The Role of Production Sites in a Complex Economy

Course: Production Management and Logistic Systems [10592713]

Economia e management (Latina Campus)

AA 2024-2025 | Prof. Alessandro Pietrogiacomi

SAPIENZA
UNIVERSITÀ DI ROMA

Latina 29 April, 2025

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Lesson Plan for Tuesday, April 29

Overview of the lesson, and educational objectives,

Topic: **The Role of Production Sites in a Complex Economy .**

Time: **10:00–13:00**

Duration**: 3 hours**

Learning Objectives

By the end of this lesson, students will be able to:

- Define what a production site is and explain its basic role in an economy.
- Differentiate between types of production sites (single-site vs multi-site, offshore vs nearshore, ecc)
- Analyze the factors that contribute to complexity in production site management (e.g., globalization, technology, regulations, environmental concerns) .
- Evaluate future trends shaping production sites, such as automation, sustainability initiatives, and reshoring strategies.
- Develop critical thinking about how production sites can adapt to changing economic, technological, and political conditions.

Historical Perspective

Rise of Global Production Networks

Complexity Increases Over Time

1784 | 1870 | 1969 | Now

1st Industrial Revolution:

- Mechanization, steam power, weaving looms
- Large-scale transportation with steam-powered vessels and railroads
- Replacing human and animal power with machines

2nd Industrial Revolution:

- Electricity, assembly line, mass production
- Internal combustion engines, automobiles
- Radio and television

3rd Industrial Revolution:

- Electronics, computers
- Automation
- Information technology

4th Industrial Revolution:

- Cyber-physical systems
- Internet of Things
- Sensor Networks
- Advanced Robotics
- Big Data
- Machine Learning
- Cloud Computing
- Driverless cars
- 3D/4D printing-based manufacturing
- Blockchain transaction architecture

Key Functions of Production Sites

Key Function	Short Description
Manufacturing and Value Creation	Production sites transform raw materials into valuable finished goods, creating wealth and economic growth.
Job Creation and Skills Development	They provide employment opportunities and drive the development of technical and professional skills in local communities.
Innovation Hubs	Many sites lead research and development (R&D) efforts, becoming centers of innovation for new products and processes.
Supply Chain Nodes	Production facilities are critical links in global supply chains, ensuring materials and products flow smoothly to markets.
Local and Regional Economic Impact	Sites stimulate local economies by supporting suppliers, service providers, and creating secondary industries.
Global Trade Integration	They enable companies to participate in international markets by producing goods for global export and distribution.
Environmental and Social Responsibility	Modern production sites are increasingly tasked with reducing environmental impact and contributing positively to society.

Types of Production Sites

Type	Short Description
Single-Site Operations	One main production facility where all manufacturing activities are centralized; simpler to manage but riskier if disruptions occur.
Multi-Site Operations	Multiple production facilities spread across different locations, offering flexibility, scalability, and risk diversification.
Specialized vs. Generalized Sites	Specialized sites focus on making a specific product or process, while generalized sites handle a variety of products or functions.
Greenfield vs. Brownfield Sites	Greenfield sites are built from scratch on new land; brownfield sites renovate or reuse existing industrial facilities.
Clusters and Industrial Parks	Geographic concentrations of related industries sharing infrastructure, talent, and resources for greater efficiency and innovation.
Offshore vs. Nearshore Production	Offshore production moves manufacturing to distant countries (often for cost savings); nearshore production keeps it closer to home markets for speed and control.

Complexity Factors

Complexity Factor	Short Description
Globalization	Companies operate across borders, increasing opportunities but also creating complex interdependencies between countries.
Regulatory Differences	Different countries have different rules for labor, environment, and business, requiring constant adaptation and compliance management.
Logistics and Infrastructure	Reliable transport, energy, and communication systems are critical for efficient production; weaknesses cause costly delays.
Technological Advancements	Rapid innovation (e.g., robotics, AI, IoT) forces companies to continuously upgrade their production systems to stay competitive.
Environmental Concerns	Growing pressure from governments, customers, and investors to reduce carbon footprints, waste, and environmental impacts.
Risk Management (Supply Chain Disruptions)	Natural disasters, political unrest, or pandemics can halt production; companies need contingency plans to survive disruptions.
Labor Market Dynamics	Availability, cost, and skills of the workforce vary by region, directly affecting production site performance and sustainability.
Geopolitical Tensions and Trade Wars	Conflicts between countries (like tariffs, sanctions) can reshape where and how companies produce goods globally.

Production Sites in Global Value Chains

Topic	Short Description
Definition of Global Value Chains (GVCs)	GVCs describe the worldwide network of activities where goods are designed, produced, and distributed across multiple countries.
Role of Production Sites in GVCs	Production sites are key points where value is added, whether through manufacturing, assembly, or customization activities.
How Sites Affect Competitive Advantage	Well-located, efficient production sites can lower costs, speed up delivery, enhance quality, and strengthen a company's market position.
Challenges in GVC Management	Managing GVCs is complex due to risks like supply disruptions, regulatory differences, trade barriers, and geopolitical tensions.

Future Trends

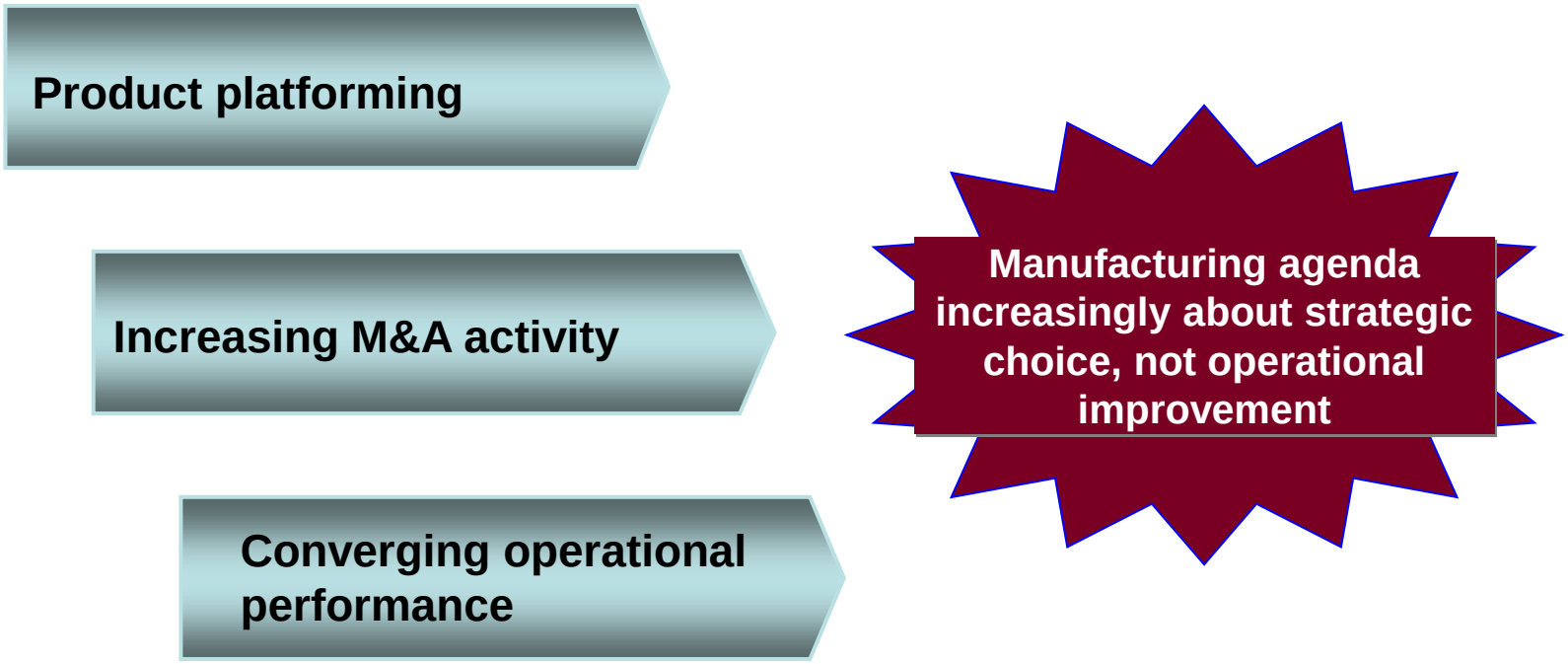
Future Trend	Short Description
Automation and Smart Factories	Increased use of robots, AI, and machine learning to automate tasks, optimize processes, and reduce human error.
Reshoring and Regionalization	Companies are moving production closer to home markets to reduce risks, improve control, and meet local demands faster.
Sustainability and Circular Economy	Focus on eco-friendly production models that minimize waste, reuse materials, and lower carbon emissions.
Industry 4.0 Technologies (IoT, AI, Robotics)	Integration of digital technologies to create highly connected, intelligent, and self-optimizing production environments.
Talent and Workforce Evolution	Demand is shifting toward highly skilled workers who can manage technology, data, and innovation rather than manual labor.
Flexible and Agile Production Models	Production systems are designed to quickly adapt to changes in demand, technology, and supply chain conditions.

