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GRIP Framework

Green Supply Chain Strategy

1. **Innovations in products, processes** & business models to reduce resource usage, lessen the carbon footprint & use renewable energy sources
2. Use Judicious combination of Re-innovations and Carbon trade
3. **The functional model:** Where the function is what matters and can be fulfilled as long as it provides the intended needs: functional foods, virtual travel, digital communities , etc.
4. **The services model:** A services model where ownership of the product is replaced by service offerings: car sharing, sell a service not product, home delivery, electronic delivery
5. Identifying **social hard constraints** such as use of local non-green timber, coal power plants or live stock for meat etc and then follow steps above.

Performance

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Enablers and Green Supply Chain Performance

	Value Chain	**Delivery**	**Institutions**	Resources
Enablers	Re Innovations, Carbon Trading GHG, Resource minimization	Green Transport Mode , Reverse Logistics ,Smart Warehousing Carbon Trade	Green Regulations Emission Caps, ISO14000	Water, Power , Cradle to Cradle protocol ,Carbon markets
GHG gases	Low if product refurbished, High Otherwise	Low	Low	Low
Cost	High Product Design Cost, Low Production Cost	High Transportation & Inventory Costs	Cost of regulation, High Environ safety	Low Costs due to recycling

- Production and consumption costs include costs of inputs such as labor and capital and do not fully reflect the cost of using environmental resources.

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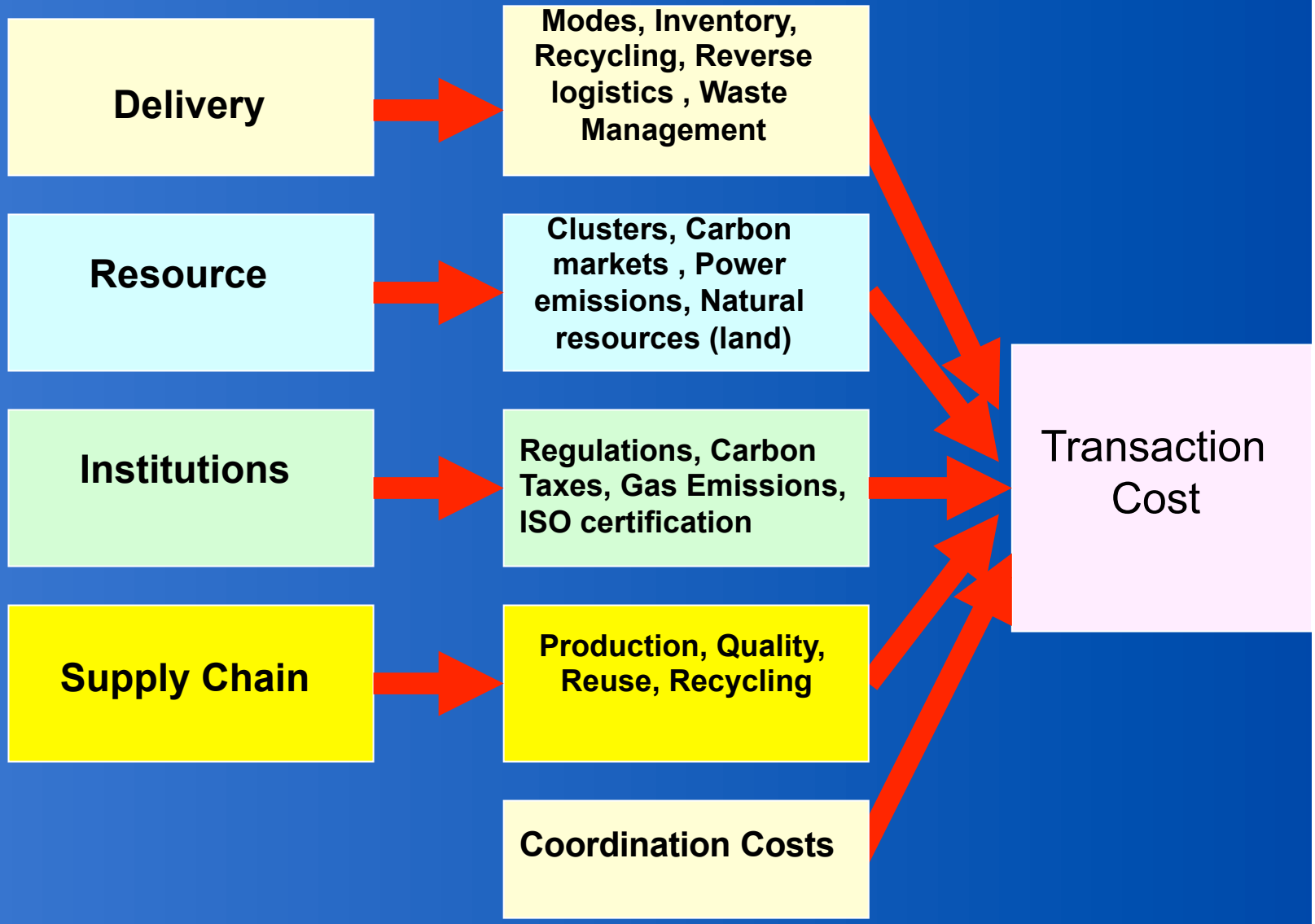
Transaction Costs



