



# Role of Information and Communications Technology (ICT) for Multi Modal Transport

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# We will discuss

- Existing applications for core operations
- Technology Trend
- Future of things



# Historical Application of ICT

Historically, the use of ICT in transport and logistics started in the 1960s.

Typical examples are

- inventory management systems,

- transport routing,

- scheduling, also known as Distribution Requirement Planning, and

- billing systems

# Historical Application of ICT..2

**Material Requirements Planning(MRP)**

and

**Manufacturing Resource Planning (MRP II)**

And then EMERGED

**Enterprise Resource Planning(ERP)**

# ENABLING TECHNOLOGIES

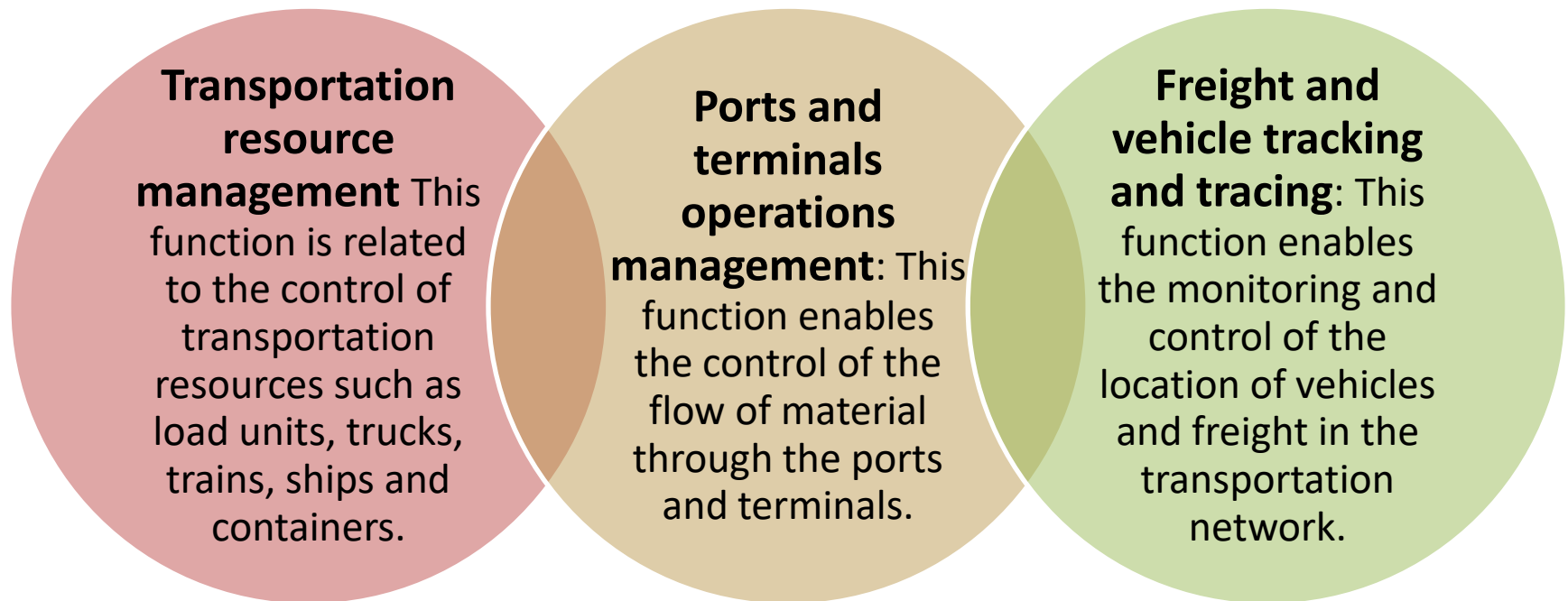
Cloud Computing

Wireless communication technologies (such as smart mobile phones, QR code, RFID and telematics tracking).

Switching from dyadic one-to-one communication to simultaneous one-to-many communication changes the way supply chains are structured and information is shared

# Proper categorisation of ICT functions

REF: Giannopoulos (2004) Three functions are described below.



# **“eFreight” Present day problems**

**Complexity of freight transport information exchange in the context of multimodal transport:**

## **Problems**

- lack of interoperability along the supply chain**
- operators provide information several times for different purposes**
- lack of information on intermodal availabilities**

## **Result**

**inefficiencies, costs, reduced visibility of freight  
administrative costs +  
perceived complexity for multimodal transport  
no full exploitation of multimodal transport / non-optimization of use of existing transport infrastructure**

**Thus there is need for interoperable interfaces for information on freight in the various transport modes**

# “eFreight”: The vision of EU

- Interoperability between paperless freight information systems
- Zero paper documents needed for planning, executing and completing any transport operation within the EU
- Reduced waiting time at hubs related to administrative procedures
- Standard framework for intermodal information exchange
- Harmonised border crossings



**Integration in the transmodal goods transport of non-EU states: Rail, Intra-Eurosteel waterway, Motor**

**Viom**  
Visions of Mobility.

Interim House  
Kornel  
Dachstein  
Ragwitz  
Northsoft Hagen  
Northsoft Lohr

**Map**

100 km

Route: France - Berlin - Westhafen

Optimizations Made EDD Quantity: 360 Duration (d/h): 13, 31 Distance (km): 8341 EDD (ME): 3964764 Costs: 42535

**Rising Segments**

From	To	Mode	HL V	Duration	Distance	Cost	Costs
Frankfurt	Paris	Train	1	2, 13	3614	252534	130211
Raila	Budapest	Rail	6	2, 18	3212	180177	113261
Budapest -	Budapest	Rail	6	1	0	2836	30021
Budapest -	Wrocław - Port	Rail	6	3, 9	1695	1200339	629056
Wrocław - Port	Berlin - Westhafen	Water	3	5, 4	1103	822173	51764

**Segment Details**

From	To	Mode	Costs
Frankfurt	Port of Frankfurt	Train	130211
Raila	Port of Raila	Rail	113261

**Possible connections sorted by total transit time (T1)**

From: Austria  
To: Netherlands  
When: Amsterdam  
4 destination terminal(s)

[Get Complete PDF Report](#) [Proceed to Logistics Benchmarking Tool](#) [Exit](#)

debugging...

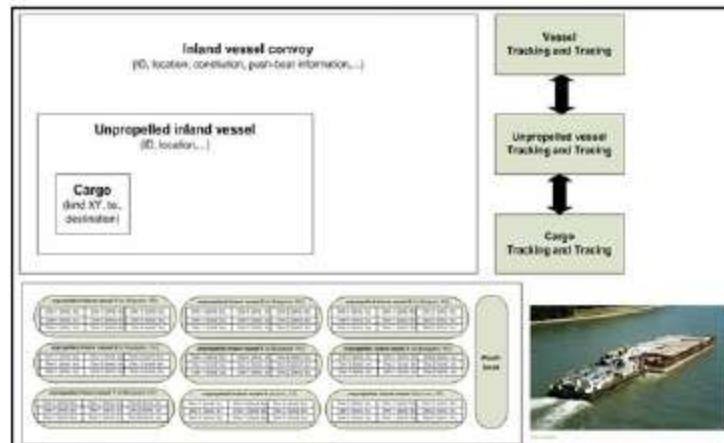
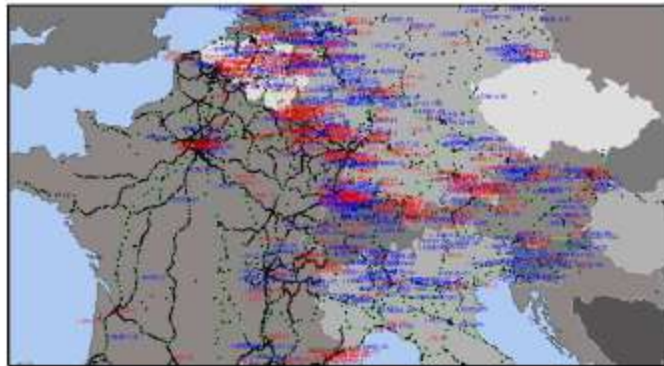
Terminal Name Origin	Terminal Operator	Total T1	Total Cost	Mode	Prog.	Country	Place	Terminal	Mode	Prog.
Wien Nordwest GCT	<a href="http://www.raibz.org.at">http://www.raibz.org.at</a>	3	1	Rail	5	Germany	Duisburg	Duisburg	Inland Shipping	1
WIENSCENT		3	1	Rail	5	Germany	Duisburg	Duisburg	Inland Shipping	1
WIENSCENT		3	1	Rail	5	Germany	Duisburg	Duisburg	Inland Shipping	1
Wien Presdenau Hafen GCT	<a href="http://www.wienscent.com">http://www.wienscent.com</a>	4	2	Rail	5	Netherlands	Rotterdam	ECT-Duis / ECT-Rotterdam	Inland Shipping	3
Wien Presdenau Hafen GCT	<a href="http://www.wienscent.com">http://www.wienscent.com</a>	4	2	Rail	5	Netherlands	Rotterdam	Rotterdam Mainwharfs - ECT	Inland Shipping	4
Wien Presdenau Hafen GCT	<a href="http://www.wienscent.com">http://www.wienscent.com</a>	4	1	Rail	5	Germany	Duisburg	Duisburg	Inland Shipping	1

