

# A Simulation-based Decision Support Framework for Real-Time Supply Chain Risk Management

by

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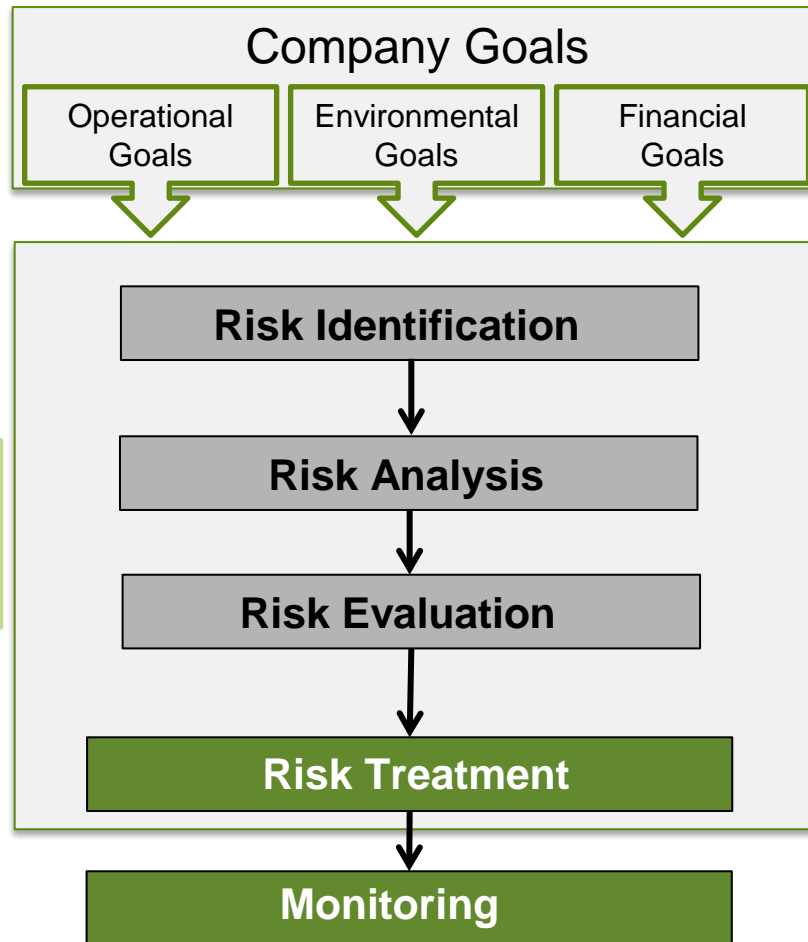
## Agenda

- Traditional Supply Chain Risk Management (SCRM) concept and tools
- The need for new concepts in SCRM
- The role of simulation in SCRM
- Agent-based simulation (ABS) and the concept of agents
- The benefit of ABS for risk management
- Virtual market by using agent-based simulation approach

# Supply Chain Risk Management Concept

## Traditional Tools

- Brainstorming
- Cause and Effect / Fishbone Diagrams
- Risk ranking and filtering
  - Hazard Analysis and Critical Control Point (HACCP)
- Pareto charts/analysis
  - Fault Tree Analysis (FTA)
- Failure Modes Effect Analysis (FMEA)
- Failure Mode, Effects and Criticality Analysis (FMECA)
  - Root Cause Analysis (RCA)



## New Approach

**SIMULATION**

Real-time decision support for risk mitigation with what-if / what-next scenario planning

## The Need for New Concepts in Risk Management

- Collecting appropriate data and transforming them into required information and knowledge
- Being able to detect, decide and act in real-time to dynamic risks
- Quantitative risk assessment
- Right combinations of corrective actions that contribute to risk measures
- Holistic view of supply chain and supply chain visibility

# The Need for New Concepts in Risk Management

## Real Time Data

Data mining in order to provide useful information to aid supply chain risk management, simulation and visualization



## Simulation

Analyse incidents that represent potential risks and actions that can be taken to mitigate these risks.

