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March 23-26, 2015  
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# The Future of Robotics in the Warehouse

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Presented by:

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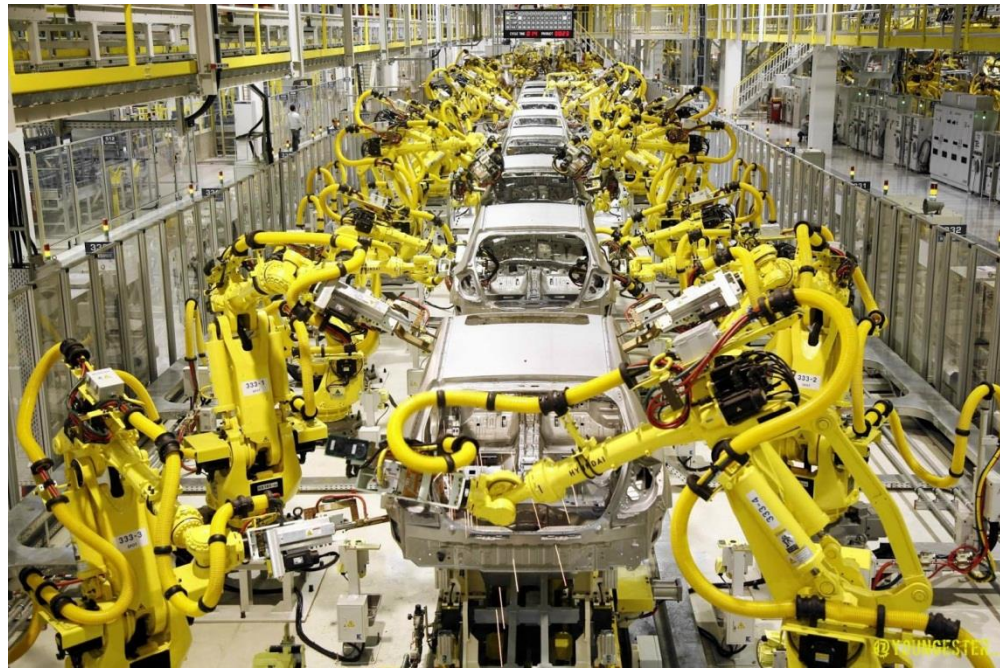
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## Presentation Goals

- What does the current landscape look like?
- What are some of the key industry trends & developments
- How will these impact the use of robotics technology in the warehouse activities

## What is Robotics

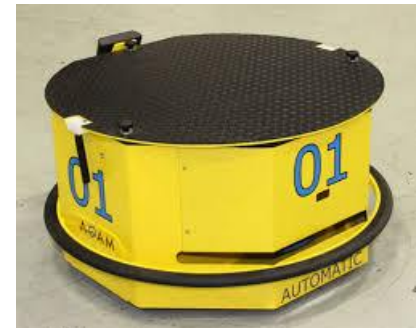
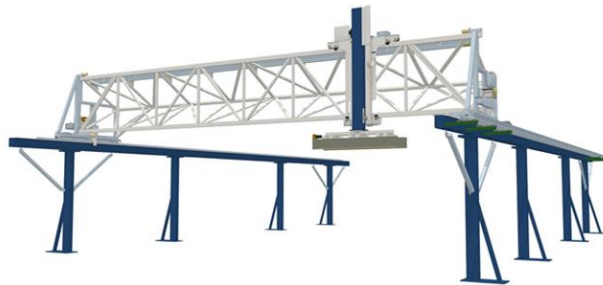
- The branch of technology that deals with the design, construction, operation, and application of robots





## What is a Robot?

- A machine capable of carrying out a complex series of actions automatically, esp. one programmable by a computer.
- Robot = Automation
- Automation does not necessarily mean robot





## Traditional Warehouse

- Pallets in -> store -> pallets out
- Lights-out warehousing has been around for many years
- Technology is very mature
- There has never been a better time to invest
  - Palletizers
  - ASRS
  - Layer Pick
  - AGV

