Supply Chain Management:
Where do we go from here?

Yossi Sheffi

Professor of Engineering, MIT
Director, MIT Center for Transportation and Logistics

Zaragoza, Spain
3 April, 2003

Supply Chains are Tough to Manage

GM announces temporary layoffs to adjust inventory

November 9, 2001

...RESS

...ut 4,000 wo...
...orp. assem...
...off next we...
...ter shuts do...
...to adjust...
...pokesman...

An asse...
Towns...

Posted at 4:45 p.m. EDT Friday, Octo...

Goodyear acknowledges shortage

On the eve of NAS...
races this weeken...
Motor Speedway,...
Co. officials tosse...
into what had been...
devoid of controv...

Friday, NASCAR changed the right-side tires used by Grand National teams this weekend and shipped them over to the Winston Cup garage in hopes of preventing a shortage of tires in Sunday's UAW-GM Quality 500 Winston

*An unidentified...
Goodyear wor...*

Intel Experiences Some Shortages In Pentium II Chips

...l Signals

Semiconductor manufacturers
The great chip glut

Pal...
prod...

By Ian F...
Staff Wri...

USX's Net Income Declines 26% On Inventory-Related Oil Charge

Shortages of an Intel Microprocessor Create Backlogs, H...

NASCAR it did not have enough right-side tires for teams to use in Sunday's race. ...
shortage is a result of losing "several hundred" tir...

is chopping the price of several of its older models.

Palm is cutting the price of its Palm Vx from $349 to $299, after having already trimmed the price last month with the announcement of two

Trends

1. Globalization
2. Customer power
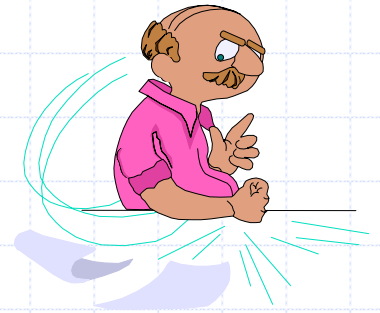3. Information and communications technology
4. Outsourcing
5. Security issues

Trend 1:
Globalization

- Long and complex supply lines
- Global distribution
- Global competition

Customer Power

- **High level-of-service expectations**
  - Determined by other verticals
- **Explosion of SKU-s**
- **Short product life cycles**
- **Strong pricing pressures**
  - "cost-based" pricing => "price-based" costs
- **Lower customer loyalty**

Trend 3:
Info. & Comm. Technologies

- ◆ Huge advances is technology
  - ▪ ERP, APS, CRM,…
  - ▪ Still implantation, compatibility and integration problems
- ◆ The internet
  - ▪ New channel
  - ▪ New communications medium
  - ▪ New integration and collaboration medium
  - ▪ Reduction in S/W costs (ASP)
  - ▪ Information dissemination (higher customer expectations)
- ◆ Strengthen other trends:
  - ▪ Short product life cycles
  - ▪ High customer expectations (instant communications)

Outsourcing

- ◆ More actors in the supply chain
  - ▪ The rise of contract manufacturing
- ◆ Need for collaboration – greater than ever
  - ▪ Partnering as a core competency
- ◆ The rise of 3PL/4PL

Trend 5:
Security

- ◆ Terrorism
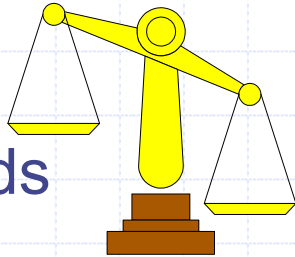 - ▪ Supply disruptions
  - ▪ Changes in demand patterns
- ◆ The war on terror
  - ▪ Increased security costs
  - ▪ More laborious procedures
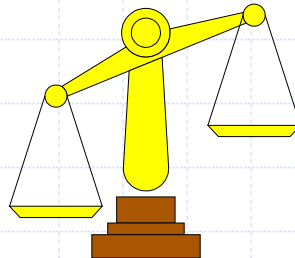 - ▪ Government reaction to attacks

