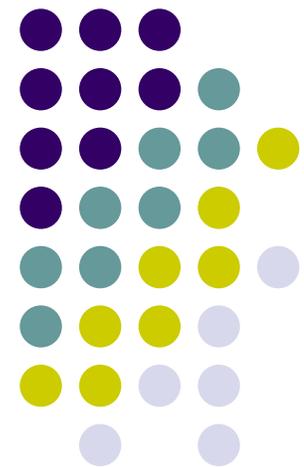


Transformational Organizations and Hyper Innovation Rates: Institut Pasteur and Biomedicine, 1889-1918*

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Why be concerned about transformational organizations?



- **Relevance to crisis: transformational organizations are capable of high rates of innovation. Interest in them in science policy circles.**
- **Relevance to innovation: provision of a check list of what to look for in the evaluation of a transformational organization.**
- **Relevance to theory: adds to the theory of innovation**

Problem: how does one locate transformational organizations, which are rare by definition?



- **Methodology for finding transformational organizations**
 - select a measure for radical innovations or scientific/technological breakthroughs in specific discipline, e.g. various prizes
 - create a census or quasi-census of these over a long time period, 30 to 100 years
 - find which research organizations have a number of scientific breakthroughs across a century of time
 - study the characteristics of the organizations that would appear to account for the high rates of innovation
- *Observation: When evaluators have to develop ideas about what are effectively rare events or organizations, history provides a way of solving the problem provided that one adopts a long enough time period.*

The Results of this Methodology



- **31 research organizations in the four countries accounted for one-half of the close to 300 scientific breakthroughs**
- **Six research organizations—Rockefeller, Johns Hopkins, Cambridge, California Institute of Technology, Institut Pasteur, Harvard Science—accounted for one-fourth of the breakthroughs**
- **One of these six, the Institut Pasteur, had 8/12 major breakthroughs in one 30 year period, more than any other**
- ***Observation: We can focus on this research organization and find out what accounts for this remarkable record.***

Locating characteristics of transformational organizations in the empirical literature



1. At the team level:

- complex research teams
- cross-fertilization of ideas
- Brown and Eisenhardt, 1995; Kanter, 1988; Kumar et al. 1996; Menke, 1997; Miller, 1995, Undawdia, 1990; Verhaeghe and Kfir, 2002

2. At the research organizational level

- relatively small and highly flexible
 - low centralization and bureaucratization
 - moderate diversity and high capacity to recruit diversity
 - leaders that can integrate diversity
 - high integration
 - Hollingsworth, 2006
-
- *Observation: We need more precision about what organizational characteristics facilitate the creation of complex teams and cross-fertilization of ideas.*

Factors that create complex research teams and lead to high flexibility



- **In the Institut Pasteur, 1889-1918, the important characteristics are:**
 - **complex charter, three or four goals**
 - **visionary team of leaders, not just one**
 - **recruitment from diverse sources, national and international**
 - **multiple sources of funding, not just the state**
- ***Observation: It is the interaction of these factors together that explains the complexity of the research teams because all of them facilitate diversity of recruitment and make the organization flexible in its strategy.***

Elements of the complex charter



The initial goals:

- **basic research and more specifically microbiology**
- **applied research and specifically biomedicine**
- **education of physicians to change the public health of France**
- **production of serums and vaccines so that the Institut is not dependent upon the state**
- *Observation: these goals move considerably beyond Stokes' (1997) discussion of Pasteur's Quadrant and their interaction results in the creation of complex research teams.*

Characteristics of the visionary team (Duclaux, Roux, and Metchnikoff)



Cognitive Differences between them:

- **different training**
- **different intellectual styles**
- **different cultures**
- **different visions**
- *Observation: It is the mix of their training, intellectual styles, cultures and visions that is so important in explaining both complexity of the research teams and the flexibility of the Institut Pasteur, not a single leader. One might call this the Hewitt-Packard model of innovation*

Consequences of the different visions for the evolution of the Institut Pasteur



New fields that were added during 1889 to 1918

1. cellular approach to immunology*
2. physiology
3. biochemistry*
4. virology*
5. fermentation in both beer and milk
6. protozoology*
7. biology of radium treatments for cancer
8. chemical therapy*
9. phage research*
10. bio-physics

▪ The asterisk indicates the first such research program in the world.

