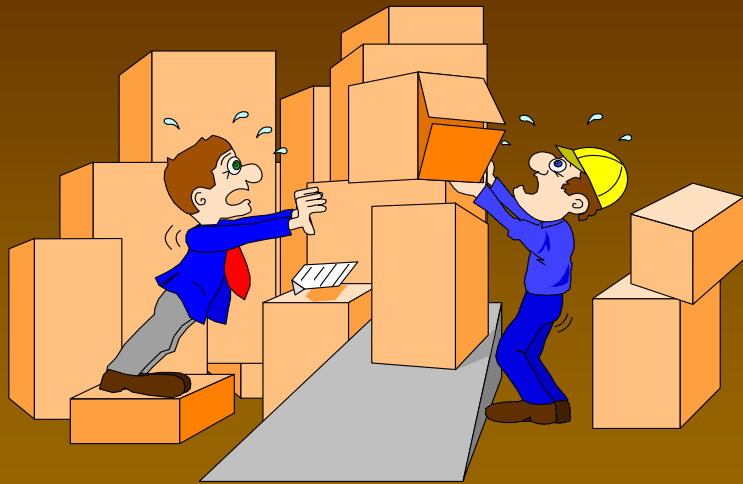# Inventory / Information Trade Offs:
the answer to today's rising costs of inventory

Friday August 17th, 2007

Thomas L. Freese

Principal, Freese & Associates, Inc.

f&a

How do you make sense of safety stock requirements with SKU proliferation, increasing customer expectations, supply chain interruptions and the growing list of issues all supply chain professionals must face everyday?   As the cost of carrying inventory rises and the cost of information (future demand) falls, now is the time to understand the trade offs available between more accurate information / forecasting and inventory.

This session will examine;

- ✓ the use of inventory to address the unknown,
- ✓ the increasing costs of inventory,
- ✓ the impact of incorrect inventory,
- ✓ the components of inventory carrying costs,
- ✓ the availability of insight into future requirements,
- ✓ the ways that information systems, collaboration and information exchange can lower costs while at the same time increase market share, and
- ✓ a look at the future of information inventory relationships.
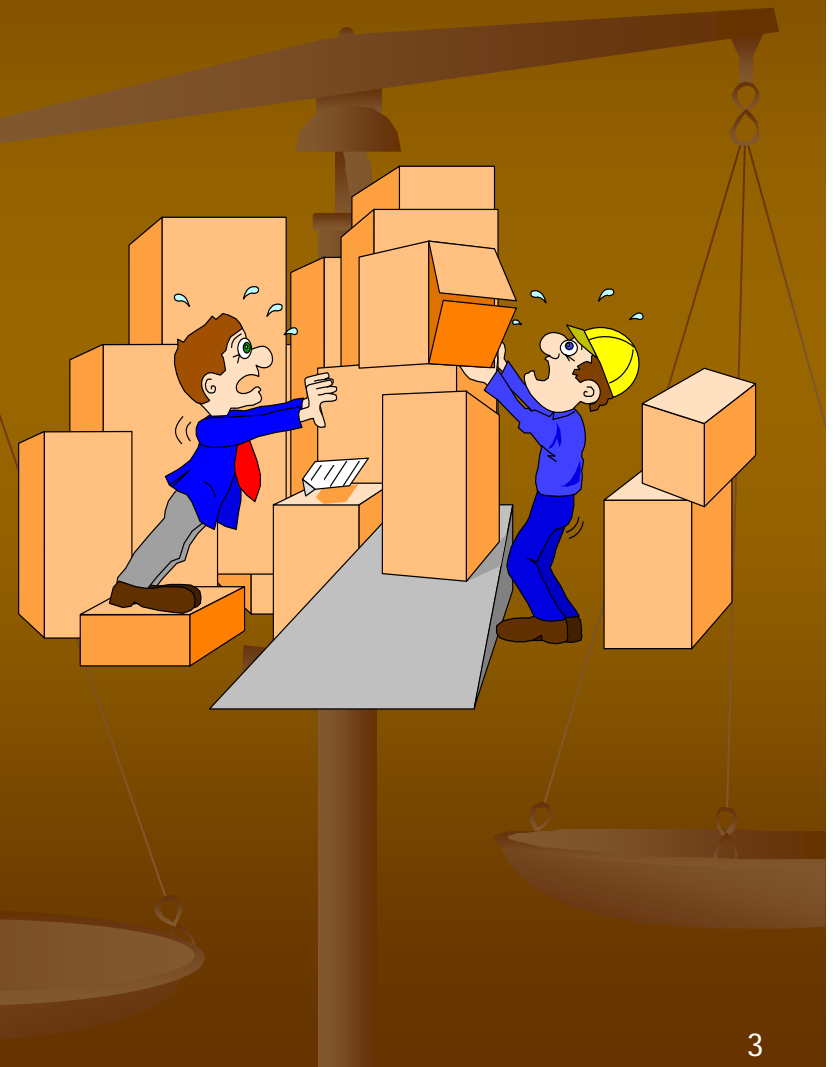
Agenda

- **The DuPont Model**

- **Inventory**

- **Safety Stock**

- **Demand Driven Forecasting**

- **Collaboration**

Inventories impact financial performance in at least two ways:

1.) net profit margin

2.) return on assets or return on investment

- Net Profit

- Asset Turnover

- Return On Assets

- Financial Leverage

- Return on Equity
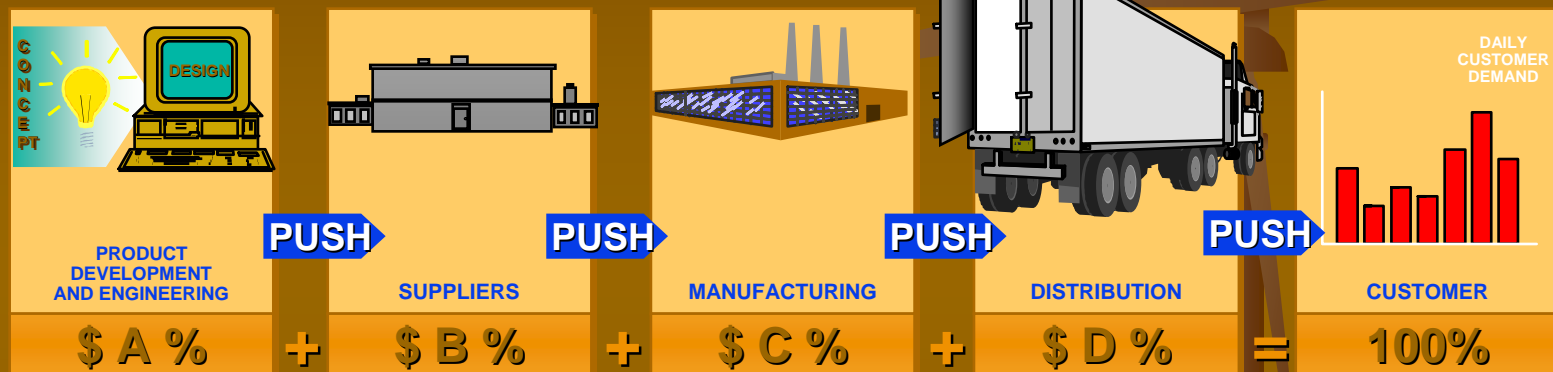
Inventory Carrying Costs

Inventory Carrying Cost Category

- Capital Costs
- Storage Space Costs
- Inventory Service Costs
- Inventory Risk Costs

Inventory Carrying Cost Components

- Inventory investment
- Plant Warehouses
- Field Warehouses
- Other Warehousing
- Insurance
- Liability
- Obsolescence
- Damage
- Shrinkage
- Relocation Costs

| PRODUCT DEVELOPMENT AND ENGINEERING		SUPPLIERS		MANUFACTURING		DISTRIBUTION		CUSTOMER
$ A %	+	$ B %	+	$ C %	+	$ D %	=	100%

Push inventory systems "FORCE" products through the supply chain, assuming the manufacture determines sales based upon availability.

Pull inventory systems "Draws" products through the supply chain elements,
As such it is a demand driven approach.