Innovations

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Innovations in the Green Supply Chain Ecosystem

- Supply Chain
  - Cradle to Cradle Protocol : Redesign of Products to be modular and reuse friendly and processes to minimize waste and energy consumption
  - Design selection based on supply chain carbon foot print
  - The business model: Selling eco-friendly solutions, home delivery
  - Eco-efficient procurement, manufacturing, Distribution, Transport
- Institutions
  - Standards development
  - Monitoring the GHG emissions, pollution levels
  - Taxes and Regulations that improve sustainability
- Delivery Mechanisms
  - Re-Innovations: Reuse, Recycling ,Repair
  - Inbound, Outbound and Reverse logistics design; Model selection
  - Wellness and Convenience Embedded Packaging
  - Waste Disposal
- Resources
  - Carbon trading and outsourcing
  - Research labs

Innovations in Supply Chain

- Low-carbon innovations aren't just new products and technologies. They also include new services and processes in such industries as ICT, chemicals and materials, agriculture, law, accounting, and consulting.
- Examples:
  - The Dutch flower industry cultivate flowers in rock wool & transport in the same trays, reducing shipping time and cost.
  - Best Buy partnered with GE to bring new home energy management systems, smart appliances, and renewable energy products to market more rapidly
  - Morrison & Foerster LLP began law practice focused on clean technology offering corporate and litigation services, along with technical expertise in intellectual property, energy, and environmental law. Billings grew from $6 million in 2006 to around $100 million in 2011.
  - Automakers are adopting new "start-stop" battery systems from Johnson Controls that turn vehicles' engines off rather than idle when the vehicles stop.

Delivery Innovations

- **Videoconferencing system** substitutes for many forms of business travel. HP and its customers saved 66,000 metric tons of carbon dioxide-equivalent (CO2e) greenhouse gas (GHG) emissions in two years, and HP reduced its employee business travel by 43 percent.
- SAP introduced Carbon Impact On Demand 5.0 carbon management software in 2010, leading the $1.3 B Enterprise Carbon Accounting (ECA) marketplace.
- HP works with corporate customers to design, implement, and manage an imaging and printing infrastructure. For one customer with 10,000 employees, HP has reduced printing energy consumption by 66 %. Fortune 500 companies could avoid about 2.3 million metric tons of CO2 annually by reducing printing.
- **For low-carbon innovations to take root, companies must develop the necessary networks of external partners that enable them**

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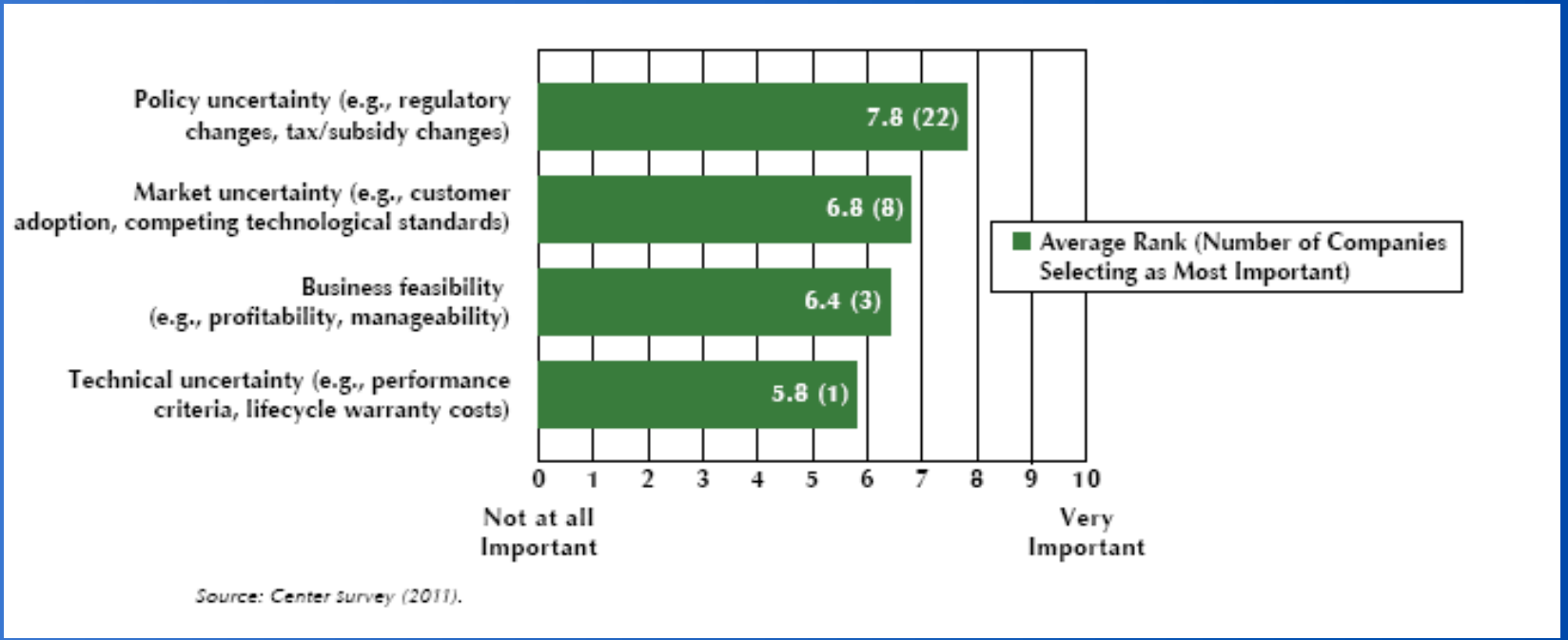
Risk