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# ASRS





## Layer Picking Robots

- Can hold hundreds of SKUs
- High throughput, good ROI



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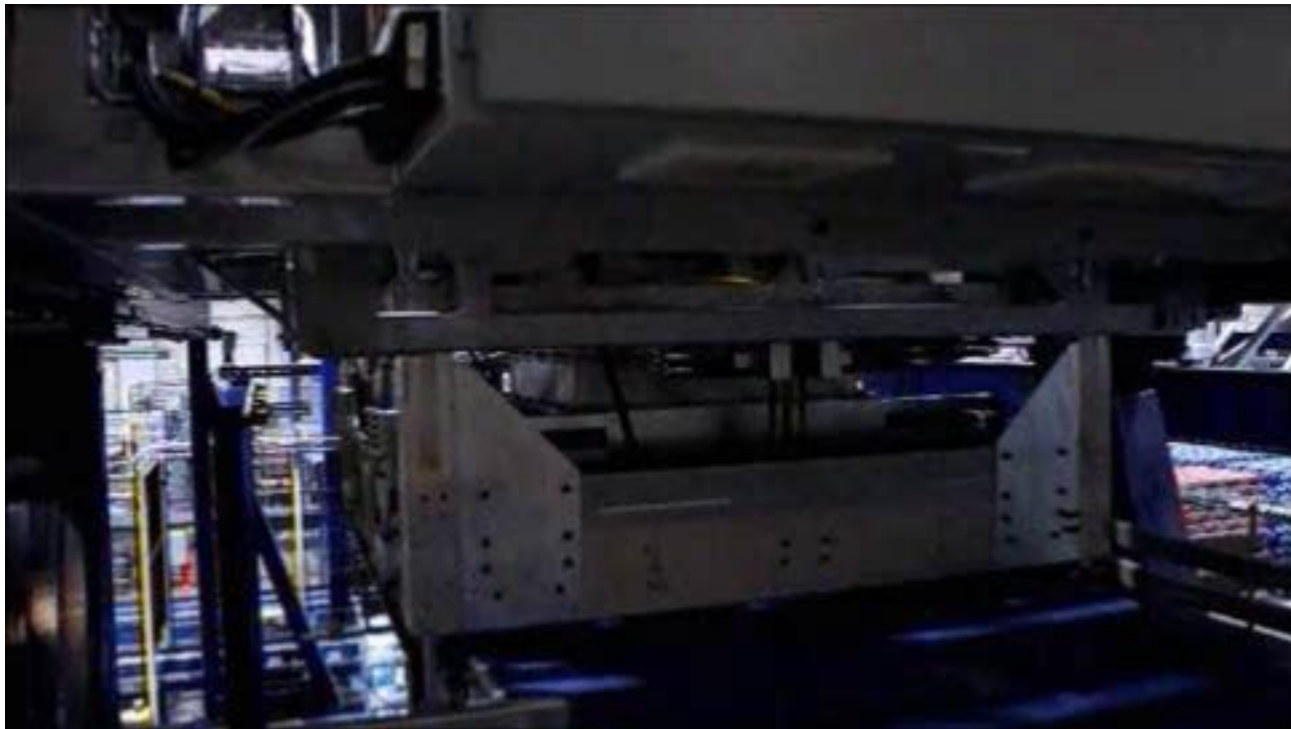
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## Case Picking Robots

- Can hold hundreds of SKUs
- Pick 1, 2.... 10 cases @ time







## Goods To Person Robots

- Can hold thousands of SKUs
- Maximize human traits
- Goods to Robots Robots?



## Order Fulfillment Centres

- Multi Channel under one roof
  - Wholesale (pallet, layer)
  - Retail (DSD – case, piece)
  - Online / Mobile (piece)
- More orders
- More complexity
- Faster turnaround
- ✓ Robotics can help with all of this



