

What do we know about the structure and design of organizations?

Phanish Puranam

This version: 2008

This presentation draws on my joint work with several co-authors and PhD students: in particular Marlo Goetting, Ranjay Gulati, Srikanth Kannan, Thorbjorn Knudsen, Tobias Kretschmer, Paul Lawrence and Harbir Singh.



“.....fossils of ancient cooperation” from the Paleolithic age
--Steven Pinker, 1999



Solutre, France

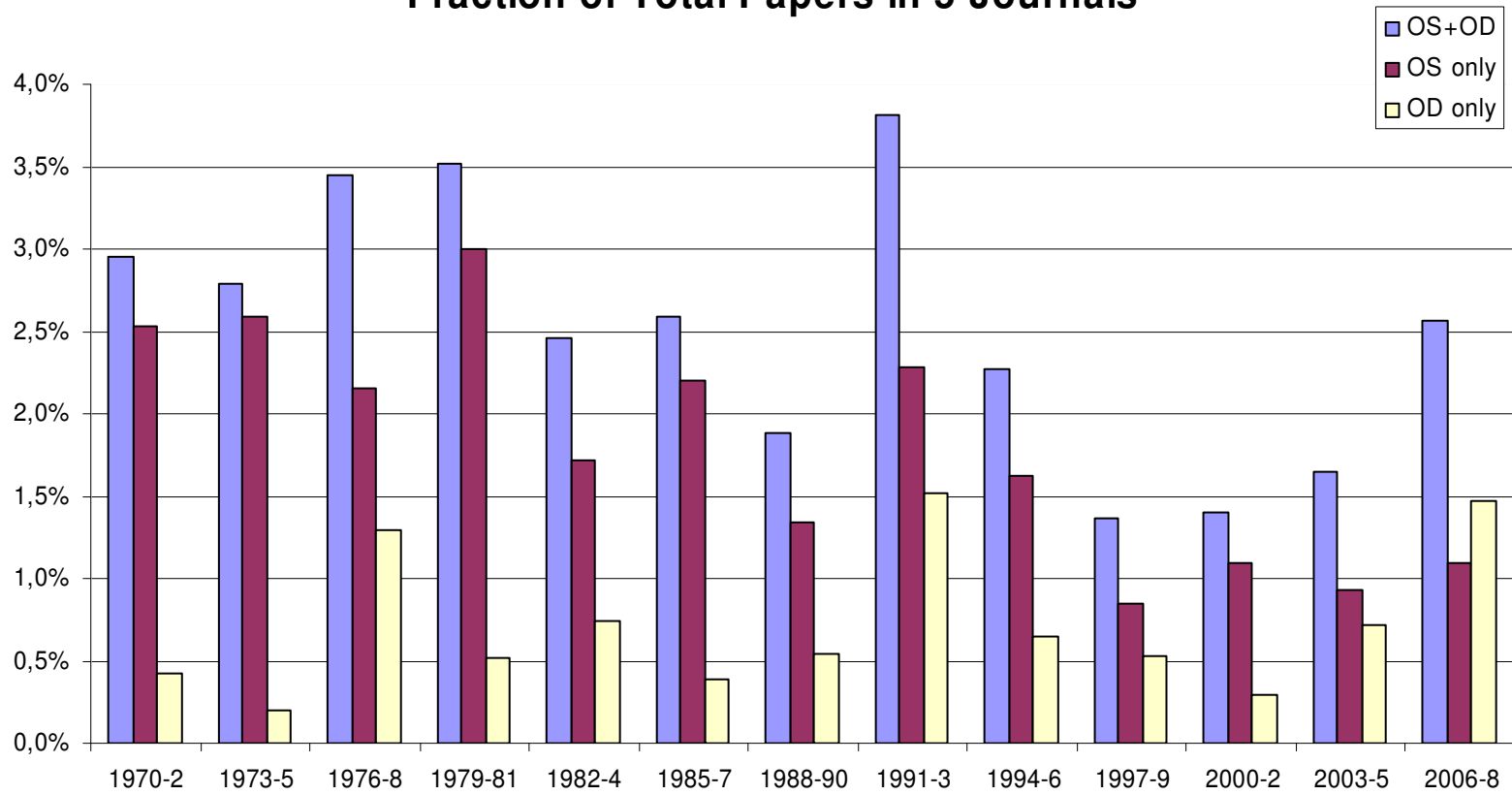
Organizational Structure

- Stable patterns of interaction between individuals
 - Formal Structure is explicitly mandated
 - Informal Structure is emergent
- Formal and Informal structures need not be orthogonal (expect perhaps in the short run)
 - Informal organization influenced by formal structure;
 - Choice of formal structure shaped by existing informal structure

Descriptive vs. Normative

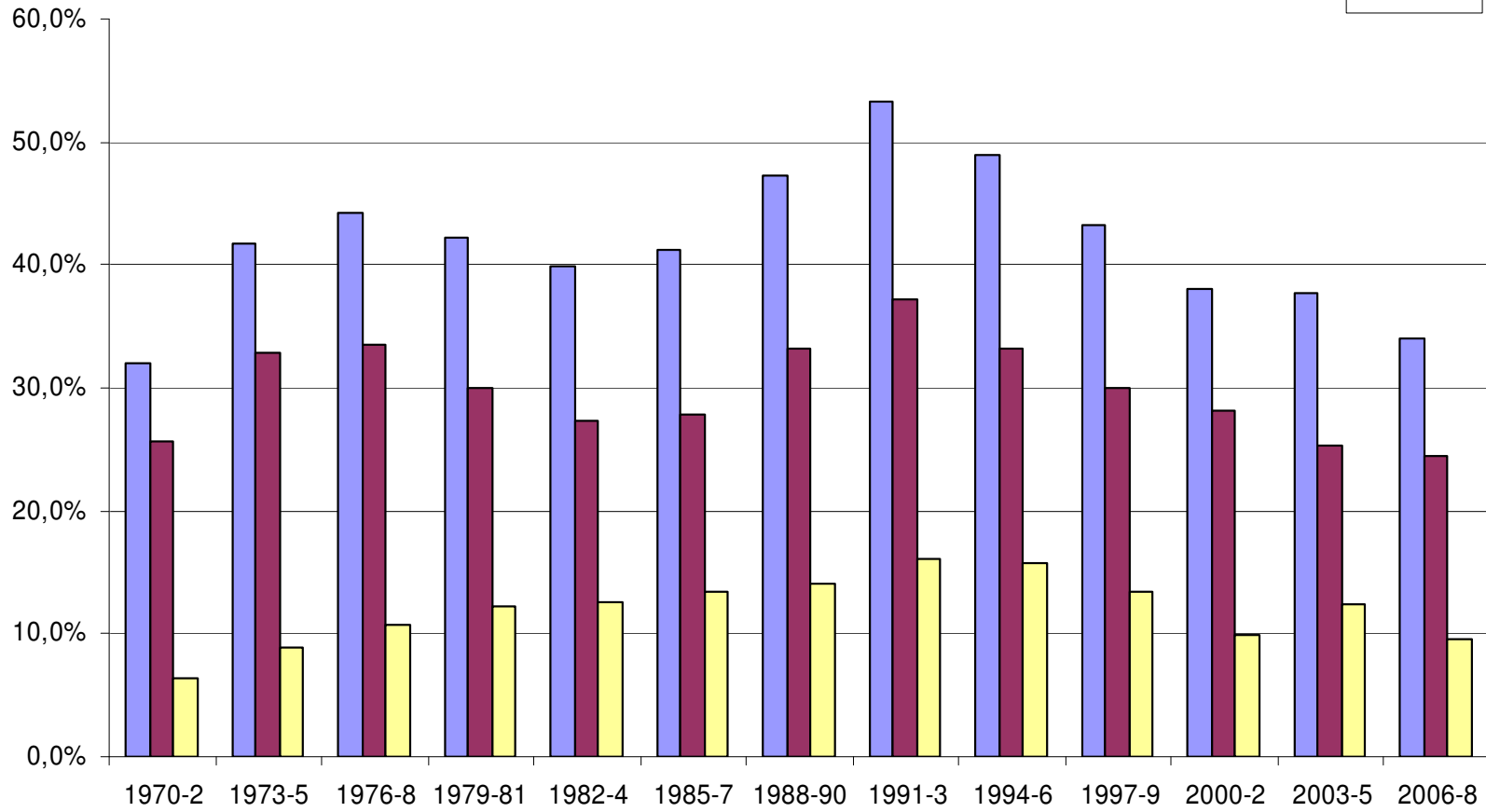
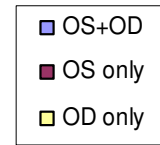
- Why do organizations have the structure they do?
- What should be the optimal structure of an organization?
 - Both questions are equivalent under assumptions of rational choice by designers/ performance based selection by environment

Papers with OS/OD in Abstract as a Fraction of Total Papers in 5 Journals



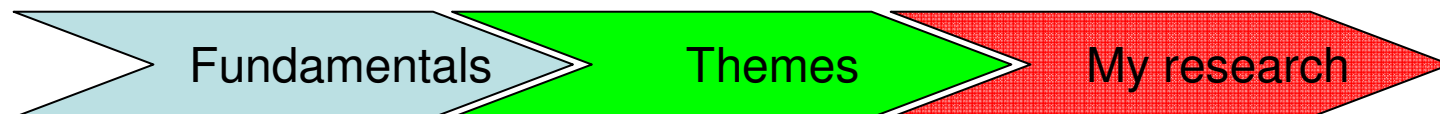
Note: data for 2006-2008 is censored

**Papers on OS/OD as a Fraction of Total Papers in all 5 Journals
based on unlimited full text search**



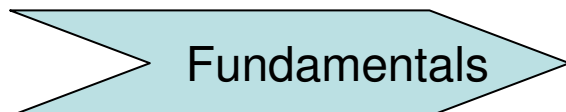
Agenda

- Fundamental issues
- Themes in the literature
- Some current areas for research



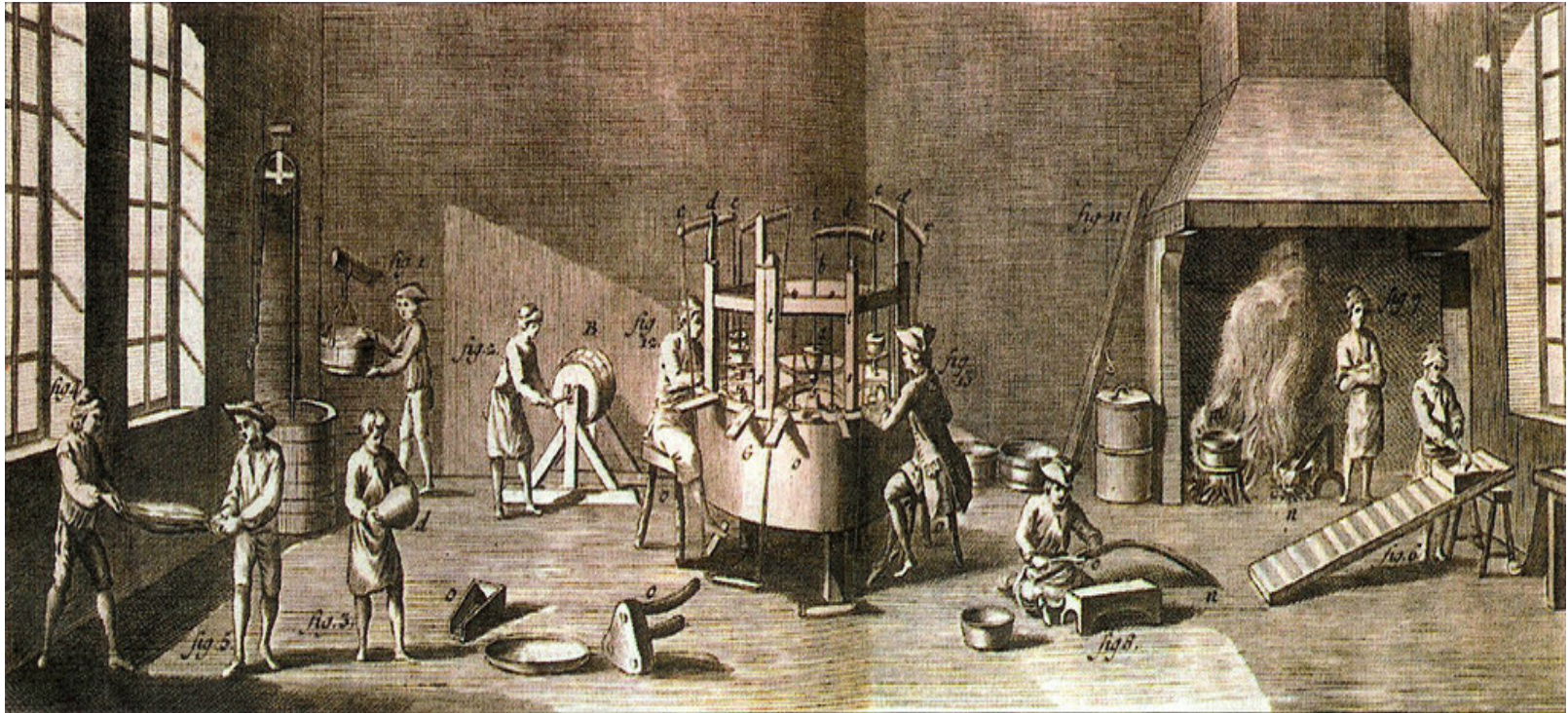
Fundamentals

- The design of organizational structure involves two complementary problems:
 - the division of labor
 - the integration of efforts