Risk

- Companies need to understand how global warming could impact their supply chain; assessing potential climate-related vulnerabilities such as new rainfall patterns, increased storm activity, higher prices for natural resources, and potential political instability and energy insecurity.



Source: Center survey (2011).

Policy and Market Uncertainties

- May companies (65%)named government policy uncertainty as the biggest risk.
- Sectors, such as electricity , are regulated both at the federal and **state levels; policies often vary state-by-state.**
- **National priorities shift with elections**. President Clinton's clean car initiative meaning fuel efficiency, safety & less emissions, gave way to a hydrogen fuel initiative of President Bush. President Obama is focusing on electric cars.
- **Market acceptance**. Will customers pay more for electric cars and other highly fuel-efficient vehicles? The answer may change depending on fuel prices, the state of the economy, government policies.

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Risks in Green SCNs

Ecosystem Elements	Risks
Supply Chain	• Pollutants during the production • Waste disposal, hazardous waste liability, Recycling • Opportunistic behaviour by partners • Social & Govt. influence on buying patterns • Perceived non-commitment by top management • Product recalls and after effects
Resources	• Criminal / Insurance liability for violations and accidents • Inability to identify and remedy non-compliance or risk • Accidents due to a lack of training or awareness • Public pressures to Ban or restrict raw materials • Natural resource (land) usage, Deforestation
Institutions	• Political/social pressures for regulations • Policy Changes • Changes during elections
Delivery Infrastructure	• Reverse logistics and Waste disposal infrastructure • Operational readiness for accidents • Lack of infrastructure

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Governance: Partner Selection, Coordination and Execution

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Governance: Partner Selection, Coordination & Control

- A separate chain is formed for each order
- **Partner selection** (Optimization, Social Network Analysis)
  - Structural features (asset specificity, capabilities)
  - Relational ties (Governments, Social organizations, cluster managements, Educational Institutions, etc.)
- **Coordination :** Determining who does what and when and communicating to everyone involves supply chain planning and visibility
- **Execution: Control Tower to** Monitor order status so that processes work as per plan & control exceptional events

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Partner Selection

Partner Selection

- We identify suppliers for various Components and Services from all over the globe
- We short list them based on the criteria mentioned such as Location, Country policies, Delivery costs, Asset Specificity, Risk proneness, Innovation capabilities, Technology sophistication of hard and soft infrastructure, etc.
- Optimization, TCE, Social Networks, are used in the pre-selection process

TCE and Partner Selection

- Transaction costs are the costs incurred to coordinate and connect all links in the global supply chain.
- Transaction costs relate to finding a suitable trading partner, negotiating, setting up the contract and monitoring compliance with the selected partner.
- Transaction costs include
  - **Observable costs:** transport costs, import duties, customs tariffs and other formal trade barriers
  - **Soft costs :** Costs for information gathering, negotiation & monitoring contracts, trust building, networking, risk handling and mitigation, making up for cultural differences and miscommunication, compliance with safety regulations , labor laws etc.
- The hard observable costs decrease with trade liberalization and decreasing transport costs , the soft costs of social connections gain relative importance

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Coordination

Coordination

- Determining who does what and when and communicating to everyone
- The coordination includes Software based method for
  - For every order, selecting of suppliers; assigning functions to them such as what to supply, how is it to be produced (e.g., product tolerances and process standards), the production and delivery schedules , etc given the product specification and communicating to the chain partners.