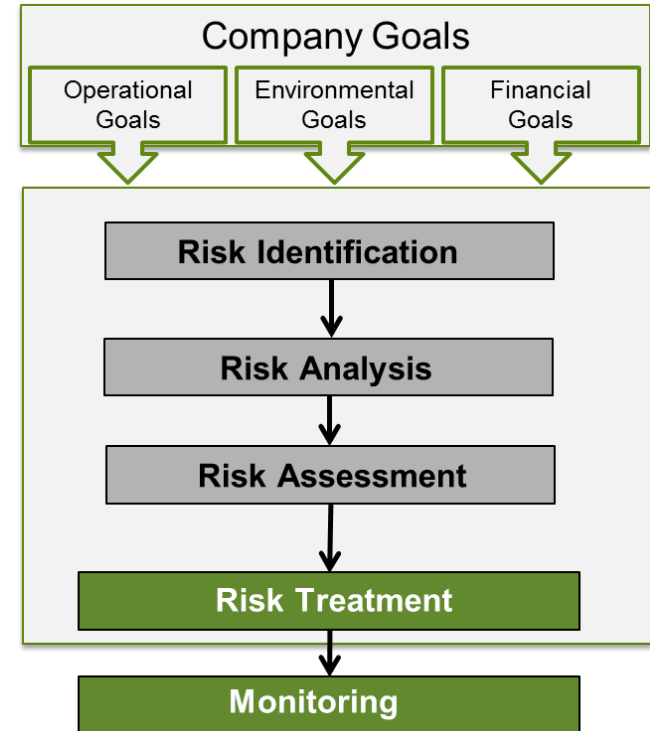


## Supply Chain Visualization

Real time status of the supply chain and risk related data such as natural disasters, manmade crises and financial instability



## Risk Management Process



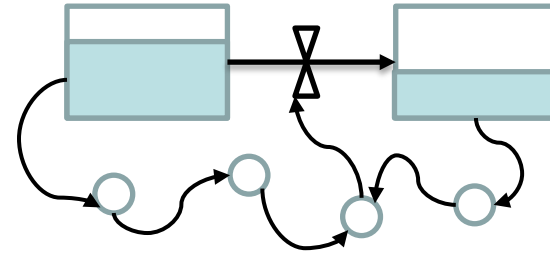


Macro-level

Top down perspective

**System Dynamics**

- Simulate strategy decisions in the global market place

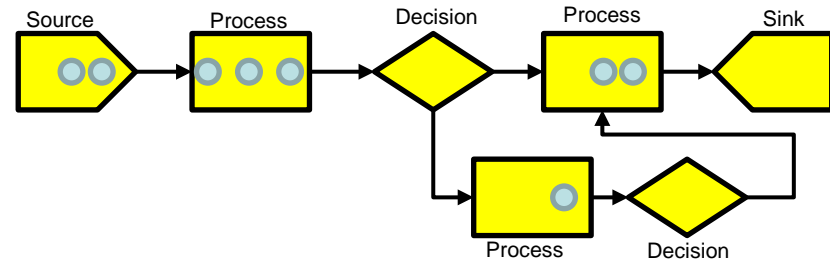


Meso-level

Workflow perspective

**Discrete-event Simulation**

- Simulate a factory setting or a materials flow system: reengineering work process