| SUPPLIERS | MANUFACTURING PLANTS | DISTRIBUTION CENTERS | CUSTOMERS | END USERS |
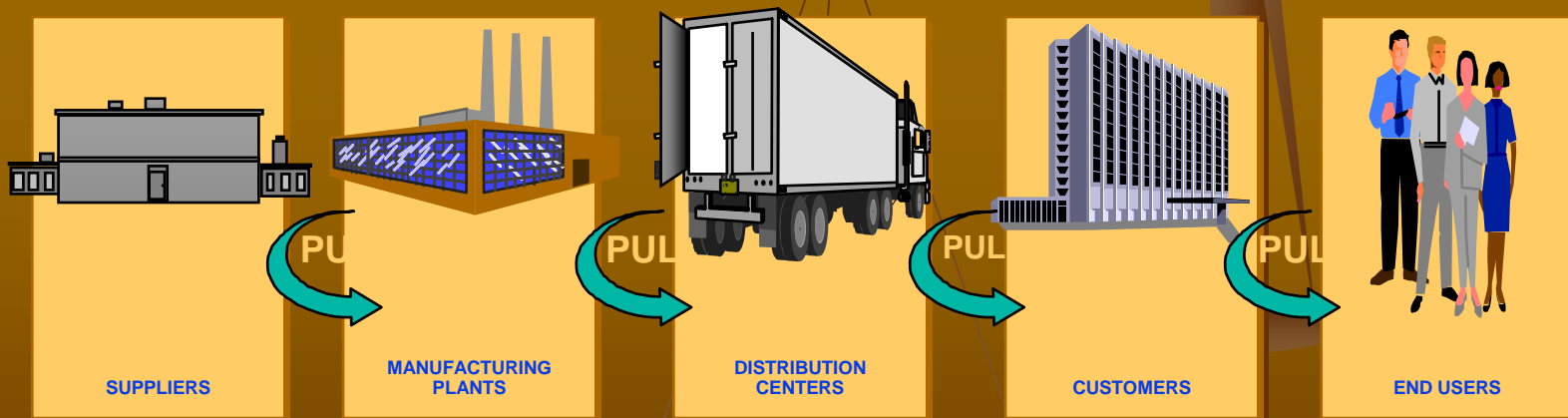
The River of Inventory
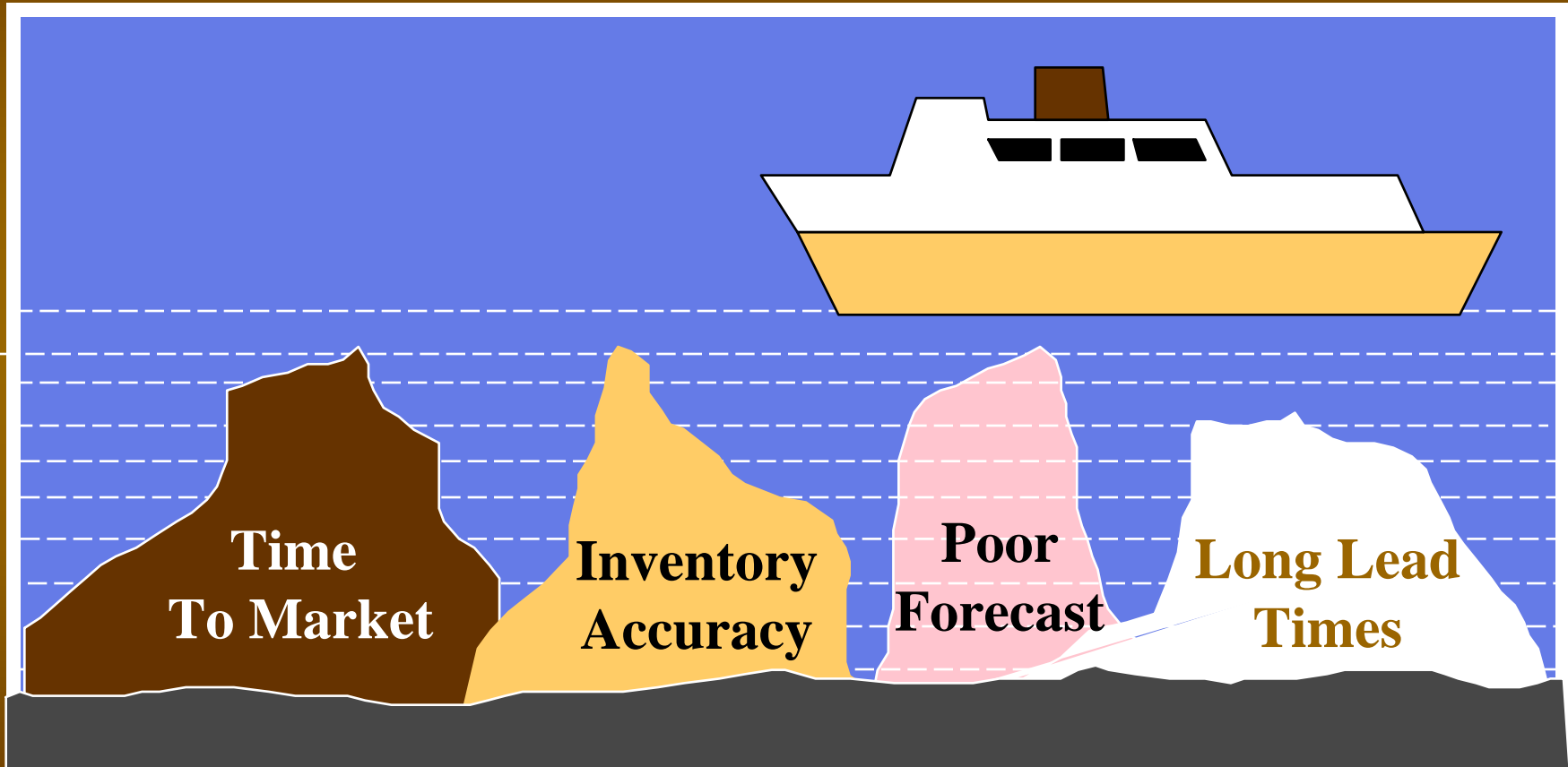
"Inventory Accuracy is the Lifeblood of any <u>Formal</u> Planning <u>System</u>"

<u>Formal</u>

➢ Proactive

➢ Integrated

➢ Structured Plans & Schedules
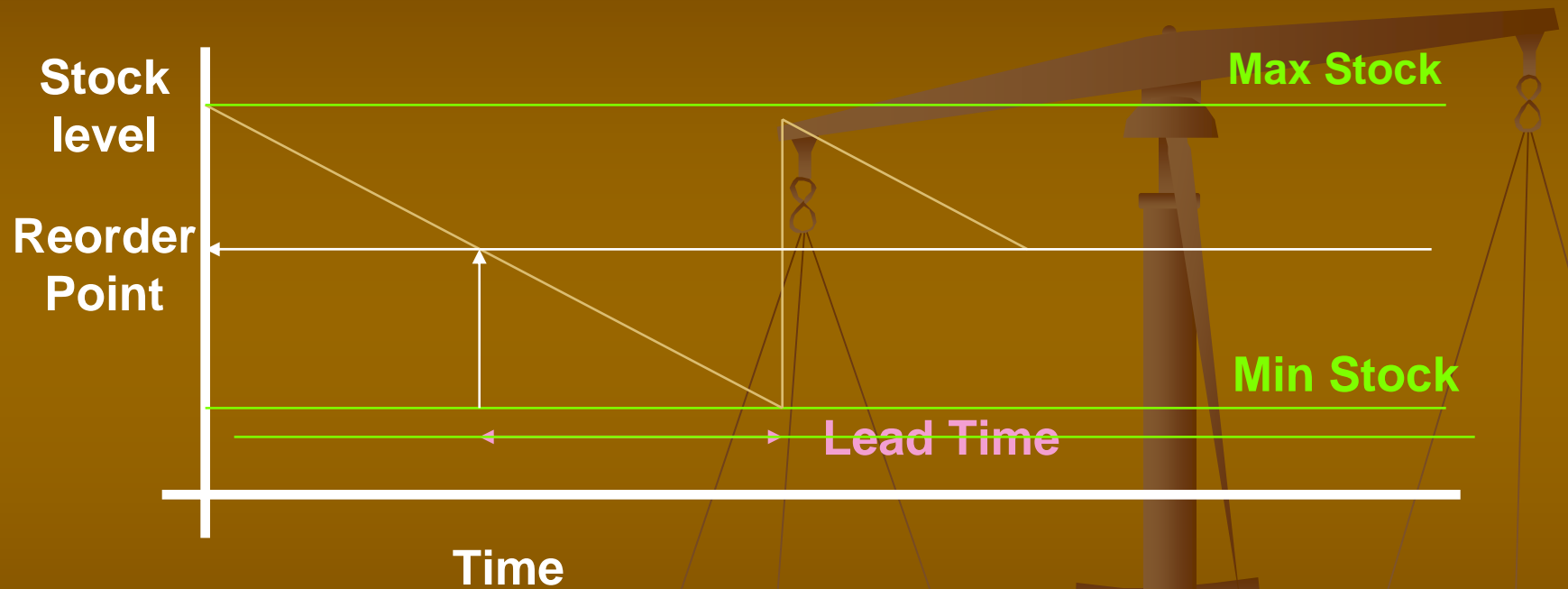
➢ Data Intensive

➢ Disciplined

➢ Rational

<u>Informal</u>

➢ Reactive

➢ Compartmentalized

➢ Hot Lists & Shortage Lists

➢ Expedite Intensive

➢ Assumes Inaccuracies

➢ Emotional

Factors To Consider

Stock level

Reorder Point

Max Stock

Min Stock

Lead Time

Time
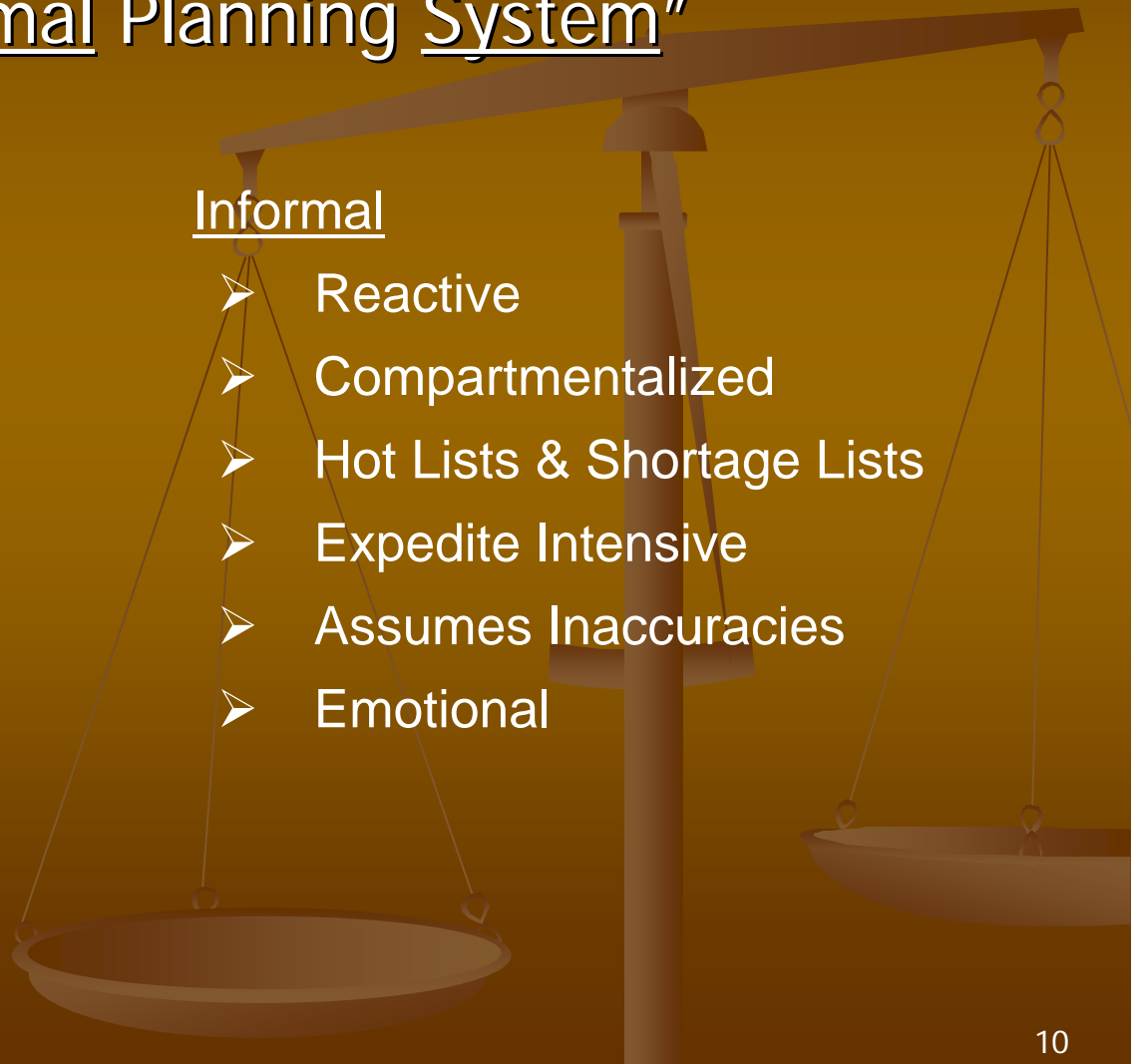
When the stock reaches the reorder point again

$$EOQ = \sqrt{\dfrac{2PD}{CV}}$$

Where:

