Innovation in Advanced Communication Systems

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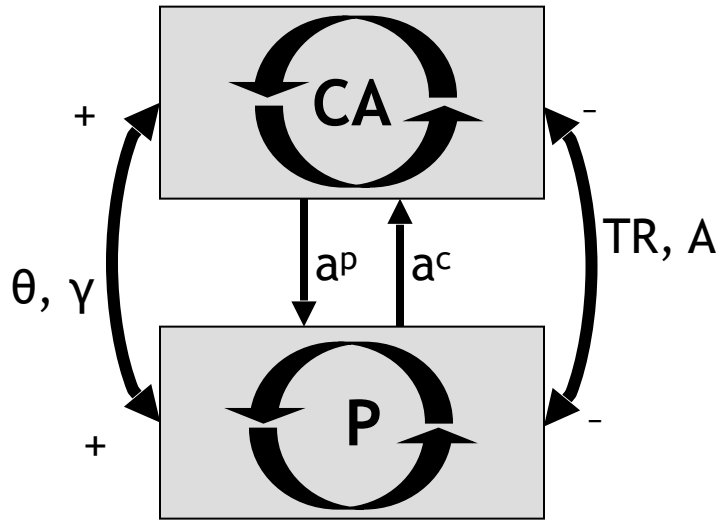
Innovation as an evolutionary process

- Innovation is traditionally defined as new products, services, processes, marketing approaches, and designs that create value
- From an evolutionary perspective it is an experimental, directed combination and recombination of knowledge (e.g. Antonelli 2011)
- Success and failure are the outcome of a process of variation, selection (in the market place or via other mechanisms), and replication
- Digital technology accelerates this cycle of experimentation, real-time feedback, and replication of successful innovations (Brynjolfsson 2011)
- This dynamic process is not stationary but “creative” (Zittrain 2008; Koppl, Kauffman, Felin, & Longo 2015)