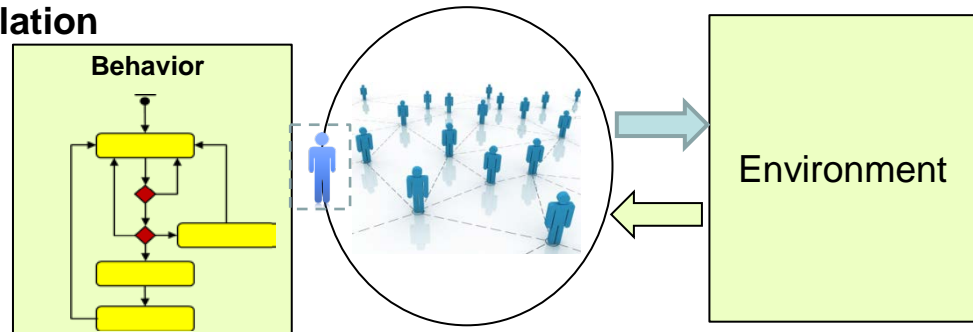


Micro-level

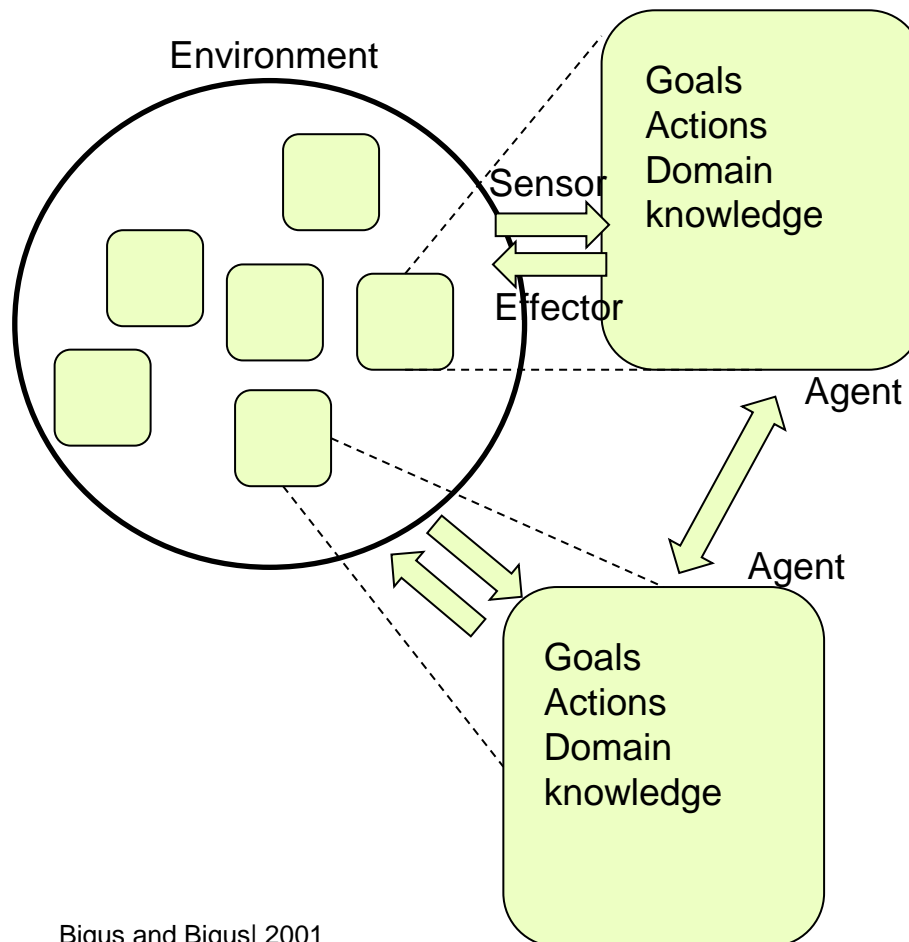
Individual level, Bottom up perspective

**Agent-based Simulation**

- Simulate market and customer behaviors, such as customers' reaction to price change



## The Concept of Agents



- **Autonomy:** agents are able to take decisions without a central controller in order to fulfil their objectives.
- **Social ability:** an agent can interact with other agents or the environment through the use of an agent communication language allowing it to asynchronously send/receive messages to/from other agents.
- **Reactivity:** agents can perceive their environment and be capable of performing fast reactions to specific changes in this environment with their own actions whenever necessary.
- **Pro-activeness:** agents do not simply respond to changes in their environment, but can initiate actions.