Need for Balance

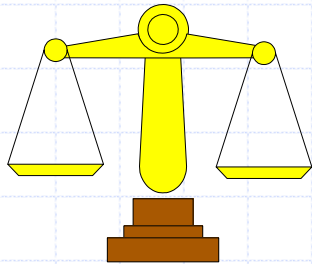Partnerships; information sharing

Security needs

Commodity suppliers (e-markets)

Cost pressures

Level of service and innovation pressures

Two Main Corollaries and Challenges

- Much more difficult to forecast

- Need for full system optimization

Reactive Variability Management: Forecasting (5 Rules)

1. The (Point) forecasts are always wrong
2. Aggregate forecasts are more accurate
3. Forecasts over shorter time horizon are more accurate
4. Having a long history helps
5. Somebody else usually has some idea what is going on

Many of the trends mentioned before exacerbate the difficulty in forecasting

Proactive Uncertainty Management

- Risk pooling/Postponement
- Build-to-order
- Double ordering
- Collaboration
- Technology
- Agility

Uncertainty Management:
Risk Pooling

It is easier to forecast aggregate variables over time, space, products, etc.

$$CV = \frac{\sigma}{\mu}$$

Coefficient of variation

Y-axis: **Coeff. of var.** (1, 0.8, 0.6, 0.4, 0.2, 0)

X-axis: **Number of Random Variables** (1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25)
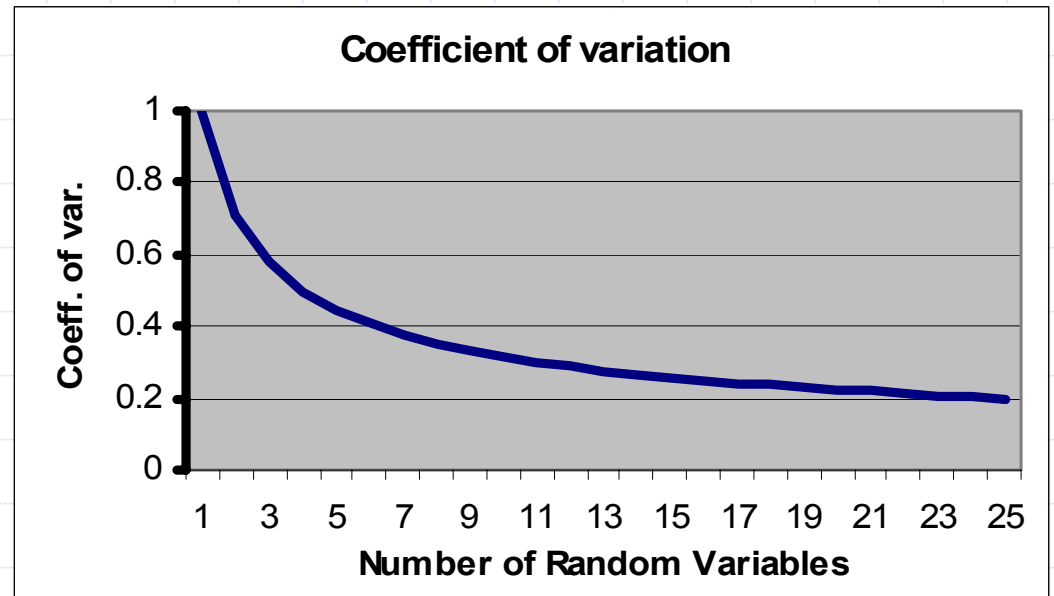
Uncertainty Management:
Examples: Risk Pooling and Postponement

◆ Cadillac automobiles in Florida

◆ Benetton for sweaters and T-shirts

◆ HP European printers

◆ Gillette for blades in Europe

◆ Sherwin Williams paint

◆ Motorola modems

◆ Zara Fabrics

◆ Dell build-to-order

Nine West Offerings

◆ Nine West **InCrowd**

$64.95

◆ Nine West **Alsina**

$66.95

Traditional Supply Chain

```
┌──────────────┐   ┌──────────────┐   ┌──────────────┐   ┌──────────────┐        ◇          ┌──────────────┐
│ Shoe sample  │   │ Samples OK   │   │              │   │  Delivery    │      Sales?   Yes  │ Sell-out or  │
│  ordered     │──▶│ & production │──▶│  Production  │──▶│     To       │──▶  ◇       ──────▶ │ Mark-downs   │
│ from factory │   │   ordered    │   │              │   │   stores     │        ◇          └──────────────┘
└──────────────┘   └──────────────┘   └──────────────┘   └──────────────┘
```

