Anatomy of Entry in a Nascent Phase of Industry: the Ascendant Curve by Technological Traits

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1. General Overview

	Description
Key Question	• What are fine-grained technological sub-patterns in an earlier period of a ferment phase? – What types of industry-wise technological requirements are formulated in an early phase? – What types of entrants respond to the technological requirement in the nascent stage? – How the entry of specific type of entrants change the industrial growth and evolution in an early phase?
Research Gap	• The classical discussion in Evolutionary Theory considers a ferment phase as a black box in that – technological attributes in a ferment phase do not change – it is silent on the impact of change in the technological requirement during a ferment phase • The extant literature does not explain what types of technological uncertainty arise inside a ferment phase and how the different types of uncertainty contribute to the growth pattern for entry in the early stage of life cycle. • The prior studies do not explain why industry-wide requirements for resolution of technological uncertainty attract new entrants and how the new entrants drive another change in the evolutionary dynamics.
Arguments	• First, the initial emergence of a compatible control component, which can partially coordinate otherwise incompatible proprietary functional components, is positively associated with more entries for firms with functional component technology. • Second, the present author also argues that the high technological imbalance, which isuncertainty to coordinate functional components in different speed of advancement, cultivates more opportunities of entry for firms with a control technology. • Collectively, the sequential inflection points create a significant momentum to expand the capacity of an industry to grow, leading to more entries of potential entrants of both types.

2. The Prevalence of Firms with Control Technology The 1st Sub-Pattern of a Nascent Ferment Phase

	Description
Proposition 1	• Firms with the control technology are more likely to enter the nascent ferment phase in a technology-intensive industry than those with the functional technologies.
Rationale	• Nascent Ferment Phase: the earlier period of a ferment phase prior to any type of consensus on specifications of a product or technology • A nascent ferment phase can be characterized with the greatest complexity of problem-solving due to the highest degree of interaction among knowledge elements or components as well as the absence of a reliable market for lowering the complexity. – This condition works as an industry-wise requirement, which attracts and favors the firms that have the capability to understand all the relevant knowledge elements or components of a system and to control the interactions between those components. • Thus, the evolutionary status in a nascent ferment phase selects firms that have control technology – Control Technology: the body of technology to control functional components and monitor their performance to make a system operate as one system – Firms with control technology are more likely to recognize market opportunities based on the initial industry-wise requirement in a nascent ferment phase. – The match with the initial requirement leads to a better chance of survival based on the problem-solving condition of a nascent ferment phase, allowing more firms with control technology to gravitate to enter into the premature phase of industry.

Description

Proposition 2

- As compatible control components emerge, firms with a functional technology are more likely to enter the nascent ferment phase in a technology-intensive industry than those with a control technology.

Rationale

- Compatible Control Component: a component capsuling a technology connecting other firms' proprietary functional components which are otherwise not interactable.
- If there is no compatible control component in an industry, each firm may have to design and employ its own dedicated functional components that are manufactured in-house.
- Its emergence of a flexibly interconnecting control component opens up a new possibility for firms with functional component-specialized technology, that is, an opportunity for a more scalable market for those firms with component-specific technology.
- Notably, the emergence of a compatible control component should be distinguished from the establishment of a dominant design or an industry standard.

Commonality	• The reducer of technological uncertainty • All provide a common architectural interface for other interdependent components in a system, i.e. a set of aligned specifications of information exchange between components.
Difference	• The degree of coverage and impact should be significantly smaller with a compatible control component. – Since it is an initial phase of industrial evolution, various architectures to solve a same technological problem can spring up from incumbents or flow in from new entrants. – It is also too early for an industry to have an industry-shaping firm or standard-setting institution for a technological stabilization.

- Thus, a compatible control component only stabilize some portion of the technological uncertainty while signaling the possibility of the emergence of common architecture.

