Evolutionary Trajectory in Organizational Routines: Predicting the Magnitude and Direction of Change in Networks of Action

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Organizational routines

• are a central construct in the theories of organizational stability and change.
  – organizational capabilities
  – organizational knowledge
  – organizational learning
Current theories of routines are incomplete

• Dynamics of routines are not well understood.
  – “Lock-in”
  – Endogenous change

• Existing theories on routine change are incomplete.
  – Path dependence
  – Interdependence
The goal is to build a better theory on the evolutionary dynamics of organizational routines.

- introduce the idea of *evolutionary trajectory*
- explore the effects of variation, selection and retention
- examine the effect of complexity of the routine
Organizational routines are defined as “repetitive, recognizable patterns of interdependent actions, carried out by multiple actors” by Feldman and Pentland (2003).
Routines are modeled as action network

• Nodes are abstract actions, and ties represent sequences.

• An action network can be summarized into a matrix.

• The elements in the matrix express conditional probabilities that one action will occur, given that another action has occurred.
Example: An action network for part of the academic hiring routine
How do routines change over time?
The mechanism of evolution is VSR

- An evolutionary process of random variation and selective retention

- Zollo and Winter (2003) uses VSR of routine to explain changes in organizational capabilities.

- A more precise model of variation and selective retention of action patterns within routines
Conceptual Model

Figure 1: Variation, selection and retention of action patterns
(adapted from Pentland et al., 2012)
Path dependence and Interdependence

- **Variation, selection and retention mechanism** is an example of dynamic capability (meta-routine) (Zollo and Winter, 2000).

- **Path dependence** mechanism is represented by variation and retention in the VSR framework.

- **Interdependence** between actions introduces a kind of selection in the VSR framework.
The Trajectories of Routine Evolution

A life cycle view: retention leads to lock-in (Sydow et al, 2009)

A trajectory view: on-going process evolution

Figure 1: Life cycle view vs. trajectory view
What is the evolutionary trajectory?

- is the product of magnitude of change and direction of change

- The *magnitude of change* indicates how different the network of action at two points in time.

- The *direction of change* indicates whether the routine is moving towards lock-in or away from lock-in.
• **Path dependence** mechanism is represented by *variation* and *retention* in the VSR framework.

• If variation is like the accelerator, retention is like the brakes.

• The effects of variations and retention interact and shape the course of routine.
## Predicted First Order Effects

<table>
<thead>
<tr>
<th>Causal variable</th>
<th>Magnitude of change</th>
<th>Direction of change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexity</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Variation</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Retention</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>
• **Proposition 1:** The effect of variation on the evolutionary trajectory is moderated by retention, such that the effect is stronger for higher retention level.

• **Proposition 2:** Balance of variation and retention can lead to no change in direction (Complexity-neutral frontier).
Two types of interdependence

- **Structural** interdependence means there is sequential constraints in actions. Some actions must happen before some other actions. It shows which sequence and combination of actions are **possible**.

- **Functional** interdependence means the function or benefit of one action is dependent on other actions. It shows which sequences and combinations of actions are **preferable**.
• **Proposition 3**: The level of interdependence is negatively related to the magnitude of change from one period to the next.
Use simulation for theory development

• theorizes about routines in general

• use simulations to gather data across a set of variables

• use regression to test propositions
Dependent Variables

• The evolutionary trajectory:

• The *magnitude* of change: hamming distance (+)

• The *direction* of change: (-1, 0, 1)
Interaction between variation and retention

### Table 7 Regression results (Variation and Retention)

<table>
<thead>
<tr>
<th>Evolutionary Trajectory</th>
<th>Short Run Model 1</th>
<th>Short Run Model 2</th>
<th>Long Run Model 3</th>
<th>Long Run Model 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexity (C)</td>
<td>-0.405***</td>
<td>-0.410***</td>
<td>-0.425***</td>
<td>-0.425***</td>
</tr>
<tr>
<td>Variation (V)</td>
<td>0.135***</td>
<td>0.128***</td>
<td>0.157***</td>
<td>0.146***</td>
</tr>
<tr>
<td>Retention (R)</td>
<td>-0.134***</td>
<td>-0.127***</td>
<td>-0.054 +</td>
<td>-0.047 +</td>
</tr>
<tr>
<td>Interaction (VxR)</td>
<td></td>
<td>0.107***</td>
<td></td>
<td>0.149***</td>
</tr>
<tr>
<td>Sample size (N)</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>$R^2$ (%)</td>
<td>19.97%</td>
<td>21.35%</td>
<td>20.92%</td>
<td>23.18%</td>
</tr>
</tbody>
</table>

Notes: standardized coefficients; $p<0.10$, $p<0.05$, $p<0.01$, $p<0.001$. 
Proposition 1 and 2 are supported.

<table>
<thead>
<tr>
<th>Interaction between R and V</th>
<th>Short Run</th>
<th>Long Run</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Graph" /></td>
<td><img src="image2.png" alt="Graph" /></td>
<td><img src="image3.png" alt="Graph" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Balanced points Between R and V</th>
<th>Short Run</th>
<th>Long Run</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image4.png" alt="Graph" /></td>
<td><img src="image5.png" alt="Graph" /></td>
<td><img src="image6.png" alt="Graph" /></td>
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</tbody>
</table>

*Figure 6 Interaction effects and balance points*