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

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* 6. protozoology*
2. physiology 7. biology of radium treatments for cancer
3. biochemistry* 8. chemical therapy*
4. virology* 9. phage research*
5. fermentation in both beer and milk 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 tactic 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 ½ 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:

<table>
<thead>
<tr>
<th>Factor</th>
<th>1889-1918</th>
<th>1919-1948</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex charter</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Visionary team</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Diverse recruitment</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Diverse sources of funds</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Number of breakthroughs</td>
<td>8½</td>
<td>2½</td>
</tr>
</tbody>
</table>

- **Observation:** The 2½, 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:

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<th>1919-1948</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic, risk-taking</td>
<td>yes</td>
<td>some</td>
</tr>
<tr>
<td>Intellectual integration</td>
<td>yes</td>
<td>very little</td>
</tr>
<tr>
<td>Emotional integration</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Sense of crusade</td>
<td>yes</td>
<td>no</td>
</tr>
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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 1½ 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!