P = Cost of placing an order (total ordering & receiving costs)

D = Annual demand

C = Total inventory carrying costs as a %

V = Cost of a unit of inventory

Reorder Quantity

Factors to take into account

- The Cost Of Holding Stock
- The Cost Of Placing An Order
- The Usage
- Unit Cost
- The Shelf Life
- Price And Quantity Discounts

Why We Hold Safety Stock

- Variation in demand
- The lead time
- Variation in lead time
- The service level required
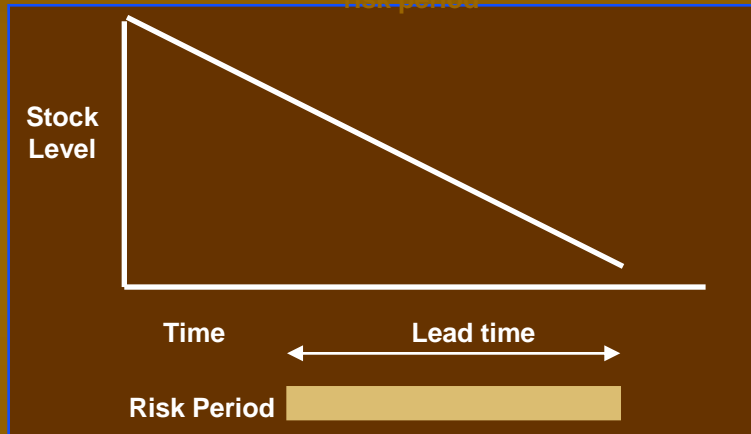
- In a make-for-stock environment, the factory demand is driven by a forecast
- The forecast attempts to predict the eventual customer demand
- The forecast and the customer demand will unfortunately NEVER be the same

Demand will fall above at and below the average

Extra stock

Demand

SAVE
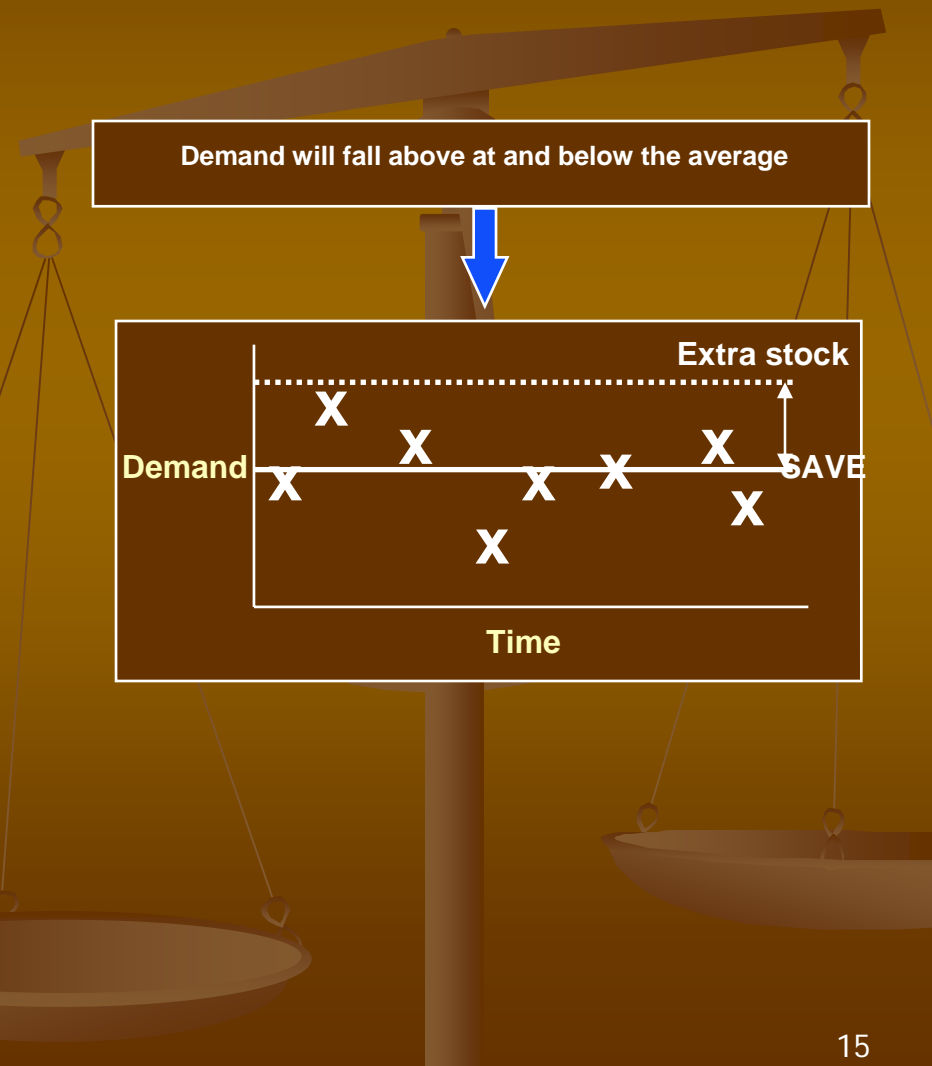
Time

Lead Time & Risk

The time when we could run out of stock is known as the: 'risk period'

Stock Level

Time   Lead time

Risk Period

Stock Level

Time   Lead time
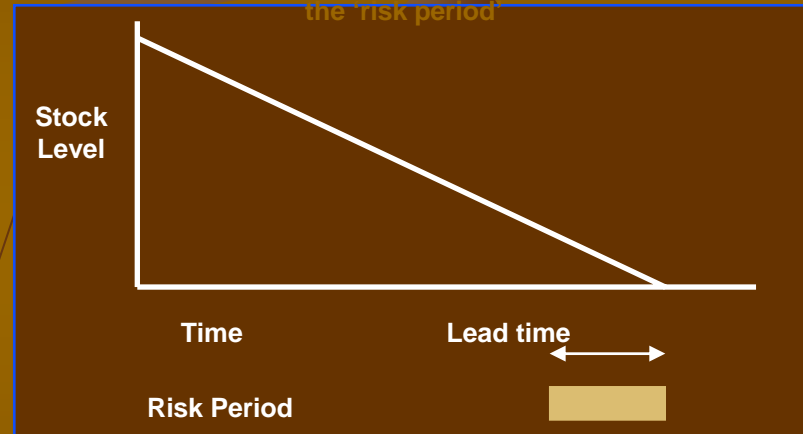
Risk Period

If we reduce the lead time we can reduce the risk period and the safety stock requirements

Safety Stock And Service Level
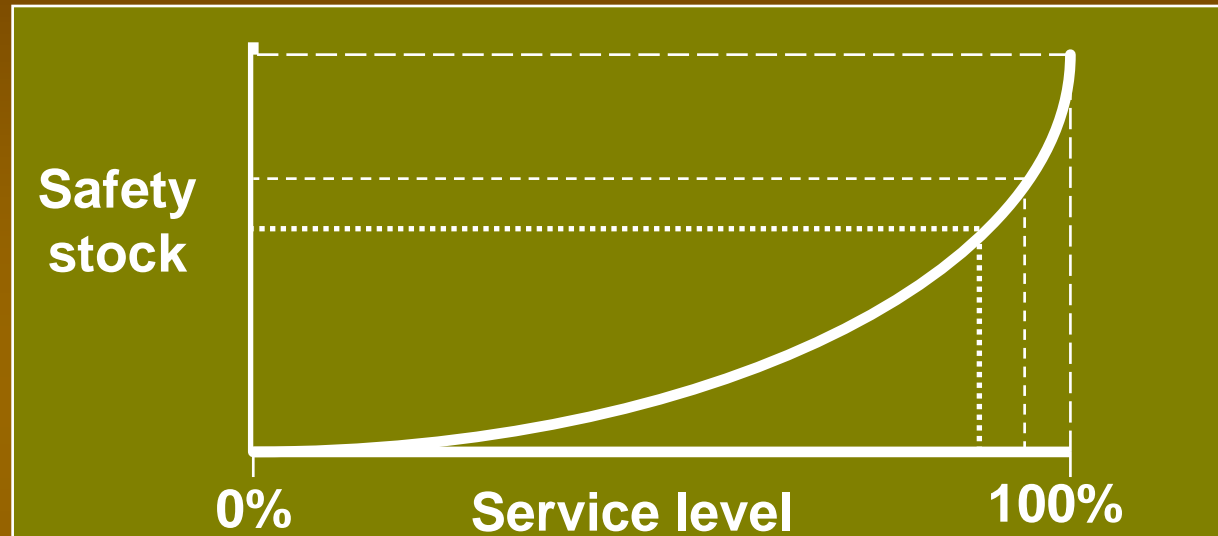
- The relationship between service level and safety stock is exponential
- 90% service level can be achieved with a relatively low level of safety stock
- 95% service level can be achieved with a higher level of safety stock
- A guaranteed 100% service level IS A VIRTUALLY IMPOSSIBILITY