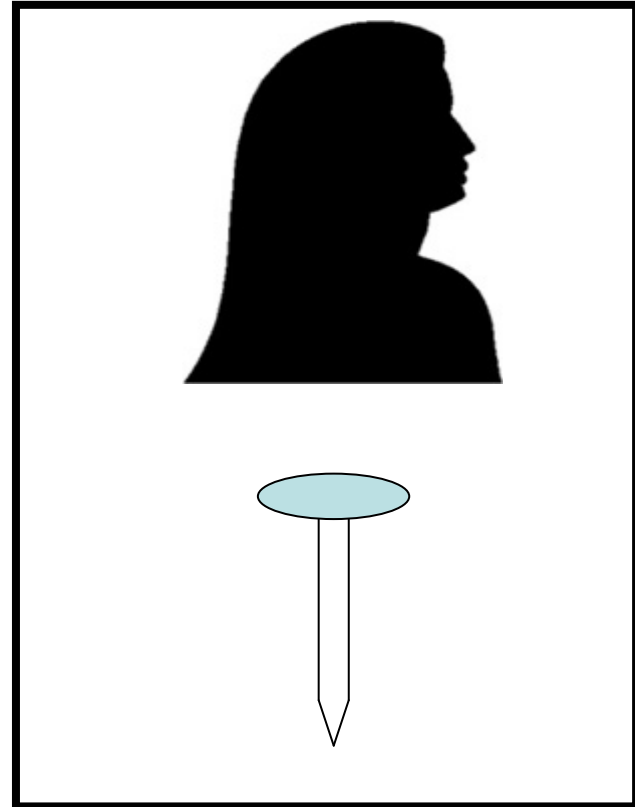
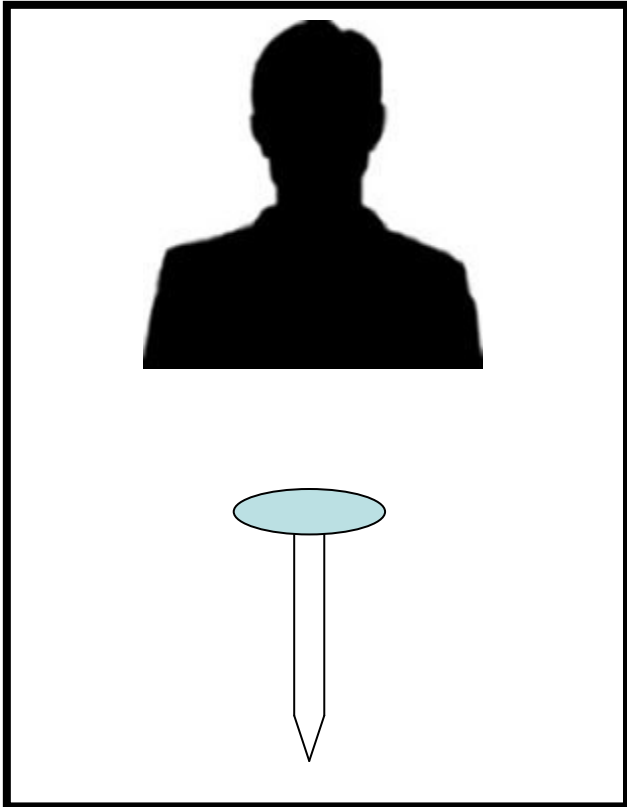
Fundamentals



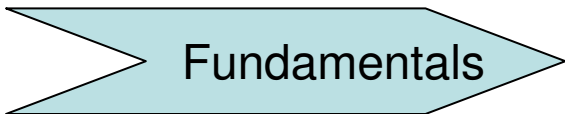
Fundamentals

Division of Labour

- Arising from effort constraints
 - Homogenous efforts
- Arising from cognitive constraints
 - To exploit the gains from specialization
- In either case, incentive structure matters!

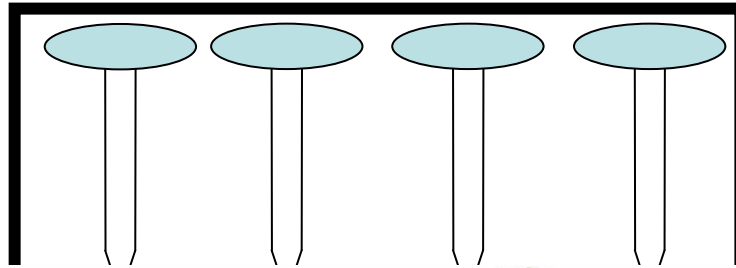
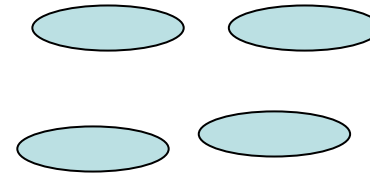
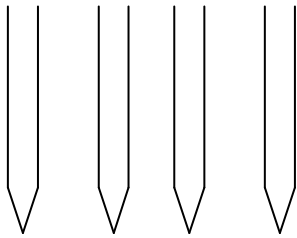


The pin factory revisited

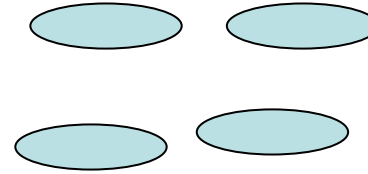
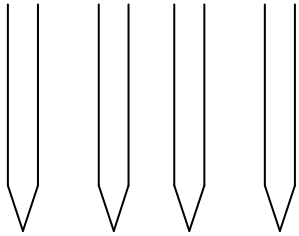




Fundamentals



Fundamentals



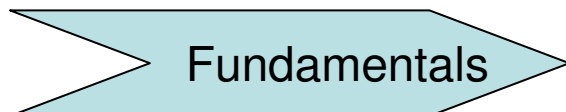
Fundamentals


**Division of
Labour**



Interdependence

- Given actors A and B with independently definable outputs, a situation of interdependence between A and B exists if the outcomes of actions taken by A depend partly on the actions taken by B, and vice versa.
- Interdependence is a concept that applies at multiple levels of analysis- between individuals, groups and organizations- but always refers to a relationship between two decision making entities.



Interdependence  **Organizational
Structure**

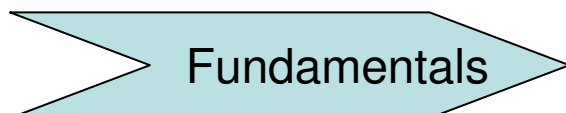
Efficient organizational structures “solve” the problems of cooperation and coordination that arise when integrating the efforts of interdependent actors.

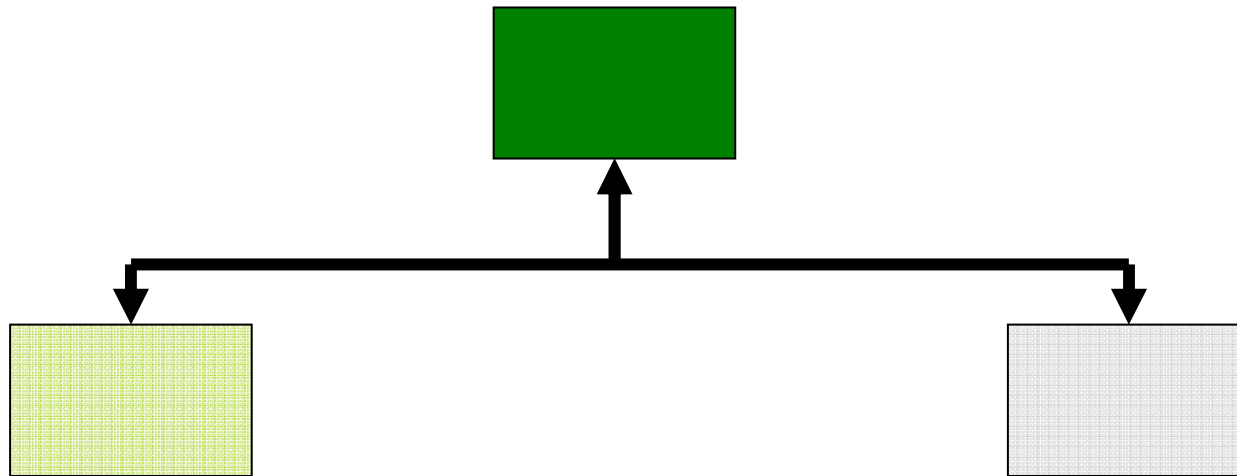
Simon, 1945

March & Simon, 1958

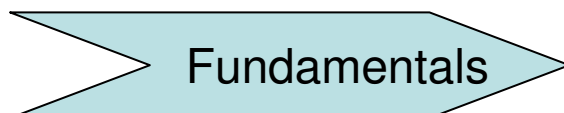
Thompson, 1967

Lawrence and Lorsch, 1967





The *interdependent dyad* (+ an authoritative designer) is the basic unit of analysis for organizational structure.

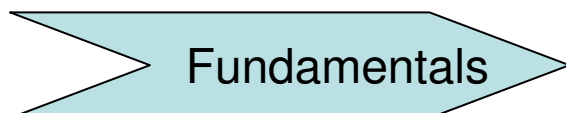
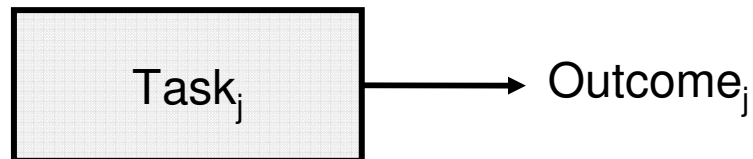
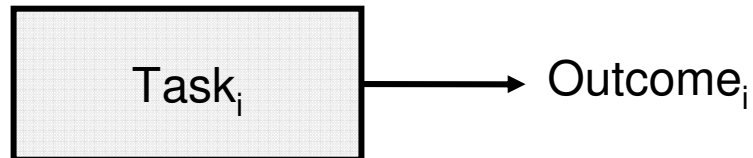


Interdependence & Organization

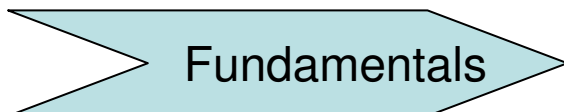
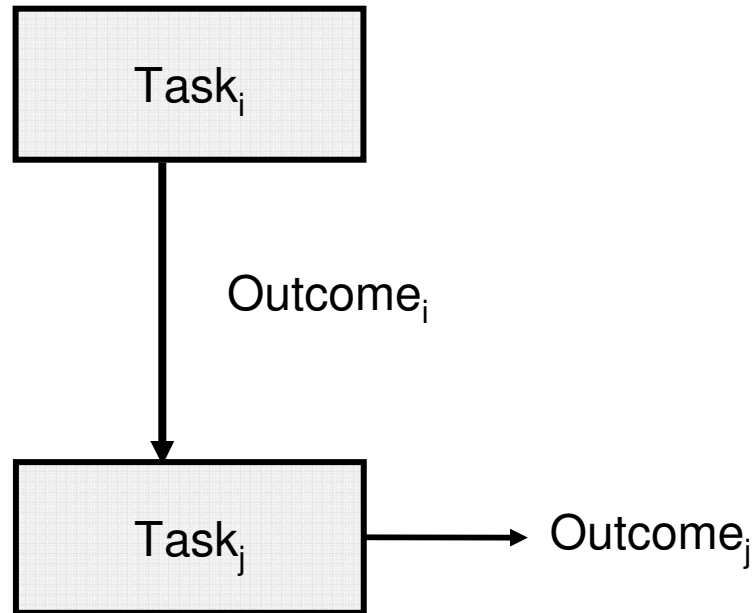
- Key issue: To explain how variations in the nature of interdependence are associated with variations in the nature of organization structure
 - Given interdependence between A and B, what makes integration of their efforts problematic?
 - What makes some situations of interdependence harder to manage than others?
 - Thompson's answer

A typology of interdependence complexity: Thompson, 1967

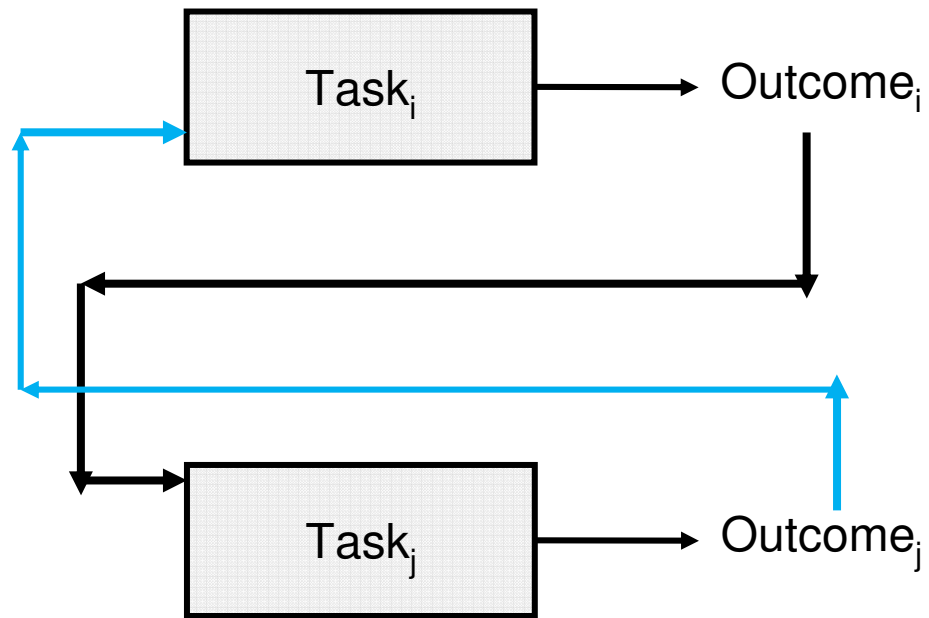
- Pooled (parallel) interdependence of tasks