- SONORA, BELOGIC,...
- eFreight, SPIN-ALP,..
- GET Service platform etc.

- IT-based intermodal route planning,
- Intermodal transport scheduling,
- Future: Integration into existing ERP systems

Sources: SONORA project, BE LOGIC project

# ICT in transport monitoring



- **Telematic (ITS) Applications for Freight:**
  - Rail: TAF-TSI
  - Road: ITS
  - Maritime: VTMISS, SSN
  - Inland water: RIS
- **Tracking and Tracing:**
  - Of cargoes (not vehicles),
  - Cross-mode (multimodal),
  - Cross-border (transnational).

# **Intelligent Transport Systems (ITS)**

## **ITS in the field of transport**

- **Providing real-time traffic information,**
- **Supporting traffic safety and transport operations etc.**

## **EXAMPLES of ITS in the field of transport:**

- Road intelligent transport systems (ITS),
- Air traffic management system (SESAR),
- European rail traffic management system (i.e. ERTMS) and rail information systems (i.e. TAF-TSI),
- Maritime surveillance systems (SafeSeaNet et al.), VTMIS (Vessel Traffic Management and Information System and
- Inland navigation (River Information Services [RIS]).

Basic

# **ICT IN INDIAN RAILWAYS**

# CENTRE FOR RAILWAY INFORMATION SYSTEMS (CRIS)

- The Centre for Railway Information Systems (CRIS), an autonomous Society under the Ministry of Railways set up in 1986, plays the role of the Information Technology arm of the Indian Railways.
- CRIS develops and maintains the major information systems deployed in the Railways, e.g. passenger ticketing, freight and passenger train operations, management of train crews, and management of fixed and rolling railway assets.

# Freight/Operations Applications

- Freight Operations Information System (FOIS), Terminal Management System (TMS) and E-Payment- About 2.9 million tonnes of freight are booked daily in FOIS.
- Nearly 1,600 Railway Receipts (RRs), amounting to about Rs 255 crore, are generated, constituting 99.9% of freight booked; approximately Rs 191 crore (75% of total) is collected through e-payment every day.

# Freight/Operations Applications

## FOIS Rake Management System (RMS)-

- About 4,353 rakes are monitored daily through this module. Loads on the run / consignments in transit can be tracked by the customers on FOIS-Web.
- The Rake Allotment System provides optimum allocation of rakes for efficient freight movement.

# Freight/Operations Applications..contd

- Control Office Application (COA) and Timetable Management System (Satsang)- About 5,00,000 arrival/ departure events of 14000 trains are recorded each day in 77 control offices through COA.
- **Satsang** assists in the preparation of train timetables to optimize running of trains.



# Freight/Operations Applications..contd

- Crew Management System (CMS)-362 lobbies are provided with CMS.
- The system serves 47,000 calls daily via SMS, enabling train crews to sign on and sign off at CMS kiosks.

# Freight/Operations Applications..contd

## **Locomotive Management System (LMS for Diesel Locomotives) and SLAM (for Electric Locomotives)**

(Software for Locomotive Asset Management)

These applications, presently implemented at a few sheds, will ultimately manage the maintenance of over 10,000 locomotives

## **Coaching/Freight Maintenance Management System (CMM/FMM)**

These applications, presently implemented at pilot locations, will manage the maintenance of 60,000 coaching vehicles and 2,50,000 wagons.

# Freight/Operations Applications..advantages

- These applications provide convenience and transparency for the Freight Customer.
- They also ease the work of the Railway staff, improving overall efficiency.
- Section controllers – reduced fatigue and stress through COA
- Running staff – optimized crew rotation and automatic mileage calculation through CMS

# Freight/Operations Applications..advantages

- Track maintenance staff – easier maintenance of records through Track Mgt System
- Locomotive maintenance staff– information at fingertips through SLAM, LMS
- Planners – Rake Allocation System of FOIS assists in optimal allotment of rakes

FOIS - <https://www.fois.indianrail.gov.in/>

Browser tabs: MICT ITI, Welcome, www.uis, FOIS-1, Railnet, ICT.png, Modern, Ministry, Ministry, Railway, Newly

Address bar: <https://www.fois.indianrail.gov.in>

Bookmarks: Apps, www.inkp.com - Ad..., Joomla [RKP], Wordpress on igyaa..., Indian Railways Kno..., Distance Education I..., Free Hotmail, Google, India Map, Map of In..., Other bookmarks

Language: हिंदी संस्करण

# FREIGHT OPERATIONS INFORMATION SYSTEM

Ministry of Railways, Government of India


IMPROVEMENTS MADE IN E-REGISTRATION OF DEMAND SYSTEM. REFER TO GUI

Site Last Updated: 01-10-2014

Navigation: Applications, E-Services, Enquiry, RBS, Rate Circulars, Guidelines

Quick Links: Web Reports, RMS Zonal, RMS Queries, TMS Queries

RA IRON ORE: Iron Ore Indents, Outstanding Demands for CKP, Rake Allocation Plan, Rake Allotment for CKP, Rake Allotment for KUR, RAS COAL



Double Stack Container Train

WELCOME TO FOIS

There has been a longstanding demand of Indian Railways for transparency in sharing of information to give the customers an upto-date business-like environment. An idea originated in the year 1986 to take advantage of Information Technology to efficiently and effectively manage the processing of information. FOIS - A Strategic Advantage to both IR and its customers. [More >>](#)

CRIS HOME | ABOUT FOIS | IR MAPS | DOWNLOADS | CONTACT US

INFORMATION

- AUTOMATIC EMPTY FLOW DIRECTION REBATE SCHEME - BENCHMARK FOR APRIL -2015 ACHIEVED FOR TRAFFIC FROM SR TO SC, NF to NR. SUBSEQUENT RRS TO GET REBATE AS PER RULES.
- Now You Can Register Your Demand Online With E-Demand Registration System. Experience the Speed, Convenience and Security with E-Demand Registration System.
- Freight Calculator Launch on

india.gov.in

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Taskbar: Windows, Google, e, File Explorer, VLC, HP, Excel, PowerPoint, Word, Internet Explorer, Mail, Print, Volume, Network, 06:13 27-04-2015

# Advances in interface technologies

- The latest development of augmented reality(AR)technology
- **Augmented reality (AR)** is a live direct or indirect view of a physical, real-world environment whose elements are *augmented* (or supplemented) by computer-generated sensory input such as sound, video, graphics or [GPS](#) data.



