



15.905 Technology Strategy

Innovation, diffusion and life-cycles

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9 April 2007



Agenda for today, Monday 9 April 2007

- ~12:45
 - Up-coming assignments and other working arrangements
- ~12:55
 - Re-cap on innovation, diffusion and life-cycles
- ~13:25
 - Kodak and the Digital Revolution
- ~14:15
 - Feedback



Working arrangements

- Apologies for posting the questions for Kodak so late
- All subsequent classes begin at 12:45 and end at 14:15
- We are going to allow more time for wrap-up slides
- The article “The Half-Truth of First Mover Advantage” did not reproduce properly
 - you can get a new copy online through MIT libraries
 - and they are also included in this deck
- We are going to facilitate some case study discussions to ensure that we integrate the distant participants fully into the program
- At the end of the session today, I would welcome feedback from any and all participants



First short interim paper

- Form a group and pick a technology and domain
 - subsequent papers in same groups
 - about same technology and domain
- Maximum four (4) pages
 - 1.5 line spacing
 - 10-12 point
 - ≥ 1 " margins
- Due Thursday 12 April
- The technology should be interesting
- You should be able to research its past evolution effectively
- You should be able to anticipate how it is likely to co-evolve with the demand opportunity
- **If in doubt, please ask!**



Your marks will depend on how well you answer the key questions!

- Why is this technology and its domain interesting and important?
- What stage of evolution is this technology and its domain now in, and what have been the episodes in its evolution over time?
- What are the implications of these data for technology strategy?
- How do you anticipate that the key technologies within this domain will evolve?

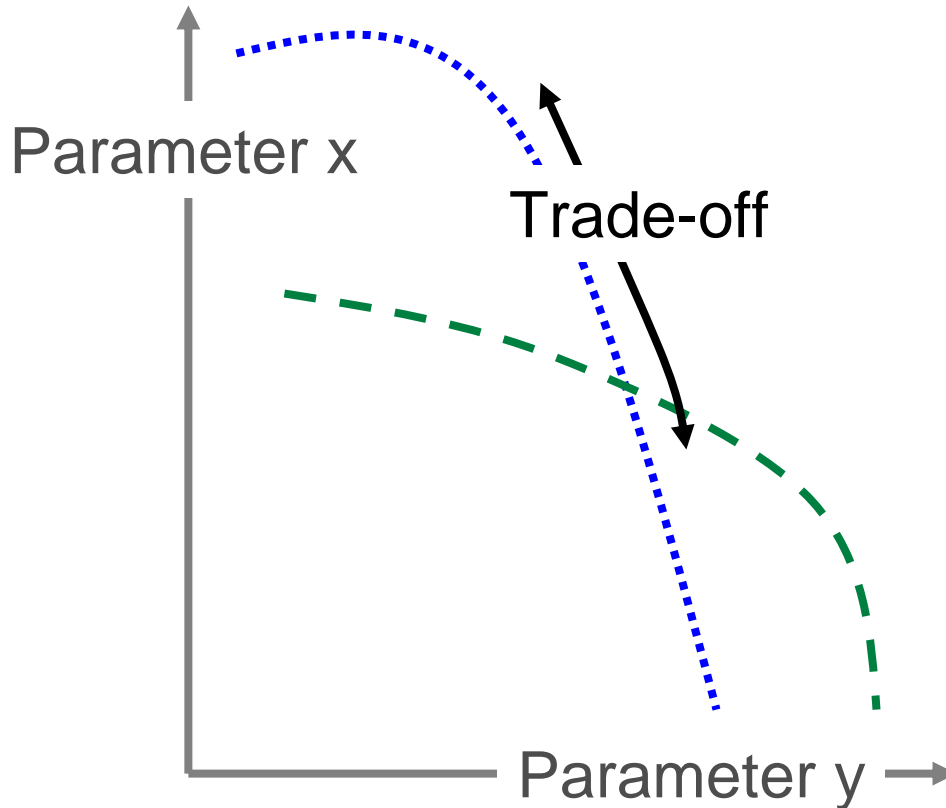


Technologies and technological innovation

- Technologies emerge
 - can be push - supply, driven by new knowledge - or pull - demand, driven by demand opportunity
- Learning takes place
 - either or both of over time, or as a result of accumulated experience
 - driven by what's possible - technological feasibility
 - and by what's worthwhile - commercial viability
- Over time, performance improves and unit costs fall
 - along which *parameters*
 - at what rate
 - locally, or causing system change



Technology envelopes and trade-offs



Technologies are characterized by performance envelopes, the limits of what can be done with them, and the trade-offs amongst parameters for them