Key messages

1 **Manufacturing strategy is increasingly important to companies**

2 Companies can create manufacturing strategies through a structured process

The manufacturing agenda is changing



Product platforming drives revisions of manufacturing strategy and plant network restructuring

	Change in product line	Change in manufacturing strategy
	**MQB Platform (Modular Transverse Matrix)** Strategy: VW developed the MQB platform (used in Golf, Audi A3, Skoda Octavia, etc.) to standardize parts across brands.	• Factories became more flexible—same assembly line could produce different models. • Cost savings: Reduced complexity by 30% in production. • Plant consolidation: Some older factories (e.g., in Germany) were retooled, while new ones (e.g., China) were optimized for MQB • **Result: Faster production, lower R&D costs, and higher profitability per vehicle**
	**Modular TNGA (Toyota New Global Architecture)** Strategy: TNGA unified platforms for Camry, RAV4, Prius, and Lexus models	• Factory redesigns: Plants like Georgetown (Kentucky) were overhauled for flexible TNGA lines. • Robotics & automation: Welding and assembly processes were standardized. • Fewer platforms: Reduced from 100+ to 5 core architectures, cutting production costs by 20%. • **Result: Higher efficiency, better quality control, and faster model updates.**
	**Gigacasting & Unboxed Process (Next-Gen Platform)** Strategy: Tesla's gigacasting (single-piece car underbody) and "unboxed" assembly aim to simplify EV production	• Fewer parts: Reduces welding/assembly steps → 40% less factory space needed. • Faster production: Berlin & Texas factories are being adapted for this method. • New factories: Future plants (e.g., Mexico) will likely use only this platform. • Result: Targets 50% cost reduction per vehicle, enabling cheaper EVs like the "$25k Model 2."

Why Platforming Changes Manufacturing Strategy?

- **Lower Costs –** Shared parts = fewer suppliers & simpler logistics.
- **Flexibility –** One factory can build multiple models.
- **Speed to Market –** New models can launch faster using existing platforms.

Increasing M&A activity creates more opportunities for operational restructuring

Number of deals worldwide; in thousands ((Data: Refinitiv, PwC, McKinsey)

Year	Global M&A Deals (Thousands)	Notable Trend
2000	**37.5**	Dot-com bubble peak
2005	**31.2**	Post-9/11 recovery
2010	**25.6**	Financial crisis slump
2015	**42.1**	Tech & healthcare boom
2020	**37.8**	COVID-19 slowdown
2021	**63.1**	Record SPAC/PE deals
2022	**51.2**	Rate hikes cooled activity
2023	**44.0**	Rebound in megadeals
2024*	**~48.0**	AI/energy deals surge
2025*	**~52.0**	Election year volatility

Each consummated deal requires post merger management on an operational level

(Projected based on 2024 H1 data)*

Why do some companies sell their factories?

General Motors (GM) – Sold Lordstown Plant to Lordstown Motors (2019)

Reason: GM was restructuring to focus on electric vehicles (EVs) and exiting underutilized factories.

Deal: Sold the Lordstown, Ohio plant (which previously made the Chevy Cruze) to startup Lordstown Motors (an EV truck maker).

Outcome: Lordstown Motors later faced financial troubles and sold the plant to Foxconn (Apple's iPhone manufacturer), which now builds EVs for other brands

Nestlé – Sold U.S. Confectionery Factries to Ferrero (2018)

Reason: Nestlé wanted to exit the low-growth candy business (like Butterfinger & Baby Ruth) to focus on healthier products**.**

Deal: Sold several U.S. factories to Ferrero (maker of Nutella & Kinder) for $2.8 billion**.**

Outcome: Ferrero expanded its U.S. presence, while Nestlé invested in coffee, water, and nutrition

Toshiba – Sold Chip Factories to Sony (Spin-off Business, 2021)

Reason: Toshiba needed to reduce debt and focus on energy & infrastructure.

Deal: Sold its NAND flash memory factory in Japan to Sony (which formed Kioxia, a joint venture with Western Digital).

Outcome: Sony strengthened its semiconductor supply chain, while Toshiba streamlined operations**.**

Common Reasons for Selling Factories

1. **Cost Reduction** – Shutting down unprofitable plants.
2. **Strategic Shift** – Exiting declining markets (e.g., GM leaving sedans for EVs).
3. **Debt Relief** – Selling assets to raise cash (e.g., Toshiba).

Three real-world examples of how M&A-driven operational restructuring created manufacturing synergies

Industry	Deal Details	Operational Restructuring Impact
Automotive Fiat Chrysler & PSA Group → Stellantis (2021)	**Deal Value:** $52B	- Factory rationalization: Closed underused plants (e.g., Opel's Gliwice, Poland). - Platform consolidation: Shared EV architectures (STLA) reduced R&D costs by 40%. - Job cuts: ~14,000 positions eliminated (mostly in Europe).
Tech/Electronics Foxconn Acquires Sharp (2016)	**Deal Value:** $3.5B	- Revamped Sharp's factories: Shifted focus from LCDs to OLEDs (especially for Apple). - Boosted automation: Foxconn's robotics expertise cut labor costs by 25%. - New Joint Ventures: Partnered with Tesla (EV components) and Amazon (smart displays).
Pharma Pfizer Acquires Wyeth (2009)	**Deal Value:** $68B	- Closed over 50 facilities: Achieved $4B/year savings in manufacturing costs. - R&D consolidation: Focused efforts on biologics (e.g., Prevnar vaccine). - Supply chain optimization: Reduced suppliers from 5,000 to 3,000.

Performance convergence reduces impact of operational excellence

Performance convergence occurs when competitors in an industry achieve similar levels of operational efficiency, making it harder for any single company to gain a sustained advantage through traditional operational excellence (e.g., lean manufacturing, Six Sigma, supply chain optimization).