Very well ────▶ Stock-out

Poor ────▶ Send to 2nd or 3rd channel at a loss

Improved Supply Chain

1000 Shoe sample ordered → **Samples air-freighted to 5 US stores** → **Sales in test stores?**

- Very well → **Increase production**
- Yes → **No change to plan**
- Poor → **Decrease production**

production ordered → **Production** → **Delivery to stores** / **Delivery to 2nd or 3rd channel**

Uncertainty Management:
Supply Chain Collaboration

JMI

"Pull"

"Lean"

VMI

QR

CPD

X-Dock

CPFR

CMI

Partnerships

CRP

JIT II

ECR

CFAR

Outsourcing

Multi-tiered purchasing

Core suppliers

Risk sharing contracts

JIT

- Daily execution
- Project-level execution
- Philosophy

SMI

keiretsu

MIT
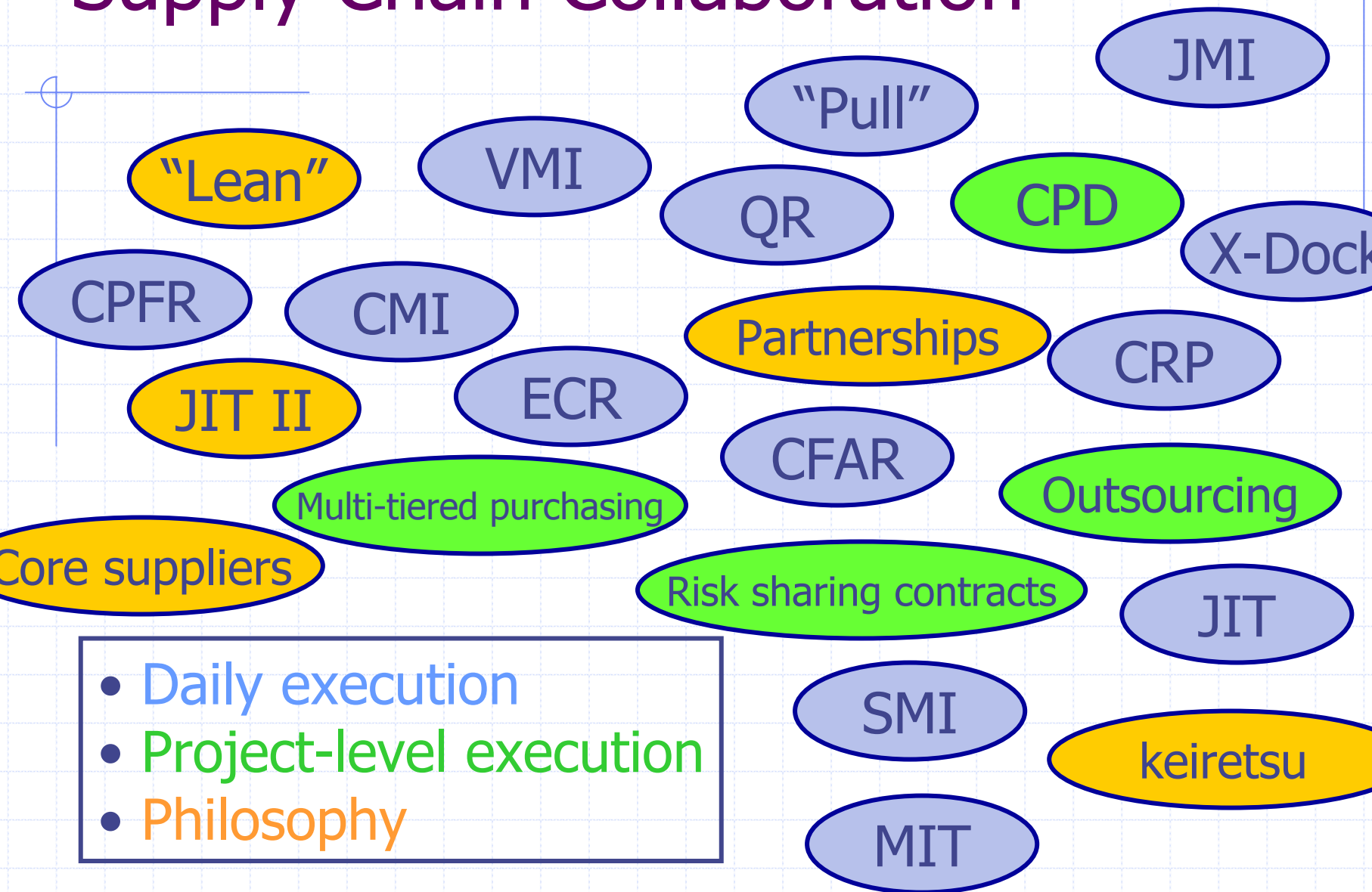
Uncertainty Management:
CPFR: Spotting Exceptions