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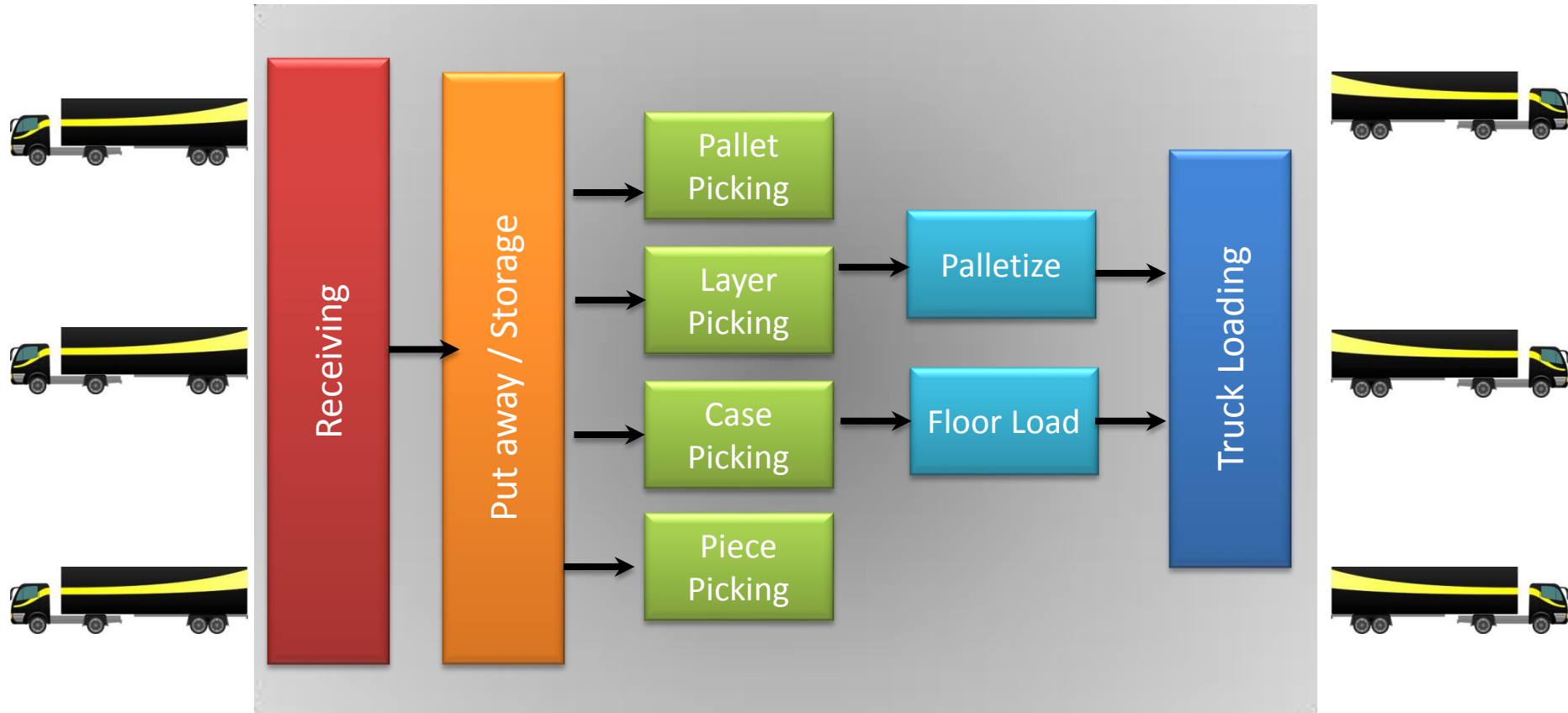


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## Material Flow



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## Industry Trends/Forces

1. Algorithms
2. Sensing Technology
3. Open source software
4. Big Data
5. Processing Power



## Algorithms

- Logic will continue to progress exponentially
- Processing power plays a big part
- Better logic will make for a more efficient system