Why this happen?	Short Description	Example
Best Practices Become Ubiquitous	Once-exclusive production methods (like lean manufacturing) are now standard across industries, reducing early movers' advantages.	Most automakers now have near-identical assembly efficiency, narrowing Toyota's historical lead.
Technology Democratization	Advanced technologies (AI, robotics, analytics) have become accessible to mid-sized and even small firms, leveling the playing field.	Small manufacturers use cloud-based ERP systems to match SAP/Oracle capabilities.
Standardized Supply Chains	Globalization has led many companies to use the same suppliers and logistics partners, reducing differentiation.	Apple and Samsung both rely on Foxconn, TSMC, and Corning for key components.
Regulatory & Cost Pressures	Strict regulations (especially in pharma, aviation) push firms toward uniform production standards, limiting unique advantages.	Generic drugmakers now meet FDA compliance at costs lower than Big Pharma.

Three Real Examples

Industry	Past Advantage	Current Situation	Result
Automotive Toyota vs. Hyundai	Toyota's lean production created a 30% cost advantage in the 1990s.	Hyundai now matches Toyota's efficiency with automation and platform sharing (e.g., E-GMP for EVs).	Toyota increasingly competes on brand loyalty rather than factory productivity alone.
Retail Walmart vs. Amazon (and Shein/Temu)	Walmart's supply chain mastery enabled 15–20% lower prices than competitors.	Amazon's robotics and Shein's real-time algorithms now achieve similar cost structures.	Price wars erode margins; companies differentiate through speed (Amazon Prime) or ultra-low-cost sourcing (Temu).
Semiconductors TSMC vs. Samsung Foundry	TSMC had 10–15% higher chip yields in the 2010s.	Samsung and Intel Foundry have closed the gap with EUV lithography and advanced packaging technologies.	Competition shifts to R&D breakthroughs (like 2nm chips) and geopolitical strategies (building fabs outside China).

Consequences for Competitive Advantage.

Consequences

- Operational excellence becomes a "table stake" (necessary but not sufficient for dominance).
- Differentiation shifts to innovation, branding, or business models (e.g., Tesla’s software > its assembly line).
- Margins compress as efficiency gains no longer justify premium pricing.

How Companies Adapt

1. Move Up the Value Chain (Example: GE pivoted from manufacturing to industrial software (Predix).
2. Hyper-Customization (Example: Nike’s direct-to-consumer model (Nike By You) beats generic lean production)
3. Ecosystem Control (Example: Apple’s vertical integration (chips, stores, iOS) matters more than Foxconn’s efficiency)

Key messages

1 Manufacturing strategy is increasingly important to companies

2 **Companies can create manufacturing strategies through a structured process**

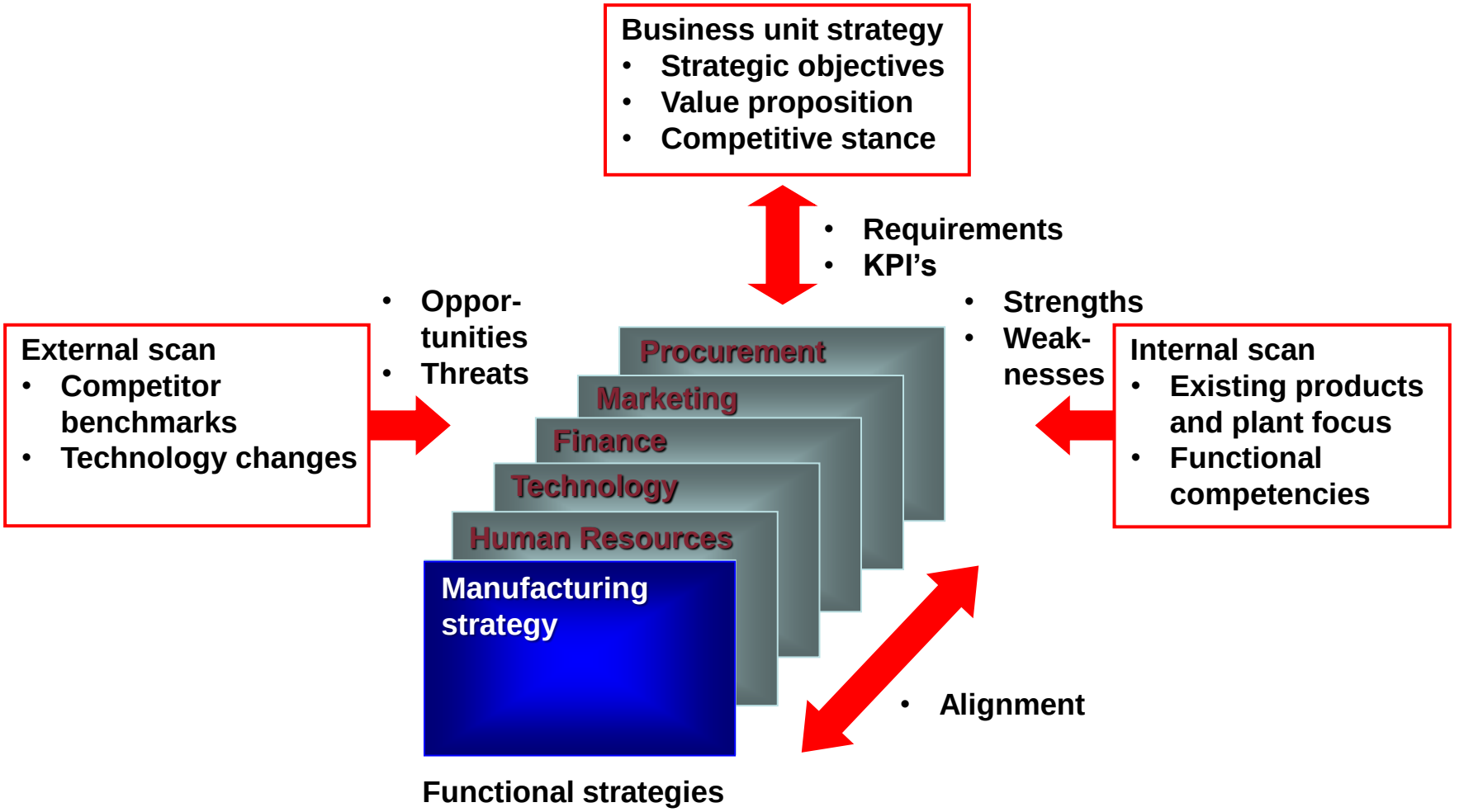
Manufacturing strategy can be developed in two stages

•Map the forces affecting manufacturing:
- Business unit strategy
- External forces
- Internal skills

•Identify implications for manufacturing strategy

•Determine what products or components need to be made by client
•Determine optimal sizes of plants
•Find best plant locations
•Allocate individual products to plants
•Identify feasible migration path from current manufacturing structure to desired end-game

Manufacturing strategy exists in a broader context



Four big decisions drive the strategic options

Developing a “textbook” manufacturing strategy is complex

Many manufacturing strategy decisions are covered by lean manufacturing

Addressed by lean manufacturing

- Relationships to suppliers and distributors
- Process technology
- Quality management
- Organizational structure
- Planning and scheduling
- Forecasting and inventory management
- Interface to product development
- Rate of product changes
- Human resource policies