# Policing Function





# Augmented Reality:

An imminent reality for  
the logistics arena





# Application of Technology

## Examples from DHL

- Vision Picking at DHL - Augmented Reality in Logistics -  
<https://www.youtube.com/watch?v=l8vYrAUb0BQ>
- DHL Supply Chain's Service Logistics innovation-  
<https://www.youtube.com/watch?v=kbFbsaLmFrw>
- [http://www.dhl.com/content/dam/downloads/g0/about\\_us/logistics\\_insights/csi\\_augmented\\_reality\\_report\\_290414.pdf](http://www.dhl.com/content/dam/downloads/g0/about_us/logistics_insights/csi_augmented_reality_report_290414.pdf)
- [http://www.dhl.com/content/dam/downloads/g0/about\\_us/innovation/CSI\\_Study\\_BIG\\_DATA.pdf](http://www.dhl.com/content/dam/downloads/g0/about_us/innovation/CSI_Study_BIG_DATA.pdf)

# Monitoring Mechanisms

Some technologies like

- RFID
- NFC
- QR Code

# RFID

- **Radio-frequency identification (RFID)** is the wireless non-contact use of radio-frequency electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects.





# NFC

- **Near field communication (NFC)** is a set of standards for Smartphone and similar devices to establish radio communication with each other by touching them together or bringing them into proximity, usually no more than a few centimetres.
- [List of applications of near field communication](#)

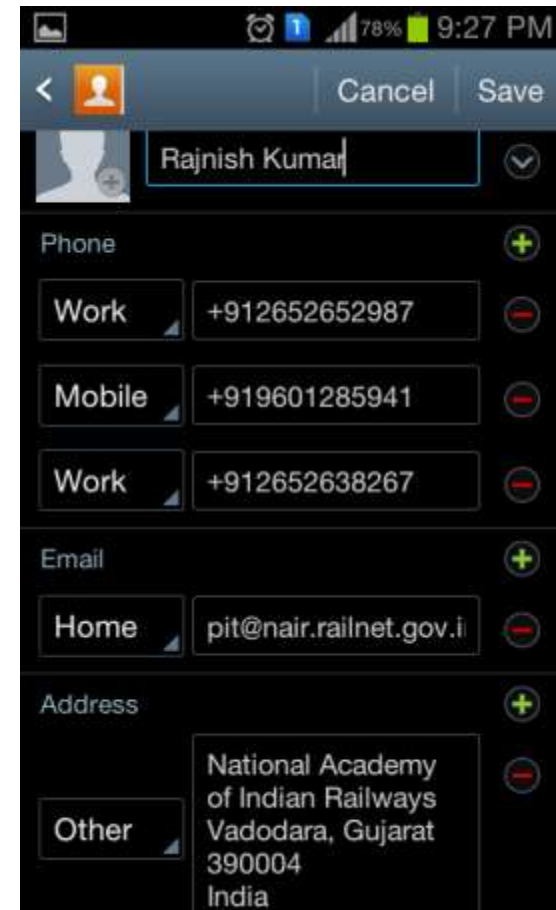


# QR Code



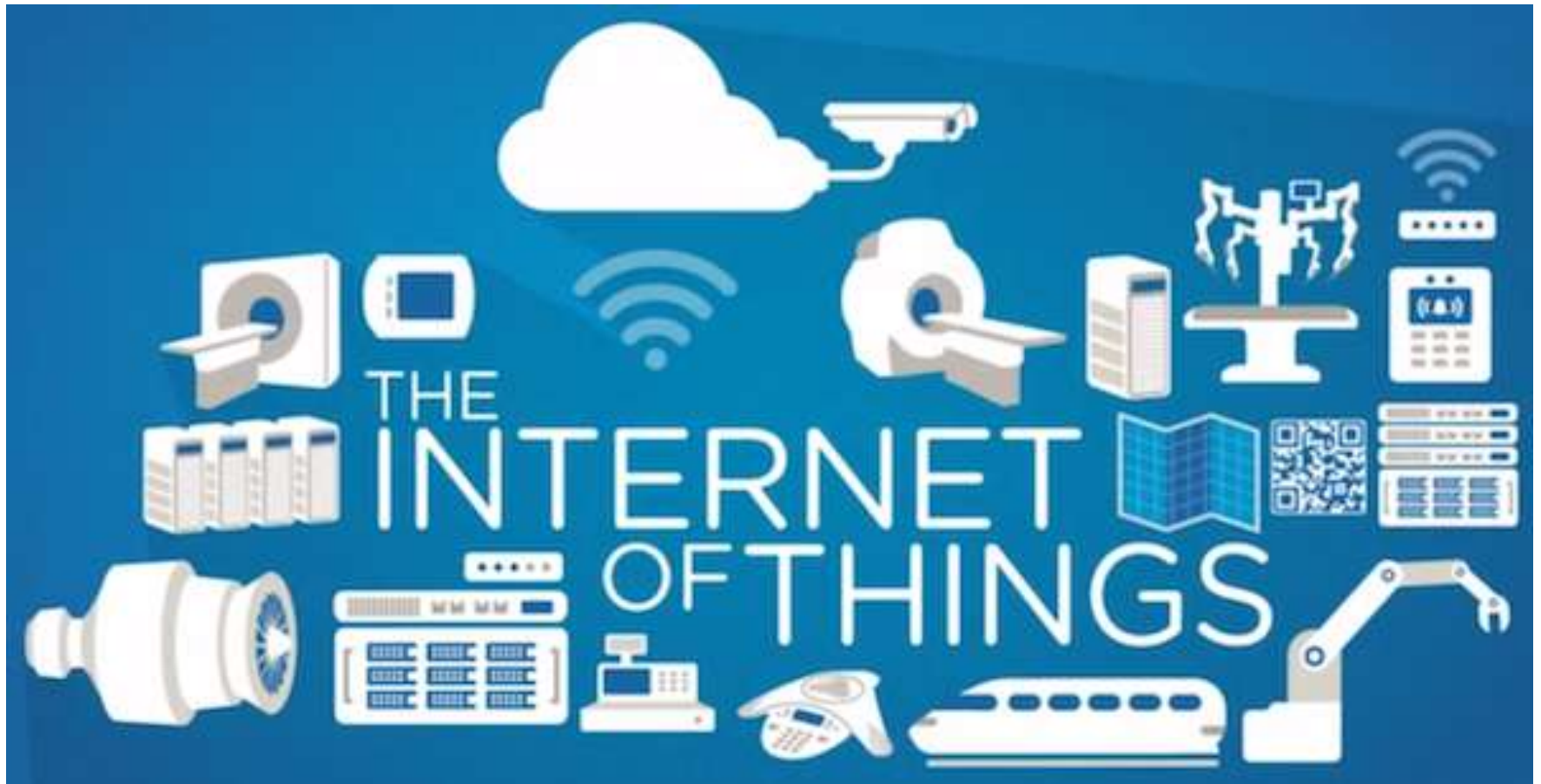
The QR (Quick Response) Code is a two-dimensional (2-D) matrix code that belongs to a larger set of machine-readable codes, all of which are often referred to as barcodes, regardless of whether they are made up of bars, squares or other-shaped elements.

# Example of QR Code





# The future



# What is IoT?

- The Internet of Things (IoT) has been defined by ***International Telecommunication Union*** in Recommendation ITU-T Y.2060 (06/2012)
- The IoT is a “network” of ‘things’ that can broadcast data and connect to the internet or to a network.
- Objects, animals or people are given unique identifiers and the capability to transfer data over a network.
- The convergence of wireless technologies, micro-electromechanical systems (MEMS) and the Internet leads to IoT.



# Potential of IoT – Internet of Things



- According to Gartner, by the 2020, there will be 26 billion devices connected to the internet, with 10 billion already connected.
- Gartner further estimates that IoT products and services will generate revenue exceeding \$300 billion in 2020. IDC on the other hand has forecast that the worldwide market for IoT solutions will grow to \$7.1 trillion in 2020.