Description

Rationale

- In a social process perspective, a product is created collectively by a network of individuals and firms such as "specialized designers, equipment suppliers, and manufactures" in a value chain (von Hippel, 1987; Kogut, 2000)
- However, the establishment of the network itself may not be attainable since a nascent ferment phase is lack of the convergence of understanding and crystallization for the overall technology.
- In this early industrial milieu, a compatible control component can only provide a partial foundation and liaison of common knowledge for connecting relevant components and technologies to some extent.
  - Since a compatible control technology virtually defines the interface for functional components in a system, it indeed provides a general language, if not extensive, for the overall technology and a screening criteria for form factors and designs of other functional components.
- In this way, the emergence of a compatible control component somewhat resolves sociocognitive uncertainty in a nascent ferment phase.
- Indeed, there can be various mechanisms how a compatible control component emerges.
  - E.g. Open up with API, R&D joint ventures, etc.
  - Far from experiencing a collective understanding on an overall technology and/or stabilizing high technological uncertainty in this stage.
- Another probable option that may fit to the logic of early compatible control technology can be an open source movement in the emerging industry, which is extensively supported by the IS literature
  - "Anyone and everyone can immediately obtain, test, and observe the value of freely revealed new software code for themselves … (and) observe the effects of really widespread, cost-free diffusion of, and peer-to-peer interaction regarding, innovation-related information." (Krogh and von Hippel, 2006)
    → Open source movement has a powerful incentive for endowing compatibility and a general language for technological and sociocognitive consensus.

Description

Rationale

- Peripheral developers in an open source project help improve not only quality assessment product but also product awareness and adoption (Setia, Rajagopalan, Sambamurthy, and Calantone, 2012)
  - High quality and diffusion of open source products can be an attractive option that potential entrants may consider before an entry of the industry
- A hybrid business model, leveraging both open source and proprietary products, offers substantial gains of performance (Bonaccorsi, Giannangeli, and Rossi, 2006)
  - Not a "transient" but rather "permanent" feature in an emerging industry
  - Firms are encouraged to compare open source components with proprietary ones, utilizing both of them at the same time, without suffering too much from a "lock-in" effect
    → The flexibility as a decent perk under high uncertainty
  - A firm with an open source product can enjoy low marginal costs to tailor a solution to customers' need

  ➔Leading to meaningful resolution of technological as well as sociocognitive uncertainty in this early stage
- Although a compatible control component may not provide a fully authentic compatibility (Fosfuri, Giarratana, and Luzzi, 2008), the initial emergence of partial compatibility may signal that a major consensus for bridging still-evolving components is not too far away.
- In the case of absence of standard, a compatible control component may practically perform the role of the standard interface in part, leading to relatively more momentum for functional components by opening up an opportunity for firms with functional component technologies.
- Therefore, since the resolution of the uncertainty influences positively on entry and growth of the industry (Nelson and Winter, 2000), the existence of a compatible control technology formulates a favorable condition on firms with function-specific technology, attracting functional component specialists.

4. The Resurge of Firms with Control Technology

The 3rd Sub-pattern of a Nascent Ferment Phase

Description

Proposition 3

- As technological imbalance deteriorates, firms with a control technology are more likely to enter the nascent ferment phase in a technology-intensive industry than those with the functional technologies.

Rationale

- Langlois (2002) argues modularly decomposable products enjoy better fitness for technologically uncertain environments
  - Because a nondecomposable system deters efficient "interfirm communication" and "information sharing," leading excessive costs of information transfer (Langlois, 2003)
- However, as identified in the extant literature, a system of a product in a ferment phase rarely achieve such a high level of modularity (Kapoor and Adner, 2012)
- Meanwhile, a group of functional components that can interoperate with the compatible control component is less exposed to the risk for redesign, a benefit providing a more stable condition for improvement and possibly leading to an accelerated development of component-specific technology.
- Thus, the conditional setting in which a compatible control component can make an expedited advancement in some group of functional component technology can amplify the variance in speed of technological development in industry
  - Brusoni, Prencipe, and Pavitt (2001) point out that salient difference in speed of component technology advancement "creates a system-wise performance problem that needs to be accommodated via conscious coordination." ➔ Saliency Problem
- It should be increasingly more troubling for the firms which assemble a finished product based on their own control component and other firms' proprietary functional components,
  - because such firms should synchronize the differential speed of development of the components with costly intervention and coordination.
- Consequently, the technology imbalance in the speed of improvement combined with the performance uncertainty induced by the change in component technology enhances the value of control component technology.

4. Source of Data

	Description
Data	• Association for Unmanned Vehicle Systems International (AUVSI): the largest non-profit organization for the unmanned systems and robotics community – the world's most comprehensive robotics database across 2,400 products of 900 companies – contains the technological specification and the performance measurement of each UAV unit • USPTO patents – Technological focus of each firm (Control vs. Functional) • CB Insights Database, each manufacturer's website, media reports, the Nexis Lexis database, and industry experts – The establishment/exit date of a manufacturer and the commercialization date of a product