Demand Variability

Reorder point

Reorder quantity

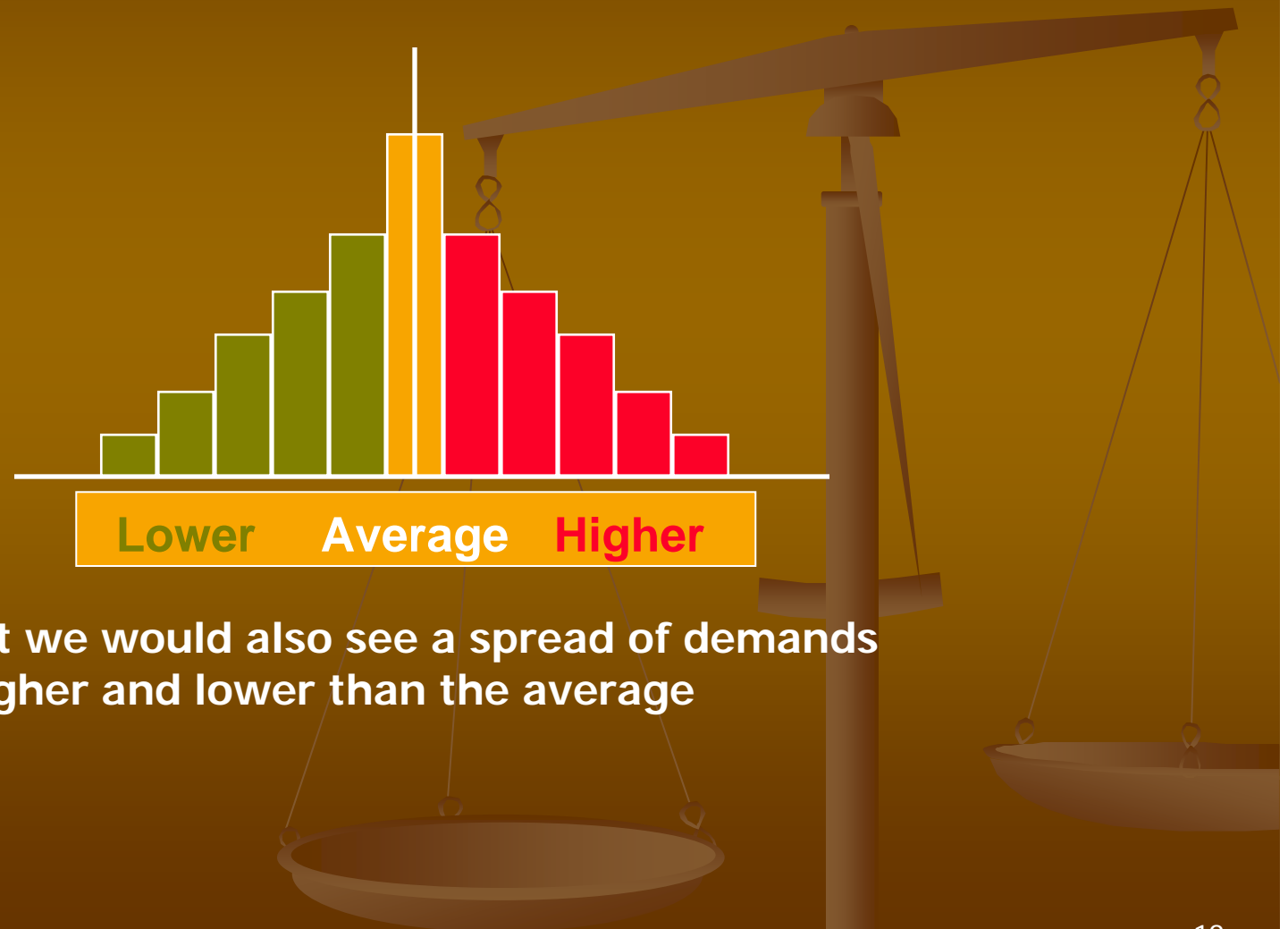lead time

Working stock

Safety stock

Average lead time demand

We must consider working stocks, reorder points, lead times and the variability or uncertainty of each

If we examine demands over a number of periods we would see that there would be an average demand

Lower **Average** **Higher**

But we would also see a spread of demands higher and lower than the average

To calculate the probability of stock outages if we need to combine all of this information

Reorder point

Reorder quantity

lead time

Working stock

Safety stock
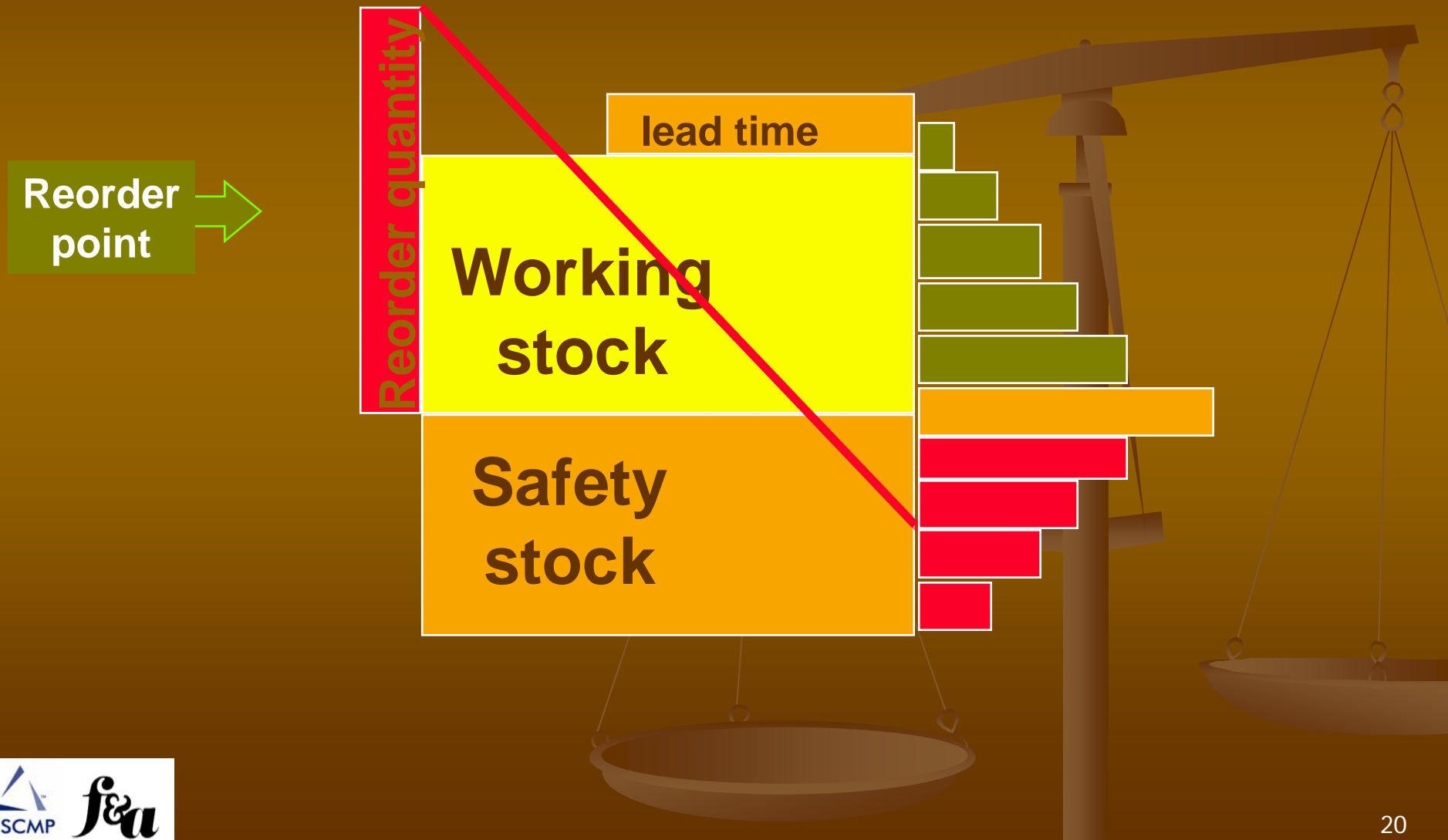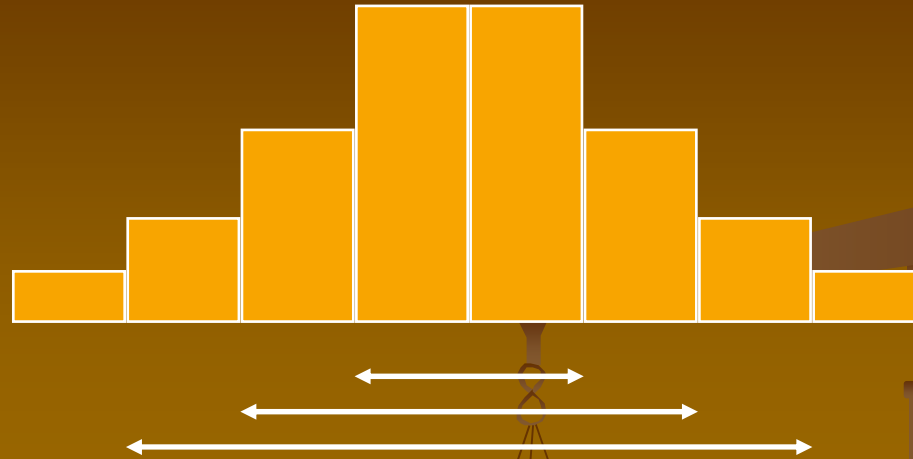
68.27% of demand will fall within one standard deviation of the mean
95.45% of demand will fall within two standard deviations of the mean
99.73% of demand falls within three standard deviations of the mean

The Mean Absolute Deviation is calculated as

$$MAD = \sum \frac{\underline{Actual\ demand - Forecast\ Demand}}{n}$$

where n = the number of observations

Normal distribution has two key statistics:
The mean (or average) and the standard deviation.