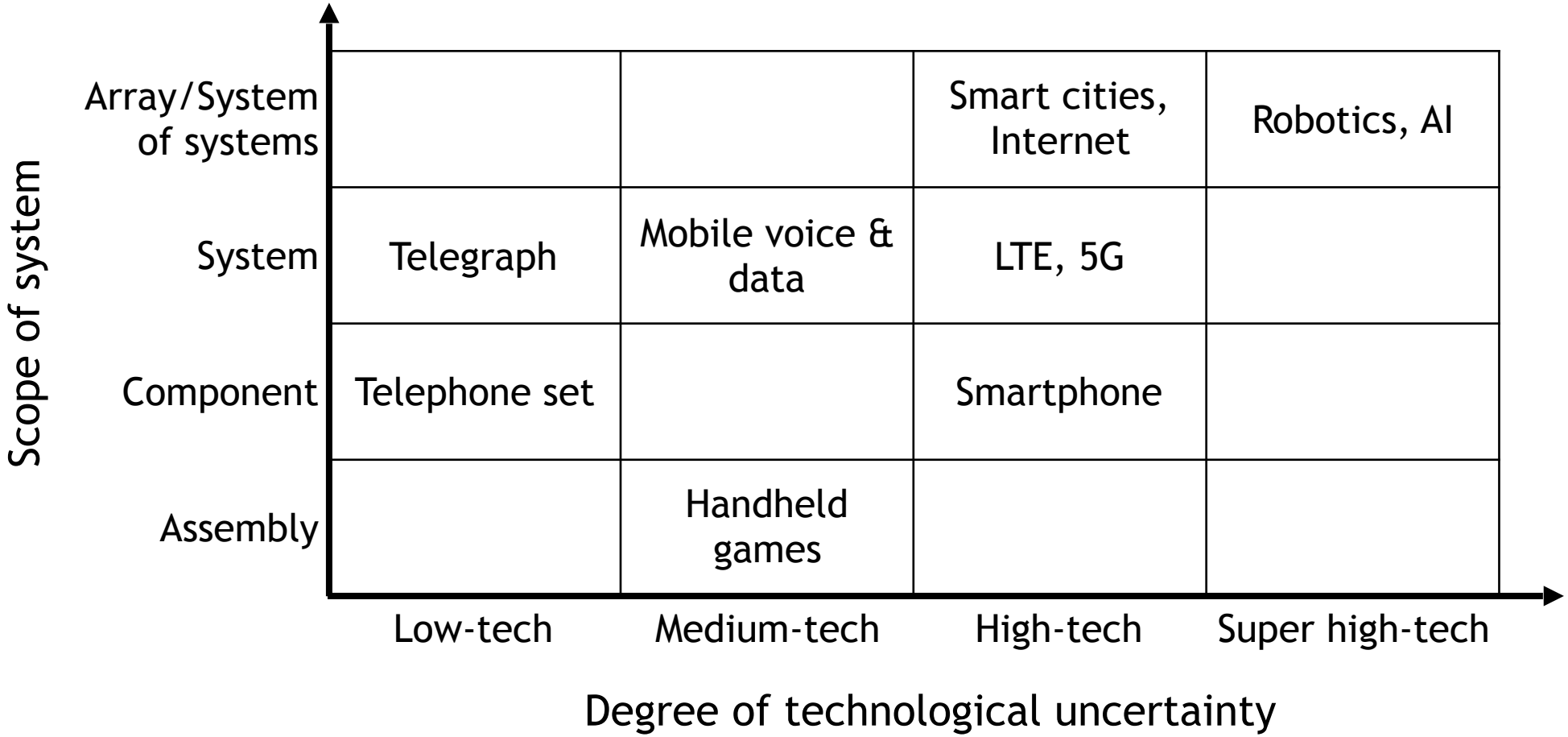
Complementary innovation dynamics



P … platform operators; CA … content and application
providers; TR .. transaction costs; A … adaptation costs; θ, γ … coefficients measuring strength of complementarities; a^p, a^c ... charges (if permitted) between platforms and content providers

- Innovation incentives in each related layer (P, CA)
  - Opportunities (+)
  - Appropriability (+/-)
    - Concentration (+)
    - Contestability (-)
  - Firm capabilities (+)
- Interdependencies between layers (P → CA, CA → P)
  - Complementarities (θ, γ) (+)
  - Transaction costs (TR) (-)
  - Adaptation costs (A) (-)
- See Bresnahan & Trajtenberg 91995), Bauer & Knieps (2017)