Different technologies have different envelopes and trade-offs

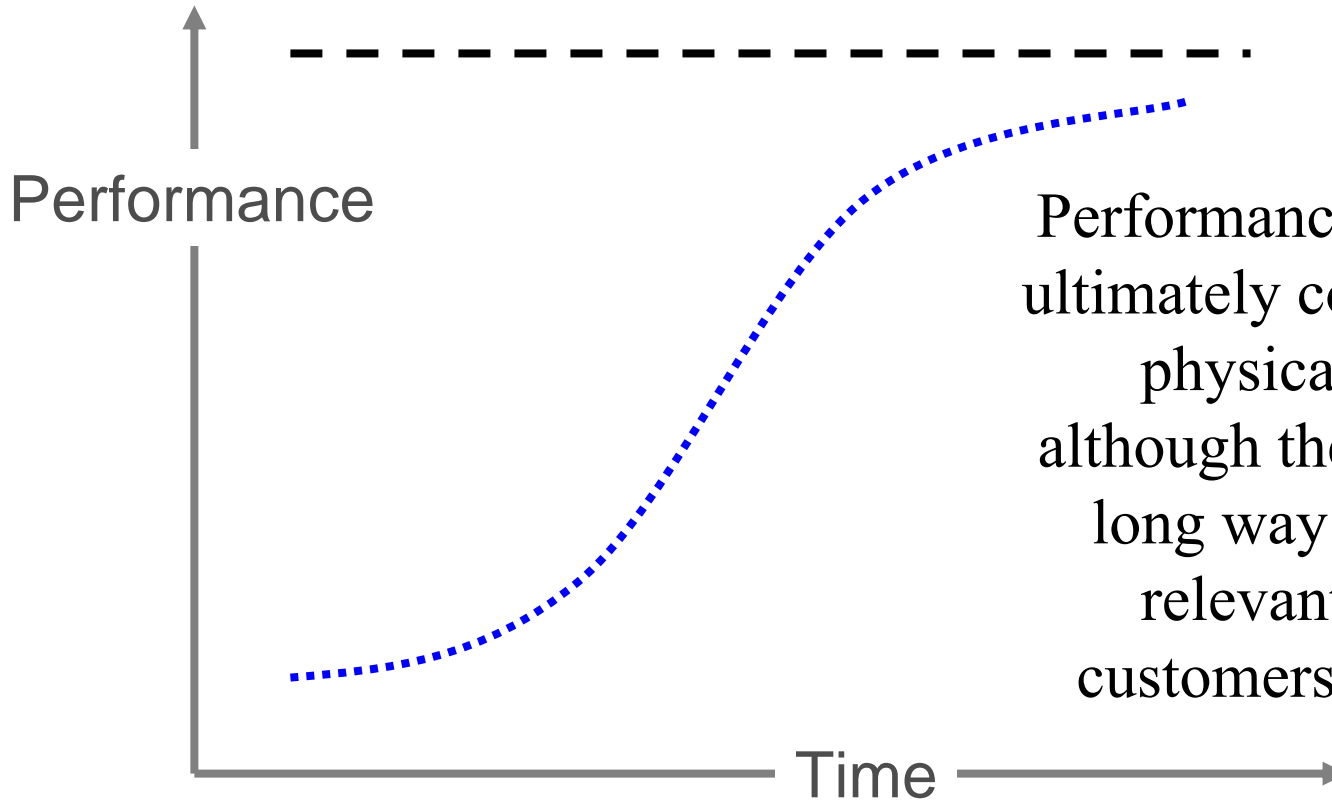


Technologies compete with each other for potential applications

- At any time, there are typically a range of competing technologies that are candidates for each application
- Each of these technologies can be characterized in terms of its key *parameters*
- Each technology typically has a performance *envelope*, which defines the trade-offs inherent in the technology
- Over time, technologies follow an *innovation trajectory*, a vector or function that describes how they have evolved and may evolve, either over time or in response to effort invested in their development
 - rate of change
 - **direction**