## Agent-based Simulation (ABS) for Virtual Market

### ■ Creating a virtual market based on ABS

- A virtual market is an agent-based simulation of the market for a defined set of products being offered for sale by a collection of sellers and available for purchase by a collection of customers.
- Population of customer agents
- Seller agent
- Competitors agent
- Business environment

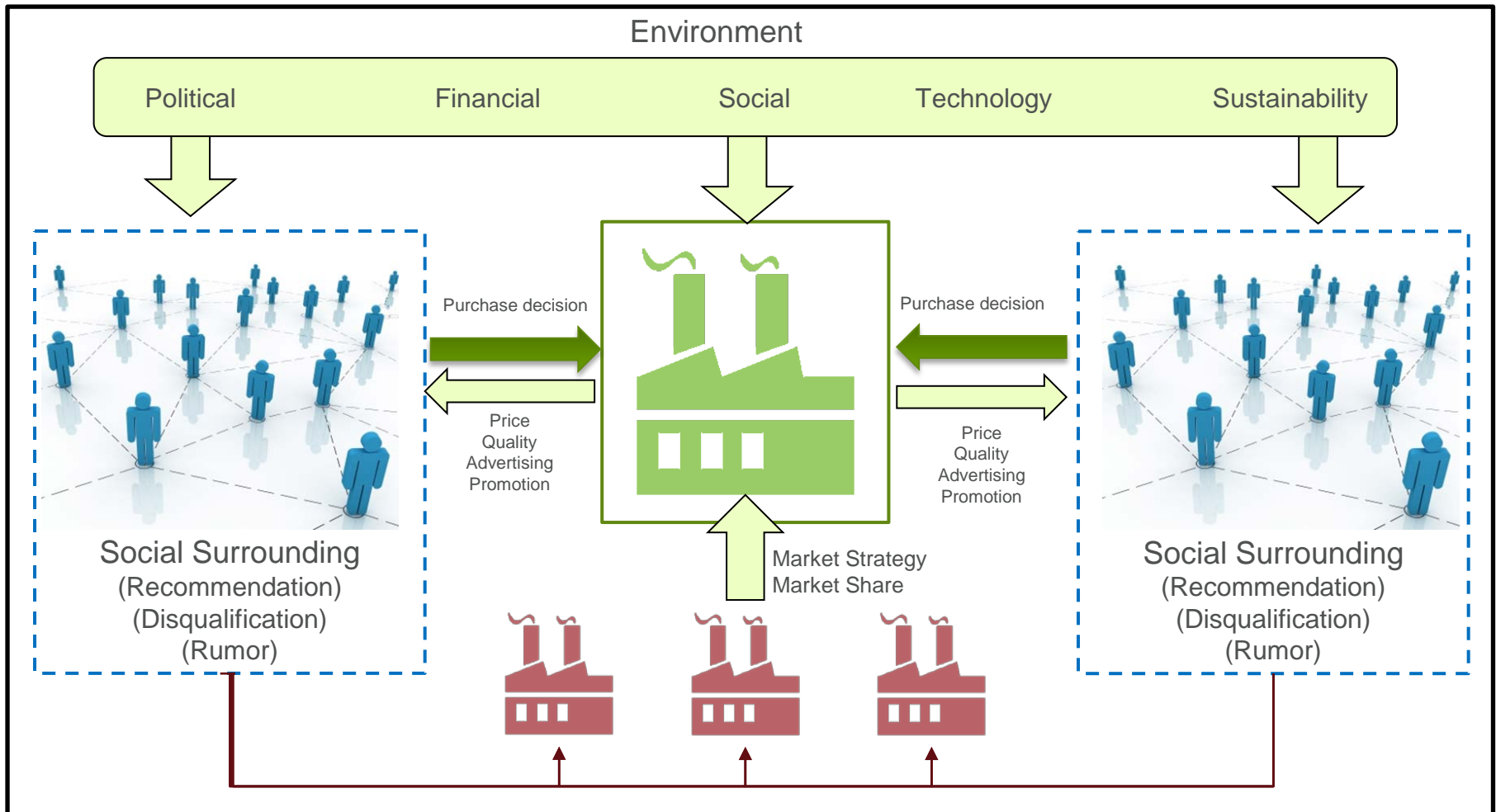


