

# SUPPLY CHAIN DYNAMICS, AGILITY AND RELATIONSHIP MANAGEMENT: BSS 421



**WEEK 8: SUPPLY CHAIN COMPLEXITY  
BY  
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# Recap of Week 6 Topic



We discussed;

1. Concept of agility and its implication to business approaches.
2. Agility was defined as a rapid change that is unpredictable and can come from anywhere.
3. While there are many models ; drivers (causes), enablers and responses stand out as key characteristics of agility.
4. Businesses as well as people can only be prepared for consequences of agility by being flexible and adaptable.

# Recap of Last Week's Topic Cont'd



Agility orientation tries to balance the requirements of other business orientations such that:

1. Stock is held frequently as work in progress that requires customization rather than finished goods.
2. Stock should be held deliberately but not build without the organization having control.
3. Stock should be held close to the stage of finished items so that quick assembling or reassembling is possible when an order is made.

## **Recap of Last Week's Topic Cont'd**

### **Technology based manufacturing paradigm.**

It aims at supporting sustainable production through digital technologies and smart manufacturing.

These should support circular production that benefits ;

1. Economy of a country.
2. Create and utilize renewable sources of energy.
3. Ensure the well being of the people and other organisms.

# Objectives of Week's Topic



Overall objective is to describe supply chain complexity as a supply chain dynamic.

Specific objectives include;

1. Production approaches as a source of supply chain complexity.
2. Bullwhip effect as a source of supply chain complexity.
3. Internal systems variability as a source of complexity.
4. Supply chain risk as a source of supply chain complexity.

# Complexity from Type of Production



1. Some craft production is being carried out by educated people with capability of automating production. It dominates local supply chains.
2. Modular production has been adopted by mass producers in contract manufacturing.
3. Digital and smart manufacturing is disrupting well established supply chains by enabling contract manufacturing.
4. Outsourcing manufacturing under offshored manufacturing is being recalled in form of insourcing.

# Supply chain Complexity from Type of Production Cont'd.



Contract manufacturing is driven by

1. Product family Architecture.
2. Reconfiguration of manufacturing system.
3. Delayed differentiation.

This capability destroys local supply chains that are dominated by producers without big investments similar to those of large scale manufacturers.

# Supply Chain Complexity from Bullwhip Effect.



Bullwhip effect refers to variation in accumulation of inventory in the upstream part of supply chain as a result of small variation by retail consumer demand.

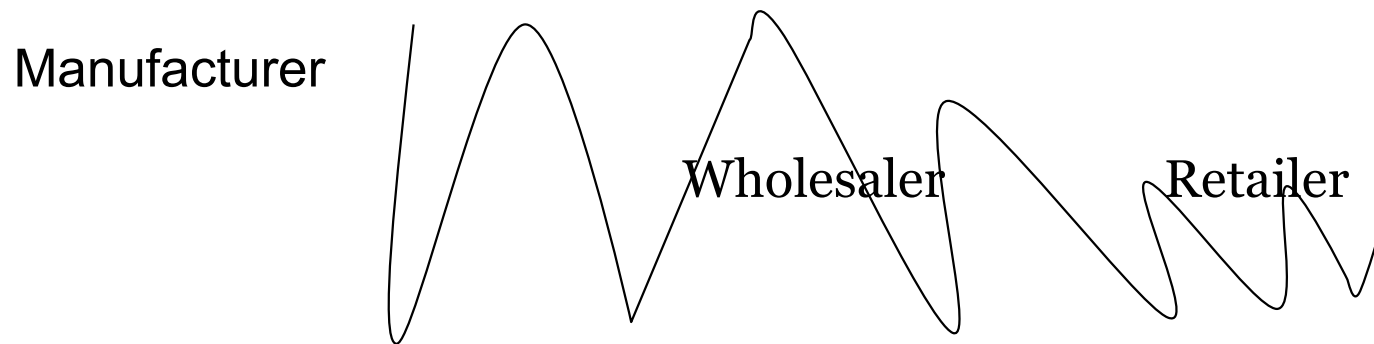
Chase et al. ( 2013) p 422 explains that bullwhip is a supply chain phenomenon where there is oscillations like variability of inventory which is more visible towards the manufacturer or the upper part of the supply chain.