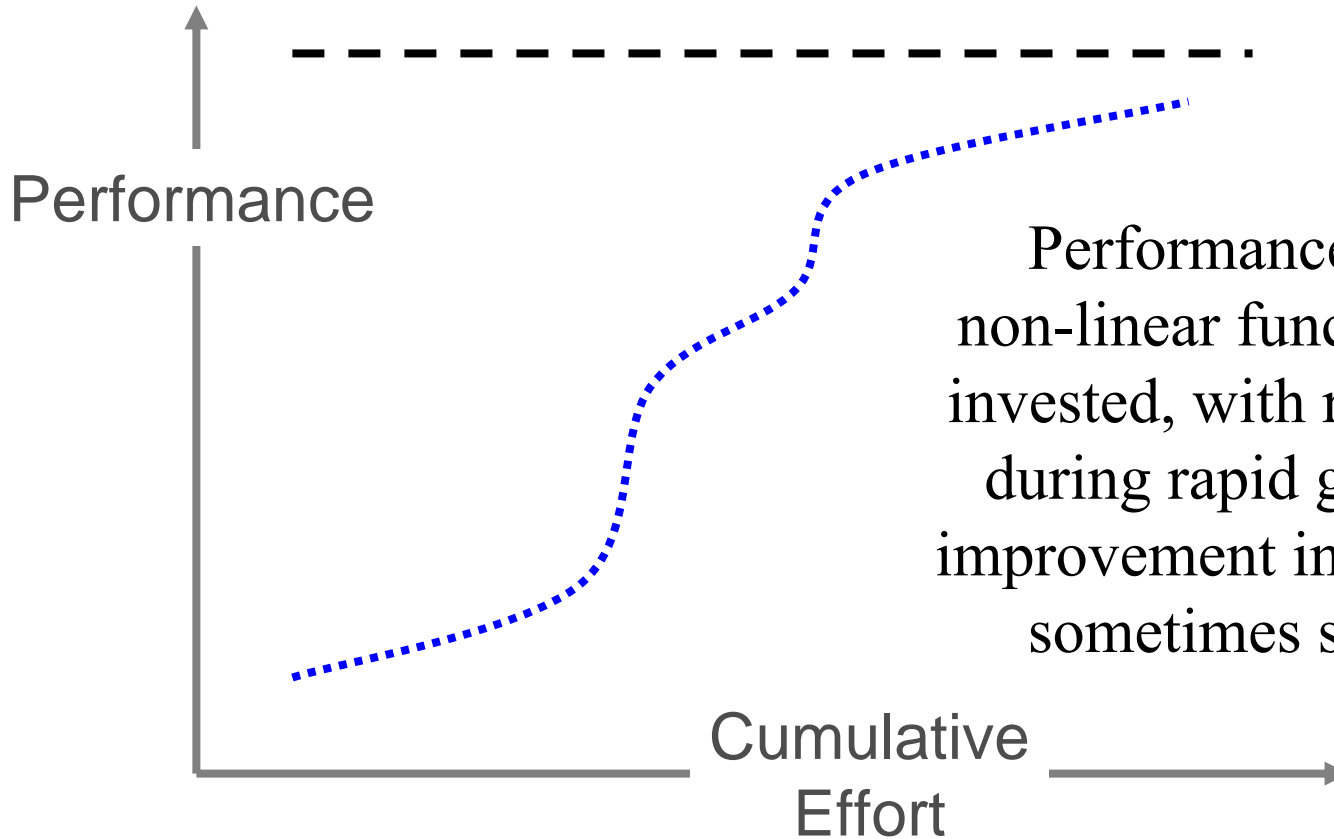
Innovation trajectories



Performance tends to be ultimately constrained by physical limits - although these may be a long way off, or not relevant to what customers want done



Innovation trajectories



Performance is often a non-linear function of effort invested, with rapid progress during rapid growth, slow improvement in maturity, and sometimes slowdowns