### ■ Agent-based simulation of consumer behavior

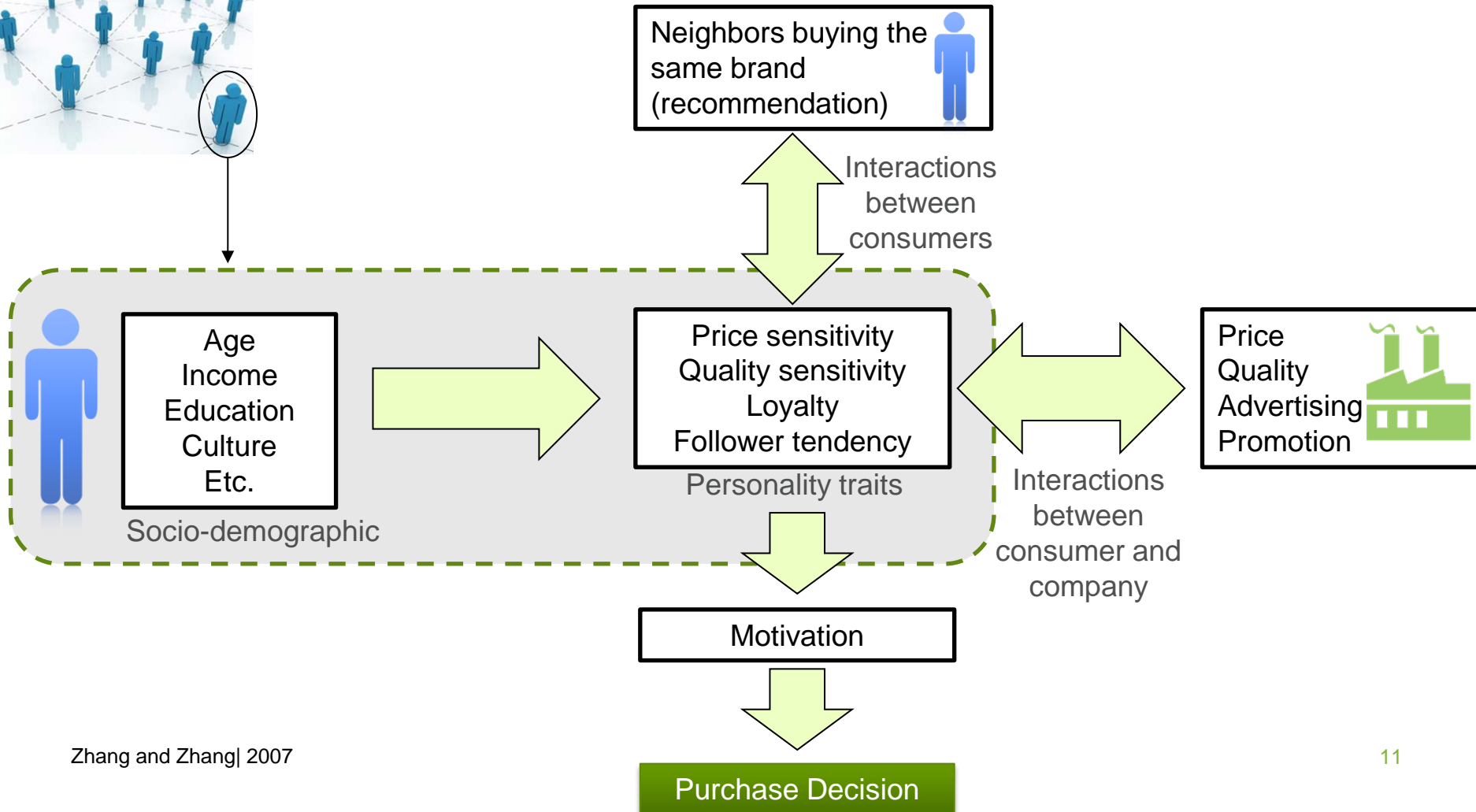
- price, promotion, and quality (interactions between consumers and company)
- Loyalty
- others' purchasing decisions (interactions among consumers)
- technological development (e-commerce, internet)
- social factors (age, education, income, culture)
- personality traits (price sensitivity, quality sensitivity, susceptibility, and follower tendency)