# Supply chain Complexity from Bullwhip Effect.



It is called bullwhip because it resembles whip cracking associated with Jay forster (1961).

It resembles the following shape.



Oscillations of inventory along supply chain.

# Supply chain Complexity from Bullwhip Effect.



Literature on bullwhip effect attributes the observation of the effect in P&G, now P&A company where unexplained inventory variation of baby diaper occurred along the supply chain yet the demand was appearing to be predictable.

Scukanec et al.,( 2007) pp 290-292 observes the following as Causes of bull whip effect.

1. updating of the demand forecasting.
2. Grouping of orders ( batch orders)
3. Price fluctuation
4. Re-distributions (rationing)

# Supply chain Complexity from Bullwhip Effect

## Cont'd



1. **Updating of the demand forecasting.** Sometimes the demand is not captured properly leading to over production. The produced goods take longer in the manufacturer's or wholesaler's warehouses or stores when demand down stream is less.
2. **Grouping of orders (batch orders).** Retailors make different orders while the manufacturer produces in definite amounts. The combination leaves some amounts of merchandise not ordered to stay in stores for longer period of time.
3. **Price fluctuation.** Affects the purchasing power of consumers who do not buy some merchandise if prices increase.
4. **Re-distributions (rationing).** If merchandise is less the producer divides into smaller portions so that each order gets a fraction.

# Supply chain Complexity from Bullwhip Effect.



Others include

1. **Disorganization by supply chain participants;** Each member of supply chain is pre-occupied with meeting their own goals and only remembers another member when they need them.
2. **Lack of communication;** This is a major cause of bullwhip effect. When retailer at the tail do not communicate upstream accumulation of inventory occurs.
3. **Free return policies of goods ;** Consumers can return a purchase even for small things they can manage when there is a free return policy.
4. **Lead time challenges;** Delivery logistics at last mile is always a challenge.

# Supply chain Complexity from Bullwhip Effect.



Read on beer game and bullwhip effect. It is an experiment that was conducted to prove existence of bullwhip effect. It explains practical testing of bullwhip effect on supply chains and it is well documented in literature.

1. Scukanec A. Rogic K, Babic, D. (2007). Bullwhip Effect in Supply Chains. Promet- Traffic&Transportation, Vol. 19(5), 289-293.
2. Chase, R. C. Shankar, R., Jacobs, G. & Aquilano, N. J. (2013). Operations and Supply Management, McGraw Hill Education (India) private limited

# Supply chain Complexity from Bullwhip Effect

## Cont'd



Effects of bullwhip include;

1. Increase operational and labor costs in the upstream of supply chains.
2. Wastage of stock from over production.
3. Increased losses of stock due to spoilage while in store.
4. Loss of customers due to unreliability of supply. Bullwhip effect disorganizes manufacturers and wholesalers and at times they are caught up by increased demand.
5. Strained relationships with suppliers when orders are cancelled.
6. Price fluctuations occur when customers buy in large quantities and stock up for the future in reaction to bullwhip effect.

# Supply chain Complexity from Bullwhip Effect Cont'd



Effects of bullwhip cont'd

Overall,

1. Bullwhip effect can cause disruptions to both the supply chain and to the manufacturer's operations, such as increased costs associated with storage, transportation, spoilage, losses of revenue, delays to shipments etc

2. The dynamics resulting from bullwhip effect on one member of supply chain sends ripple effect that can affect associated supply chains. This was one of the consequences during the covid-19 period where demand was erratic at customers level just before lock down was introduced. It led to chaos in supply chains of entire world .

# Source of complexity from Internal Systems Variability



- **Internal systems variability** refers to the inherent fluctuations, inconsistencies or differences in a process's output as observed by Stevenson (2007) pp 454, 469

It is caused by variability in movement of goods caused by

1. Queueing of in process inputs.
2. Preventive maintenance policies that introduce uncertainty into the manufacturing system.
3. Inherent variability in the mechanical and technical system such as faulty equipment.
4. Human error as result of incompetence.
5. Defective operational system.
6. Large portion of manual operations.
7. Outdated technology matched with modernized equipment etc

# Source of complexity from Internal Systems Variability Con'd



Types of variability include :

1. **Random variations;** These are inherent variations in the system such as the specification of the equipment which cannot be achieved beyond a certain point. They are errors that man cannot control. However, they are random and their effect cancel out. A slight negative performance at one point of equipment or processing line is balanced by another positive performance at another point.