# 2020

4  
BILLION

Connected People



\$4  
TRILLION

Revenue Opportunity



25+  
MILLION

Apps



25+  
BILLION

Embedded and  
Intelligent Systems



50  
TRILLION

GBs of Data



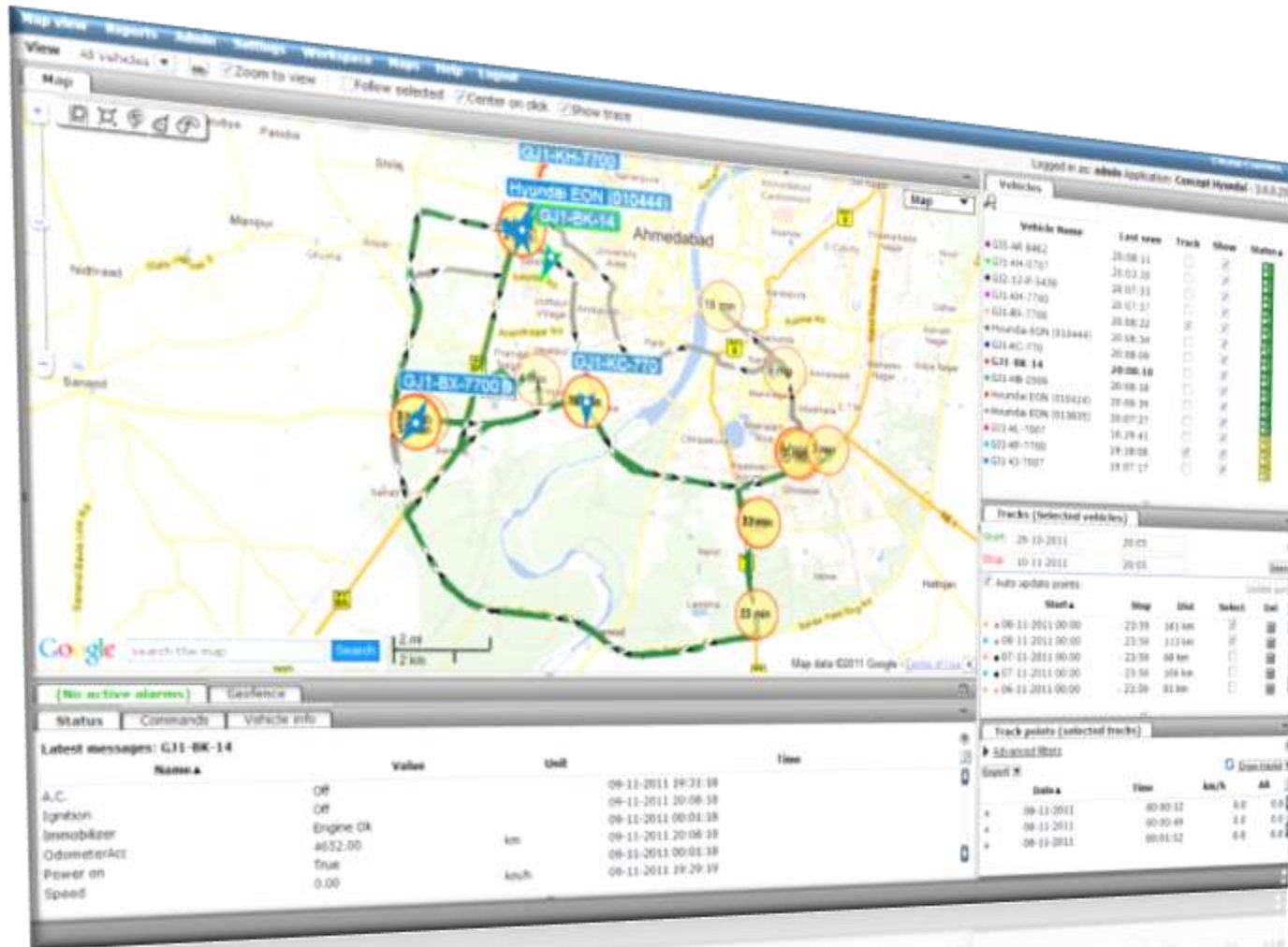
Source: Mario Morales, IDC

***By 2020, the Internet of Things will have achieved “critical mass”. Linking enormous intelligence in the cloud to billions of mobile devices and having extremely inexpensive sensors and tags embedded in and on everything, will deliver an enormous amount of new value to almost every human being. The full benefits—in terms of health, safety and convenience—will be enormous.***

**REAL LIFE EXAMPLE OF IOT**



# Cold-Storage and Supply-Chain Management



- Real-time monitoring of Cold-storages
- Regular Performance Feedback
- Business Integration
- Advanced Reporting
- Complete Supply Chain Management System under one single umbrella

## Cold-Storage – Technology Specifications

- Very Specialized Temperature Technology
- Completely Digital Temperature sensing Technology
- Measurable Temperature Range :  $-55^{\circ}\text{C} \sim +125^{\circ}\text{C}$  ( $-67^{\circ}\text{F} \sim +257^{\circ}\text{F}$ )
- Accuracy :  $\pm 0.5^{\circ}\text{C}$  @  $-10^{\circ}\text{C} \sim +85^{\circ}\text{C}$
- Maximum Resolution :  $0.0625^{\circ}\text{C}$
- Very Stable Technology: Once installed, does not require any kind of maintenance or services



# Cold-Storage - Real-Time View

- Specialized View for monitoring of the Cold-storages.
- You can see your complete supply-chain cold-storages in single view on the map.