We can make an estimate of the standard deviation by :

Standard Deviation = 1.25 x MAD

Then the safety stock can then be estimated by using a formula

Safety Stock =
Safety Factor x 1.25 MAD

as explained by this example

Period	1	2	3	4	5	6
Actual Demand	100	109	116	120	111	117
Forecast Demand	115	115	115	115	115	115
Error	15	6	1	5	4	2

MAD = 33/6 = 5.50

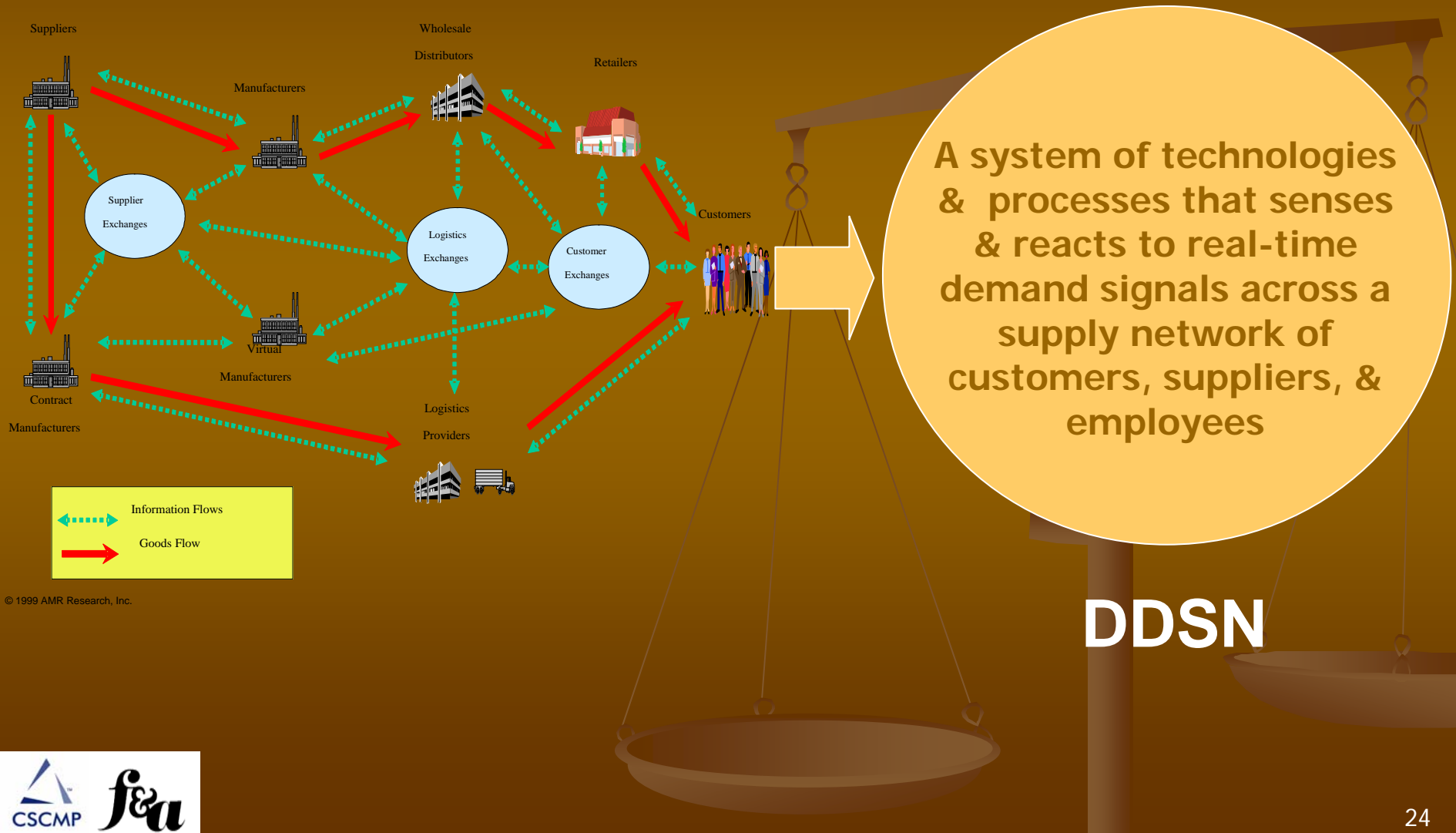In calculating the MAD the error is treated as an absolute number not net.

Therefore the Standard formula for the calculation of safety stock to provide a 99.0% service level is:

- Safety factor for 99.0% from statistical tables = 2.32
- If the MAD is 5.5 (from the last table)
- Safety stock = safety factor x 1.25 x MAD
- Safety stock = 2.32 x 1.25 x 5.5
- =15.66 = 16 or 16/115 = 13.91% of forecasted demand

Suppliers

Wholesale
Distributors

Retailers

Manufacturers

Supplier
Exchanges

Logistics
Exchanges

Customer
Exchanges

Customers

Virtual
Manufacturers

Contract
Manufacturers

Logistics
Providers

Information Flows

Goods Flow

© 1999 AMR Research, Inc.

A system of technologies & processes that senses & reacts to real-time demand signals across a supply network of customers, suppliers, & employees

DDSN

CSCMP f&a

The SCOR Model
Supply Management
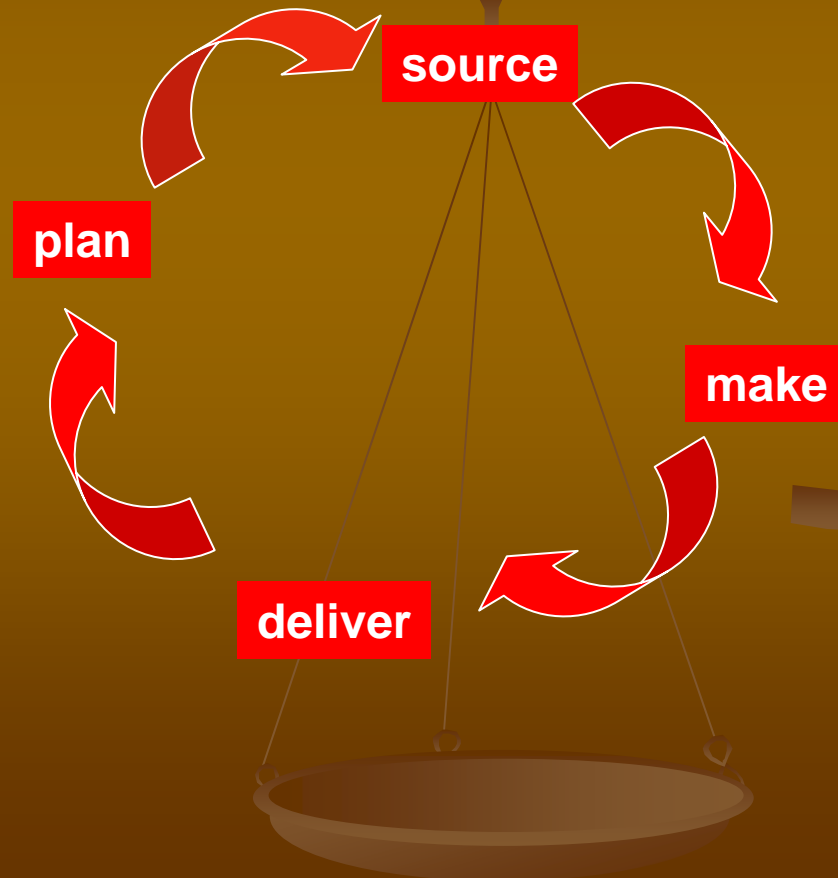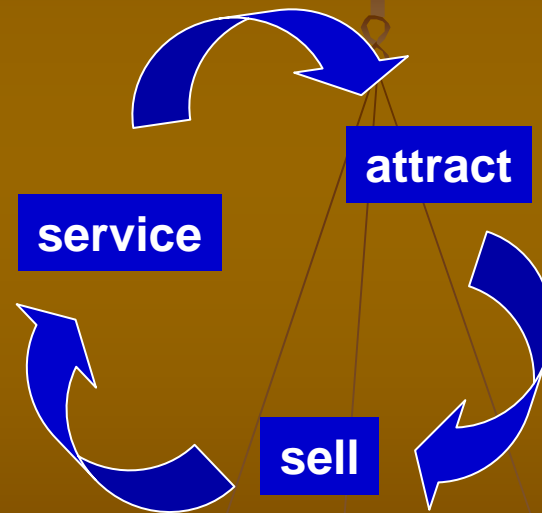
source

