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From Early Curiosity to Space Wide Web: Emergence of the Small Satellite Innovation Ecosystem

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Research Questions:

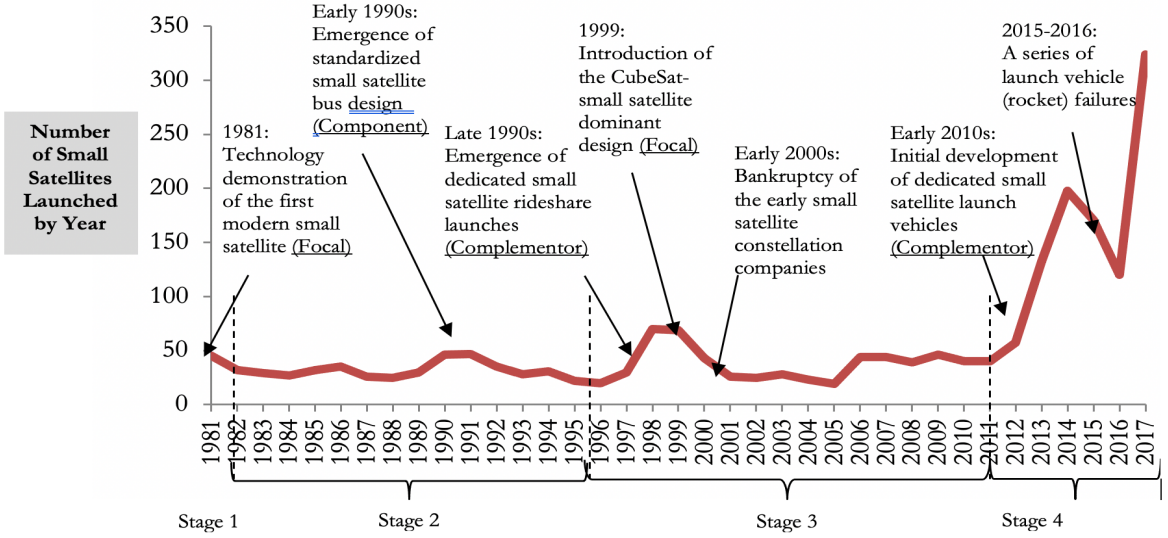
- How did the small satellite ecosystem emerge and evolve?
- Although the first modern small satellite UoSat-1 was successfully launched in 1981, and the CubeSat dominant design was introduced in 1999, the sales takeoff of small satellites did not occur until the early 2010s. What explains this long time period?

Research Background: Innovation Ecosystem

Literature on innovation ecosystem has identified a few necessary conditions for a seed innovation to become an innovation ecosystem:

- *Multilateral interdependency:* the value creation for one firm depends on value creation from other firms
- *Non-generic investments:* firms make nonfungible investments into the specific technology
- *Customer-centric, economic value proposition:* mass market, economic benefits

Number of Small Satellites Launched by Year and Key Events in the Modern Small Satellite History



Key Findings:

- It took the small satellite more than 30 years to evolve from a seed innovation to a complete innovation ecosystem
- Our analysis reveals a long-time struggle to develop and materialize an economic value proposition, absence of which stalled the development of the small satellite ecosystem.
- Four stages of ecosystem evolution:
  - 1981 Technology demonstration. Only few firms making non-fungible investments into the technology
  - 1982~ early 1990s Technology reliability and non-commercial usefulness of the technology. Specialized components and buses start to emerge
  - Late 1990 ~l ate 2000s Commercial usefulness of small satellites. Initial non-generic investments from launch vehicle providers
  - Early 2010s ~ now – Strong economic returns and establishment of the innovation ecosystem
- The incremental investments from a collective of actors contributed to the ecosystem formation