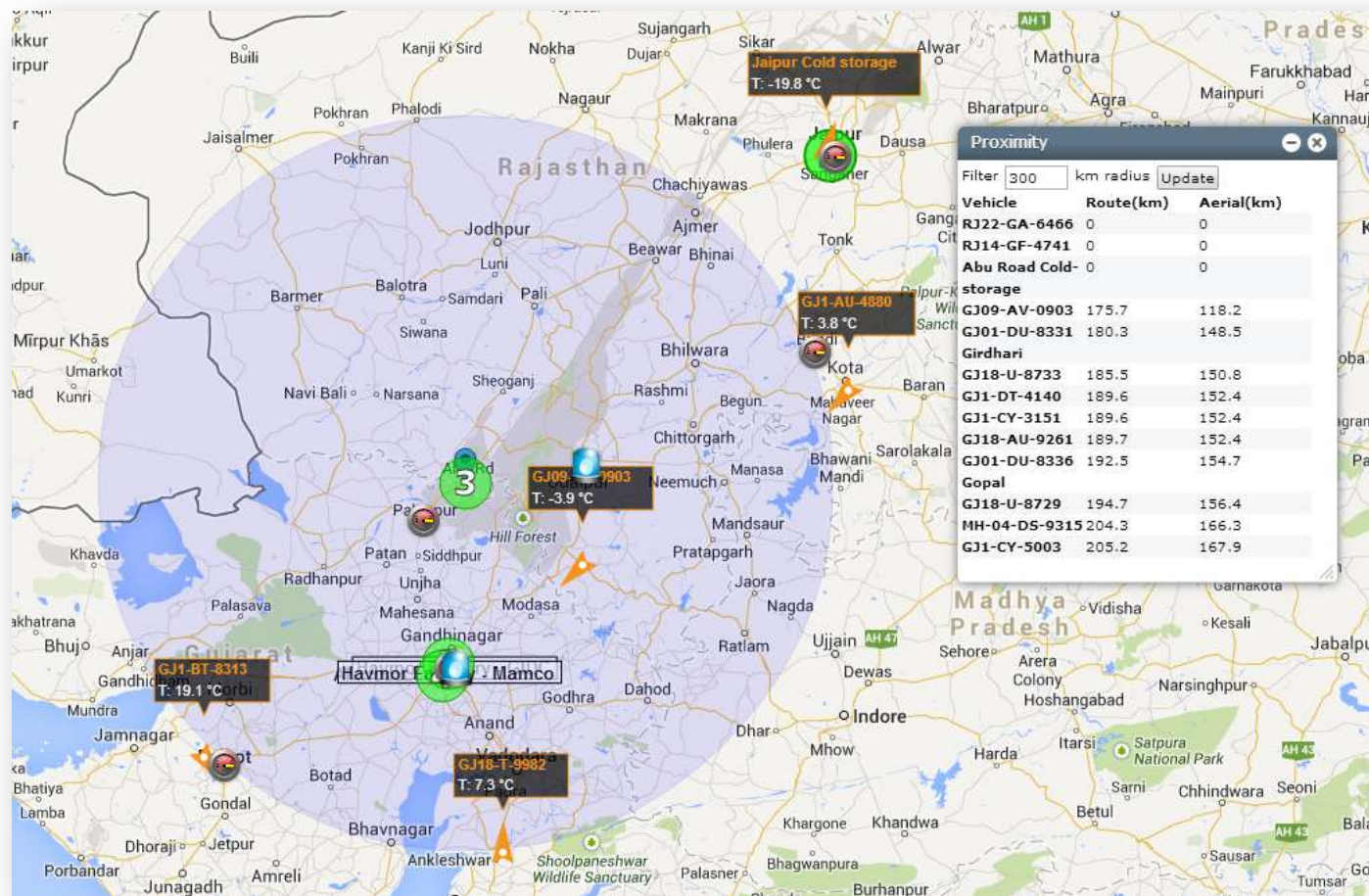
## Cold-Storage – Preventive Measures

- If units are disconnected or Temperature sensor is disconnected inside the Cold-storage, an alert can be raised on the server with actual time of disconnect.
- Supervisors are immediately notified of any such event.

Temperature	-19.70	°C	08-04-2014 18:09:22
Temperature Sensor Status	Connected		08-04-2014 00:00:12
Voltage	11.70	V	08-04-2014 18:12:22

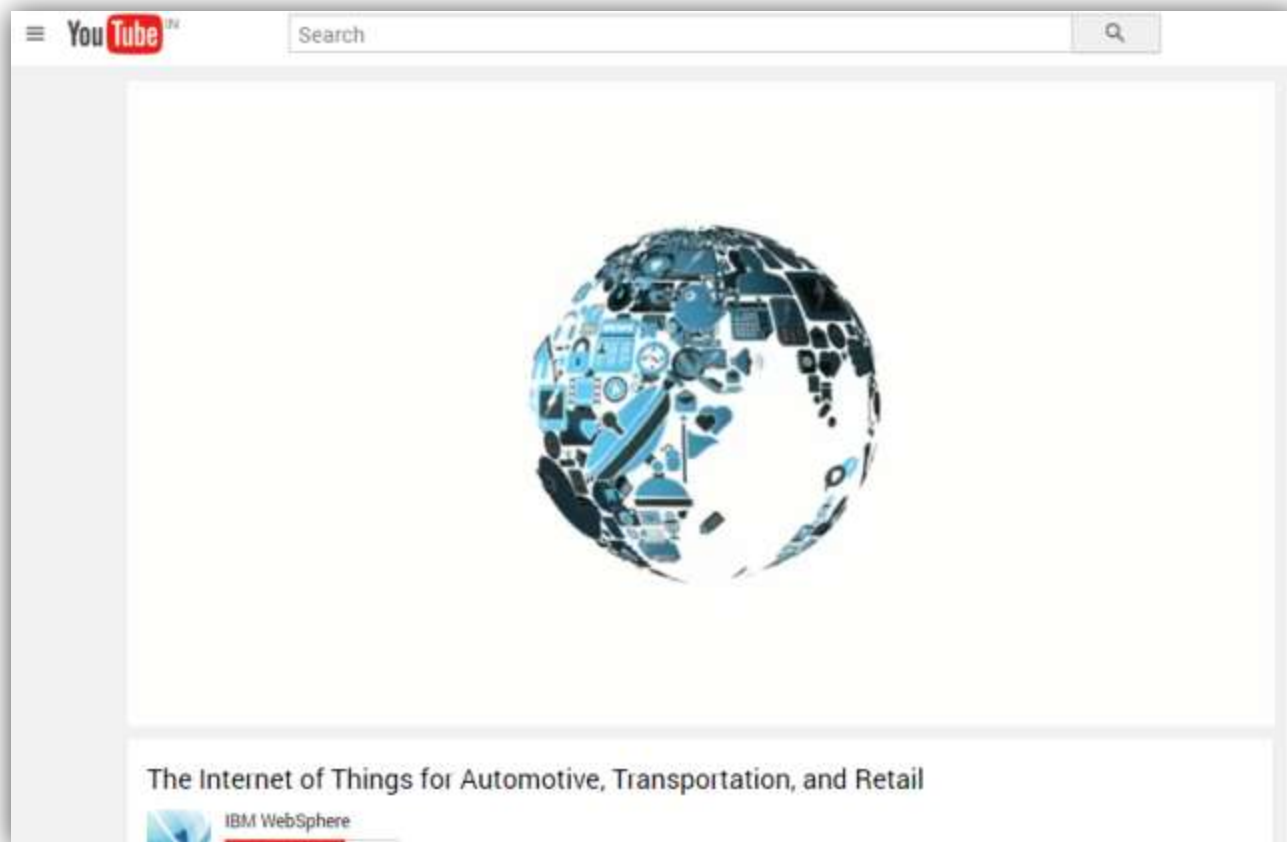
# Cold-Storage – Advanced Supply Chain Management

- For Ex: This screen shows all vehicles in 300 Km. proximity of the ABU ROAD Cold-storage.