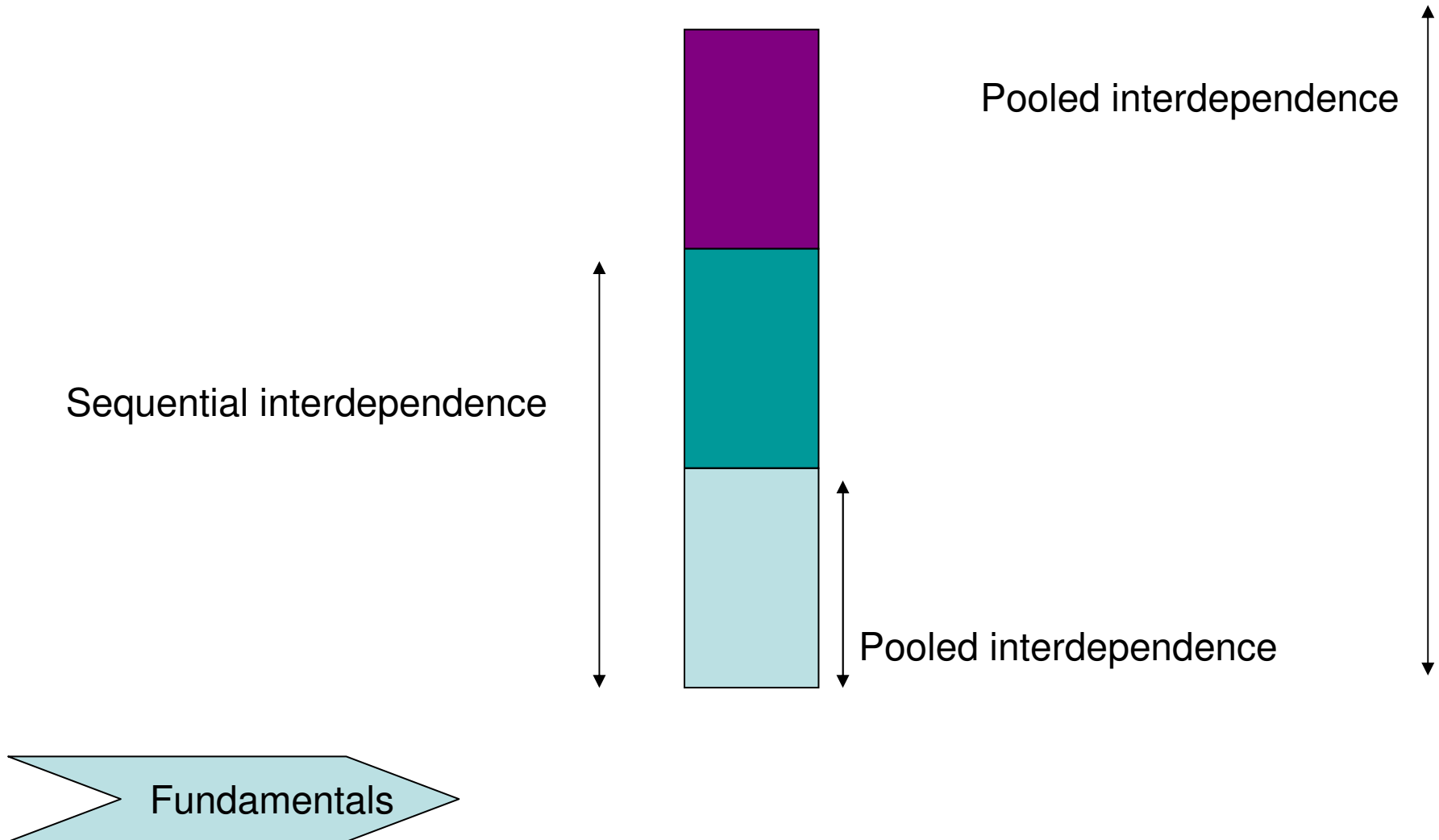
- Sequential interdependence of tasks



- Reciprocal interdependence of tasks



Interdependence Complexity (Thompson, 1967)



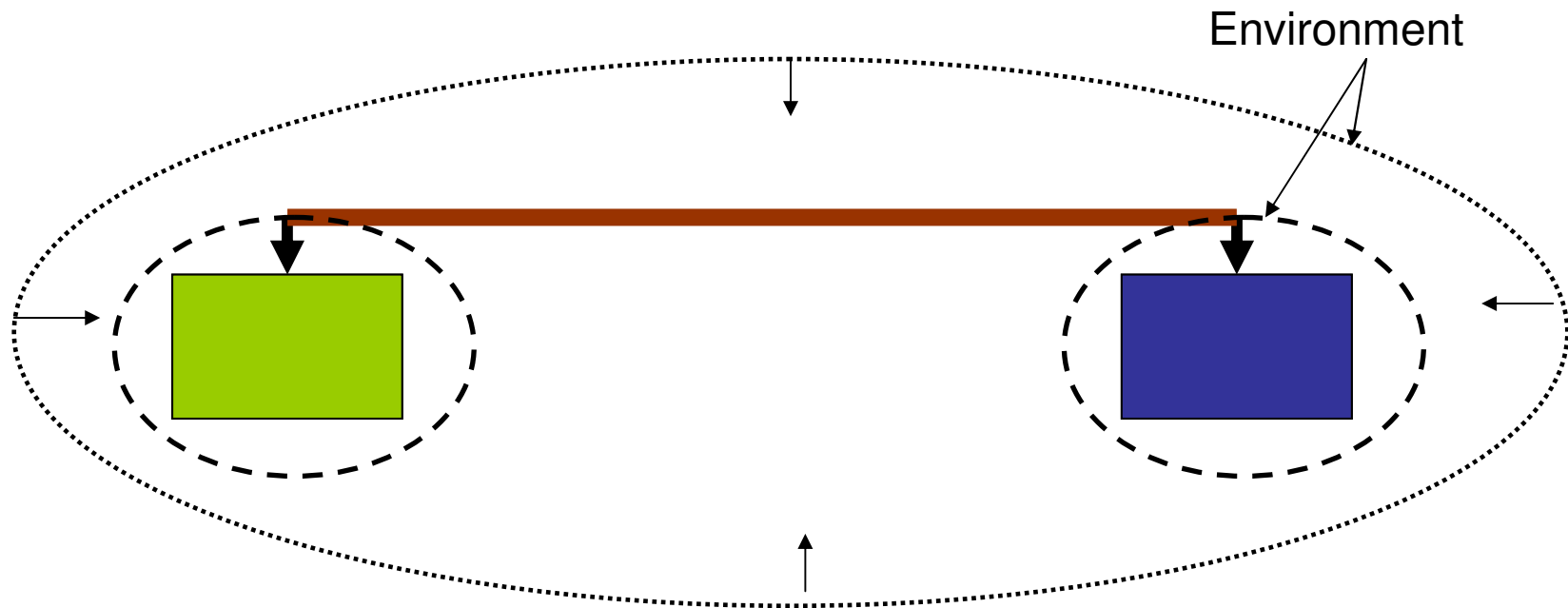
The Information Processing perspective

- The epistemic consequences of interdependence
- Task Uncertainty- “the difference between the information required to perform a task and the information already possessed” (Galbraith, 1973; Arrow, 1974)
- Information processing- “The greater the uncertainty of the task , the greater the amount of information that has to be processed between decision makers” (Galbraith, 1974)
- Complex, hard to understand and changing forms of interdependence generate greater task uncertainty (Tushman, 1978; Tushman and Nadler, 1978).

Alternative: The “Incentive” perspective

- When interdependence creates conflicts of interests
 - Potential value created by managing interdependence – “synergies”
 - Organization needed when there are potential conflicts over how the synergies are to be shared- eg. gains from free riding, rents from hold-up, asymmetric risk preferences etc.
 - Design is the re-distribution of value in a way that motivates A and B to take optimal actions
 - Eg. most economic approaches; in organizations, Williamson, 1975; Kelley and Thibault, 1978; Victor and Blackburn, 1987

Lawrence and Lorsch (1967)



The secondary consequences of the division of labour

- Organizational *Differentiation*
- .
- & the resulting challenges of *Integration*

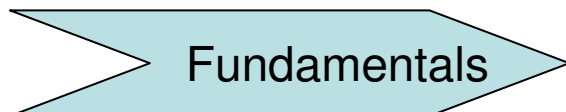
Fundamentals

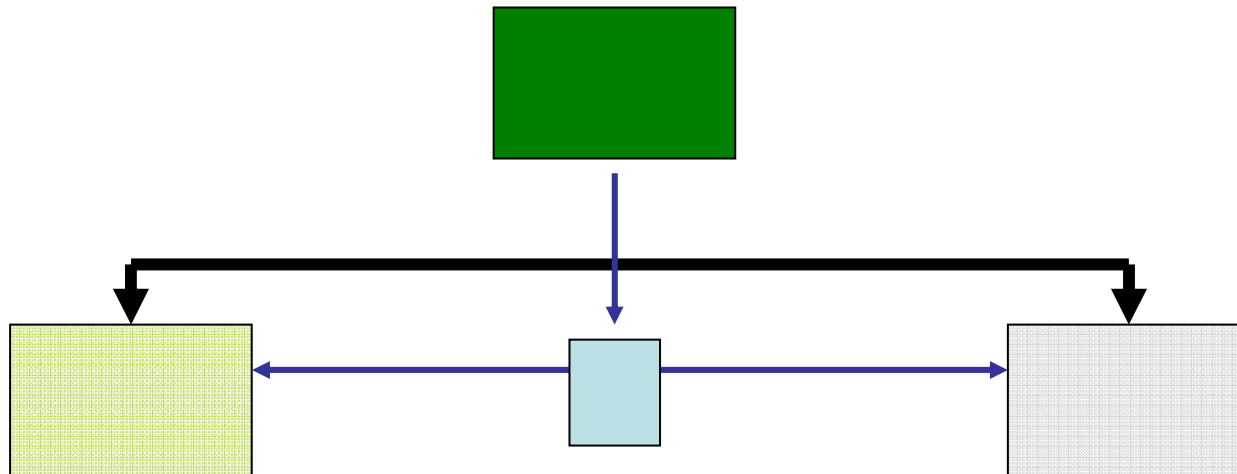
The environment

- “Everything outside the boundary of the unit of analysis”
 - Unit level vs. Organizational level
- Structure = design choice, Environment = exogenous parameters
- Many dimensions used to map attributes of the organizational environment to the
 - Nature of interdependence within the organization
 - knowledge requirements for integration within the organization.
- Also, interdependence between units as constraints on unit level adaptation to unit environments

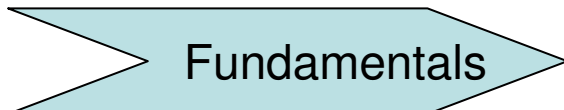
Integration mechanisms

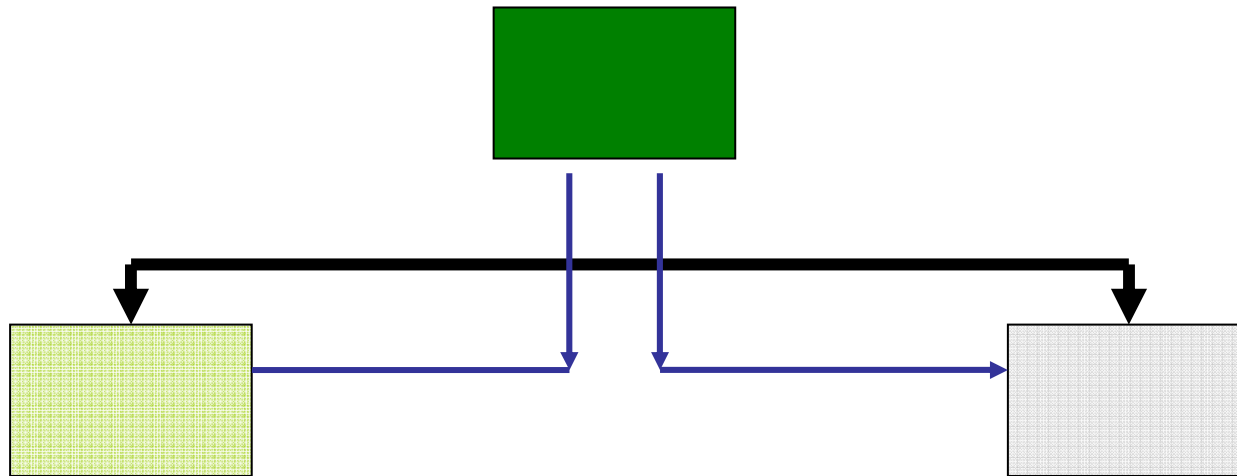
- Focus is on information processing rather than incentives
- These mechanisms can readily be interpreted as dealing with the problem of creating sufficient individual and shared knowledge to generate integrated (i.e. coordinated) efforts



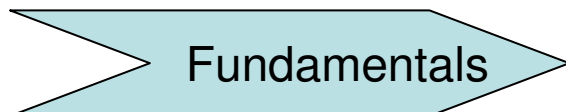


Programs: Plans, schedules, standards, procedures; “interfaces”