Yossi Sheffi, MIT
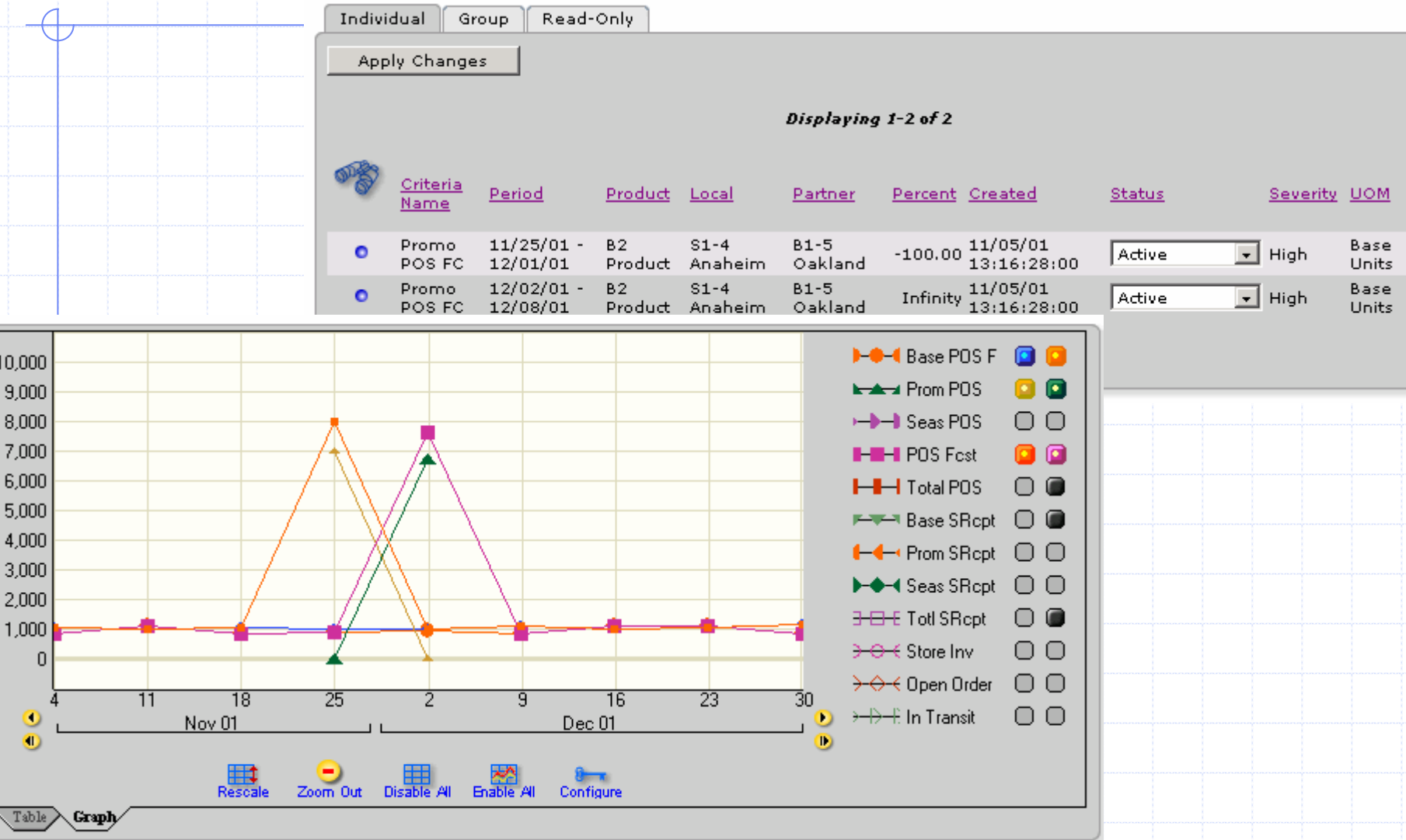
Uncertainty Management:
CPFR Pilots