# IoT Introduction-Potential

<https://www.youtube.com/watch?v=RFqIsAh7wqE>



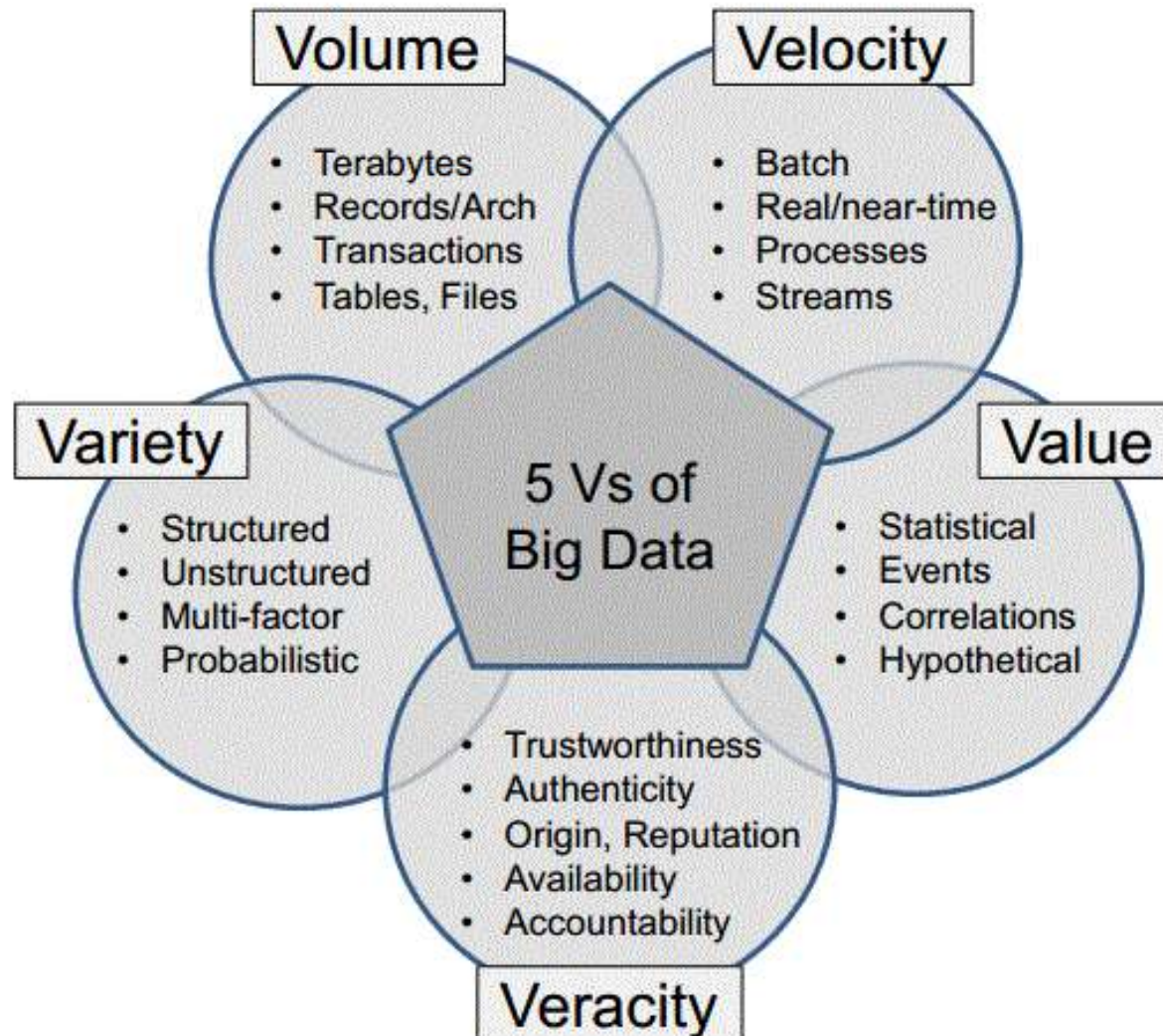
# Big Data



**Big data** is a term for **data** sets that are so **large** or complex that traditional **data** processing applications are inadequate. Challenges include analysis, capture, **data** curation, search, sharing, storage, transfer, visualization, querying and information privacy.

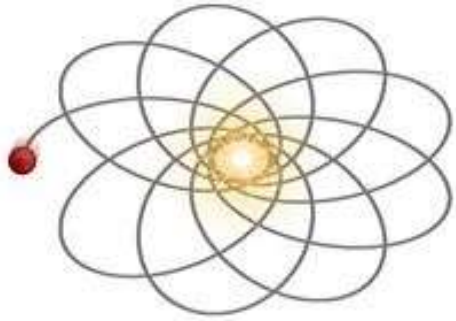


# Big Data ... just a little bit more!!!



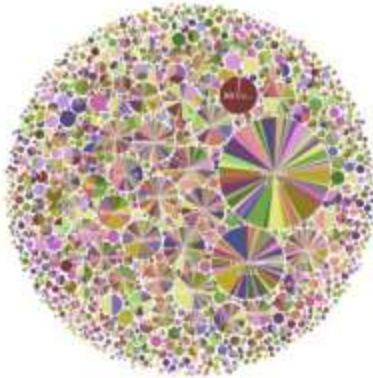
# What is Analytics?

**Mathematical or Scientific methods that highlight data for insight**



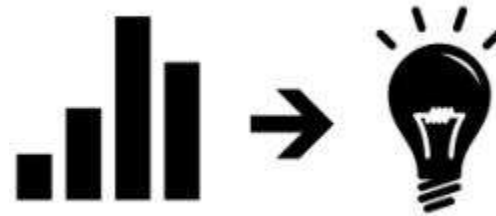
$$\lim_{n \rightarrow \infty} \left| \frac{a_{n+1}}{a_n} \right| = r.$$

**Data is becoming the world's new natural resource**



**Insight = Competitive Advantage**

**Used to inform actions and decisions**



**With analytics, insights are created to augment the gut feelings and intuition for decisions**



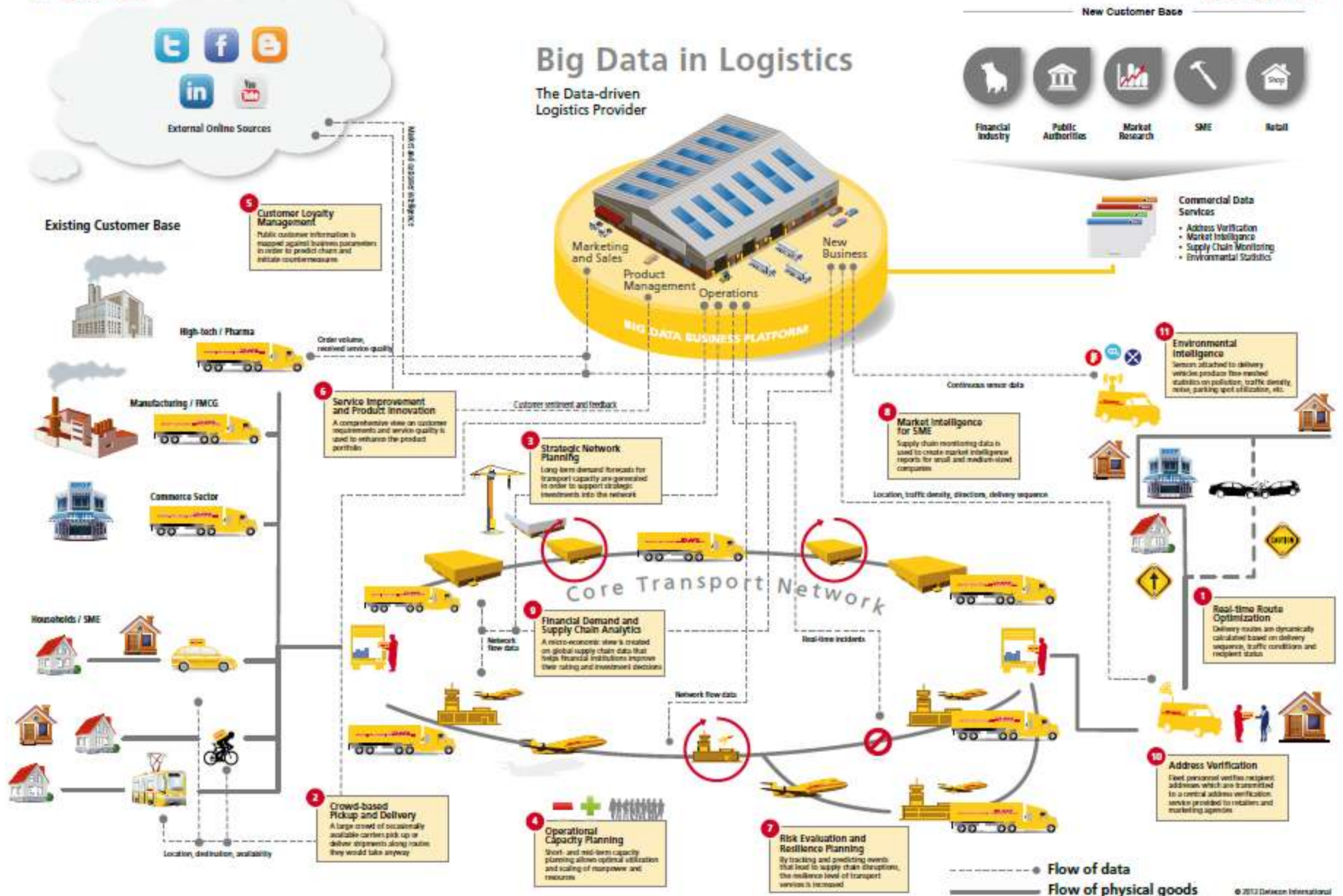
# Big Data & Analytics

A great example of Visualization

Hans Rosling's 200 Countries, 200 Years, 4  
Minutes - The Joy of Stats - BBC Four

[Link to Video](#)

<https://youtu.be/jbkSRLYSojo>





# Big Data Potential

In addition to data fusion, there is process fusion—such as standardizing processes and understanding the various interlinked processes.