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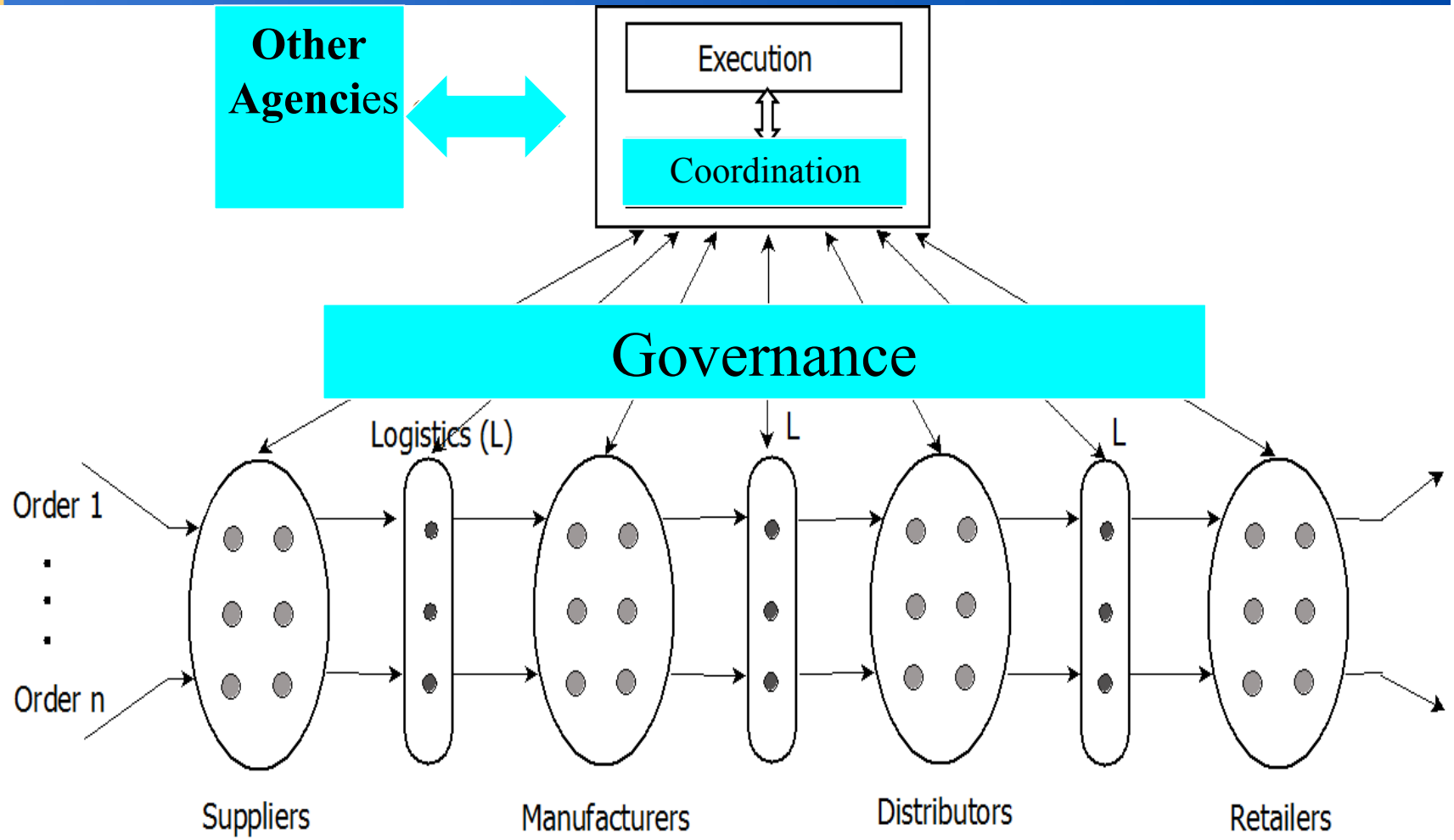
The Control Tower

Network Governance, Coordination and Execution



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Conclusions

- Green supply chain design is a complex exercise with risks of non compliance from partners
- Totally green products as currently being sought after may not be a feasible proposition since it requires collaborative developments across all partners.
- A feasible green solution that is a balance between resource use, carbon foot print, customer acceptance and profitability is the one that should be sought after. This is vertical/ product dependent
- Can be used with advantage for SMEs, Hospitals, Cities, Villages, etc.
- Theory development needs Integration of Social networks, Machine learning, Optimization, Game theory with SCNs.