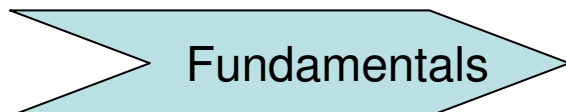


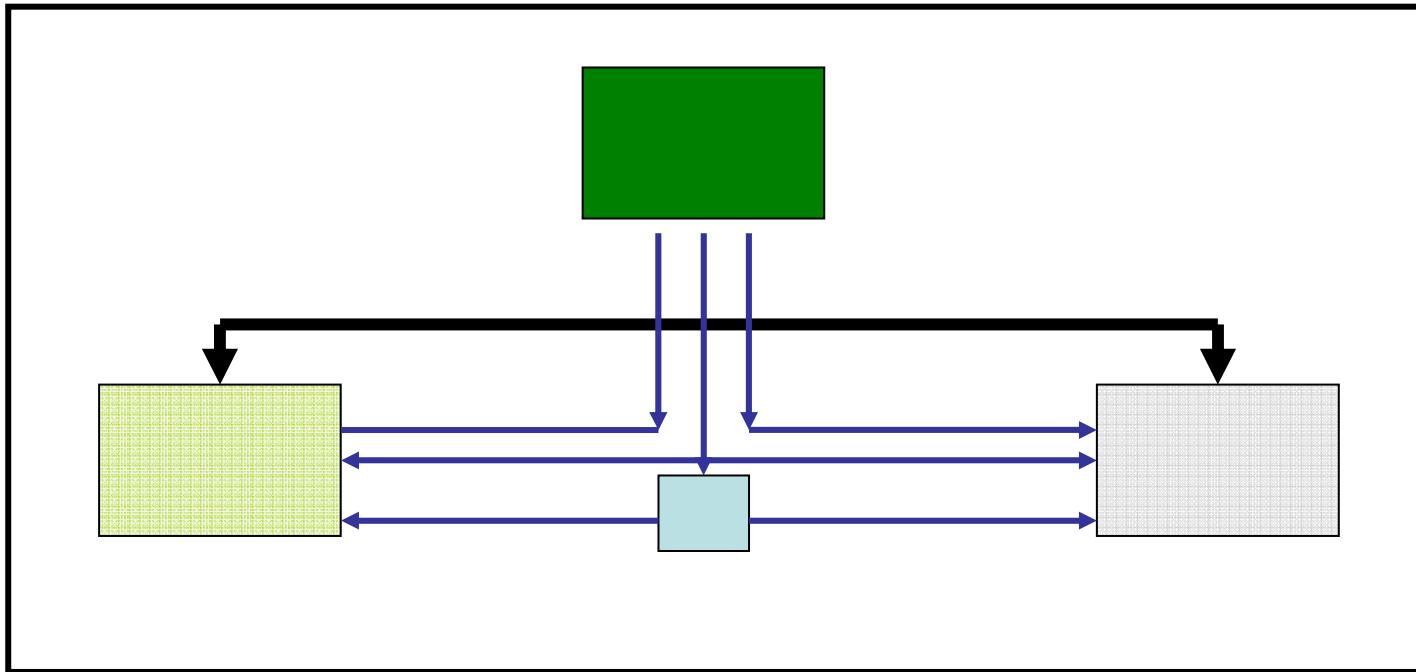
Hierarchical Elements: A dedicated coordinator with authority





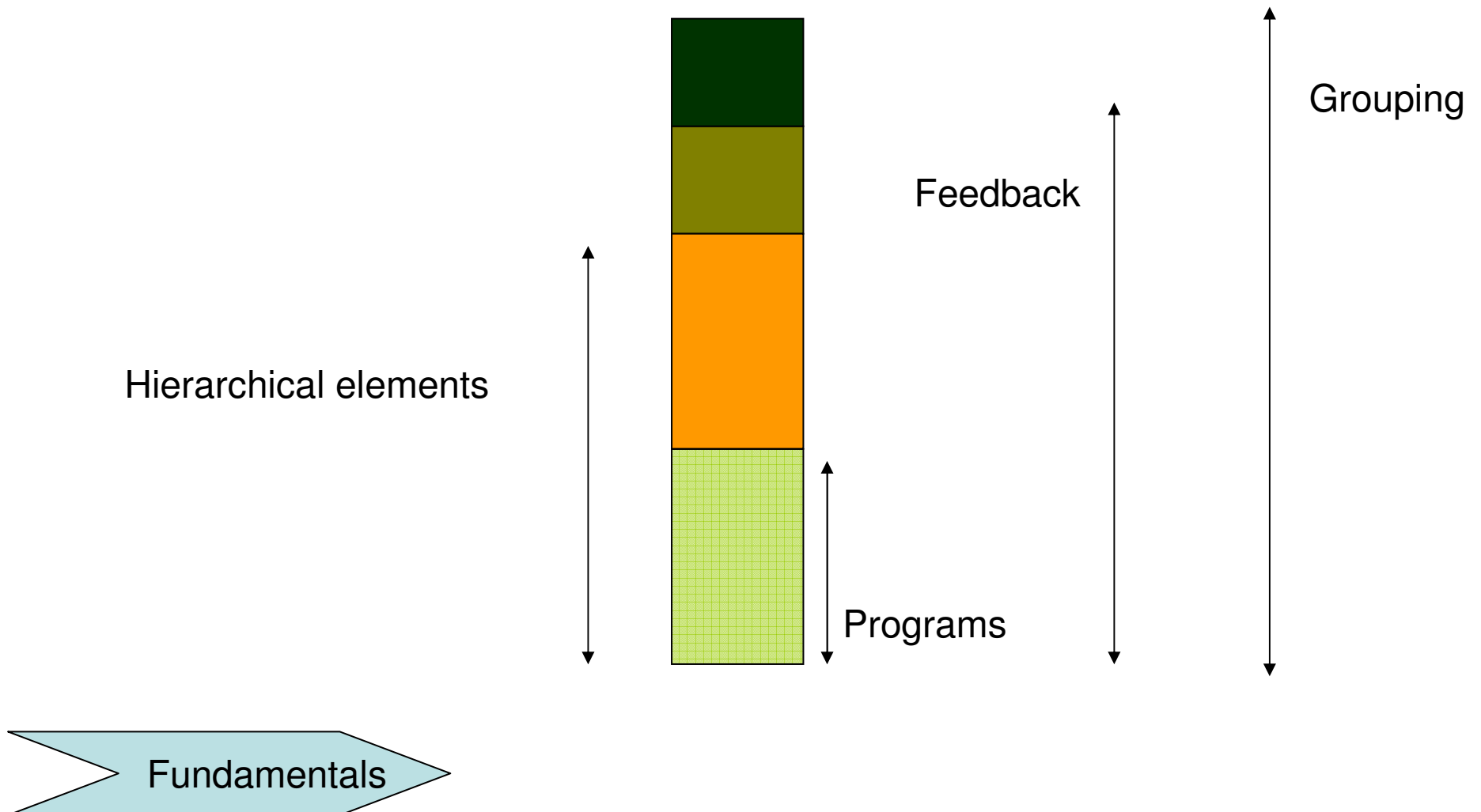
Feedback: Direct exchange of information between interacting actors





- Grouping: Enclosing interdependent tasks within a common organizational boundary;
- Options: By Output, Activity or Use

Information processing capacity (Tushman and Nadler, 1978)

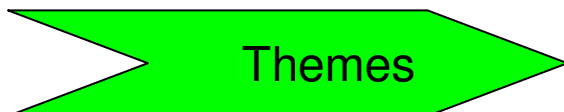


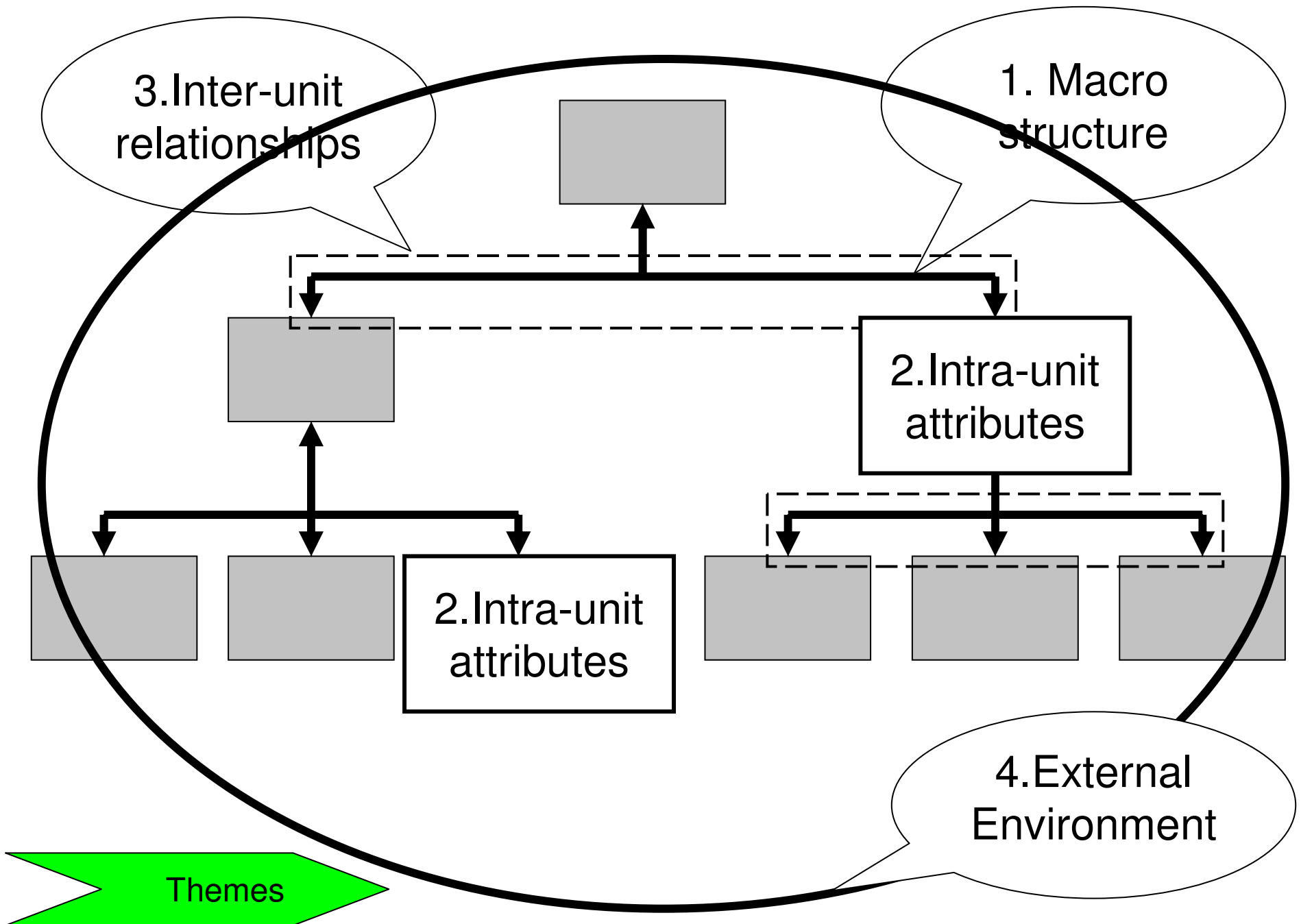
Summary

1. The **division of labour** creates **interdependence** (which makes **integration** necessary), as well as organizational **differentiation** (which makes integration harder)
2. The nature of the division of labour → **complexity of interdependence** → **task uncertainty** → need for **information processing**
3. Organizational and Unit **environments** influence the division of labour
4. Hierarchy of **integration mechanisms** in terms of information processing capacity; possible interactions between them
5. **Grouping** is the most powerful integration mechanism; can occur by output, use and activity.