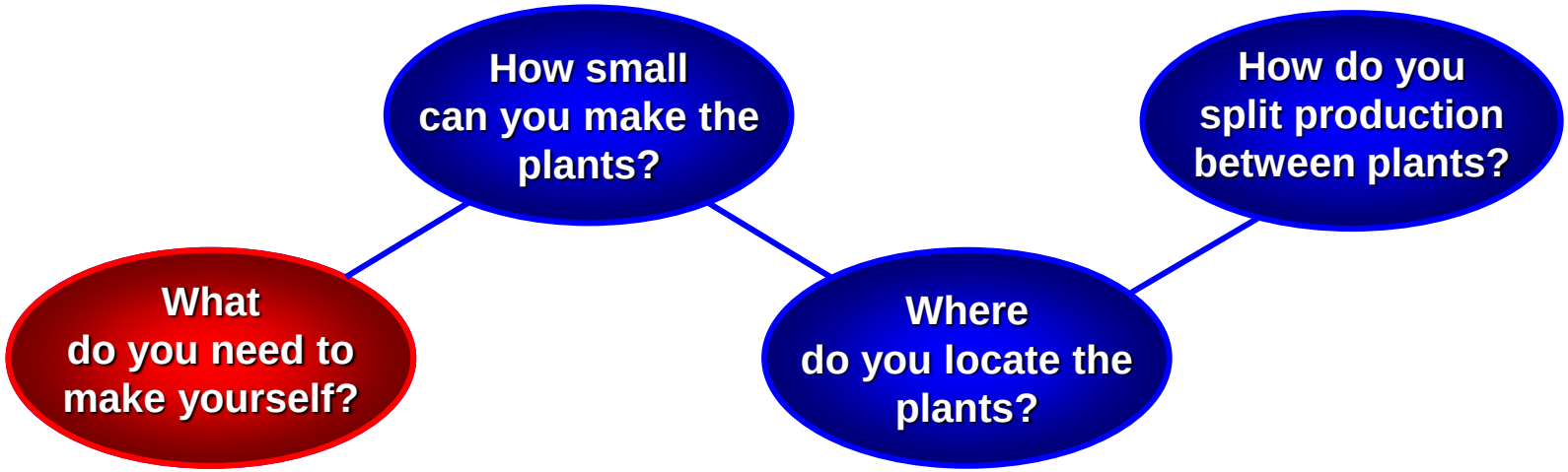
Most elements of plant configuration and conduct covered by lean manufacturing…

Not addressed by lean manufacturing

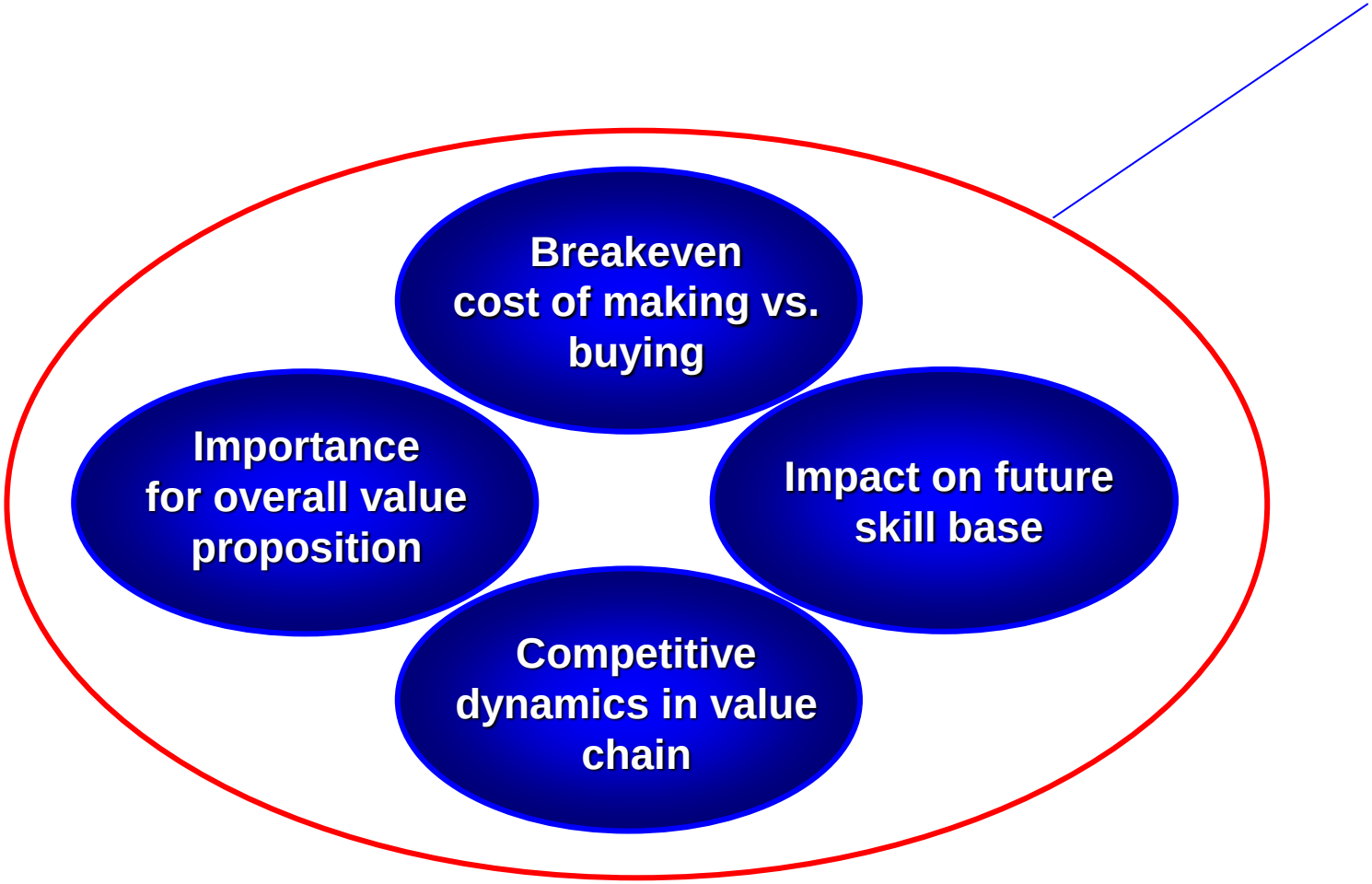
- Degree of vertical integration
- Size and number of plants
- Location of plants
- Production split between plants