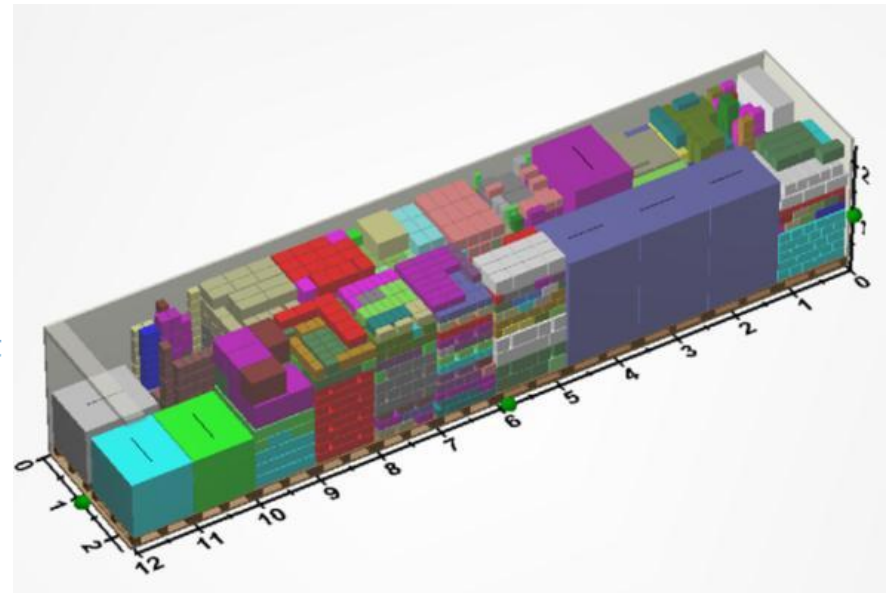
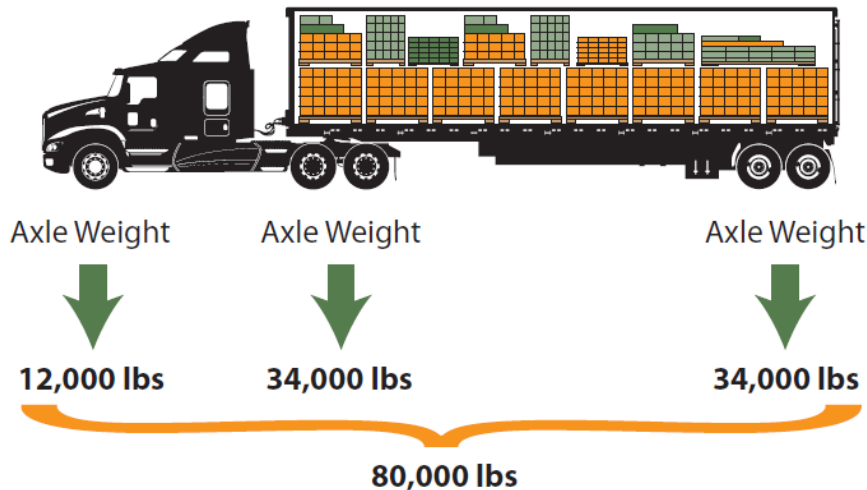
## Algorithms – Mixed Palletizing

- Mixed pallet build logic has created new application for robotics
- More stable loads
- Better cube utilization



## Algorithms – Load Planning

- Extended to trailer load planning
- Better planned pallets can mean better planned loads



## Algorithms

- Better planned loads can mean better planned routes
- Better planned routes means faster, more efficient deliveries
- Less trucks, less drivers
- Savings can be in the millions
- All enabled by Robotics





## Sensing Technology

- Most robotic operations have been based on targeting
- BCR, Photo eyes, encoders etc.
- Rely on electrical inputs and outputs to figure out where things are



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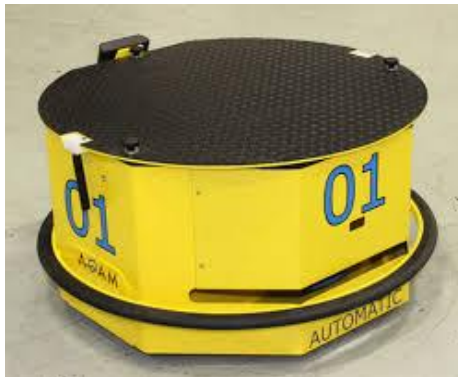
## Sensing Technology

- More powerful processors & algorithms are allowing for more complicated operations



## Sensing Technology Application

- Autonomous Mobile Robots
- More flexibility than traditional AGV
- Laser range finder for localization and obstacle avoidance





## Motion Sensing Devices

- Off the shelf gaming device is becoming a standard for low cost, high flexibility vision based robotic control
- Applications using this sensing have not moved into the industrial space as they have not proven to be robust enough for the environment
- .....but it's close
- Open source application development a key
- Will industry embrace it?
- Will end users develop it?





## Sensing Technology Application

- Hobby robot
- Low cost open-source robot
- \$ 2,000



CALU: Collision Avoidance  
with Localization Uncertainty

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## Sensing Technology Application

- Gaming sensor being industrialized at a fast pace



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# Sensing Technology Application



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# Sensing Technology Application Trailer Unloading





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# Sensing Technology Application Trailer loading



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## Sensing Technology Application

- Combines 2D & 3D image processing
- No pre-programming of SKUs necessary



## Robots working alongside Humans

- Leverage advantage of each other
  - Complimentary tasks
  - Repetitive tasks (robots)
  - Dexterity / variety (humans)
- Advances in safety systems
  - Vision, sonar, lasers
  - Torque sensing motors



## Cage-free robot

- 360° sonar & camera
- Slows speed when humans close by
- Torque sensing motors
- Compliant joints
- No sharp edges
- Vision cameras



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**Robot Working Alongside Humans**

