A **Flat World** is an exciting but dangerous world...
Accidents in remote plants can have large consequences for a supply chain...
Natural Disasters can disrupt business around the globe...
**Terrorism** has a wider reach than ever before...
A basic principle from Factory Physics is central to security engineering.

**Buffering Principle:** Systems with variability must be buffered by some combination of:

1. inventory
2. capacity
3. time.

**Buffer Flexibility Corollary:** Flexibility reduces the amount of variability buffering required in a production system.
Strategies for dealing with risks depend on likelihood and severity of event.
Redundancy in a supply chain can be either inventory or capacity.

Insight: usually optimal to place protection at a single level in the supply chain.
Flexible buffers are more effective than rigid ones

Full Flexibility

Chained Flexibility

Sub-Chained Flexibility

production plant  demand type
Supply chain disruptions can have both tactical and strategic consequences.
Impact of a supply chain disruption on sales revenue

![Impact of a supply chain disruption on sales revenue diagram]

- **Pre Event**
- **Disruption Event**
- **Pent-Up Sales**
- **Post Event**

- Short Term Sales Loss
- Market Share Loss
Impact of maintaining an inventory buffer

![Graph showing the impact of inventory buffer]

- **Sales Revenue**
  - **Time**
    - Pre Event
    - Disruption Event
    - Pent-Up Sales
    - Post Event

The graph illustrates the sales revenue over time, highlighting the pre-event, disruption event, pent-up sales, and post-event periods.
Impact of securing a **backup capacity supply**

![Graph showing impact of securing backup capacity supply](chart.png)

Sales Revenue vs. Time

- **Pre Event**
- **Disruption Event**
- **Pent-Up Sales**
- **Post Event**
Contingency Planning is one way to prepare for risky events.

Anticipate → Plan → Prepare → Event → Execute

Update
We can use network theory to measure structural flexibility in organizations.

The smaller the **average path length** of the worksharing matrix, the more robust the system is to routine variation and exceptional disruptions.
Globalization, connectivity and complexity are posing serious new security threats.

*Factory Physics and Network Science are useful tools in the emerging field of Security Engineering.*
Thank you on behalf of the OPEM Research Group!

Operations Mgmt
- Zigeng Yin: Robust Supply Chains
- Wendy Lu Xu: Terrorist Supply Chains
- Jie Xu: Integrated Product and Supply Chain Design
- Rob Lien: Flexible Transshipment Systems
- Bora Kofal: Flexibility in Production and Service Systems

Social Networks
- Bilal Gokpinar: Innovative Team Structure
- Yao Cheng: Crisis Management
- Fang Liu: Innovation Networks
- Gigi Yuen: White Collar Work Systems

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