# Source of complexity from Internal Systems Variability Cont'd



**2. Assignable variations;** They are variations from a known cause and can be eliminated. They can originate from staff in the process of working either out of negligence, incompetence or ignorance of the consequences of their actions, fatigue etc. Human errors include defective input, Incorrect methods, wrong equipment adjustment, malfunctioning machine etc.

# Complexity from Supply Chain Risk



- Risk can be defined as what is likely to happen in future if certain actions are taken or not taken (Sigh et al.,2009) p326.

Risk becomes of concern when-;

1. Amount or intensity of exposure to hazard.
2. The time risk starts.
3. Duration the risk lasts.

Risks and uncertainty have increased in supply chains because of product/service complexity, e-business, outsourcing, globalization and emerging technologies mainly digitalization.

Lysons & Farrington (2006) identifies two types of supply chain vulnerability namely ;

1. Internal supply chain risks
2. External supply chain risks

# Complexity From Supply Chain Risk Cont'd



**Internal supply chain risks;** Are risks within a supply chain and includes ;

1. Lack of supply chain ownership caused by undefined boundaries because of complicated supply networks. E.g. Relationship of a buyer with a bank and a relationship of the supplier with the same bank.
2. Chaos risks that are caused by mistrust and distorted information by supply chain members. While supply chain is expected to work for all members, each member pursues own goals first and foremost.
3. Decision risks caused by lack or wrong Information from SC members.

# Complexity from Supply chain Risk Cont'd



4. **JIT relationship risks caused by lack of buffer inventory.**  
Keeping zero inventory is very difficult and risky because of the lead times by suppliers and irregular customer demand.
  
5. **Inertial risks** caused by general lack of responsiveness by customer or supplier due to contingent challenges. Examples of challenges such as break down of means of transportation of a distributor.
  
6. **Supplier base such as a single source**  
who will at some point fail to deliver supplies.

# Complexity from Supply chain Risk Cont'd



Kabus et al. ( 2020) p 471 identifies additional risks found within the supply chain as;

1. Economic crisis,
  2. Price fluctuations,
  3. New technologies,
  4. Alternatives in substitution
  5. Exchange rate fluctuations,
  6. Non-payments, demand fluctuations,
  7. Competition and domination Changes
  8. Product ageing.
- Members of supply chains are affected differently and they in turn react differently to the supply chain as they try to improve profit margins.
  - **External risks** are risks outside a particular supply chain and they include political risks such as war, terrorism, strikes, legal provisions, customs duties.

# Complexity from Supply chain Risk Cont'd



**Enterprise Risk** ; Risk associated with individual business organizations. These are ;

1. **Financial risk**; Limited sources of funds to finance obligations and sustain the operations.
2. **Strategic risk**; Present and future profit of a firm is not certain.
3. **Operational risk** ; They threaten normal operations of an organization. They are the highest type of risks in organizations.
4. **Human resources risk**. There include Insufficient manpower, lack of skilled and competent manpower and Lack of sufficient human resource to detected risks and deal with them.

# Complexity from Supply chain Risk Cont'd



5. **Technological risk**; lack of technology for automation of the processes, lack of updated technology, non-integration of buyer and supplier technologies or lack of compatibility of the technologies etc.

6. **Reputational risk** : Risk that occurs when an organization cannot sell its products and services because of negative perception by customers and suppliers or when an organization cannot attract skilled and competent employees.

**Legal risks** ; These arise when an organization has not complied with requirements of law.

# Complexity from Supply chain Risk Cont'd



- Kabus et al. ( 2020) Summarises operational risks within an enterprise as failure of on-time deliveries, lack of flexibility to orders, poor quality in relation to customer expectations, security and safety of the employees as they work, wrong prognoses of the risks , lack of proper trade-off between stock keeping and orders and forester effect .
- **Note.** Forester effect is bullwhip effect which affect an organization without being aware of build up of inventory until it is quite late.
- Information technology is specifically singled out posing risk to entire supply chain through attacks by viruses and hackers, information deformation and breakdown of information systems.

# Summary of Supply Chain Risks



Donald Waters ( 2007) Provides details of broad risks that are common to enterprise, internal and external to supply chains.