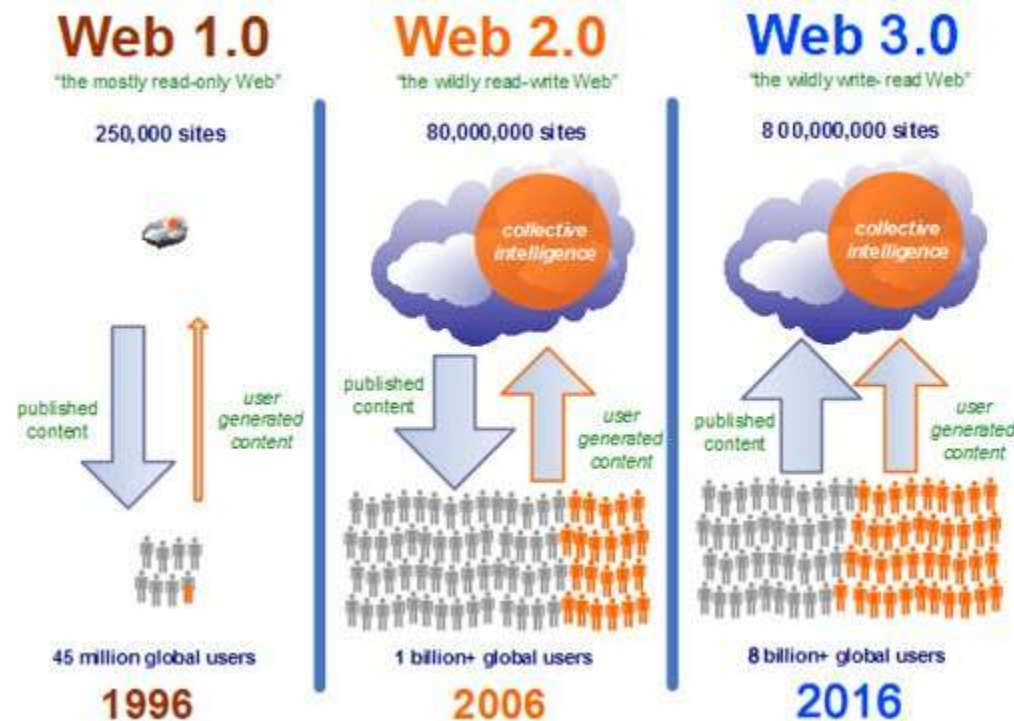
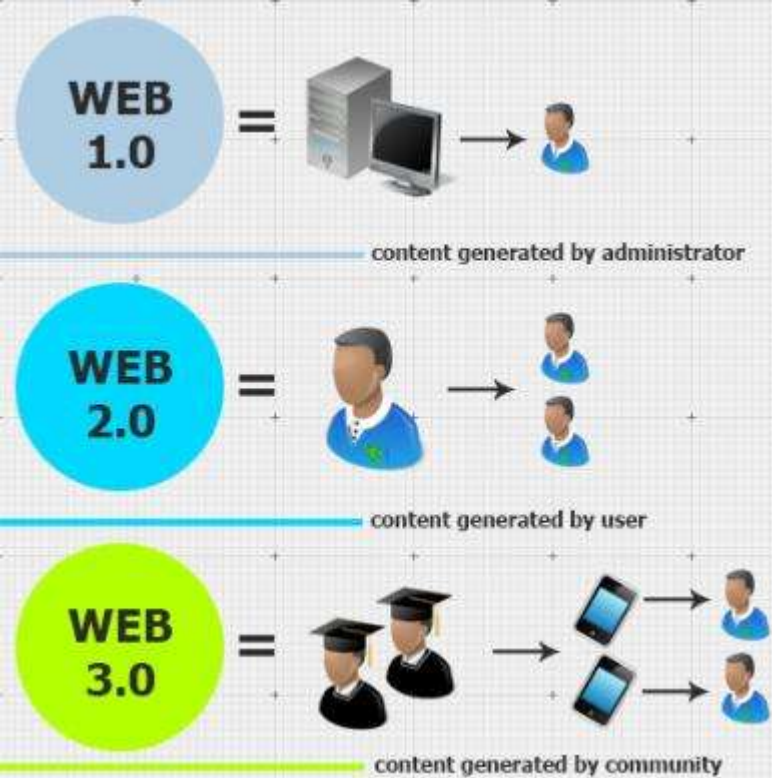
This provides operations visibility across the entire process chain, which can improve all logistics-related functions, such as:

- Distribution center sort optimization
- Back-haul activities
- Revenue and fuel management

# Cloud computing



- **Cloud computing** is a service provided by IT experts that acts as an alternative to the ongoing high-cost of investment into IT resources and management which minimises technology- and in particular user-related barriers.
- **Software as a service (SaaS)** is becoming a popular way of accessing specific software on-demand through an Internet browser via a fixed or per usage subscription fee.



# Web 3.0 and Social Networking

The development of social networks should accelerate the development of the business network sector

With social network sites such as Facebook and Twitter bringing revolutionary changes in the way individuals communicate,

The same technological platform could be used in the transport and logistics environment to facilitate instant communications between various stakeholders.

Ref: (<http://www.sciencedirect.com/science/article/pii/S0925527314002837>) .

# Yammer

-A private social network for business called Yammer has recently gained momentum. Now acquired by Microsoft

growing

COLLABORATION +  
ENTERPRISE SOCIAL NETWORKING =  
SOCIAL FOR GETTING WORK DONE TOGETHER

LAUNCHED SEPTEMBER  
2008

with a team of  
350+ employees

2012  
LEADER  
Forrester Mobile Work

2012  
LEADER  
Forrester Activity Streams Work

2012  
LEADER  
Forrester Social Network

23  
languages

USED IN  
150  
COUNTRIES

growing  
\$1  
billion

FUSING A  
get w  
SHAREPOINT  
700,  
DEVELOPERS  
building on the platform

TOGETHER  
THE MOST C

Microsoft

Yammer

Profile Settings Invite Admin Sign Out

YourCorp

find person, group, tag, message

Home Members Groups Tags Links Files Images

What are you working on?

Update

Attach file

Keith McCarty: Photo of new location being built. Supposed to be ready in 2010.  
1 attachment  
4 days ago in Your Corp

Leann Lundstedt in reply to Keith McCarty: Thanks for posting these. I was actually looking for photos from the conference for #press purposes. Can I pass these along to the New York Times, Wall Street Journal, and Forbes?  
4 days ago in Your Corp

Noah Rubin in reply to Ilya Yakubovich: Here is an .flv video file you were looking for of the TechCrunch50 presentation.  
1 attachment: TechCrunch50\_Yammer\_Presentation.flv  
4 days ago in Your Corp

Ilya Yakubovich in reply to Keith McCarty: Great Images, @marketing did a great job. Where can we get a video of the presentation?  
4 days ago in Your Corp

Keith McCarty: Check out the images from the #techcrunch50 conference. We had a wonderful presence and were well received.  
7 attachments  
4 days ago in Your Corp

Welcome  
Keith McCarty (edit)

Get Started

☐ Complete my profile  
☐ Download desktop client  
☐ Add mobile phone

My Feed

Received

Sent

All

Add Group >>



# Microsoft & Yammer

SharePoint Skype Office 365 Microsoft Dynamics

COLLABORATION +  
ENTERPRISE SOCIAL NETWORKING =  
**SOCIAL FOR GETTING WORK DONE TOGETHER**

LAUNCHED SEPTEMBER  
**2008**

with a team of  
**350+** employees



**BEST**

Collaboration System  
Forrester, Gartner, and  
Analyst

**yammer**  
the enterprise  
SOCIAL NETWORK

2012  
**LEADER**  
Forrester Mobile Wave

2012  
**LEADER**  
Forrester Activity Stream Wave

TRANSLATED  
INTO  
**23**  
languages

USED IN  
**150**  
COUNTRIES

growing like crazy

**\$1**  
billion

SHAREPOINT  
**FASTEST BUSINESS**  
to reach \$1 billion



YAMMER adding  
**250,000**  
users per month

FUSING A PLATFORM TO HELP PEOPLE  
get work done

SHAREPOINT  
**700,000**  
DEVELOPERS  
building on the platform

YAMMER  
**150** &  
COUNTRIES **23**  
LANGUAGES

**TOGETHER WE WILL DELIVER**  
THE MOST COMPLETE SOLUTION IN THE MARKETPLACE

**Microsoft**

[www.microsoft.com/news/presskits/office/](http://www.microsoft.com/news/presskits/office/)