Themes in the Literature

- Macro-structure
- Inter-unit relationships
- Intra-unit attributes (micro-structure)
- ..and the effect of the organizational environment on all of the above





3. Inter-unit relationships

1. Macro structure

2. Intra-unit attributes

2. Intra-unit attributes

4. External Environment

Themes

Some of my research on Org Design

- Integration through Incentives in Differentiated Organizations
- Renewal through reorganization
- The coordination–autonomy paradox in post-merger integration



Integration through Incentives in Differentiated Organizations

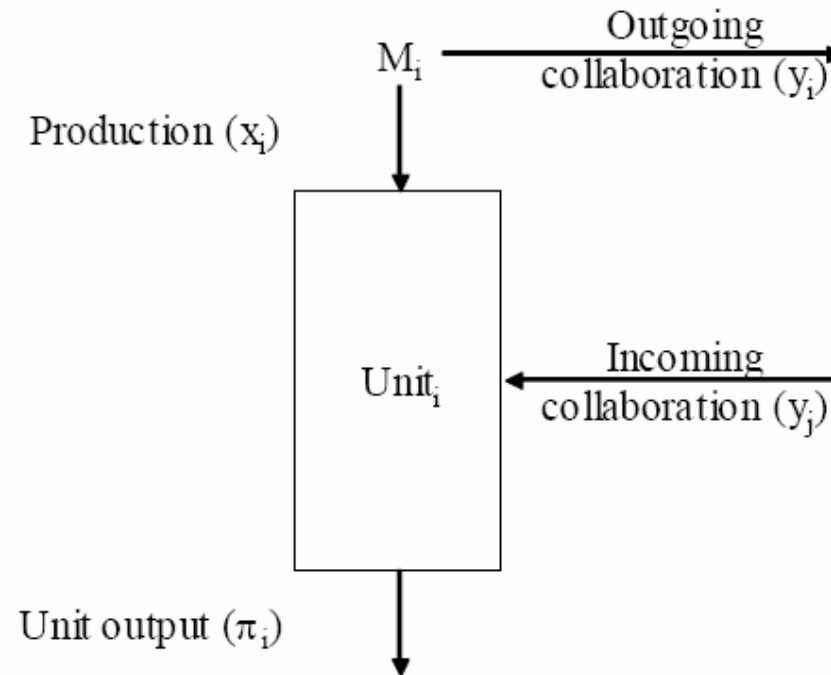
(with T. Kretschmer, Org Science 2008)

- Literature on collaborative incentives: The ant colony vs. the pin factory
- Division of Labour
 - Gains from Specialization
 - Gains from Integration (i.e. managing Interdependence)
 - Differentiation as an impediment to Integration





Org. designer picks collaborative incentive structure



Model structure

$$\alpha\pi_i + \beta\pi_j \tag{A1}$$

$$\pi_i = \alpha_i + (1-\tau)y_j + \gamma_i y_j + \varepsilon_i \tag{A2}$$

$$\mu_i = x_i^2 + y_i^2 \tag{A3}$$

Gains from Integration (γ) : $\partial^2 \pi_i / \partial x_i \partial y_j \geq 0$



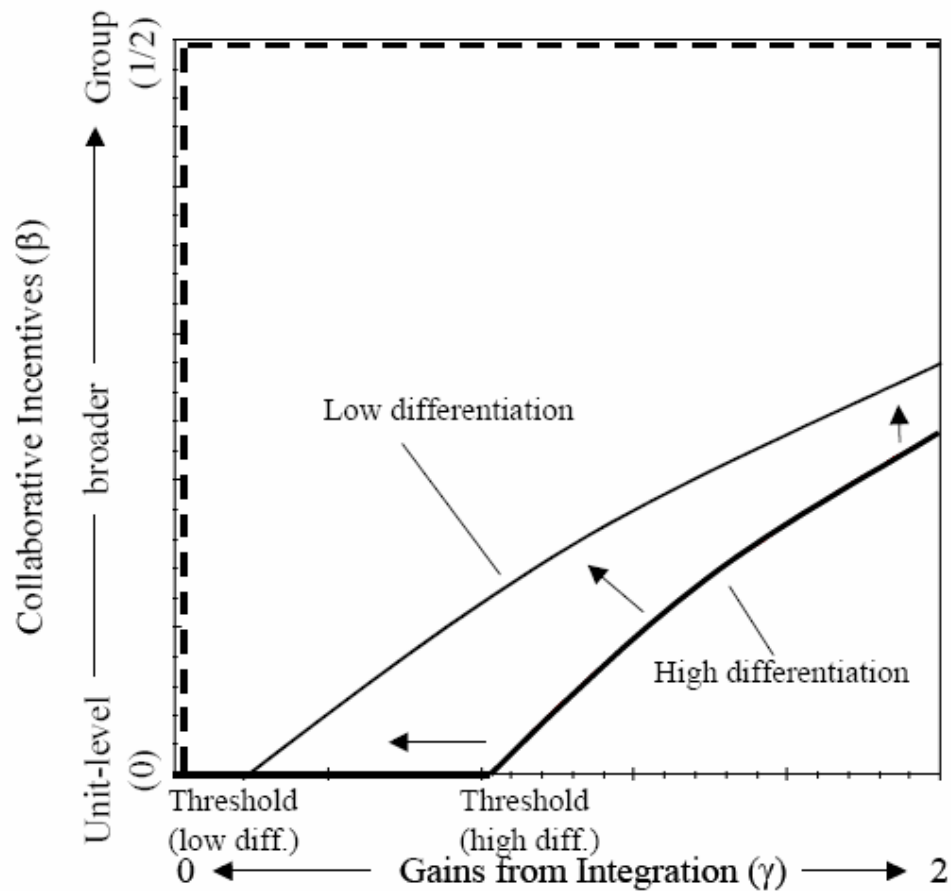


Figure 6: Collaborative Incentives and Integration thresholds in Complex Organizations (k=1)



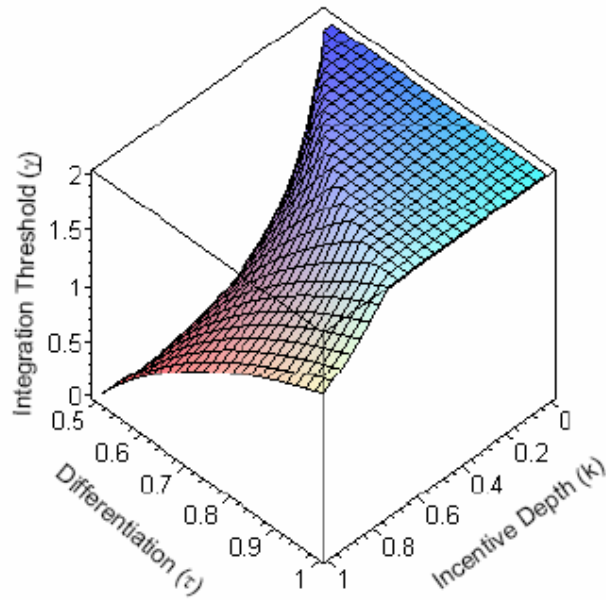


Figure 5: Integration thresholds, incentive depth and differentiation



Renewal through reorganizations

(with R. Gulati, Org Science 2009)

- Reorganizations are painful because of the inconsistencies created between the formal and informal organization
- But inconsistencies may be useful!
- Reinforcing interactions between formal and informal organization:
 - Supplementary
 - Compensatory



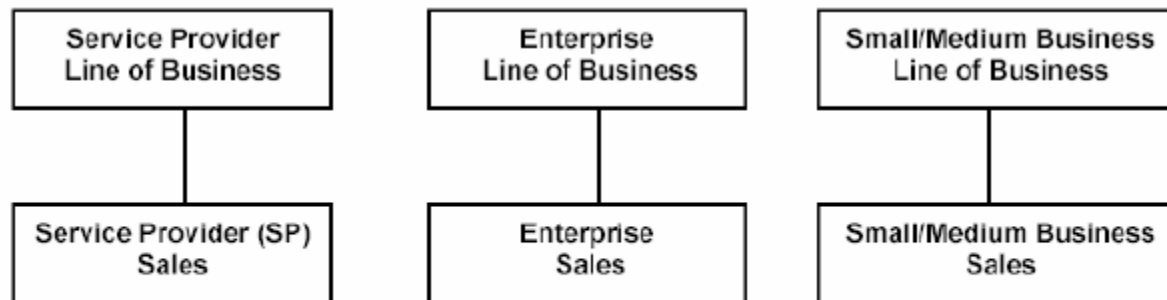
Overview of core argument

- Inconsistencies that arise between the formal and informal organization after reorganizations can be the basis for corporate renewal through the pursuit of “dualities”.
- Dualities are *jointly desirable, but organizationally incompatible* objectives (Evans and Doz, 1989). Eg. Exploration vs. Exploitation; Cost vs. Differentiation Focus; Organizational Differentiation vs. Integration
- Reorganizations can help the pursuit of jointly desirable dualities when the resulting formal organization and the informal organization *each emphasize opposing poles of a duality*.
- → Reorganizations as a path to realizing the gains from ambidexterity

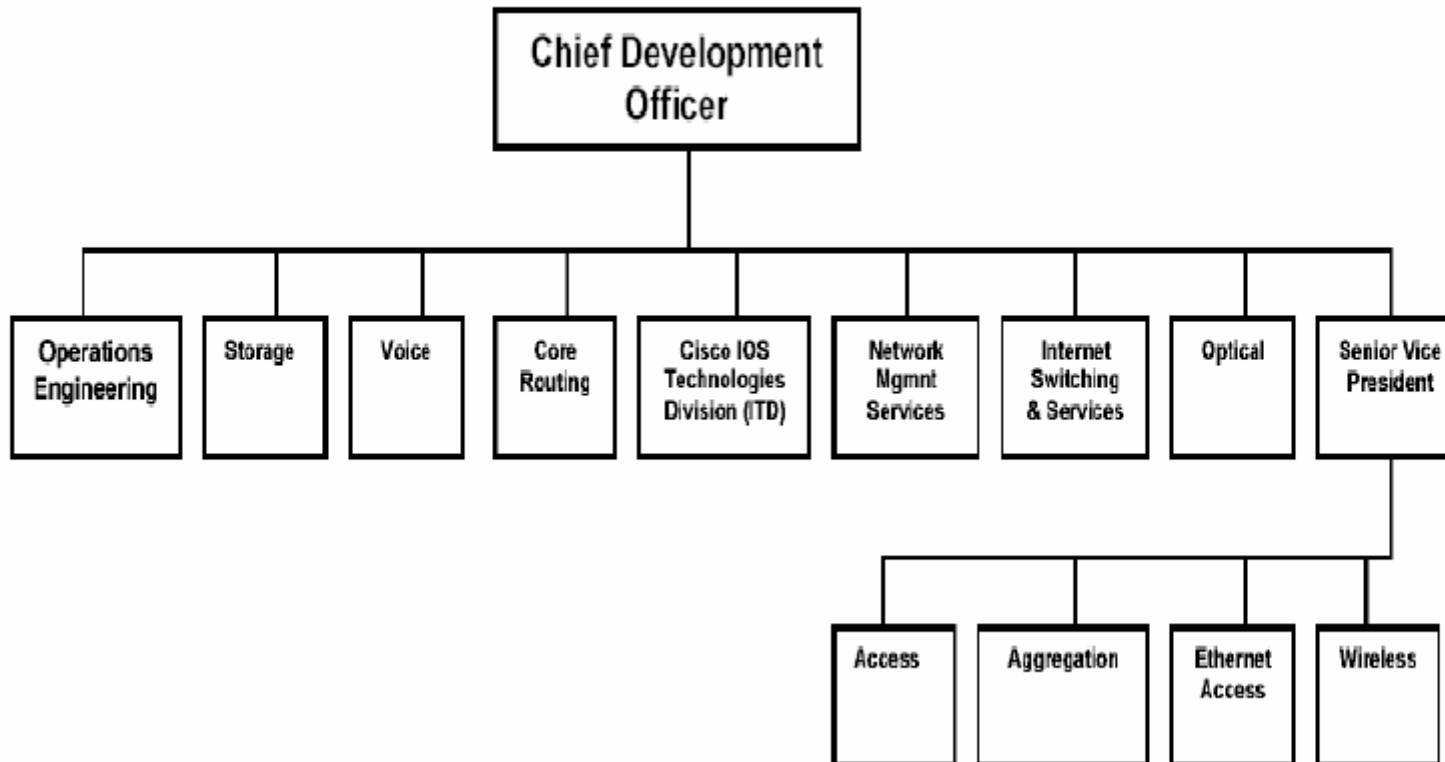


Figure 1 Cisco Systems before August 2001

Organizational Structure (pre-August 2001):



August 2001 Restructuring



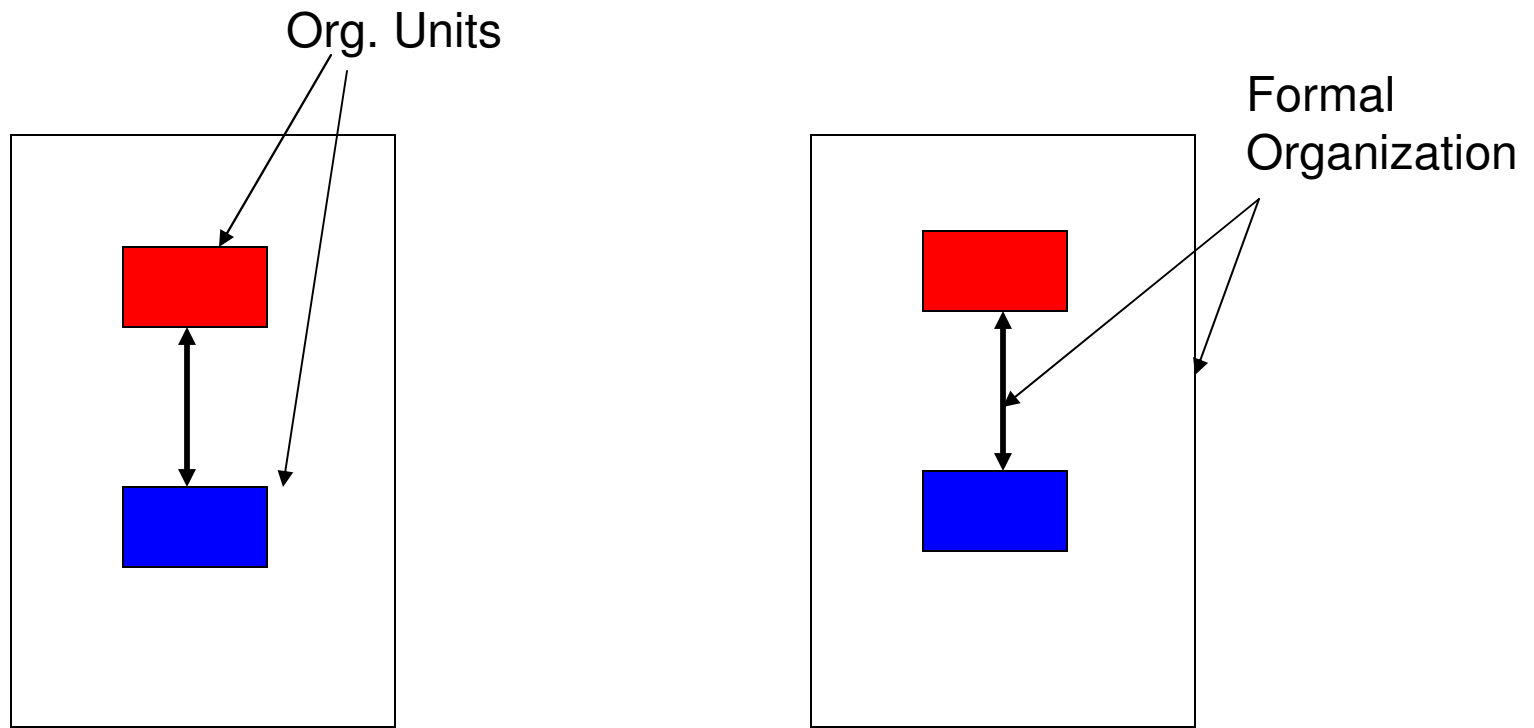
Inconsistencies post-reorganization arising from

- A deeply entrenched **culture** of customer advocacy
- A pattern of **unofficial relationships** that survived the change in the formal organization

... were found to be very useful!