# A Virtual Market



# A Virtual Consumer

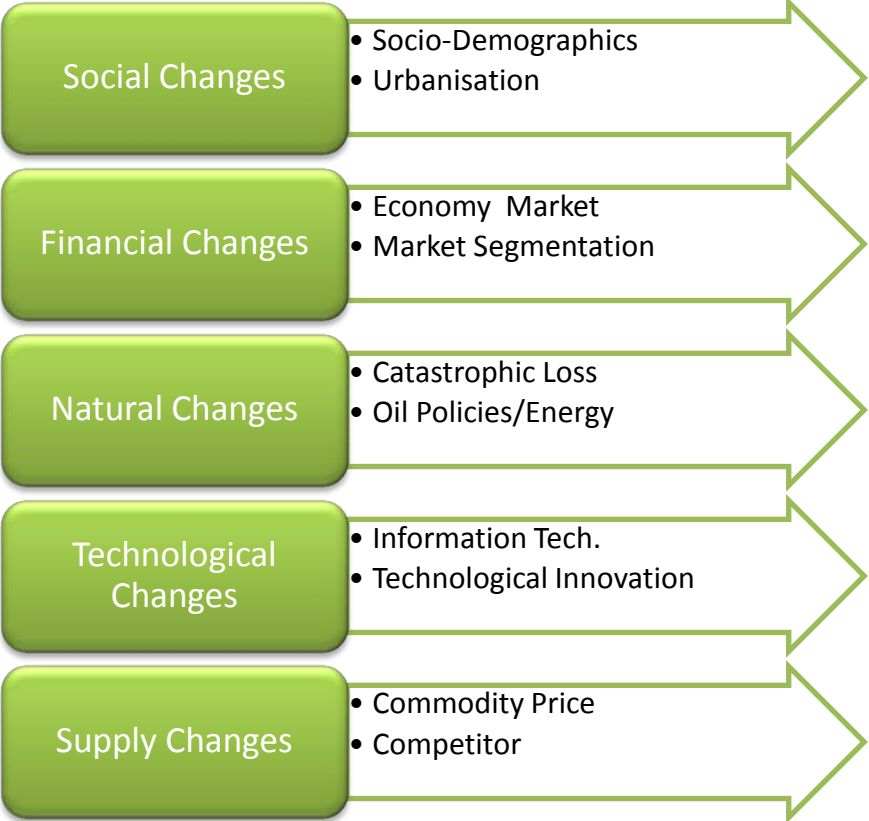


## Change (Risk) Drivers

- Consumer Demand
- Oil Policies/Energy
- Shifting Lifestyles
- Economy /Financial Market
- R&D
- Consumer Attitudes
- Market Segmentation
- Manufacturing Technologies
- Personal Identity
- Legislation & Regulation
- Socio-Demographics
- Globalisation
- Environment
- Urbanisation
- Vulnerability
- Safety
- Competitor
- Technological Innovation
- Sensitivity
- Capital Availability
- Human Resources
- Image and Branding
- Channel Effectiveness
- Commodity Price
- Customer Want/ Trend
- Information Tech.
- Infrastructure
- Political Customer
- Satisfaction
- Catastrophic Loss



## Change (Risk) Categories



After gathering all possible change drivers, five main categories are composed. For instance; Shifting Lifestyle, Customer attitudes or Globalization changes are included in Social Effect Category.

