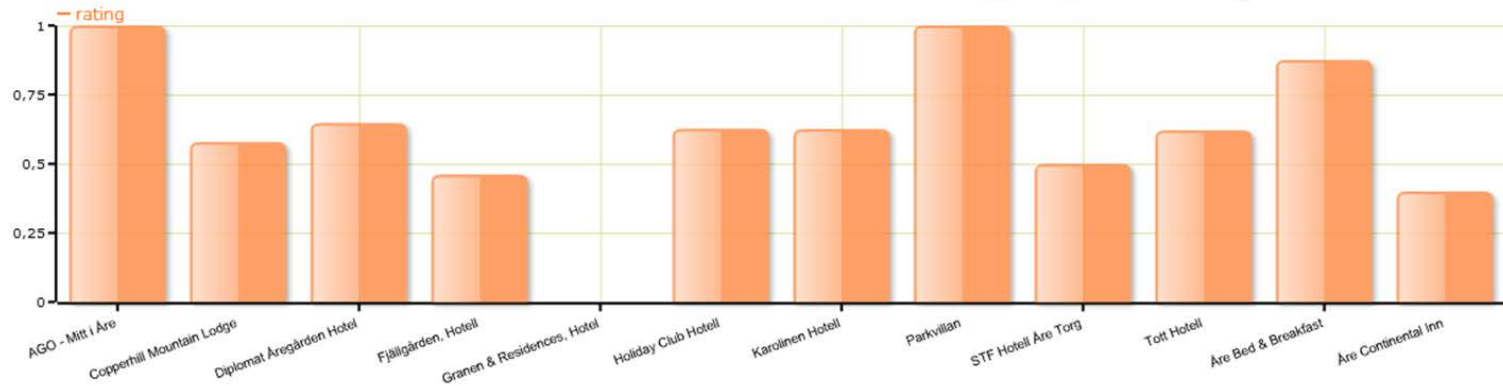
UGC | Dashboard | OLAP reviews | OLAP statements | choose another data pool here:


**Respondent | guest feedback**

average feedback value of review statements | by   ←



average feedback value of review statements | by   ← Positive/Negative





Home | Booking | Web Navigation | Feedback

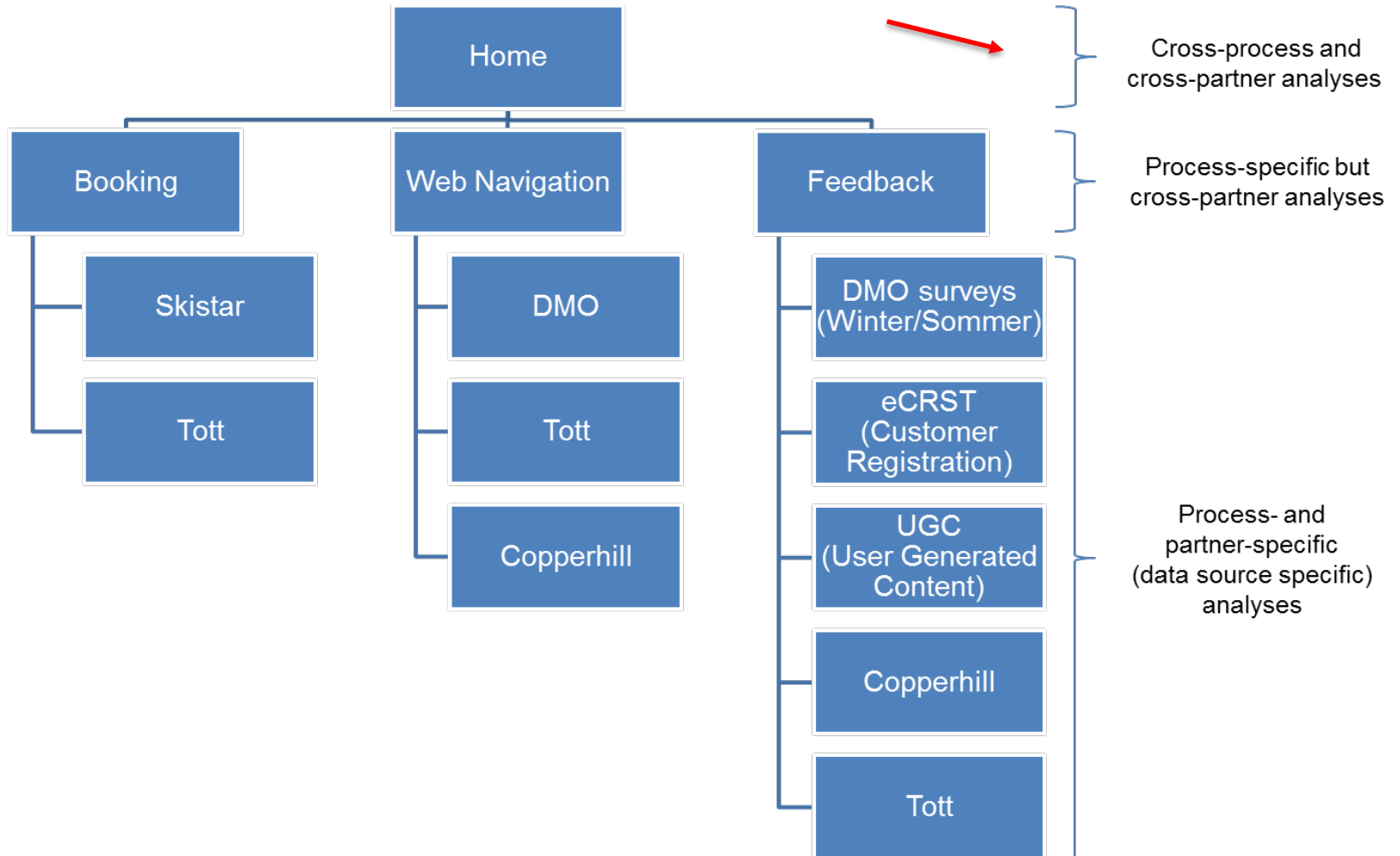
UGC | Dashboard | OLAP reviews | OLAP statements | choose another data pool here:

average feedback value of review statements | by

items	Copperhill Mountain Lodge	Diplomat Åregården Hotel	Fjällgården, Hotell	Holiday Club Hotell	Karolinen Hotell	STF Hotell Åre Torg	Tott Hotell	Åre Bed & Breakfast	Åre Continental Inn	Granen & Residences, Hotel	MårtenLiens Gård	AGO - Mitt i Åre	Park
Food/Breakfast	0.478	0.704	1	0.565	0	0.500	0.667	0.667	1	?	?	?	?
Location	0.841	0.938	0.556	0.772	1	0.909	0.933	1	0.667	0	1	?	?
Mixed	0.576	0.633	0.667	0.722	1	0.625	0.895	1	0.625	0	?	1	1
Rooms	0.524	0.500	0	0.429	0.333	0.333	0.227	?	0.111	?	?	?	?
Service/Personnel	0.522	0.750	0	0.562	?	0.500	0.750	1	1	?	?	?	?
Wellness	0.950	0.778	?	0.917	?	?	0.857	?	1	?	?	?	?



# DMIS Prototype



The destination management information system in tourism

[Home](#) [Booking](#) [Web Navigation](#) [Feedback](#)

## Frequently viewed product areas on websites

### KPIs | by

 Country  GO 2013   null values  new window

Group by attribute	Total bookings	Total clicks	Total feedback, answers	Total sessions	Average booking price in SEK	Average number of persons per booking	Average time between booking and arrival in days	Average stay duration per booking	Average time spent on single webpage in seconds	Average visit time on websites in seconds	Average pages visited on websites	Average feedback value
Finland	3155	4543	1039	893	7852.046	4.386	95.536	6.160	16.915	100.814	5.087	0.812
France	25	2923	12	739	4616	3.040	38.318	5.042	19.187	82.978	3.955	0.715
Germany	105	3268	150	665	5307.040	3.155	124.426	6.644	13.377	82.701	4.914	0.837
Spain	13	1096	0	305	4776.231	3.231	35.385	3.846	13.889	64.287	3.593	0
Sweden	56073	162942	36880	39139	5023.956	3.860	83.014	5.498	17.407	84.981	4.163	0.773
Switzerland	48	1398	0	292	4282.787	3.149	51.023	4.957	14.687	84.761	4.788	0
Hungary	2	82	0	33	1480	2	61.500	1	15.917	63.667	2.485	0
Iceland	6	220	0	40	4961.500	3.667	89.333	5.833	21.151	151.440	5.500	0
United Kingdom	1042	48513	303	12843	4929.136	3.009	59.399	6.786	17.259	76.811	3.777	0.765
United States of America	30	4284	16	2307	4719.167	4.036	39.148	4.133	11.236	57.168	1.857	0.539

- ***Step towards BI-based Knowledge Destination***
  - Knowledge *generation* ⇔ customer processes **Web Navigation, Booking, Feedback**
  - Knowledge *application* ⇔ DMIS Cockpit **Dashboard, OLAP**
    - **Data mining** in future version (Clustering, Classification, Prediction)
- ***Major project outcome***
  - Performance Indicators ⇔ Multi-Dimensional Destination Data Model
  - Architectural DMIS Framework ⇔ Testable Prototype

## DMIS II Project: Enhanced experience quality & dynamic need fulfilment through *Real-Time Business Intelligence* during *on-site* phase (ERUF Halland Region 2016-2017)



### M-CRM Apps

Promising experience opportunities in RT  
(crowd situation, mood at POIs,...)

### Enhanced DMIS

RT service recovery, RT insights in supply  
shortages, query redistribution in SBN,...

*Knowledge application layer*

#### Customer-oriented knowledge application

- Recommendation services
- Community services
- Location based services

#### Supplier-oriented knowledge application

- De-centralized access to knowledge bases (OLAP)
- Visualization of DM results



*Knowledge generation layer*

#### Customer-based knowledge generation

- Tourists feedback
- Information traces
- Mobility behavior

#### Supplier-based knowledge generation

- product profiles, suppliers (web-sites), availability (booking engines)
- cooperation (market basket)

### RT customer data

QR Codes POIS, Ad-hoc feedback,...



### Digital Destination Eco System

Thank you!

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