… but some major decisions remain

Four big decisions drive the strategic options



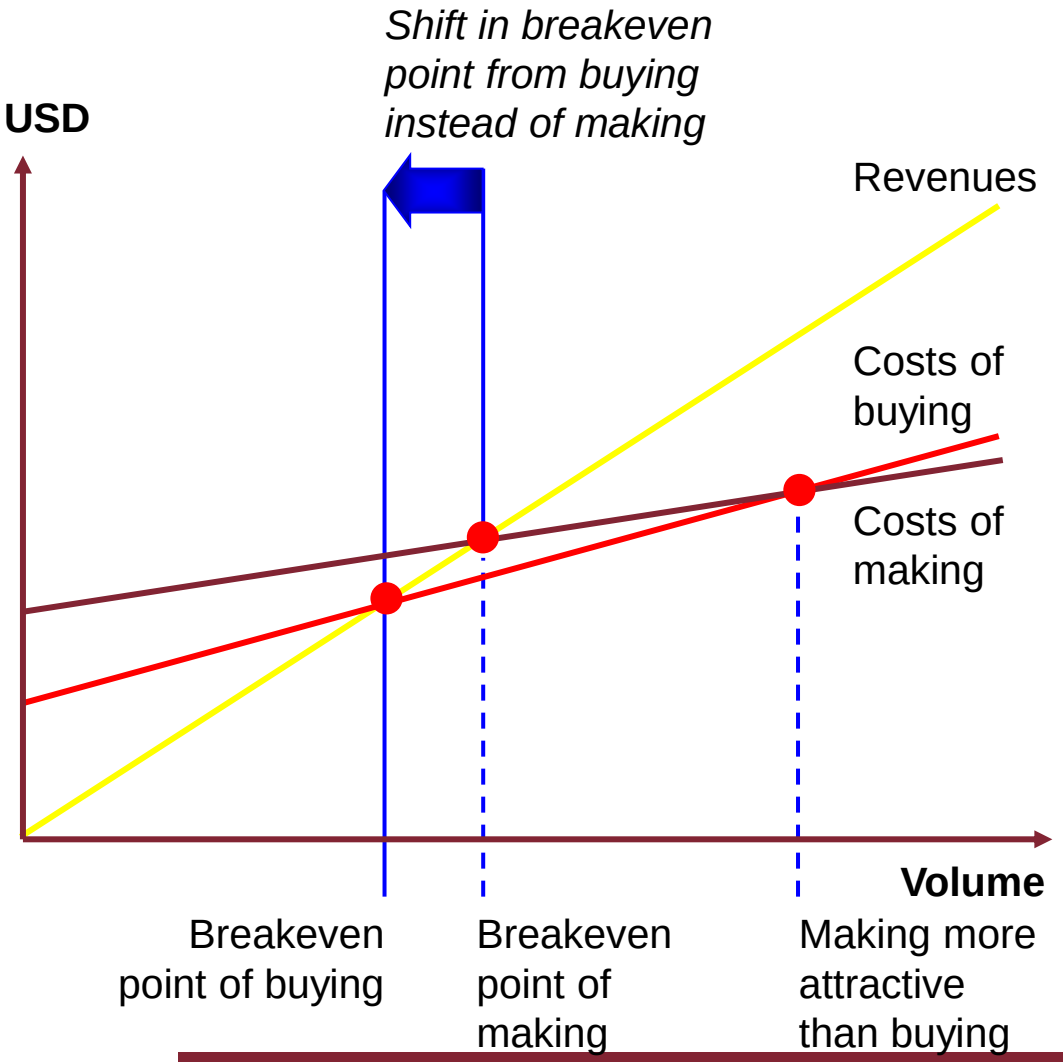
Make-or-buy decision depends on strategic factors



Options for capacity expansion

	Option		
Issue	**On-site expansion**	**New branch plant**	**Plant relocation**
Financial burden	**Limited**	Extra overhead, start-up expenses	Moving costs, new plant start-up expenses, closing old plant
Plant layout and materials handling	Increased complexity	**Radical improvement possible. Some improvement possible in old plant**	**Radical improvement possible**
Process technology	Likely to keep old technology	**Branch can use new technology**	**Can make step change**
Production/ inventory control	Likely to keep old system, becoming more complex	**New plant can use new approaches**	**Radical improvement possible**
Product proliferation	Increased complexity	**No proliferation if organized by product**	Can design for new level of complexity
Size of work force	Increased	Increased	**Depends on technology choice**
Ease of future growth	Further increase in complexity	**Relatively easy, either through expansion of plants or opening more branch plants**	Similar to on-site expansion alternative

Can someone make it more cheaply than you?



Buying instead of making can lower breakeven point of product

Why does TESLA outsource its big earners?

Gigafactory Shanghai (China) – Tesla's largest and most productive factory.

Models: Model 3, Model Y (for local and export markets)

Note: Plays a crucial role in supplying Asia and Europet

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Models: Model 3, Model Y (for local and export markets)

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Upcoming/Planned Factories:

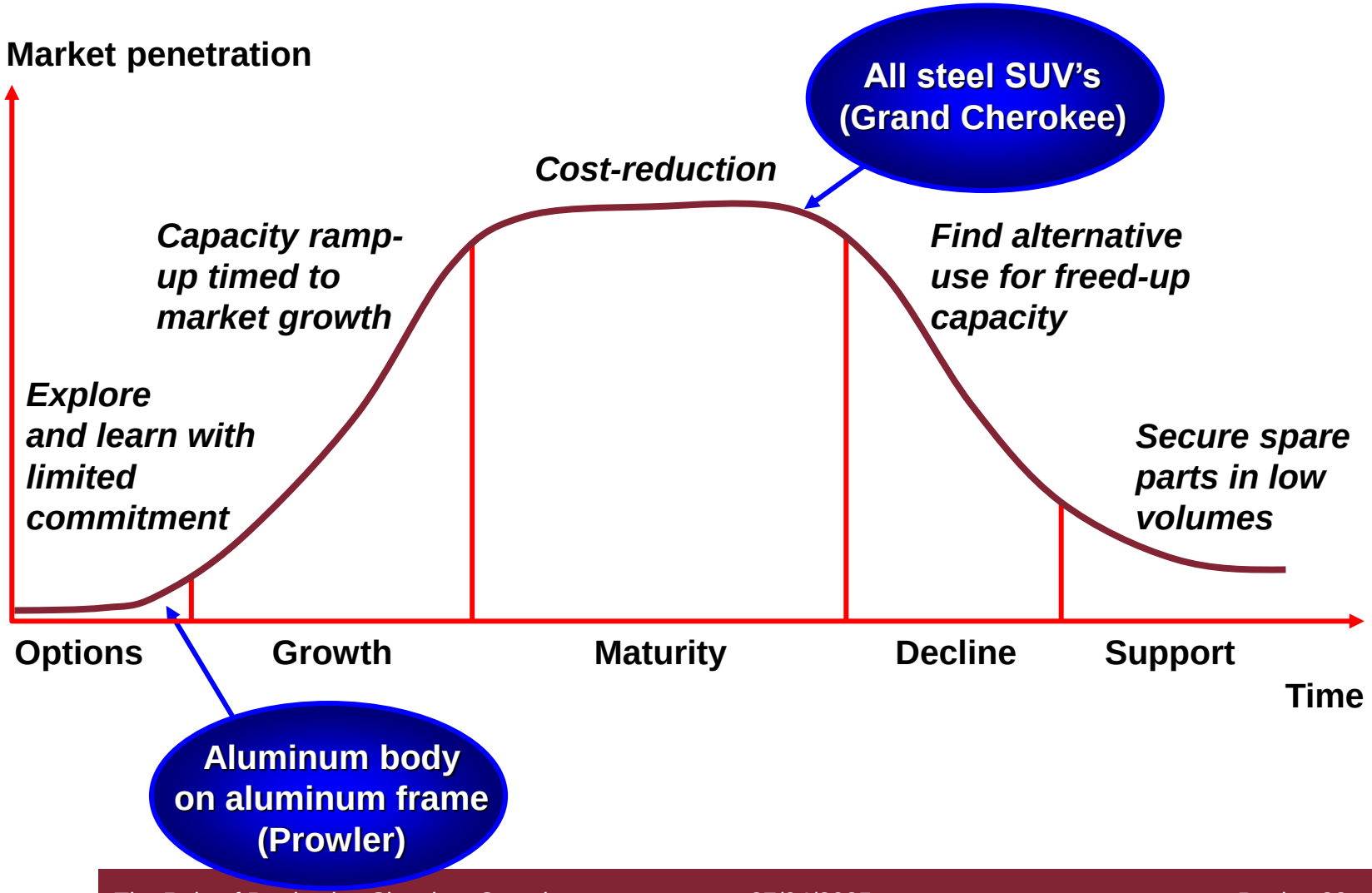
- Mexico (Gigafactory Nuevo León) – Announced for future production (possibly next-gen vehicles).
- India & Indonesia – Potential future locations under consideration.