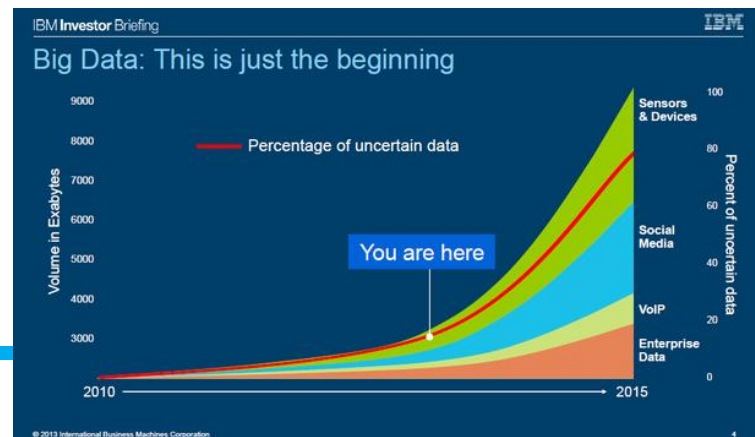


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## Big Data

- Big data is a popular term used to describe the exponential growth and availability of data, both structured and unstructured
  - Transaction data, sensors, machine-machine
  - Unstructured text documents, email, video, audio, stock ticker data and financial transactions





## Industry Trends/Forces

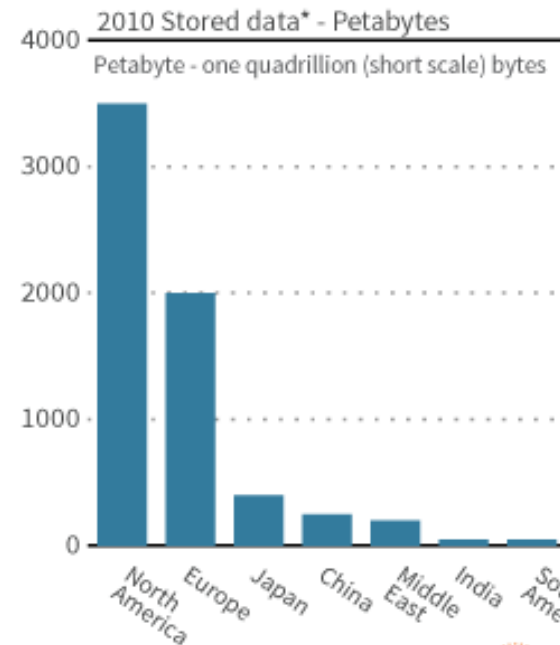
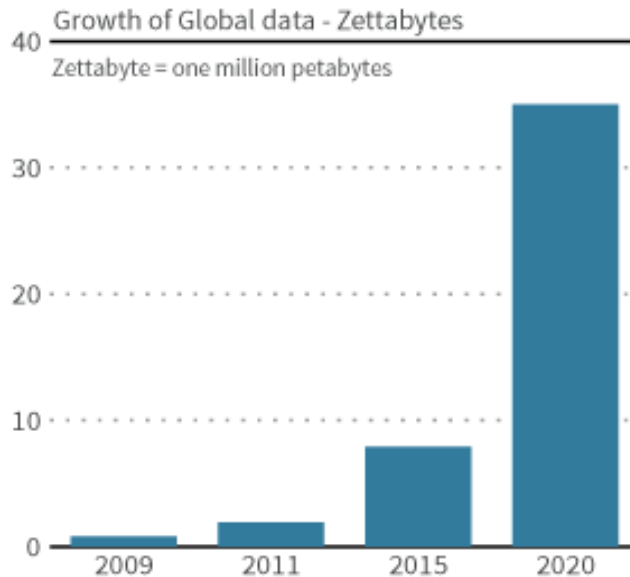
- Big data may be as important to business – and society – as the Internet has become
- Why? More data may lead to more accurate analyses
- More accurate analyses may lead to more confident decision making.
- Better decisions can mean greater operational efficiencies, cost reductions and reduced risk.