# Key Enabling Factors for Multimodal Integration

## Data standards

Development of common global standards such as General Transit Feed Specification (GTFS)

GTFS allows transit agencies globally to share information in a standardized format with developers of multimodal trip applications

## Technology advancements

Advancements in technologies for real-time vehicle tracking, and real-time information at transit stations and on mobile phones

## Role of major technology companies

Investments by companies such as Google, IBM, Siemens, Cisco, and Panasonic to promote smart urban mobility

Google Transit, which provides multimodal transit planning service, has expanded to over 250 cities in 67 countries, since its launch in 2005 in Portland, Oregon

## Role of application developers

A growing community of start-up application developers, who are developing innovative apps using GTFS data, for multimodal trip planning.



# Future Outlook

## Ocean Freight

- Maritime Agenda 2010-20 objectives will be a key driver
- Growth of non-major ports, containerisation and east coast ports
- BOT terminals opened for international bidding

## Rail Freight

- Rising investment in the rail will fuel growth in allied industries
- Wagon manufacturing, port handling equipment, railway electrification systems and construction companies key areas

## Air Freight

- Tier-2 cities next cargo centres
- Development of 25 greenfield airports in Tier-2 and Tier-3 cities
- Modernization of 35 non-major airports

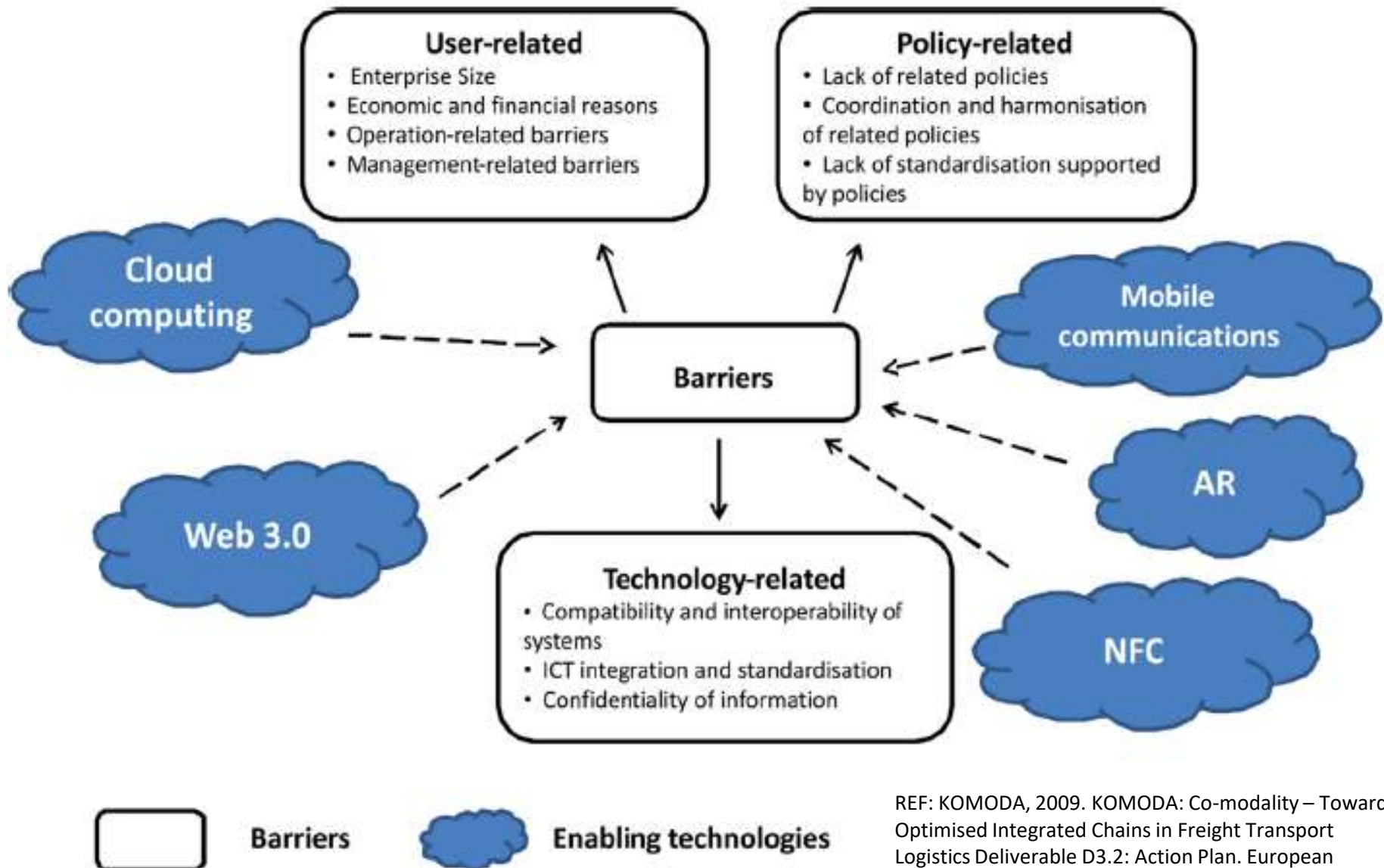
## Trucking

- About 110 new logistics parks are expected to be operational
- Spread over approximately 3,500 acres at an estimated cost of USD 1 Billion

## 3PL Services

- Companies currently outsource an estimated 52% of logistics, and 3PL represents only 1% of logistics cost – huge potential
- Revenue expected to increase from USD 1.2 Billion (2010) to USD 4 Billion (2015)

# Barriers to Adoption of Technology



REF: KOMODA, 2009. KOMODA: Co-modality – Towards Optimised Integrated Chains in Freight Transport Logistics Deliverable D3.2: Action Plan. European Commission within the Seventh Framework Programme (2007–2013).

# Barriers to ICT implementation

- Large investment requirements,
- The implementation costs,
- Managing and maintenance costs
- **Operation-related barriers** include human capital issues such as difficulty in employing qualified personnel,
- Lack of ICT specialists, and personnel skill shortage to operate new applications,

# Barriers to ICT implementation

- Management capability has a large impact on how companies perceive the adoption of ICT.
- For example, the uncertainty of commercial success with regard to ICT applications, including a lack of knowledge on payback times and unclear returns on investment, seems to act as an obstacle hindering organisations from investing and implementing ICT applications in multimodal transport.

# The technology-related barriers

- Relate to the technological constraints that prevent operators making full utilisation of ICT applications, including the issues such as interoperability of systems, ICT integration, standardisation, security and data protection
- Low compatibility may exist between these ICT applications thus serving as a key barrier to the interconnectivity between different applications and integration with future applications.
- The interconnectivity of applications used by different actors in multimodal transport is of vital importance for reliable and efficient cargo movement.

# References

- Irina Harris, Yingli Wang, Haiyang Wang, ICT in multimodal transport and technological trends: Unleashing potential for the future, International Journal of Production Economics, Volume 159, January 2015, Pages 88-103, ISSN 0925-5273, <http://dx.doi.org/10.1016/j.ijpe.2014.09.005>.  
(<http://www.sciencedirect.com/science/article/pii/S0925527314002837>) .
- BELOGIC EU project: <http://www.be-logic.info/>
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Discussion