1) Effect Type

2) Effect Duration

**PREDICTIVE CHANGE PLANNING**

Run the simulation

**SOCIAL EFFECT**

Social Effect 1/5 Years

Social Effect Duration: 50

Social Effect Volume: 0

**NATURAL EFFECT**

Natural Effect 1/5 Years

Natural Effect Duration: 50

Natural Effect Volume: 0

**PROMOTION EFFECT**

Promotion Volume: 0.5

Global Promotion Duration: 15

Local Promotion Duration: 10

**FINANCIAL EFFECT**

Financial Effect 0.005

Financial Effect Duration: 30

Financial Effect Volume: 0

**SUPPLIER EFFECT**

Supplier Effect 0.003

Supplier Effect Duration: 20

Supplier Effect Volume: 0.5

**TECHNOLOGICAL EFFECT**

Technological Effect 0.005

Technological Effect Duration: 20

Technological Effect Volume: 0

3) Effect Volume

The simulation is generated in order to define customer demands by taking account various expected and unexpected effects. These six effects given above can be arranged before simulation run according to effect's volume and effect's duration.

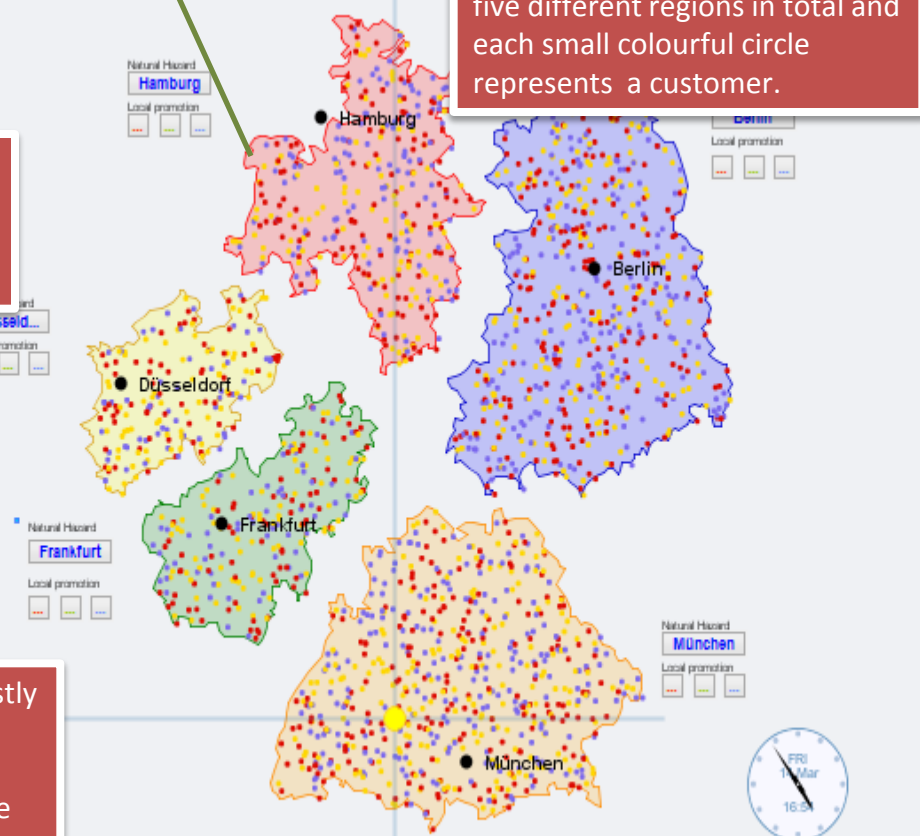
3 Suppliers

3 Suppliers are defined with their special material cost, lead time and quality properties.



5 Regions

2000 customers are created for five different regions in total and each small colourful circle represents a customer.