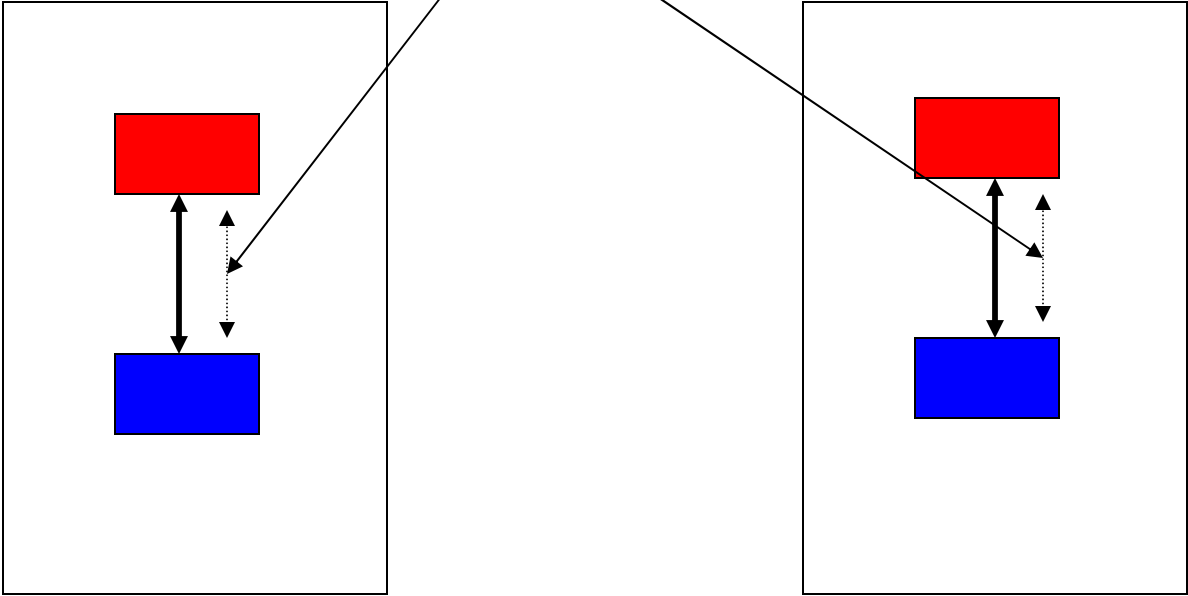


The effects of re-organization on the formal and informal organization

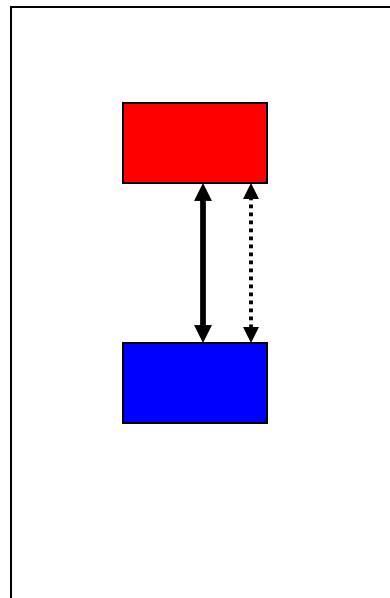
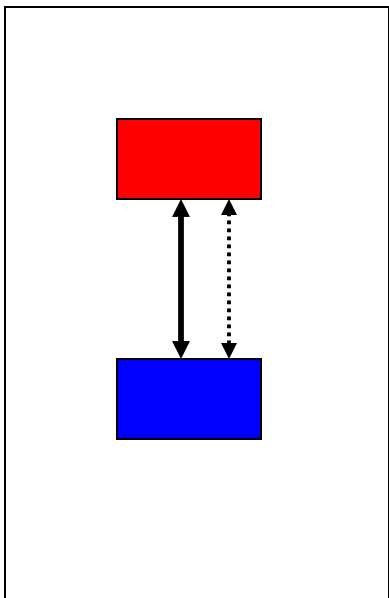


T=0

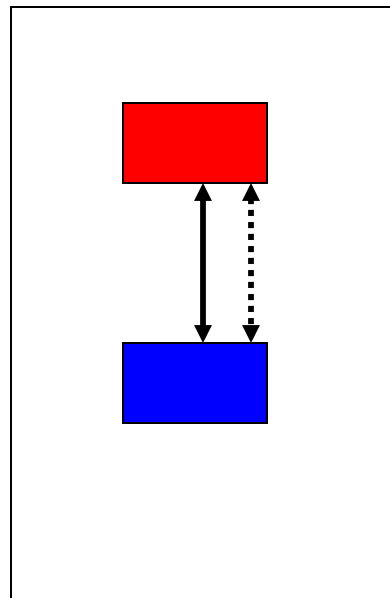
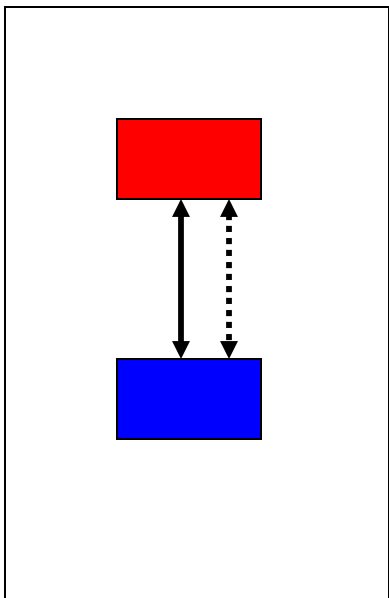
Informal Organization