plan

make

deliver

Demand Management

supply

demand

product
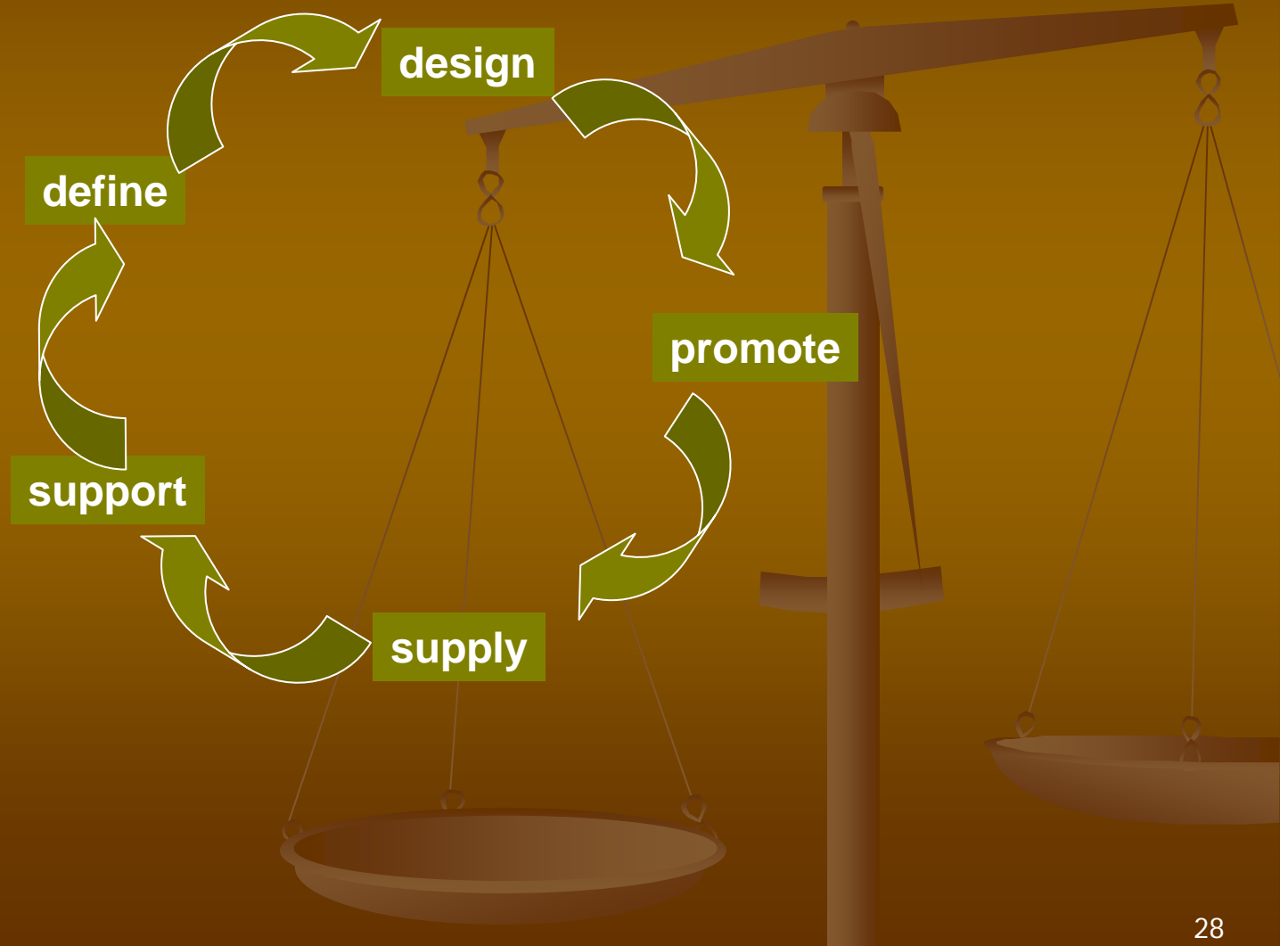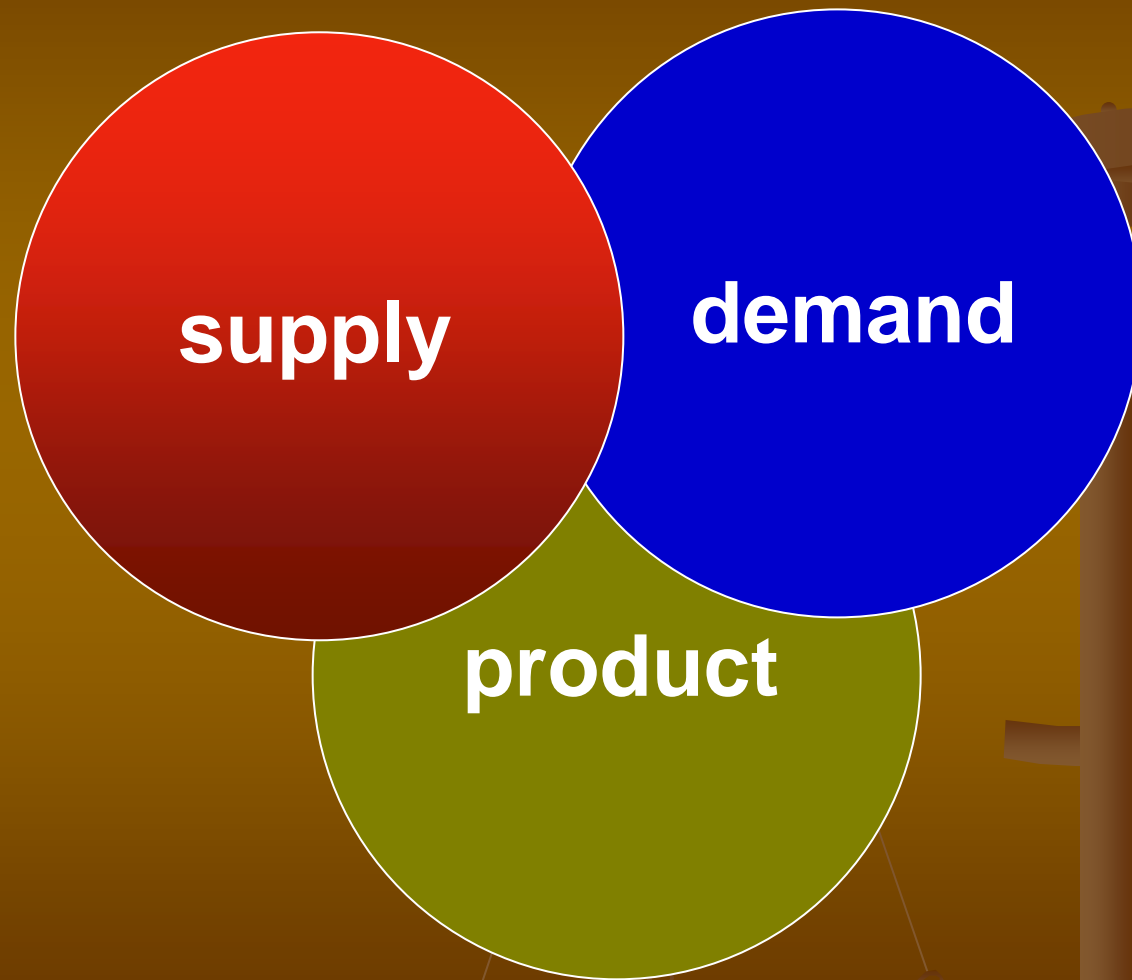
Deliver 20%
More Perfect
Orders...

...Hold a third less
inventory...

...and have lower costs
equal to 5% of revenue

Leaders	90%
Laggards	68%
Leaders	54 Days
Laggards	72 Days
Leaders	21%
Laggards	26%

CSCMP f&u

30

Demand Visibility

100%
90%
80%
70%
60%
50%
40%

10%

20%

40% 50% 60% 70% 80% 90% 100%

Perfect Order
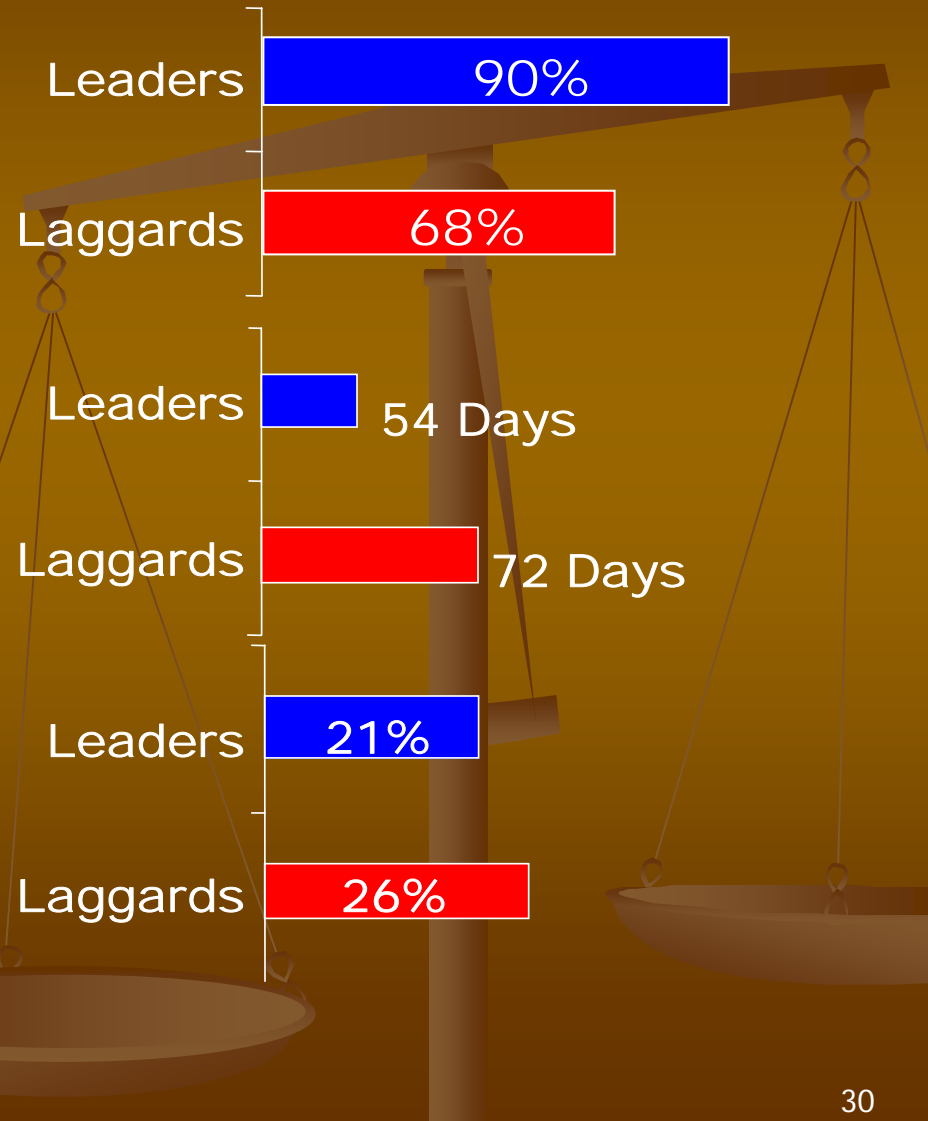
Focus area:	Industries:
Demand sensing	Media and home entertainment and direct store delivery consumer products
Services and the after-market experience	Boeing, Cisco
Managing of contract manufacturing	Pharmaceuticals and high tech
Vendor managed inventory processes	Consumer Goods
Sales and operations planning	Chemicals companies and high tech
New product launch	Automotive and high tech