What skills are integral to your value proposition?

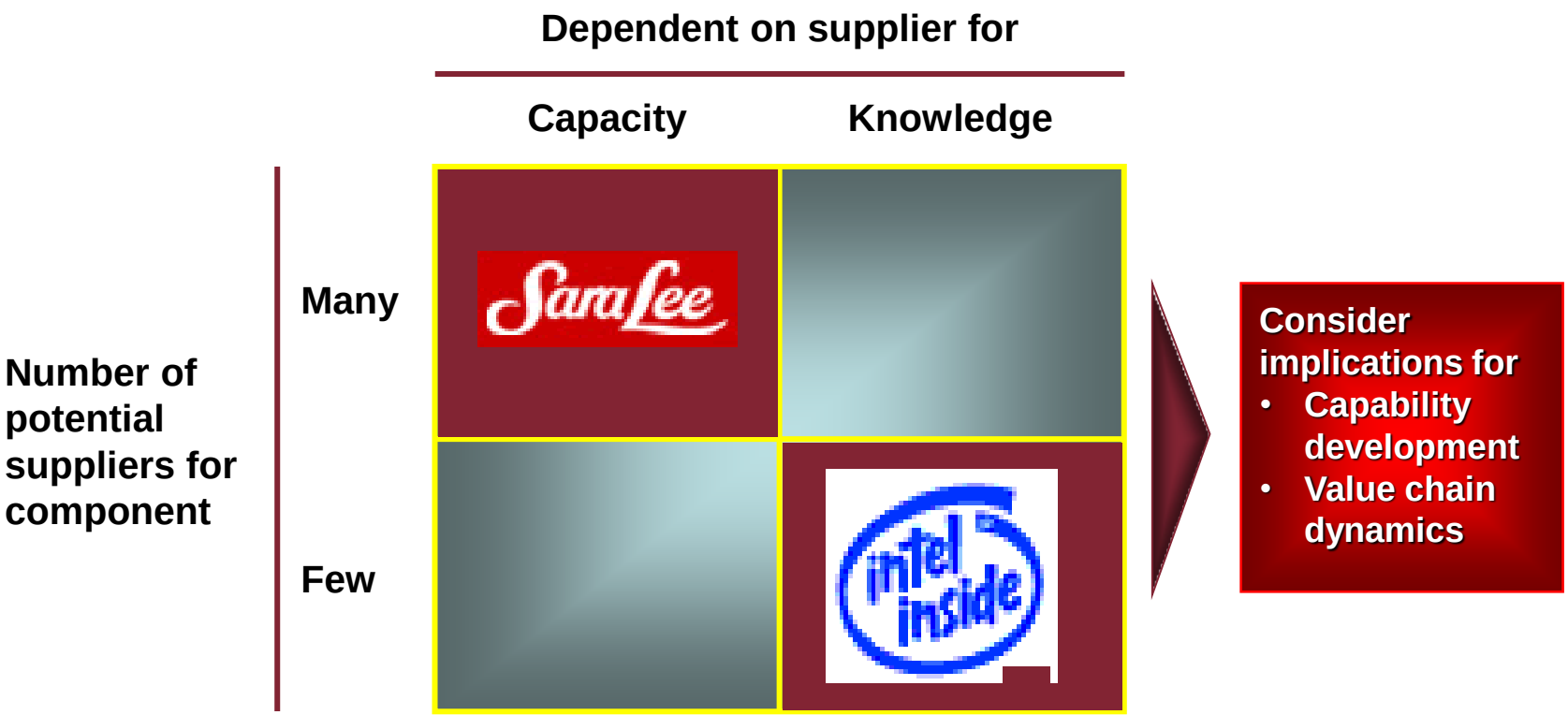
Company	Value proposition	Implication for manufacturing strategy
ALESSI	High quality designer goods at moderate prices	Must deliver high quality manufacturing in a high variety environment, at low cost
VOLVO	Safety	Must maintain world-class competence in designing and manufacturing safe car bodies
BMW	“The ultimate driving machine”	Must maintain skills in seamless integration of chassis system

What skills will you need tomorrow?

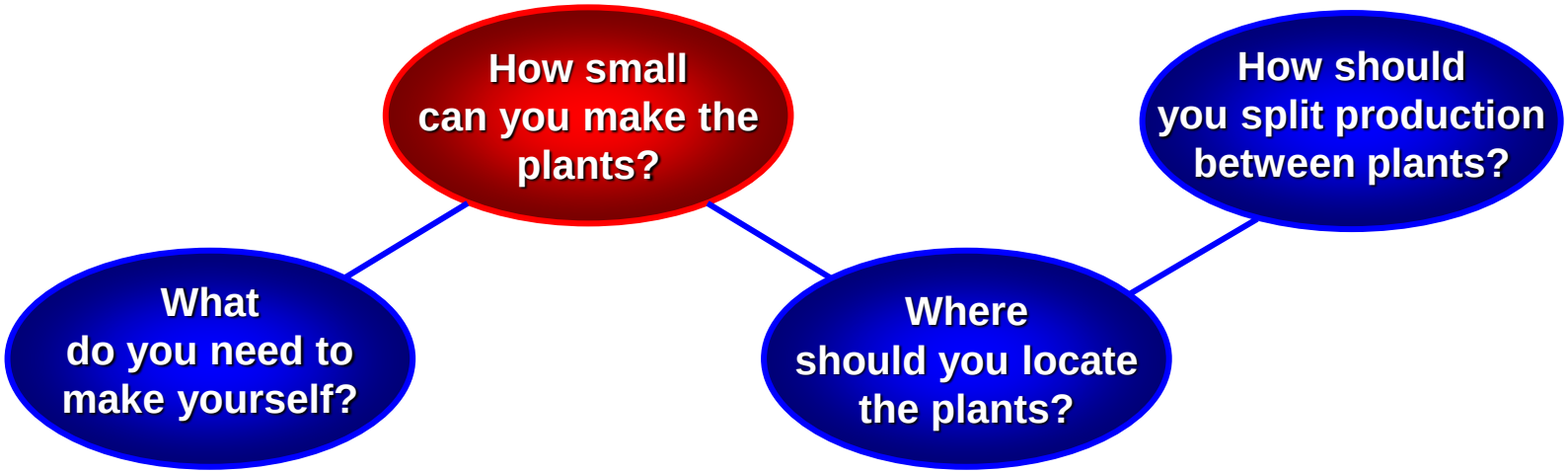
OUTSIDE-IN HYPOTHESIS



Can your suppliers grab the value?



Four big decisions drive the strategic options



How small can you make the plant?

Smaller plants desirable…

- Can locate near each market
- Limited risk through smaller investment
- Can improve efficiency through clear focus in the plant

… but scale remains a concern

- Higher volume gives reduced capital cost per unit
- Overhead functions distributed over more units

Are small plants the most efficient?

Company / Industry	Small Plant Efficiency Example
Tesla’s Giga Press (Fremont, California)	Tesla uses highly compact "microfactories" with giant die-casting machines (Giga Press) to simplify car production and cut costs/time.
Pharmaceutical CMOs (e.g., Lonza Visp, Switzerland)	Specialized small-scale pharma plants efficiently produce biotech drugs (like mRNA vaccines) at high margins without needing mega-facilities.
Food Industry: Craft Breweries (e.g., BrewDog)	Craft breweries operate smaller facilities that are extremely efficient at small-batch production with high quality, enabling rapid flavor innovation.