T=1

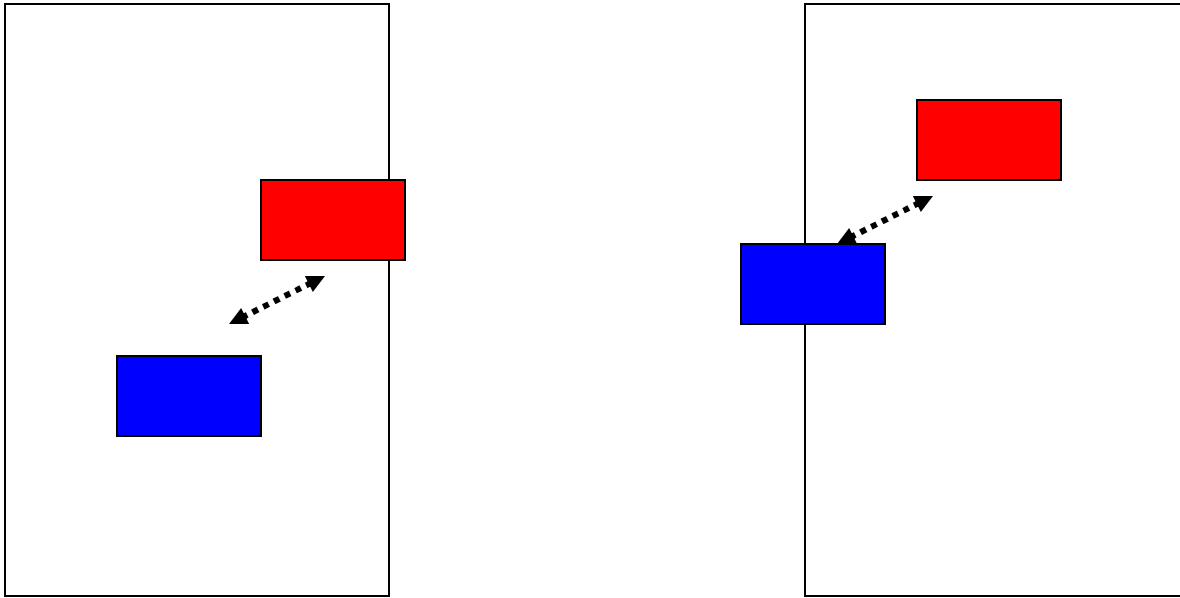


T=2



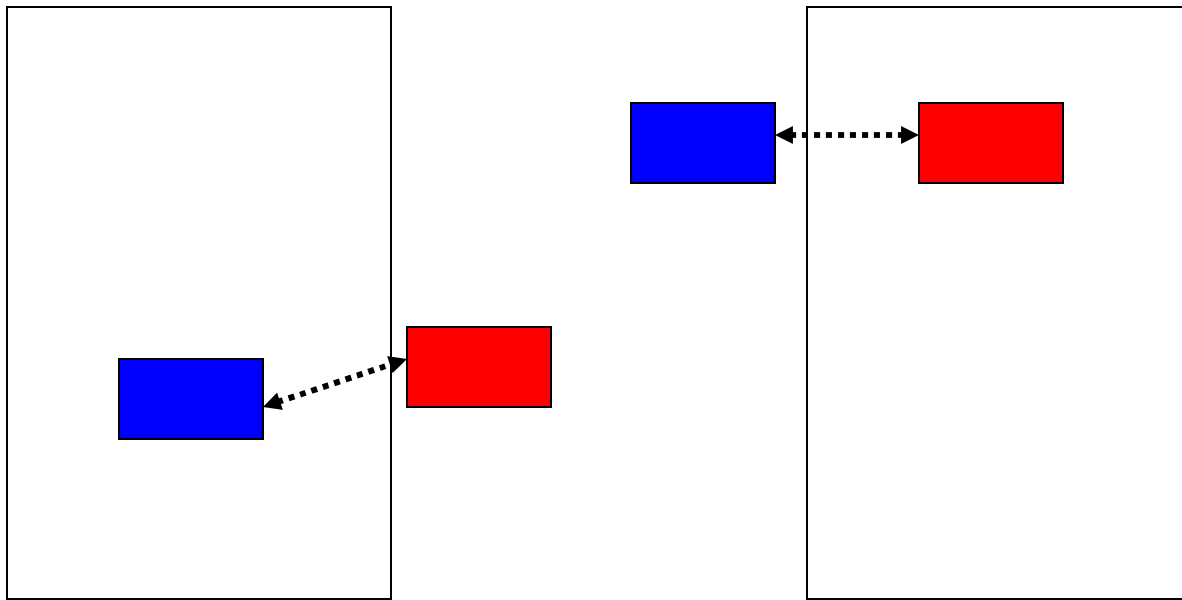
T=3

Re-Organization



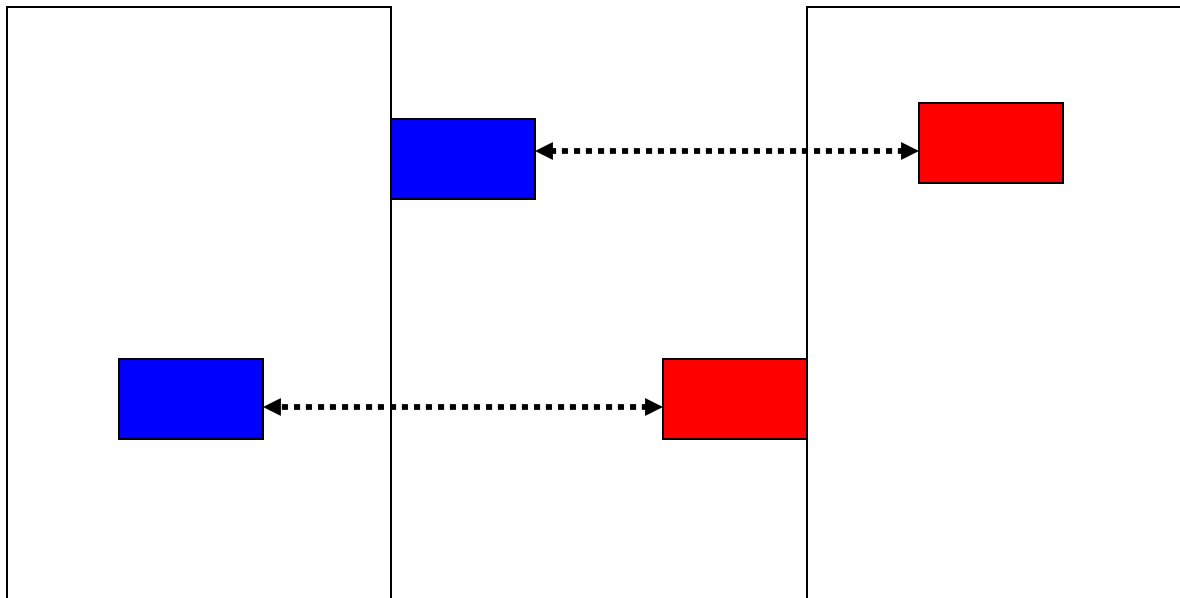
T=4

Re-Organization



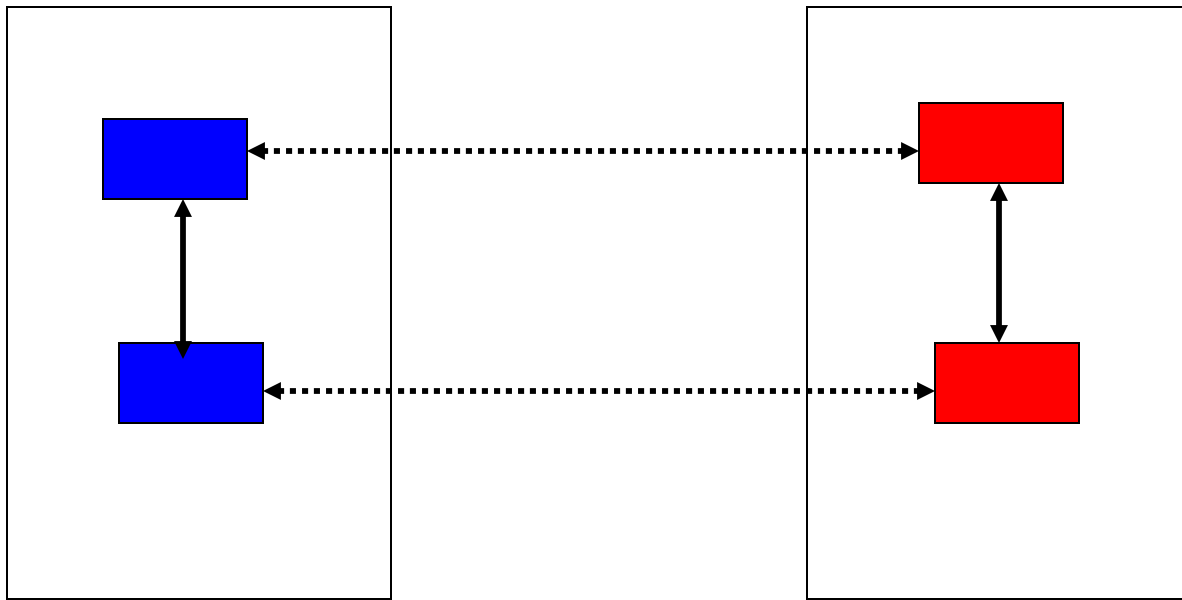
T=5

Re-Organization



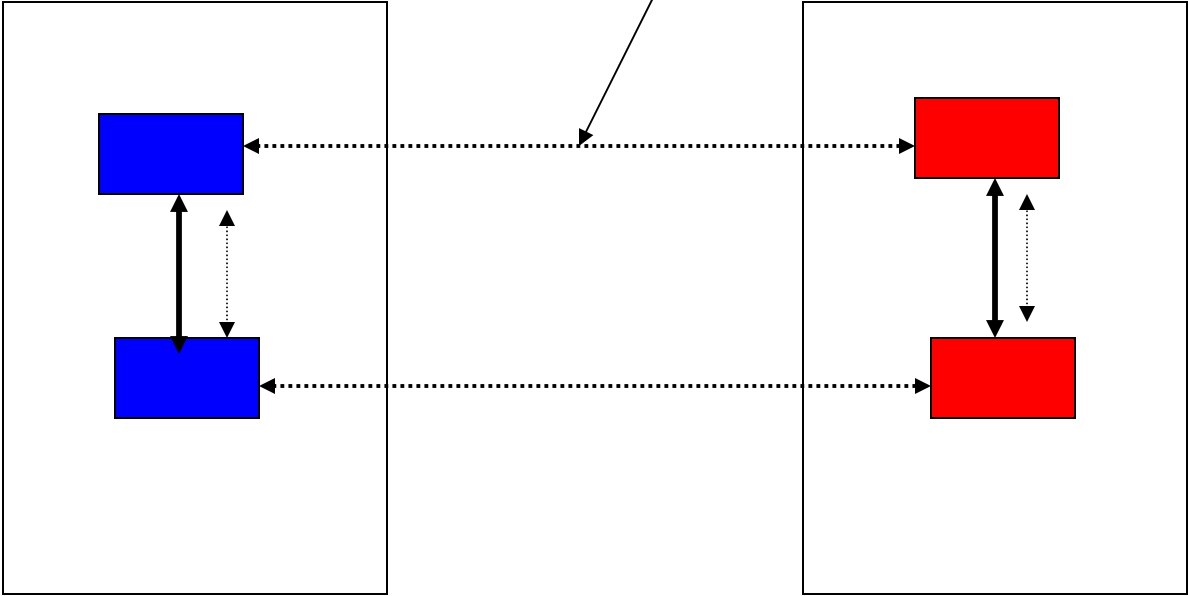
T=6

Re-Organization

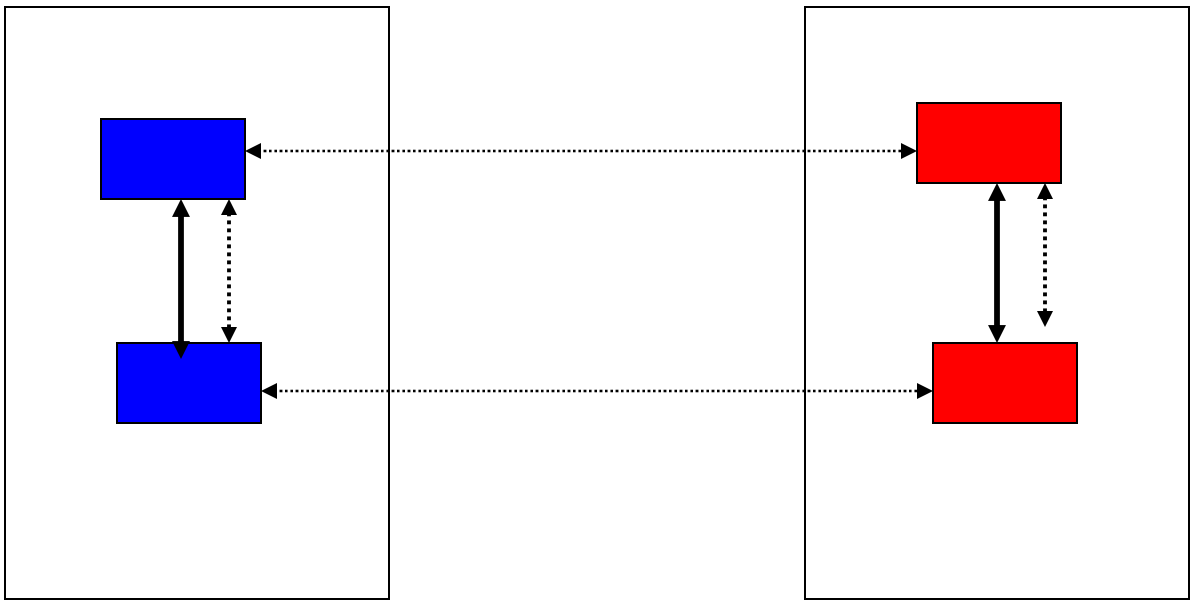


$T=7$

Persistence of older
Informal organization

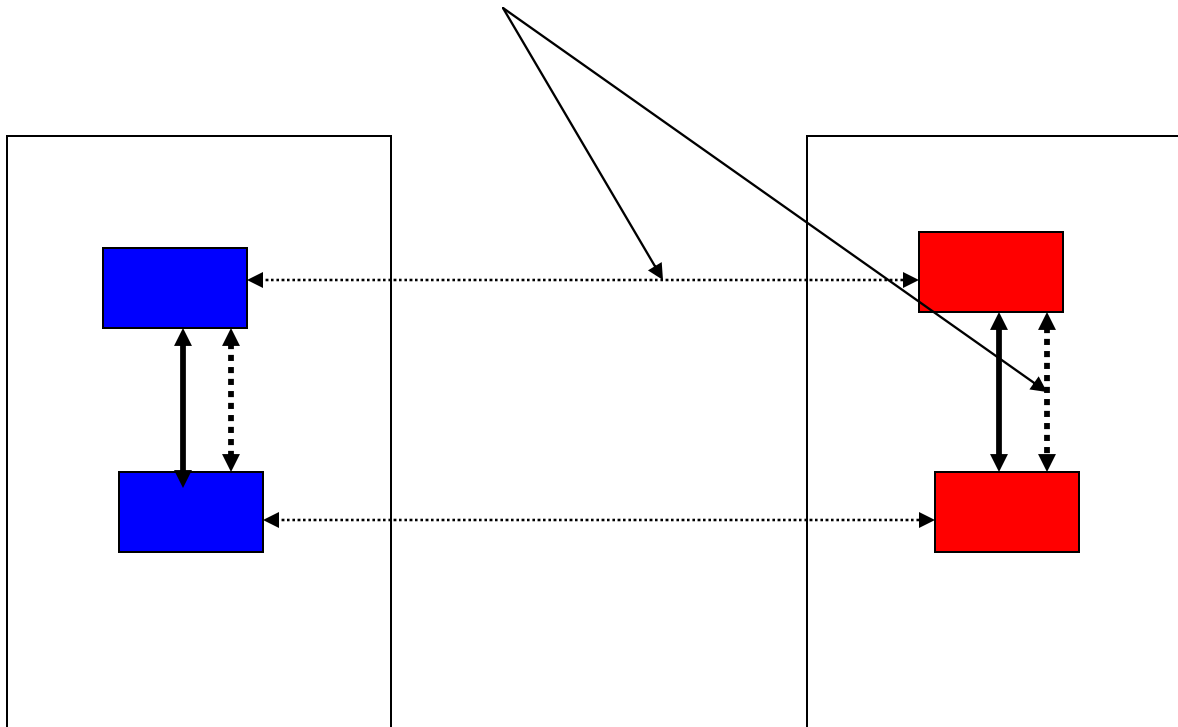


T=8



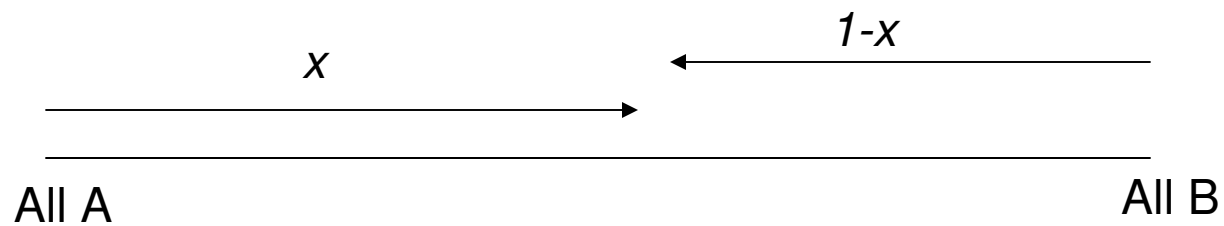
T=9

Emergence of new informal organization
& weakening of the older one.



T=10

Employees effort allocation



$$w(x) = w_f(x) + w_i(x) \quad (\text{i})$$

Where $w_f(x) = [(\frac{1}{2} + \theta)]x + [(\frac{1}{2} - \theta)](1 - x)$ and $w_i(x) = [(\frac{1}{2} + \delta)]x + [(\frac{1}{2} - \delta)](1 - x)$.

$$c(x) = \frac{x^2}{2} + \frac{(1-x)^2}{2} \quad (\text{ii})$$

$$P(x) = ax + (1-x) + \lambda(1-x) \quad (\text{iii})$$

$$D(\theta) = d\theta^2 \quad (\text{iv})$$



My research

Boundary conditions

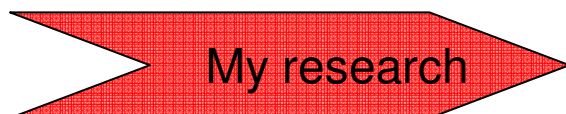
- How stable are organizational inconsistencies?
- What about the costs incurred by the individuals working in an inconsistent organization?
- What happens when conditions change?



Coordination-Autonomy paradox in post-merger integration

(AMJ2006;SMJ2007;Org Science 2009 with Singh, Srikanth, Chaudhuri, Zollo)

- Structural integration in acquisitions as a grouping decision
- Can observe both benefits and costs of structural integration
- Structural integration
 - Unnecessary when prior shared knowledge exists
 - Lowers likelihood of future innovation by target employees
 - Enhances likelihood of leverage of existing knowledge by acquirers.



Technology Grafting Acquisitions

- Acquisitions of small technology based firms by large established firms in order to access their technologies and capabilities

(Doz, 1988; Granstrand and Sjolander, 1990; Ranft and Lord, 2002; Graebner, 2004)

- IT & Life Sciences industries



“We buy not only the box on the table, but the capacity to create future products”

“What the (target) company has already achieved is of course valuable. But we are also paying for the future.”



The influence of structural form on a series of innovations

- **Key idea:** There are stages in the technological trajectory which are more exploration intensive – i.e. exploration activity is more critical than exploitation to innovate successfully.
- At such stages, structural forms that emphasize autonomy are likely to outperform structural forms that emphasize coordination.