S&OP baseline requirements

Finance

Sales

Operations

Supply Chain

1. Executive Ownership
2. Standardized, modular agendas
3. Dynamic connection to real-world events
4. The right skills
5. Tools for informed consensus
6. Total cost view
7. Focused on continuous improvement
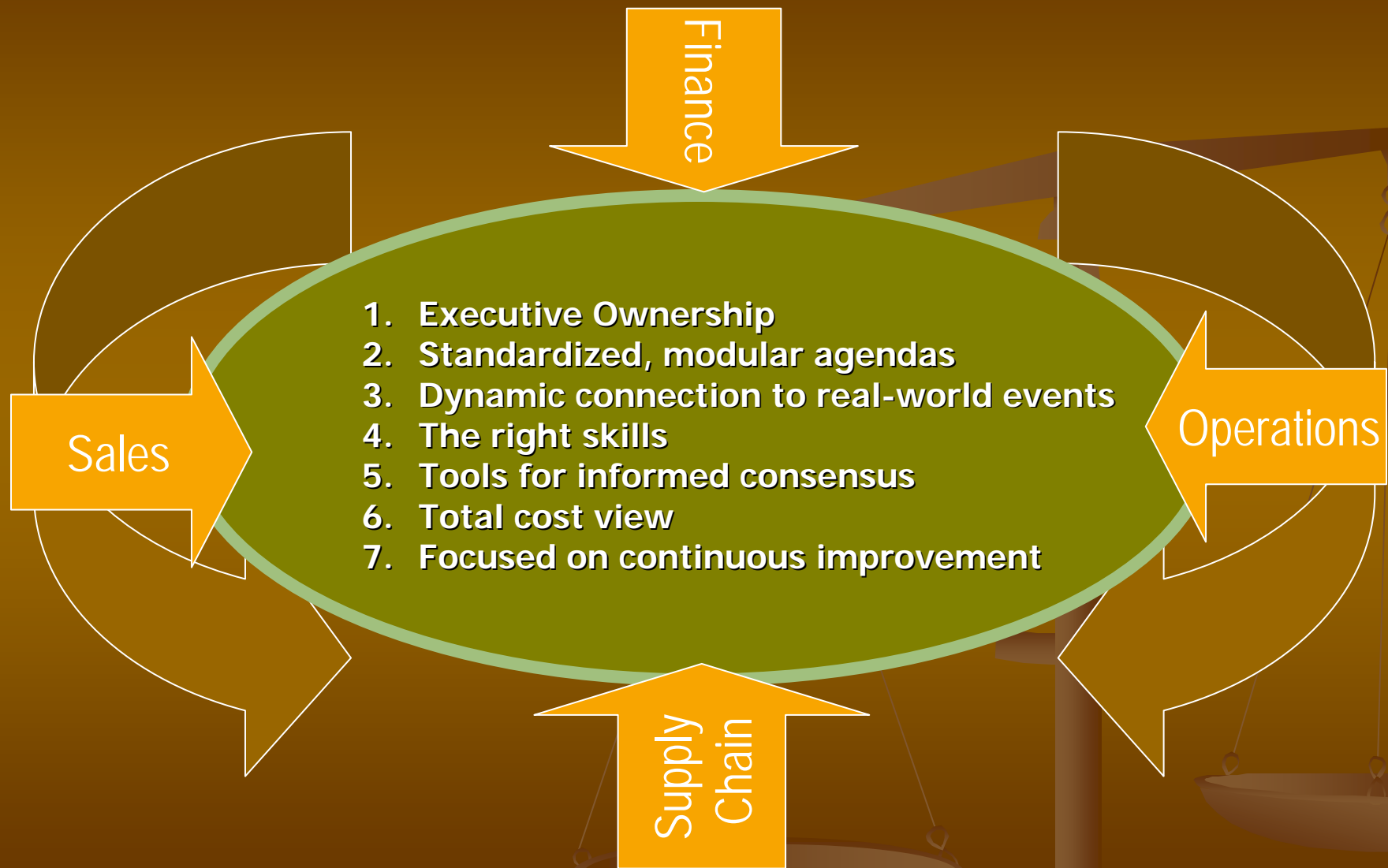
- Companies with mature S&OP processes are 3x more likely to have successful product launches
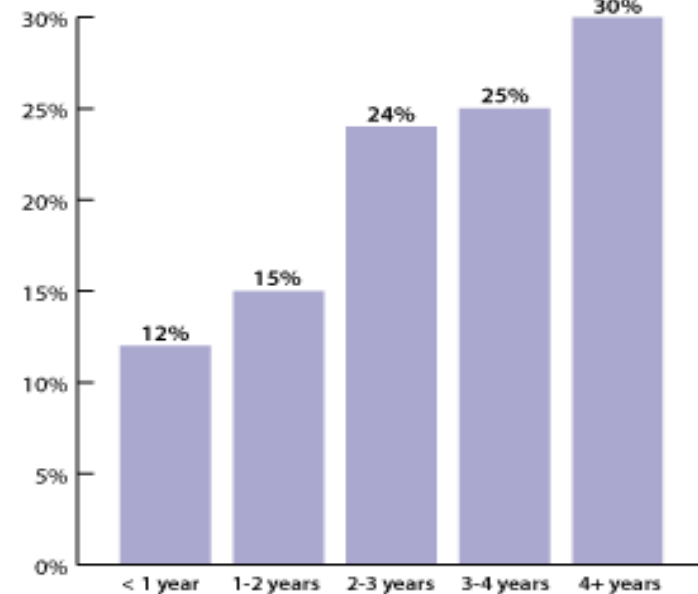
- Companies that sense demand changes more effectively double the success rate of new product introductions

- This is especially important to short product lifecycle industries

Figure 1: The impact of S&OP experience on NPDI

How many years have a formal sales and operations planning system/program/initiative been in place?

Percentage of companies indicating more than 70% of new product launches are successful.

Source: AMR Research, 2006

Source: AMR Research Alert, "Three Supply Chain Actions You Can Take Today To Improve New Product Launch", January 2006

In VMI, it's all about the planners

Optimal VMI working relationship

Typical brand – mfg relationship

sales planner

Account manager

buyer

sales ops

Price/ Gross margin

sales planner

Account manager

sales ops

Buyer

Max Operating Profit

CSCMP f&u

35

Basic VMI Architecture

Retailer

POS

| 90 | 80 | 70 | 65 | 49 | 35 | 19 |

Promotions Calendar

Inventory system

Inventory (in-transits, oh-hand)

Demand shaping analytics

VMI System

Sell-through forecast
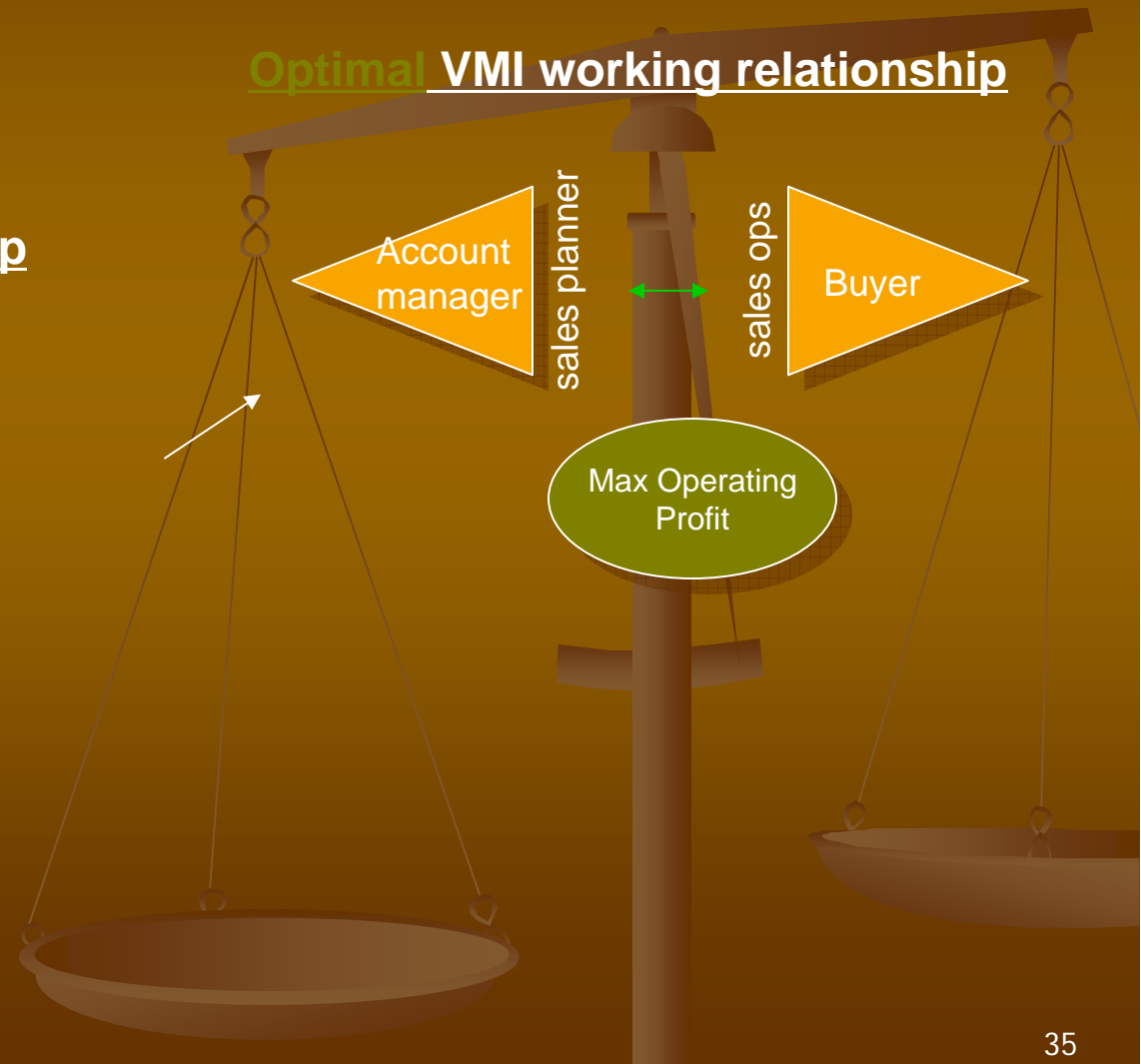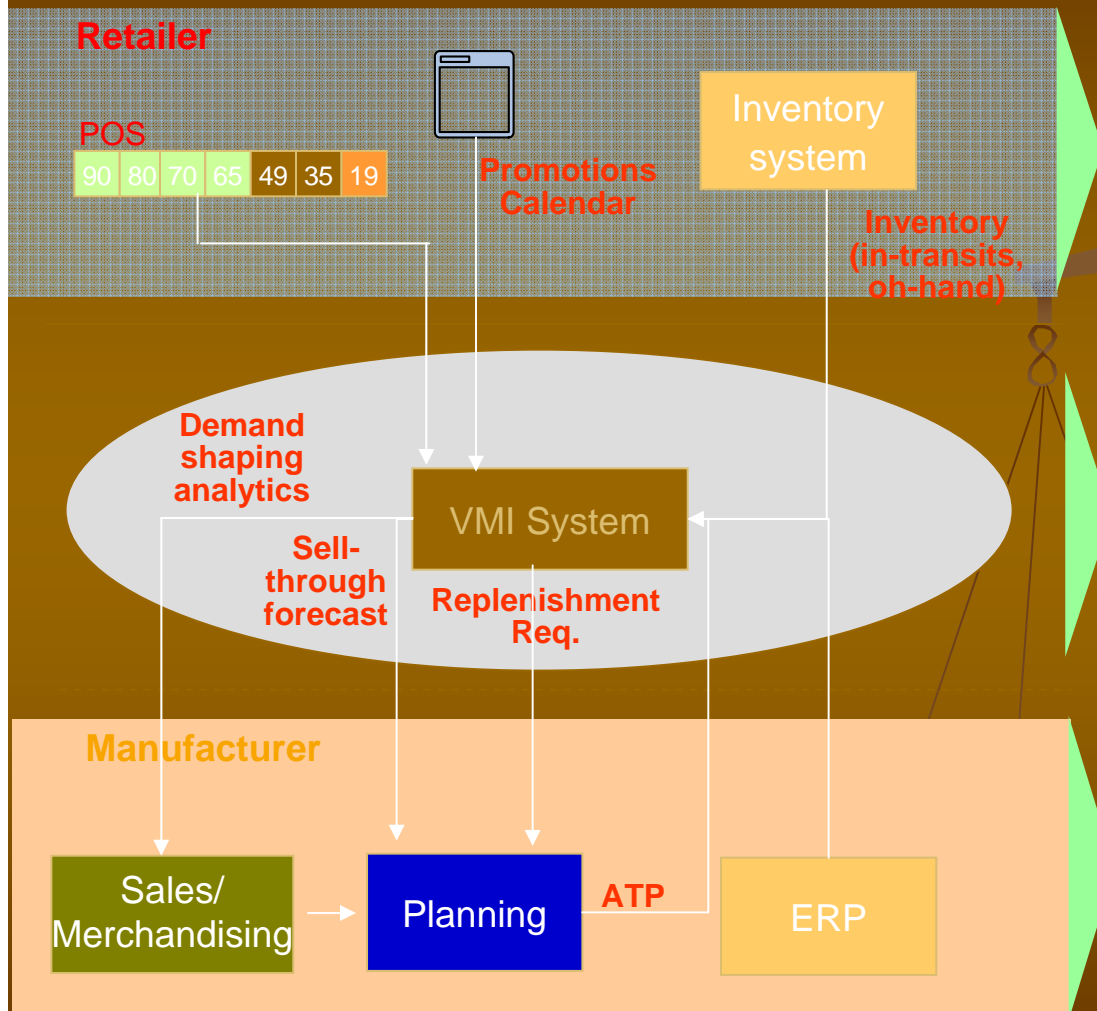
Replenishment Req.