These two Bar Charts show the fluctuation of the produced product by Supplier and demanded product by Customer



The effects are happening firstly based on particular rate and secondly manually. These buttons are designed to create manual effect

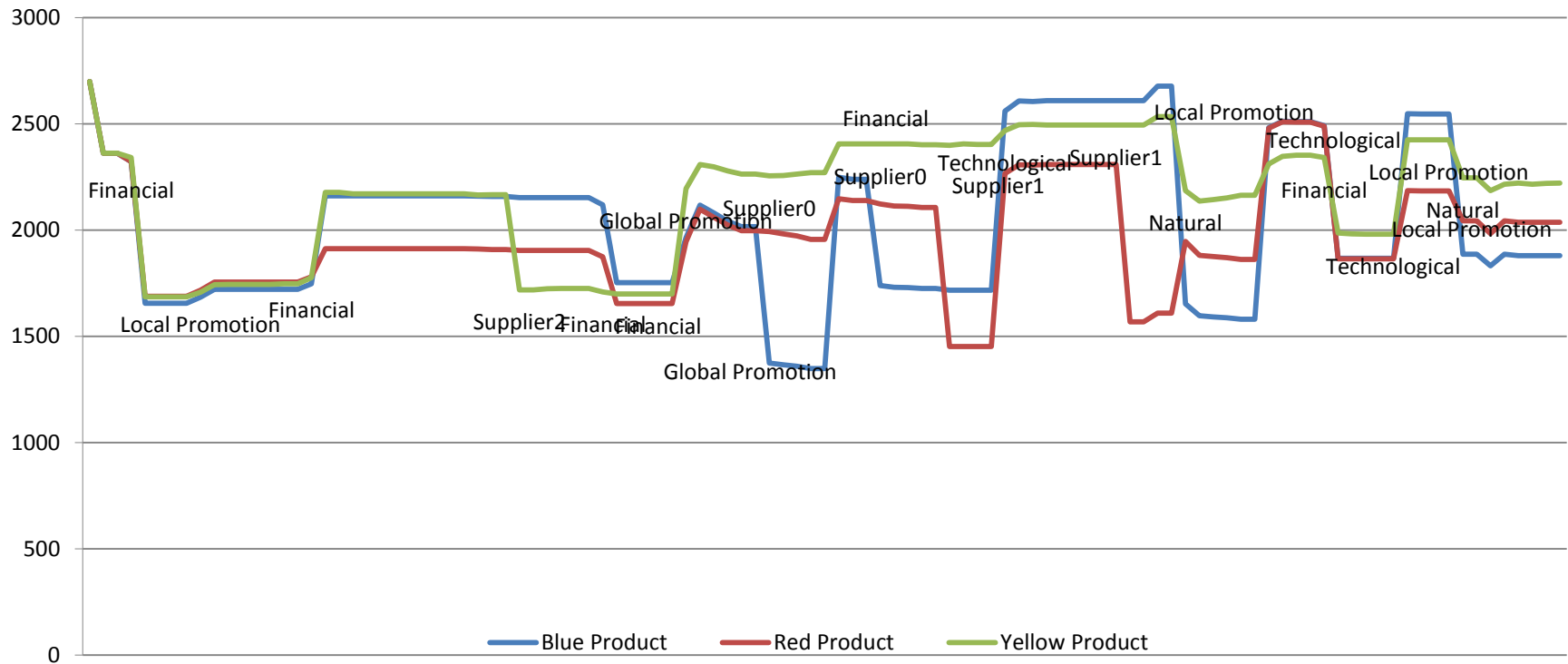


EFFECTS

- Red Global Pro...
- Yellow Global ...
- Blue Global Pro...
- Social Effect
- Financial Effect
- Technological ...

Manually Control

### Amount of demanded Product / Weekly



After ACP Simulation execution, we obtain the above graph which demonstrates the increases and the decreases on the amount of demanded products by with their reasons i.e. Financial Effects or Supplier Effects

# Thank you for your attention!

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