Sample

- Acquirers
 - IT (computing and communication) manufacturing SIC
 - Listed in COMPUSTAT every year between 1988-1998
 - Greater than 1000 employees at all times (Pavitt et al, 1987;1989)
- Targets
 - Acquisition motivated by obtaining technology/products (Ahuja and Katila, 2001)
 - <500 employees (U.S.SBA)
 - Independent firm (not divestments)
 - Between 1988-1998

207 acquisitions by 49 acquirers



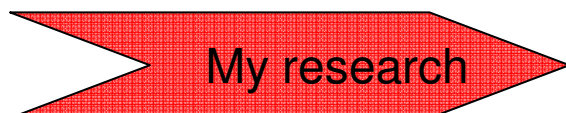
Measures

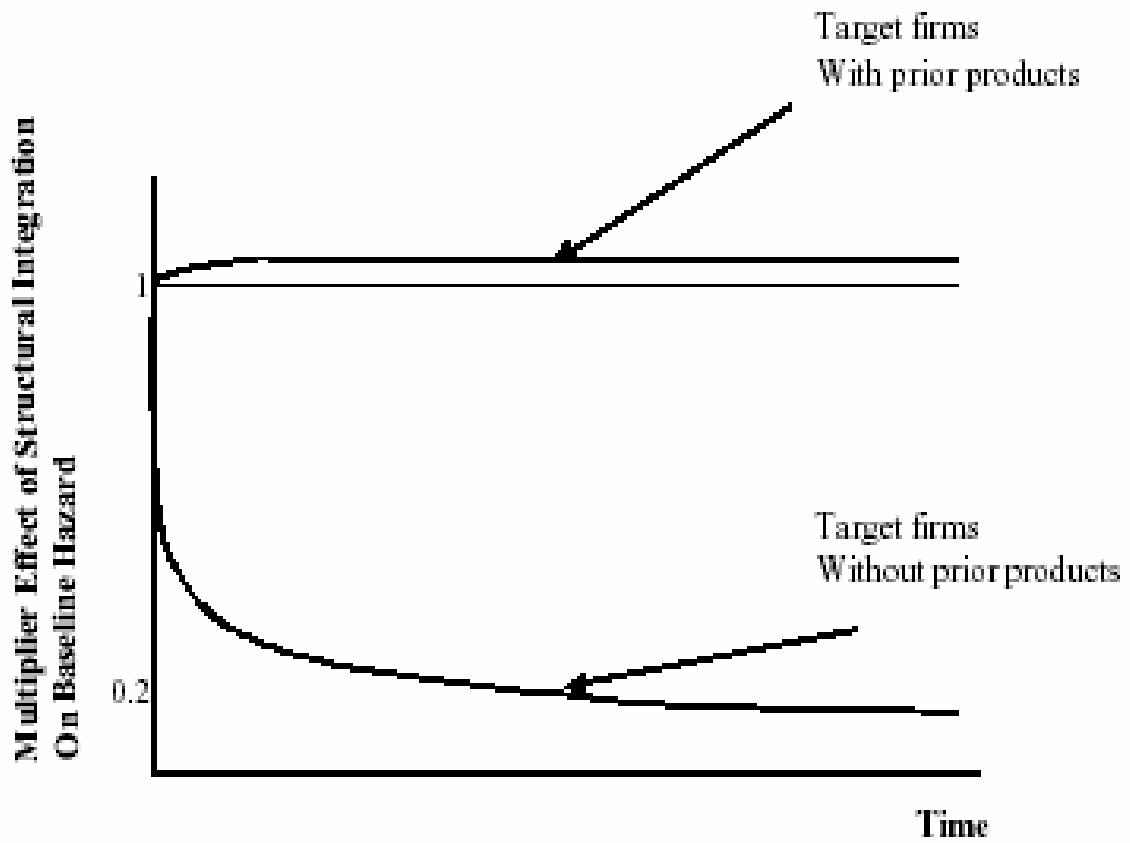
- Innovation Outcomes: Hazard of new product introduction by acquirer that builds on target firm's technology
 - Product launch dates coded from press release data.
- Structural Integration: Coded 0 if target kept as a distinct operational unit, else 1.
 - Coded from press releases and from CORPTECH database
- Pre-acquisition products & First Innovation after acquisition.

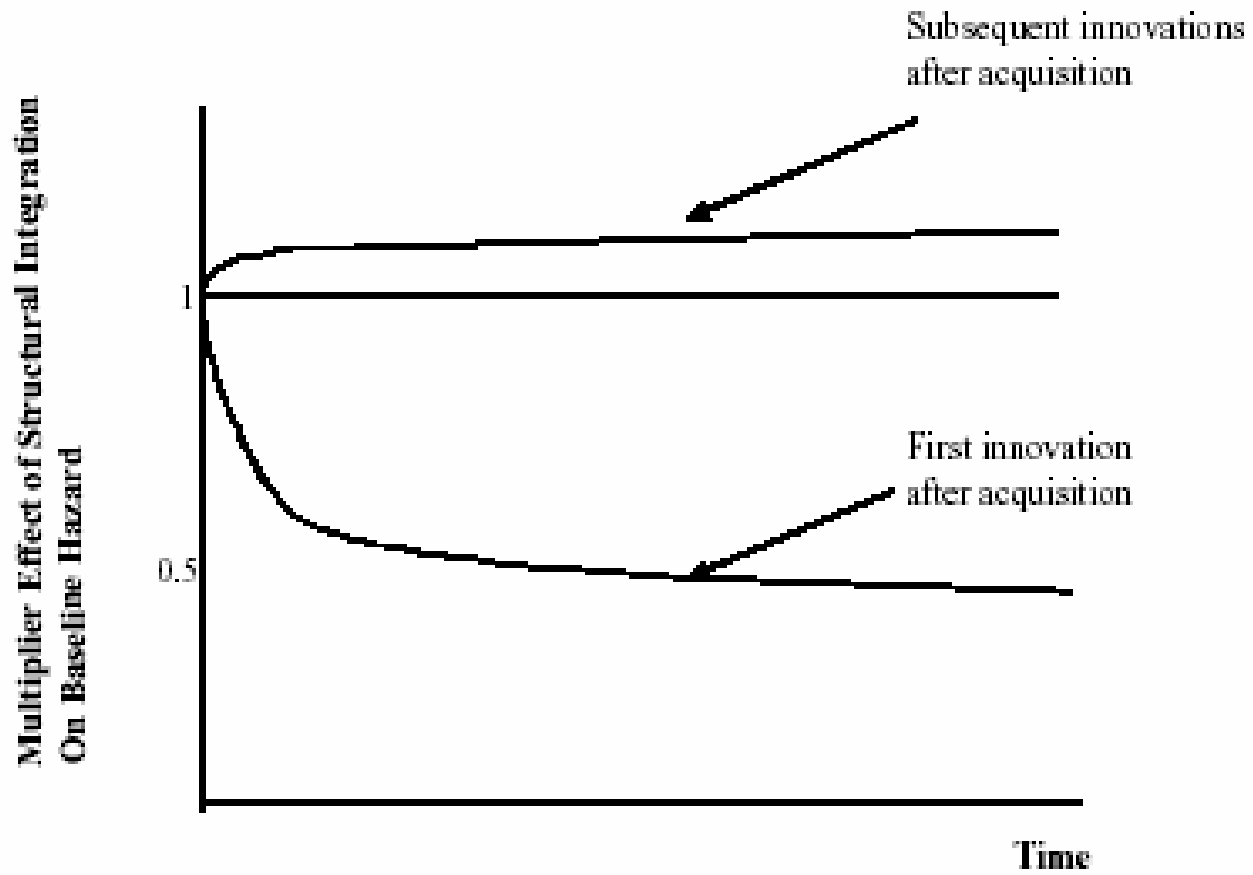


CRS Cox Regression Estimates

Structural Integration X Subsequent Innovations				0.148 **	0.148 **
				(0.057)	(0.058)
Structural Integration X Prior Product			0.260**		0.256 **
			(0.130)		(0.117)
Structural Integration [1/0]		-0.032	-0.253**	-0.117 **	-0.333 ***
		(0.036)	(0.122)	(0.048)	(0.111)
Prior Product (1/0)	0.466	0.407	-0.230	0.361	0.252
	(0.350)	(0.358)	(0.306)	(0.360)	(0.325)







My research

The influence of structural form on leveraging technology acquisitions

- **Key idea:** The effect of post-merger integration varies depending on what is being leveraged.
- Post-merger integration enables acquirers to leverage the existing knowledge of the acquired firm (“what they know”) but hinders efforts to leverage their capabilities for ongoing innovation (“what they do”).



Sample

- Acquirers
 - IT (computing and communication) and pharmaceuticals manufacturing SIC
 - Listed in COMPUSTAT every year between 1988-1998
 - Greater than 500 employees at all times
- Targets
 - Acquisition motivated by obtaining technology/products (Ahuja and Katila, 2001)
 - <500 employees (U.S.SBA)
 - Independent firm (not divestments)
 - Between 1988-1998
 - At least filed one patent in 3 year window pre-acquisition

97 acquisitions by 49 acquirers



Using patenting activity to assess knowledge and capability leverage

Patents filed by acquirer after acquisition in which		<i>Target patents are cited?</i>	
		Yes	No
<i>Target inventor(s) are authors?</i>	Yes	Capability <u>and</u> Knowledge Leverage (A)	Pure Capability leverage (C)
	No	Pure Knowledge leverage	Irrelevant (D)



FE Poisson with RSE.

TABLE 3. – Leveraging Existing Knowledge – Poisson fixed effects models with robust standard errors

	Model 1	Model 2	Model 3	Model 4
Structural Integration		0.71** (0.33)	0.92*** (0.33)	1.20 (0.76)
Inventor retention			0.41*** (0.15)	0.45*** (0.21)
Integration * retention				-0.11 (0.20)



FE Poisson with RSE.

Table 4 – Leveraging Innovation Capability - Poisson fixed effects models with robust standard errors

	Model 1	Model 2	Model 3	Model 4
Structural Integration		-0.47** (0.24)	-0.08 (0.25)	-0.92*** (0.34)
Inventor retention			0.30*** (0.06)	0.24*** (0.05)
Integration * retention				0.34*** (0.1)



Implications for the study of Organization Design

- Structural form as a mechanism for inter-organizational coordination
 - Generates coordination gains at the expense of disruption and motivation losses
 - Most effective when coordination needs outweigh motivation considerations
 - Less necessary when there is pre-existing shared knowledge



Some “*hot*” areas in the study of organization structure and design

- How does organizational structure influence organizational adaptation?
- How does the formal organization shape the informal organization?
- How does organizational structure shape the emergence of capabilities?
- How can we extend ideas about organizational structure to the inter-organizational domain
- ...

Thank you!

Appendix

Shared knowledge

- I use the terms knowledge and understanding interchangeably.
- Shared knowledge (of any order)
- φ is shared knowledge of first order among the j agents of a group G if $K1\varphi \wedge K2\varphi \wedge K3\varphi \dots \wedge Kj\varphi$
This is written as $E_G\varphi = E^1G\varphi$ and read “Everyone in group G knows φ ”.
- By abbreviating the expression $E_G E_G^{n-1}\varphi$ with $E_G^n\varphi$ and defining $E_G^0\varphi = \varphi$,
we could then define shared knowledge of φ to any order n with the axiom
$$C\varphi \Leftrightarrow \bigwedge_{i=1}^n E^i\varphi \quad n = 1, 2, \dots$$
- Common knowledge of φ = shared knowledge of φ of order $n=\infty$
- When I speak of shared knowledge, I implicitly mean of first order; in some (but not all) situations, higher order shared knowledge may also be logically necessary. Empirically, people coordinate without common knowledge as defied here.
- My interest is primarily in the ***breadth*** of shared knowledge (what kinds of knowledge must be shared) rather than ***depth*** (what order of shared knowledge is minimally sufficient for **coordinated action**)

Coordination

- **As an outcome**

- *Obtains* when there is reciprocal predictability of action among interdependent actors, leading them to efficient actions
- *Necessary* whenever there is interdependence
- *Alignment* of understanding required
- *Enabled* by the existence of common knowledge

- **As a process**

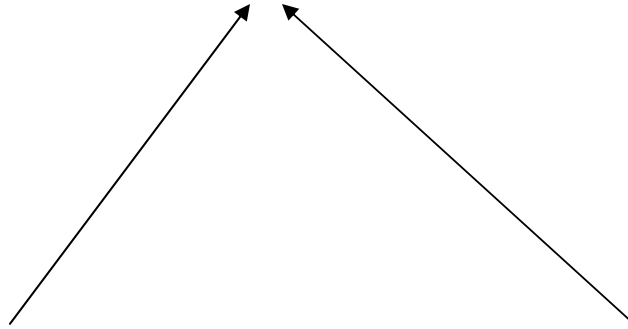
- *Creation* of sufficient common knowledge to enable reciprocal predictability of action among interdependent actors

Both are necessary....

Integration of Efforts

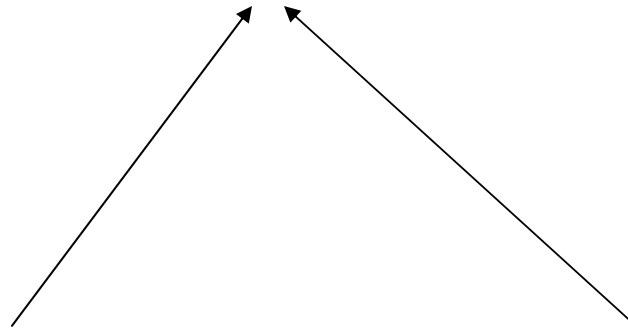
Coordination

Cooperation



Either is sufficient

Integration Failures



Coordination failures

Failures to predict &
interpret each others
actions.....

Resulting in misunderstanding,
lack of synchronization, delays

Cooperation failures

Failure to align interests.....

Resulting in hold-up,
shirking, poaching, free-riding

Two pure coordination games featuring behavioural uncertainty

Stag hunt

	Y	N
Y	10,10	-6,5
N	5,-6	0,0

Matching

	A	B
A	10,10	-5,-5
B	-5,-5	10,10

A pure coordination game featuring
structural ignorance

	C1	C2	C3
R1	(1,1)		
R2		(1,1)	
R3			(1,1)

“Joint discovery” game