- *Observation: It is not just the charter but how the charter given diverse leadership propels a research organization across time, which in turn increases the diversity for complex research teams.*

Recruitment from diverse channels



Preferences of the leaders:

- **Duclaux preferred recruiting physical chemists from the prestigious tracks such as the grandes écoles, science faculty of Paris, and Institut Agronomique**
- **Roux preferred recruiting physicians from the less prestigious tracks, e.g. military medical school, and veterinarians.**
- **Metchnikoff preferred recruiting zoologists from Russia and the Slavic countries.**
- *Observation: Each had both an intellectual bias and a recruiting network bias but these biases created a very rich diversity for the formation of complex research teams and made the organizational more flexible.*



Multiple sources of funding

Sources of funding:

- **Public subscriptions, double bang start of the Institut**
- **State, central and local government support**
- **Sale of vaccines and serums, both human and animal**
- **Donations and bequests**
- *Observation: The diverse sources provided the autonomy to promote researchers rapidly and to create new research laboratories in diverse areas, thus explaining the flexibility of the Institut Pasteur.*

Transformational characteristics that facilitate cross-fertilization of ideas or integration across cognitive distance



Forms of integration:

- **Organic structure and risk-taking or decentralized and non-bureaucratic**
- **Mechanisms that create intellectual integration**
- **Mechanisms that create emotional integration**
- *Observation: it is important to isolate how one can create integration and especially encourage the exposure of tacit knowledge given the cognitive distance involved in complex research teams.*

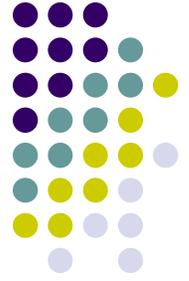
Mechanisms of intellectual integration



Mechanisms

- **Common language across many specialties via course**
 - **New journal for the knowledge community**
 - **Rotation of personnel between some departments**
 - **Teamwork between some departments**
 - **Joint publication of some researchers**
 - **Physiology as an integrative department**
-
- ***Observation: This considerably reduced cognitive distance and thus allowed for individuals to discuss each other's work.***

Mechanisms of emotional integration



Mechanisms

- **Creation of a sense of belong to a family**
- **Recruitment of family and friends via social networks**
- **Socio-emotional leaders**
- **The sense of being on a crusade (the combination of goals)**

- *Observation: The emotional integration made the problem of tacit knowledge less than it otherwise would be.*

Internal variations in the location of scientific breakthroughs



Locations where they occurred:

- **Five occurred in the two departments of Roux and Metchnikoff where there was rotation between them, joint leadership, joint publication, complex research teams, socio-emotional leaders,**
- **Two and 1/2 occurred in complex research teams connecting Paris and the Institut Pasteur in Lille**
- **One occurred in Tunis but in a complex research teams**

Locations where they did not occur:

- **Institute of Bio-chemistry**
- **Tropical medicine**
- **Hospital services**

Variations across time: 1889-1918 vs. 1919-1948



Presence of factors that facilitate complex research teams:

	<u>1889-1918</u>	<u>1919-1948</u>
Complex charter	yes	no
Visionary team	yes	no
Diverse recruitment	yes	no
Diverse sources of funds	yes	no
Number of breakthroughs	8 ^{1/2}	2 ^{1/2}

- *Observation: The 2^{1/2}, with one exception, represented teams that operated separately. These had a complex charter, visionary leadership, additional resources and involved diverse recruitment. The major exception is Ramon.*

Variations across time: 1889-1918 vs. 1919-1948 (cont.)

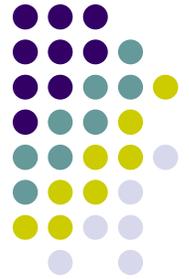


Presence of factors that facilitate cross-fertilization of ideas:

	<u>1889-1918</u>	<u>1919-1948</u>
Organic, risk-taking	yes	some
Intellectual integration	yes	very little
Emotional integration	yes	no
Sense of crusade	yes	no
Number of breakthroughs	8 ¹ / ₂	2 ¹ / ₂

- *Observation: The Lacroix commission in 1934 found that the Institut Pasteur had become a series of isolated individual laboratories in which some individuals did take risks, an absence of esprit de corps, and certainly very little integration except in tuberculosis and chemical therapy where 1¹/₂ breakthroughs occur.*

Checklist for Evaluating Transformational Organizations



- **Characteristics of Transformational Organizations**
 - complex charter, three or four goals
 - visionary team of leaders, not just one
 - recruitment from diverse sources, national and international
 - multiple sources of funding, not just the state
 - organic structure and risk-taking or decentralized and non-bureaucratic
 - mechanisms that create intellectual integration
 - mechanisms that create emotional integration
- *Observation: History can teach us and provide insights for evaluation*



Comments and questions

Please contact us if you have questions, suggestions, or opportunities to collaborate.

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Thank you!