Typology of ICT innovations

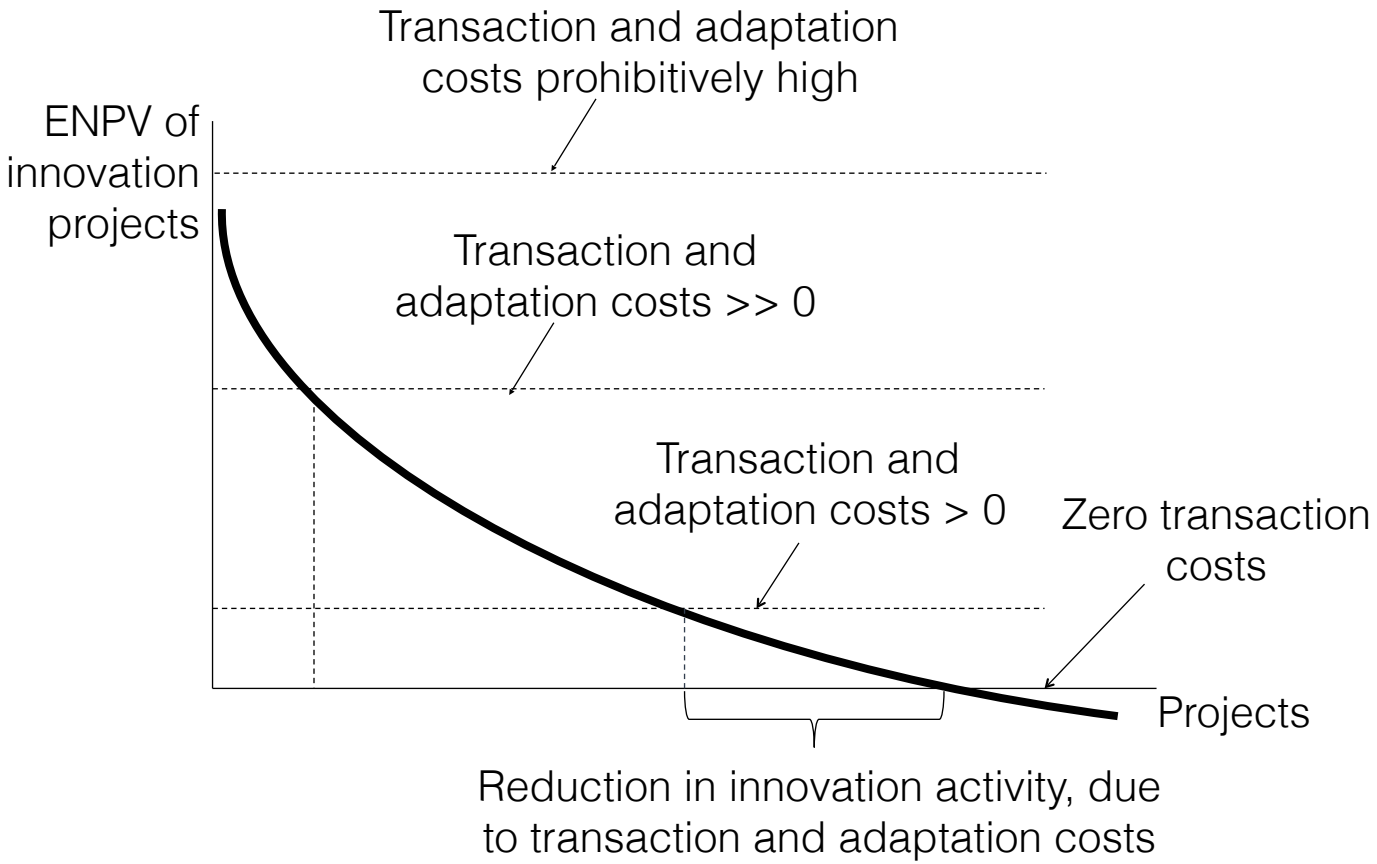


Inspired by Shenhar (1993); Hobday (1998); Bauer, Lang & Schneider 201

Coordination mechanisms

Innovation type	Examples	Examples of currently used coordination mechanisms	Possible coordination deficiencies and failures
Modular	Apps, edge innovations	Protocols, layering, APIs, design conventions	Insufficient information disclosure
Loosely coupled complementary	Streaming, video conferencing	CDNs, interconnection points	Insufficient QoS
Tightly coupled complementary	Microgrids, advanced tele-health, some IoT applications	Contracts, intra-organizational deployment	Insufficient QoS provision, missing prices for QoS, regulatory challenges
Systemic	Smart city ecosystems, smart transportation systems	Local investment, public private partnerships, government provision	Insufficient investment due to public good and spillover effects

Transaction and adaptation costs



- Transaction costs include
  - Negotiation of access of CPs to ISP networks
  - Negotiation of ISP access to content
- Adaptation costs include
  - Need to adapt apps to different networks, operating systems, browsers, etc.
- Can policy and governance mitigate?

Governance and innovation trajectories

- In the advanced communication systems, multiple innovation processes with different economic characteristics unfold in parallel
- Because innovation is an open process that cannot be modeled deterministically or even stochastically, governance needs to develop as stronger focus on the institutional framework
- This framework needs to be sufficiently flexible to allow different innovation processes to co-exist (e.g. allow network differentiation with non-discrimination safeguards)
- If transaction costs are very high (e.g. QoS cannot easily be contracted), innovation will be impeded and workarounds will likely emerge (and possibly radical innovations to overcome such constraints)
- Public policy initiatives (e.g. subsidies, basic research) may be the only way to overcome prohibitively high transaction/adaptation costs

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