Manufacturer

Sales/ Merchandising → Planning — ATP — ERP

- Provide daily feeds of POS and inventory at pre-defined granularity
- Provide promotions calendar, expected lifts and other planned events
- Analyze POS, planned promos etc., generate new sell through forecast
- Analyze inventory levels to generate new purchase and replenishment plans
- Discover and recommend demand shaping opportunities
- Execute purchase and replenishment plans
- Approve and execute demand shaping recommendations
- Provide ATP picture and inventory picture to VMI system

Pricing and Demand Management

Shape Demand

Plan for Demand

Sales and Operations Planning

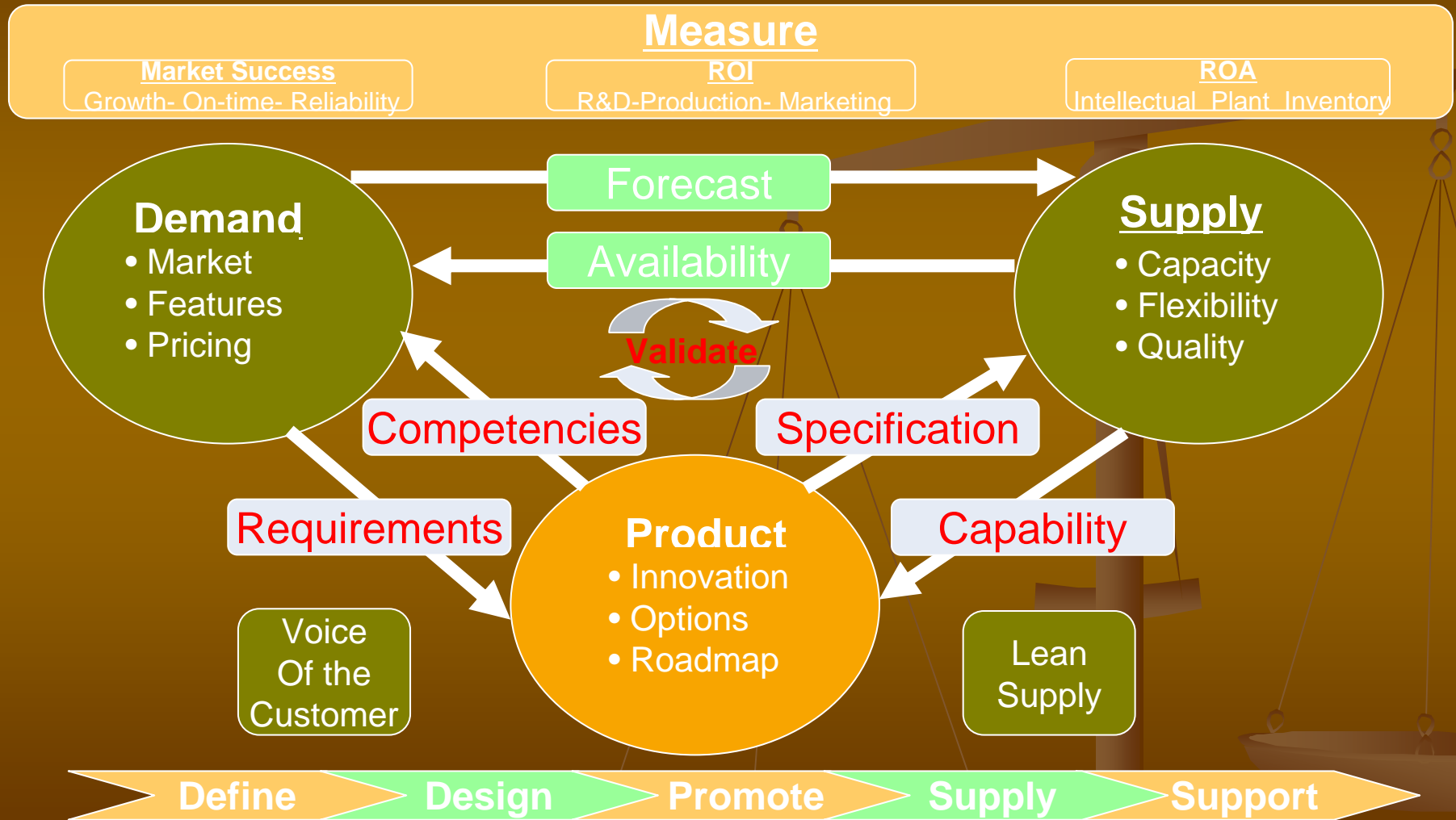**Trade Promotion Management & Optimization**

Demand Management

Retail Planning & Store Replenishment

Workflow

Understand Demand

Respond to Demand

Collaborative Product Development

Measure

Market Success	ROI	ROA
Growth- On-time- Reliability	R&D-Production- Marketing	Intellectual_Plant_Inventory

Demand
- Market
- Features
- Pricing

Forecast →

← Availability

Validate

Supply
- Capacity
- Flexibility
- Quality

Competencies

Specification

Requirements

Capability

Voice Of the Customer

Product
- Innovation
- Options
- Roadmap

Lean Supply

Define → Design → Promote → Supply → Support

DDSN maturity model : Top 25 are most mature

Orchestrating

Multi-tier Federation

Multi-tier Visibility & Collaboration

Collaborating

Single-Tier Partnering

Data sharing with 1st Tier partners

Anticipating

Every company for itself

Internal optimization

Reacting

Every department for itself

Slow & sequential planning

Process Maturity   Information Maturity
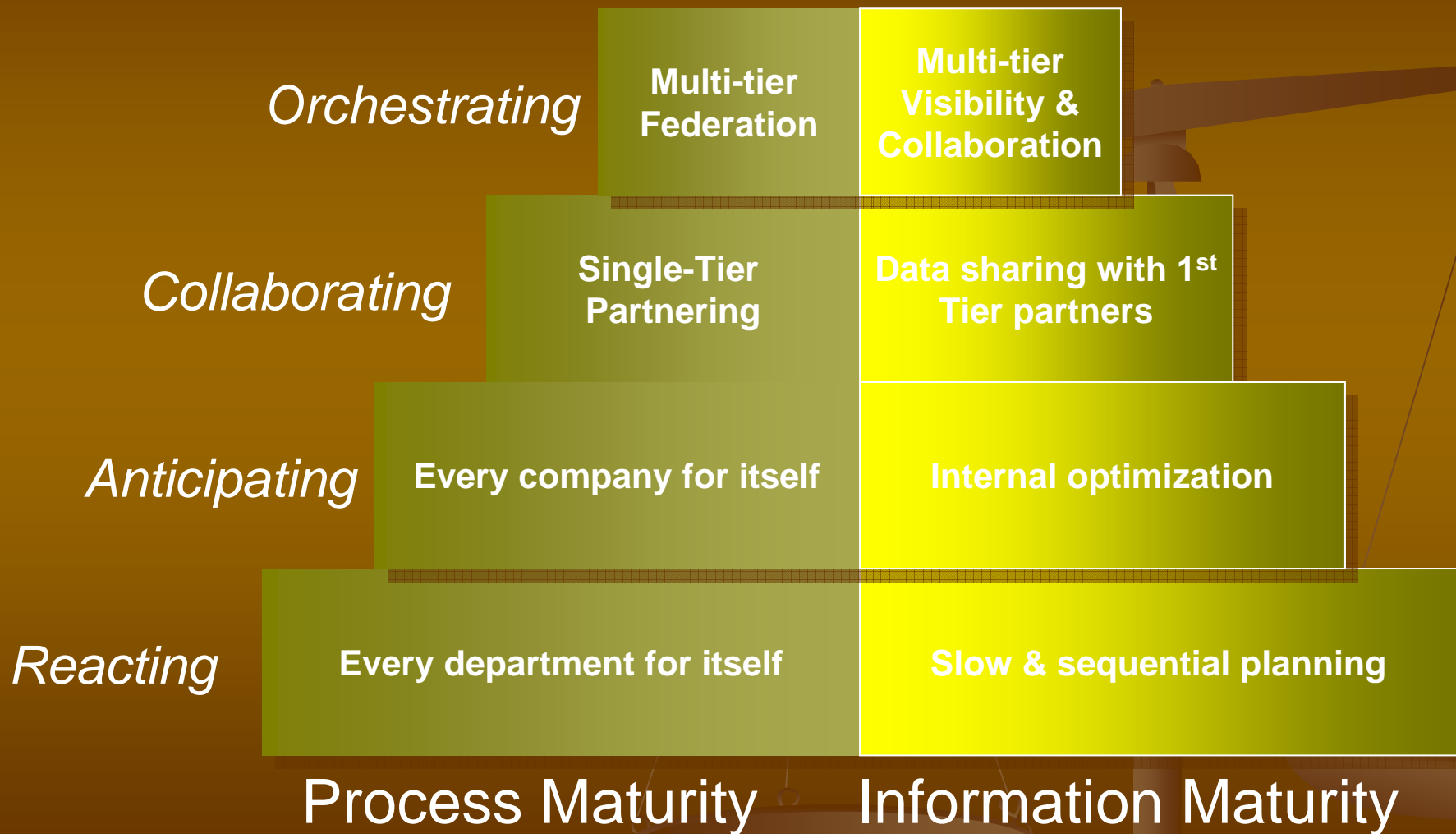
Questions

Freese & Associates, Inc. www.FreeseInc.com

f&a