These are -;

- **Strategic Risks:** Arising from strategic decisions made within organizations that directly increase the risk etc.
- **Natural Risks :** Arising from unforeseen natural events such as extreme weather, lightning, earthquakes, flood, landslides or outbreaks of diseases etc.
- **Political Risks :** such as government instability, new legislation regulations, policies, permits, treaties, custom barriers, conflicts or wars etc

# Summary of Supply Chain Risk Cont'd



Donald Waters ( 2007) classification cont'd.

- **Economic Risks** : From the broad economic environment, including interest rates, inflation, currency exchange rates, taxes and growth etc.
- **Physical Risks**: Risks to buildings and facilities, such as traffic accidents, equipment failure, congestion or limited capacity etc.
- **Supply Risks** : All issues with the movement of materials into an organization, including sources, supply market conditions, constraints, limited availability, supplier reliability, lead times, material costs, delays, etc;

# Summary of Supply Chain Risk Cont'd



Donald Waters ( 2007) classification cont'd

- **Market risks** : All aspects of customer demand, such as level of demand, variability, alternative products, competition and patterns of change.
- **Transport risks**: For all movements of materials, including risks to the infrastructure, vehicles, facilities and loads.
- **Products risk**; Risks arising from product features, including technology used, innovation, product mix, range, volumes, materials used and standardization.
- **Operations risk**; Arising from the nature of activities in the organization, type of process, complexity, technology, special conditions, after-sales service, etc

# Summary Supply chain Risk Cont'd



Donald Waters ( 2007) classification cont'd

- **Financial risk:** All money transactions, including payments, prices, costs, sourcing of funds, profit and general financial performance; etc.
- **Information risk** : Including the availability of data, data transfer, accuracy, reliability, security of systems, etc;
- **Organization risk** : Arising from the way the organization works, including its structure, disputes, types of interactions, subcontractors, communication flows, culture, etc.

# Summary Supply chain Risk Cont'd



Donald Waters ( 2007) classification cont'd

- **Management risk:** Risks arising from their knowledge, skills, experience, decisions, real aims, etc.
- **Planning risk :** Risks from the design and execution of plans for operations, including mismatch between supply and demand, inadequate detail, missed constraints, poor forecasting, lack of synchronization, etc.
- **Human risk :** From all the complex interactions between people, including working requirements, aims, culture, human errors and industrial action etc.

# Summary Supply Chain Risk Cont'd



Donald Waters ( 2007) classification cont'd

- **Technical risk** : New technology in processes, communications, new products, process designs and reliability;
- **Criminal risk**: Arising from all illegal activities, such as theft, fraud, bribery, vandalism and terrorism;
- **Safety risk**: to people and facilities, including accidents, hazardous substances and fire;
- **Environment risk**: e.g. Pollution, use of resources, traffic and regulations;
- **Local permits risk**: Usually administered by local government and including planning permissions, land use, local policies, grants, etc.

# Supply Chain Complexity and Supply chain Dynamics



1. Type of Production pose following challenges
  - Customers change loyalty based on value they gain from a product.
  - Investment in production make it difficult to change from one type of system to another.
  - Craft production supply chains are disrupting large scale well established large production supply chains
2. Bullwhip effect causes losses because it occurs in unnoticeable pattern until the there is a sudden accumulation of Inventory upstream.
3. Internal systems variability may be common in less automated process compared to the automated ones.

# Supply Chain Complexity and Supply chain Dynamics Cont'd



- Supply chain complexity from risks at the enterprise level causes the greatest supply chain dynamics. As noted from Donald Waters ( 2007) classification , enterprise risks have many causes where a risk that may look small can result to great impact in the supply chain dynamics. E.g. a slight mistake with a match box in a factory with flammable products can result to an imaginable disruption of supply chains.
- In summary, complexities from internal variability and enterprise risk are core to organization operations.
- Members of a supply chain not taking these seriously pose greatest challenge to a supply chain performance.
- Risk management has become critical for survival of enterprises and supply chains

# Task for Next Week



1. Identify the type of complexity that is causing the greatest challenge to performance of an organization you work for.
2. If you are not working, identify challenges that may be affecting a retail outlet from where you buy merchandise. Trace any supply chain of such a retailer and explain source of challenges.

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*THANK YOU ALL  
WISHING YOU WELL  
HAVE A LOVELY WEEK*