Why Smaller Plants Can Be More Efficient

- **Flexibility**: Easier to adapt to changes in demand, customize products, or switch production lines quickly.
- **Lower Complexity**: Fewer layers of management, faster communication, quicker problem-solving.
- **Quality Control**: Easier to monitor processes and ensure consistent output.
- **Lower Fixed Costs**: Smaller facilities often mean lower maintenance, real estate, and utility expenses.

This is especially true in industries where speed, customization, innovation, and agility are more important than raw volume.

But in industries where massive economies of scale are needed large plants are still dominant

- Heavy industries (like oil refining, steel production) still rely on massive plants because economies of scale are more important than flexibility.
- In those cases, unit cost per item drops as production volume increases.expenses.

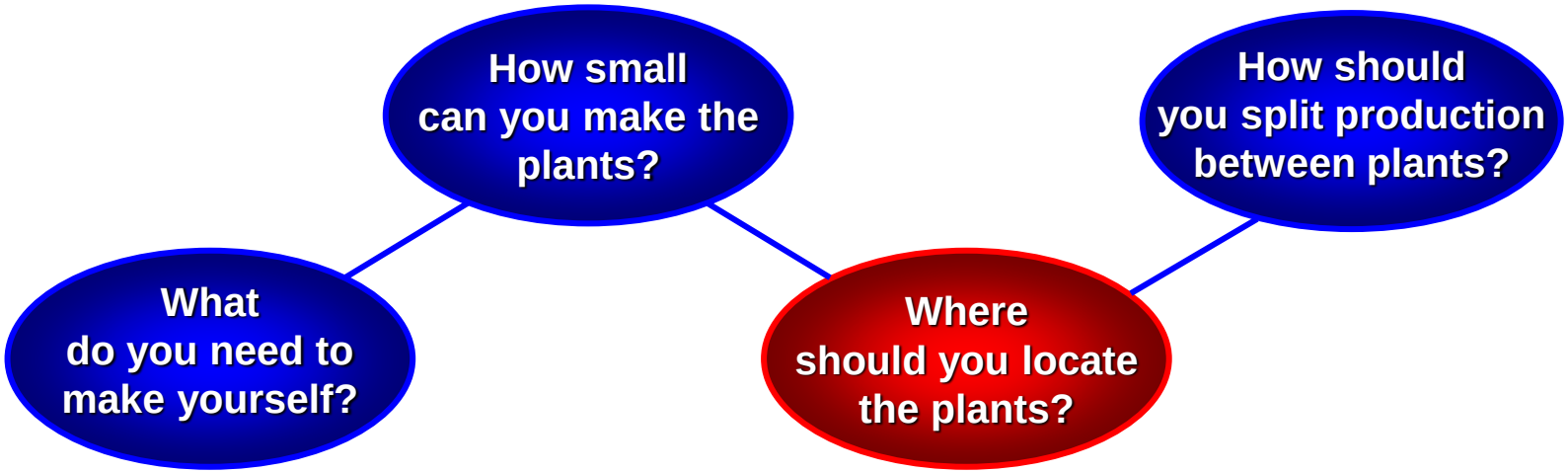
Large plants remain better where pure volume and scale dominate cost structure..

Dependency on scale can be reduced

Plant design	• **Careful value engineering of investment in plant and machinery** • **Limited automation level, but no-compromise approach to productivity** • **Future possibility for expansion designed in, at minimal cost**
Plant replication	• **Standardize plant and process design for fast ramp-up** • **Exploit learning by transferring people between plants**

- ***Example:***
  Honda's overseas assembly plants

Four big decisions drive the strategic options



WHAT IS A FOOTPRINT?

Decision on where to put production capacity

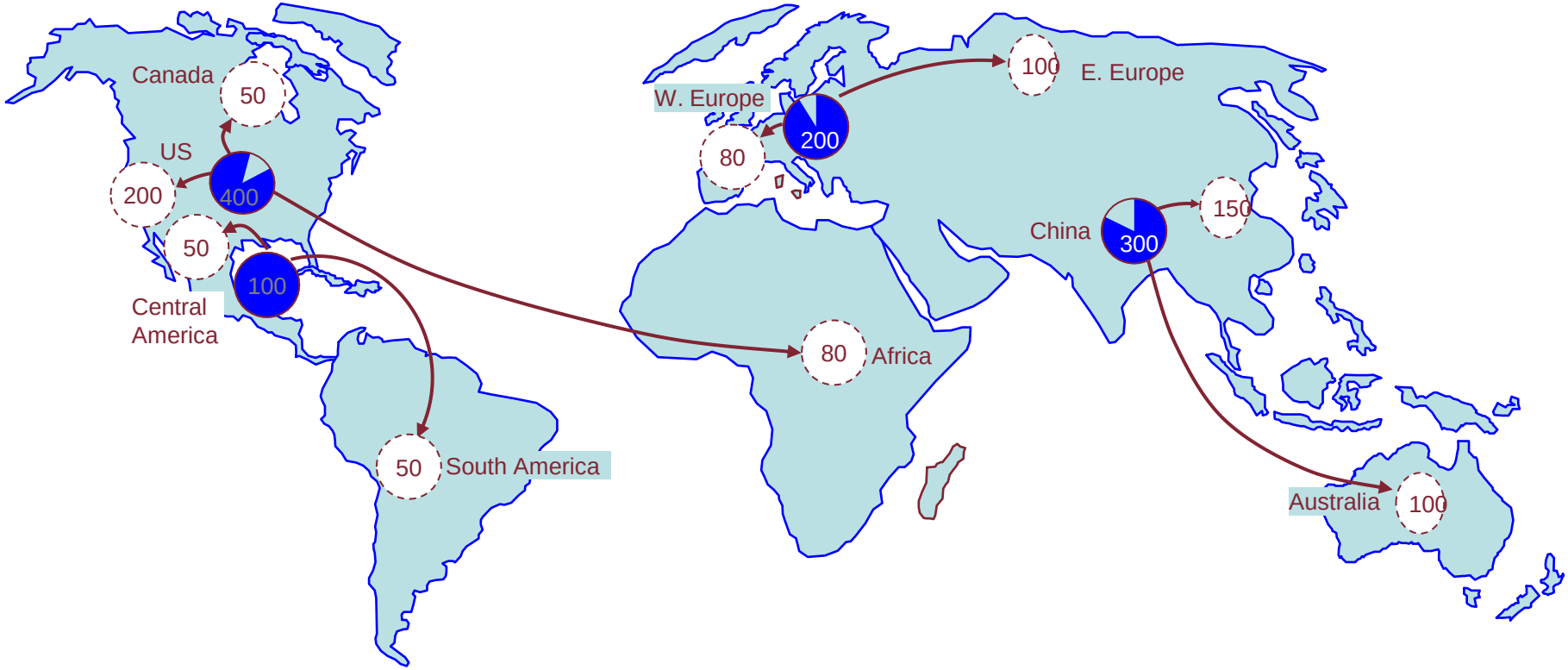
- 70 tier 1 products
- 125 tier 2 components
- 230 tier 3 parts

XX Capacity

Example: world production distribution for product X, 2015 Units

GOAL: OPTIMIZE FOOTPRINT AND NETWORK FLOWS FOR LOWEST OVERALL COST TO SATISFY DEMAND

Example: world production, demand and transportation distribution for product X Units



Decision on production level and from where to serve demand

- 13 demand regions for each product
- 169 possible product transportation routes

Plant location must fit with strategy

Case: Toyota location in Georgetown, Kentucky

Location chosen to fit Toyota Just-in-time production system

Near intersection of several major highways

On major railway line

Plant location is more than low labor cost

Cost

- Labor
- Services
- Construction and moving
- Insurance
- Taxes
- Incentives from local government