Planter nuts items **Wegmans** *makes great meals easy* NABISCO

Depend product line K mart Kimberly-Clark

Women's underwear items WAL★MART SaraLee

Various items Procter&Gamble

WAL★MART TESCO MEIJER *A Million Reasons. A Single Store.* ⊙ TARGET Sainsbury's *making life taste better*

Uncertainty Management:
Technology - AutoID

Data base storing product information

Reader / Data processing

product

Identity tag with unique ID
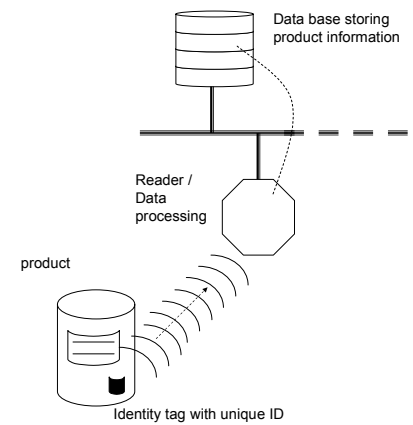
- ◆ RFID
  - Unique electronic product code (item level)
  - Networked readers
  - Shared database and DSS
- ◆ Advantages over bar codes:
  - Continuous reading
  - No line of sight
  - Bulk reading
  - System is more accurate than manual bar code readers
  - More data: "each" tagging
  - Approximate location information

Uncertainty Management:
Technology - AutoID

Data base storing product information

Reader / Data processing

product

Identity tag with unique ID
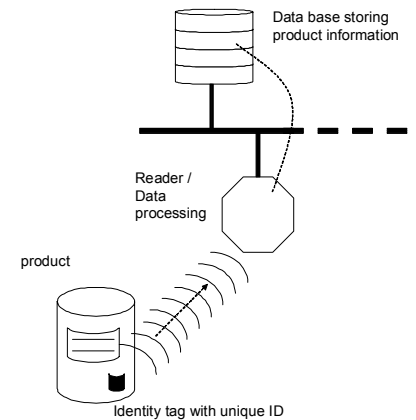
- Improving the exiting game:
  - Supply chain visibility (also behind walls; delayed optimization)
  - Theft prevention (Gillette)
  - Recalls: (Goodyear, J&J)
  - Conveyance tracking (CHEP pallets, M&S food trays, containers, trailers))
  - Continuous inventory counts (in-store operations, DC…)
  - In-facility location (phantom inventory)
  - Speeding up processes (checkout, DC pickup…)
- New Games:
  - Retain the information for home use and disposal
  - Smaller stores with higher (automatic?) replenishment
  - New warehouse designs
  - Dynamic fulfillment

System Optimization

- Yield management
- Advanced supply contracts
- Optimized MRP, TMS
- Optimized procurement

The challenge: Combining all the elements into an overall optimized supply chain, allowing the enterprise to be both lean and agile.

Any Questions?

Yossi Sheffi
sheffi@mit.edu