## Industry Trends/Forces

### Big data growth

Big data market is estimated to grow 45% annually to reach \$25 billion by 2015

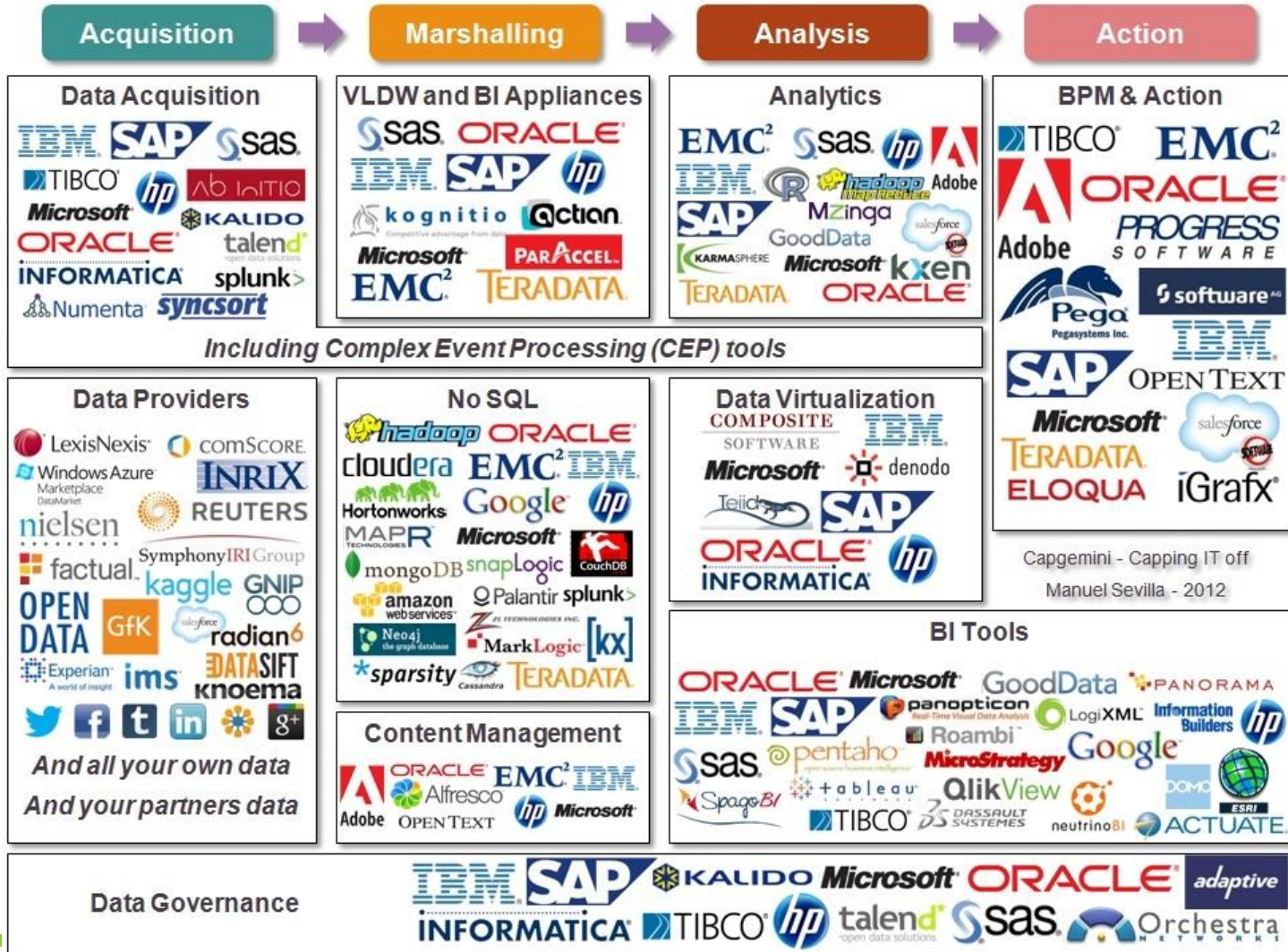


\*greater than  
Sources: Nasscom -CRISIL GR&A analysis





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## How can Big Data influence Robotics in the Warehouse?

- Analytics can optimize a system solution like never before
- Big Data, Analytics & Algorithms will give robotics the smarts it needs to be viable

## Finnish Dairy Example

Finnish Dairy empowering the robotic picking system to plan production

- Keep record of historical orders (volume, SKUs, seasonal)
- Look ahead to actual orders ( up to 48 hrs)
- Use analytics to find the optimal mix of
  - Satisfy customer orders without fail
  - Inventory level
  - Maximize production line efficiency
- Better decisions can mean greater operational efficiencies, cost reductions and reduced risk.



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## Summary / Takeaways

- Data collection, processing power & algorithms means we can design more complicated and efficient solutions
- Advancements in sensor technology will allow robots to do more than what is practical today
- More affordable sensors & Open Source robotics will allow more Small & Medium sized companies to be able to afford robots

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Or visit ProMat 2015 Booth 4237