Access

- Distance to main suppliers and customers
- Quality of roads and railroad
- Ease of airline travel
- Telecommunications quality
- Commuting distance

Talent

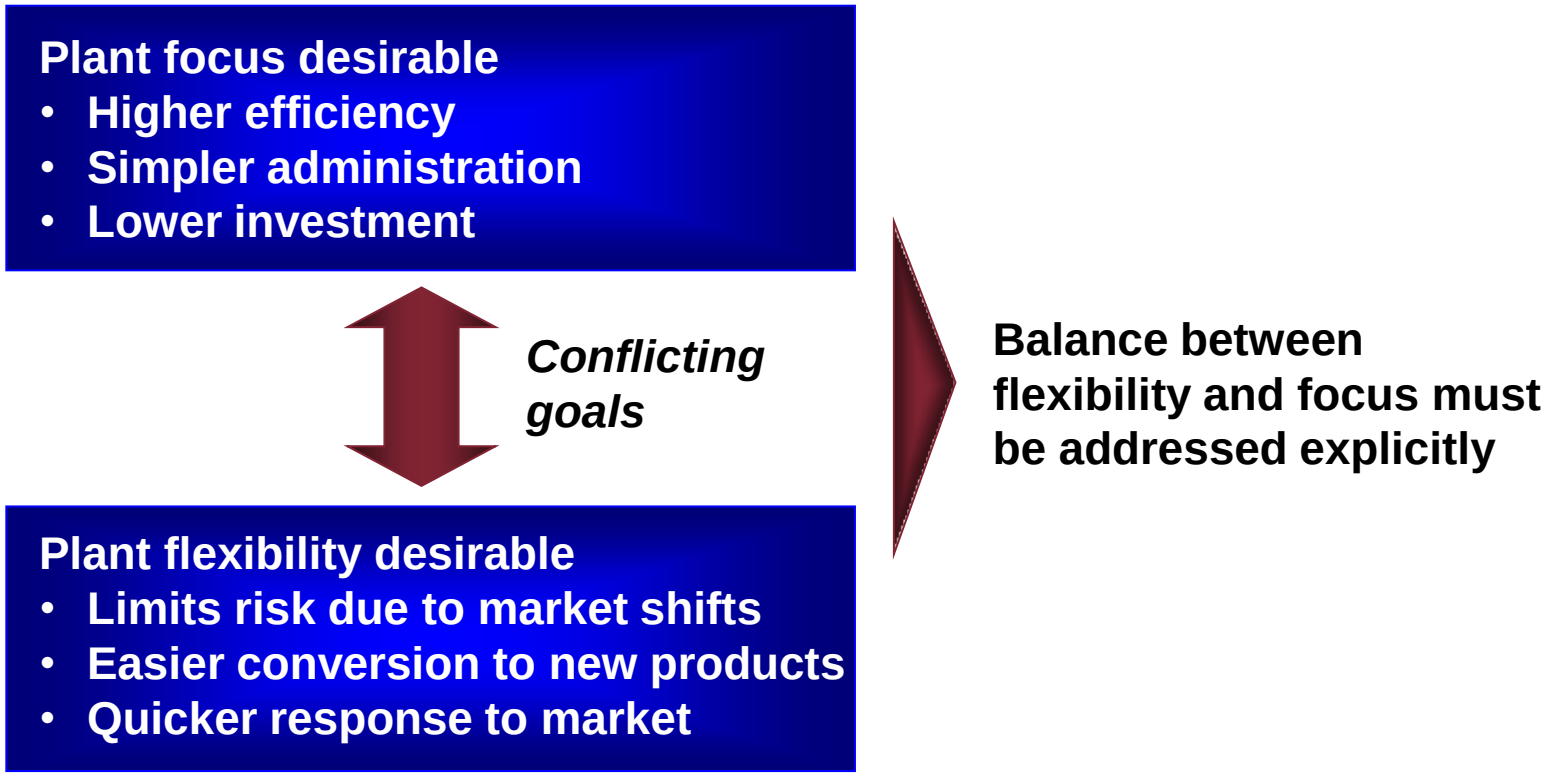
- Depth of talent pool
- Attitudes to productivity
- Quality of education system
- Attractivity to expatriates

Risk

- Political stability
- Resale potential
- Environmental concerns
- Import quotas
- Brand impact

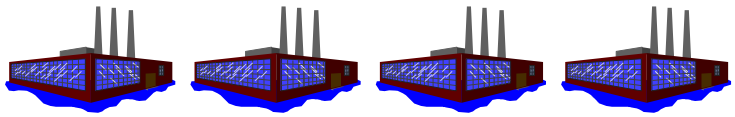
Four big decisions drive the strategic options

Product allocation balances focus and flexibility



Possible solutions to the focus vs. flexibility problem

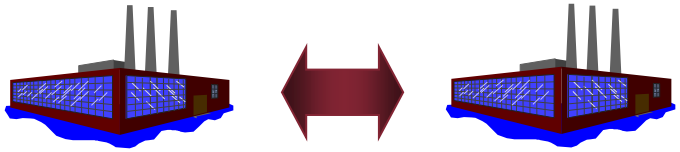
Small scale, focused plants



- Each plant is focused on single product line
- Plants kecpt relatively small
- Growth managed through replicating plants near market

- *Example*: Honda car assembly

Master/slave concept



- Each plant is “master” for a single product
- Plants have “slave” capacity to absorb excess demand for other products

- *Example*: Volvo car assembly

Recap of Key Points

- Production sites : Definition & Functions, Key roles: Types of Production Sites, Complexity Factors, Future Trends
- Manufacturing Strategy:
  - Four key decisions: Plant size, make-or-buy choices, location, and production allocation.
  - Platforming & M&A Impact
  - Performance Convergence
- Plant Location & Efficiency: Smaller plants can be efficient in agile industries (e.g., craft breweries), while scale dominates in heavy industries (e.g., steel).

Homework Assignment

Analyze how a real-world company designs and manages its production sites to align with business strategy, global trends and operational challenges.

Instructions

1. Select a Company: Choose a manufacturer (e.g., Tesla, Toyota, Nestlé, Samsung, or a local firm).
2. Research & Analyze: Address the following:
    1. Production Site Strategy: Identify the types of production sites used (e.g., single-site, multi-site, offshore/nearshore).
    2. Explain how the company's site locations align with its business goals (e.g., cost reduction, market access, innovation).
    3. Complexity Management:: Discuss one major challenge (e.g., supply chain disruptions, regulatory compliance, labor shortages) and how the company addresses it.
    4. Future Trends:Highlight one trend (e.g., automation, reshoring, sustainability) the company is adopting and its impact.

Critical Evaluation:

- Strengths and weaknesses of the company's production site strategy.
- Suggest one improvement (e.g., adopting smaller plants, relocating a site, investing in green technologies).

Deliverable Structure and Example

Deliverable Structure:

1. **Introduction** (1 paragraph): Company overview and why it was chosen.
2. **Analysis** (3–4 paragraphs): Cover the three research prompts above.
3. **Recommendation** (1 paragraph): Justify your proposed improvement.
4. **References**: Cite at least 2 sources (news articles, annual reports, case studies).

Example

Topic: How Tesla's Gigafactories Balance Scale and Flexibility

Strategy: Global multi-site network for EV dominance.

Challenge: Supply chain bottlenecks for batteries.

Trend: Gigacasting to simplify production.

Recommendation: Add nearshore sites in Europe to reduce logistics risks.