S-curves in the rigid disk drive industry

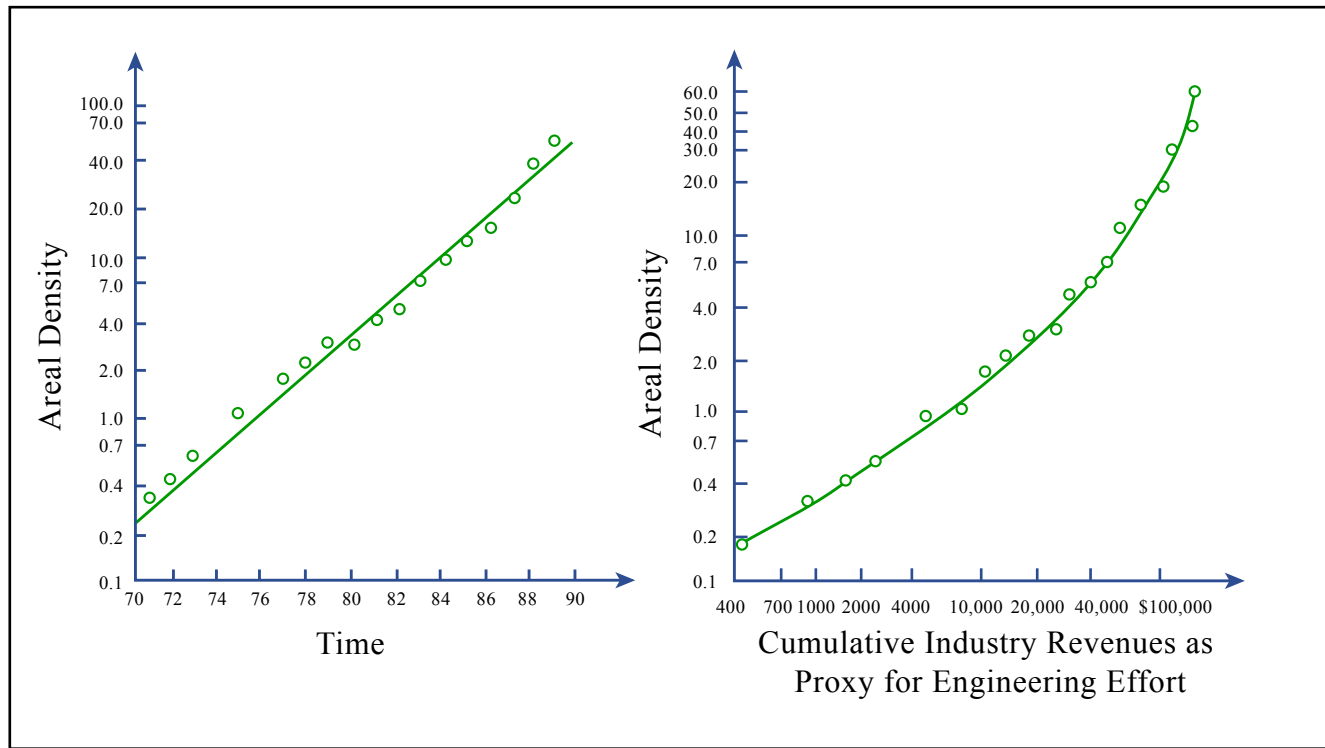


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Within this smooth overall progression, individual businesses went slower or faster

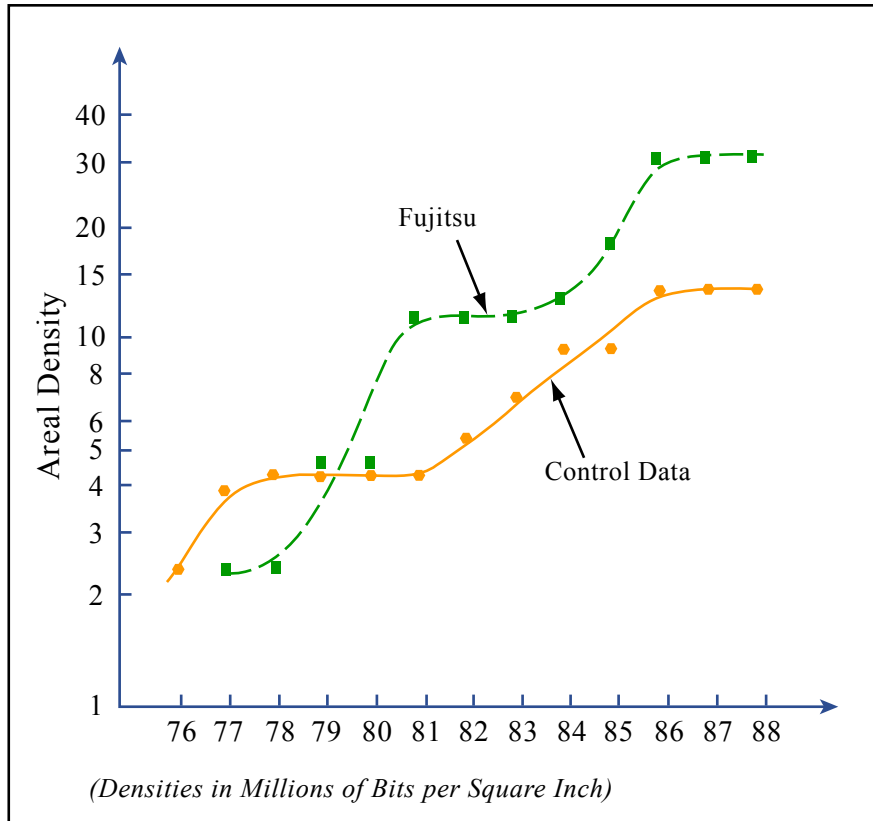


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...and make key technology transitions at quite different times

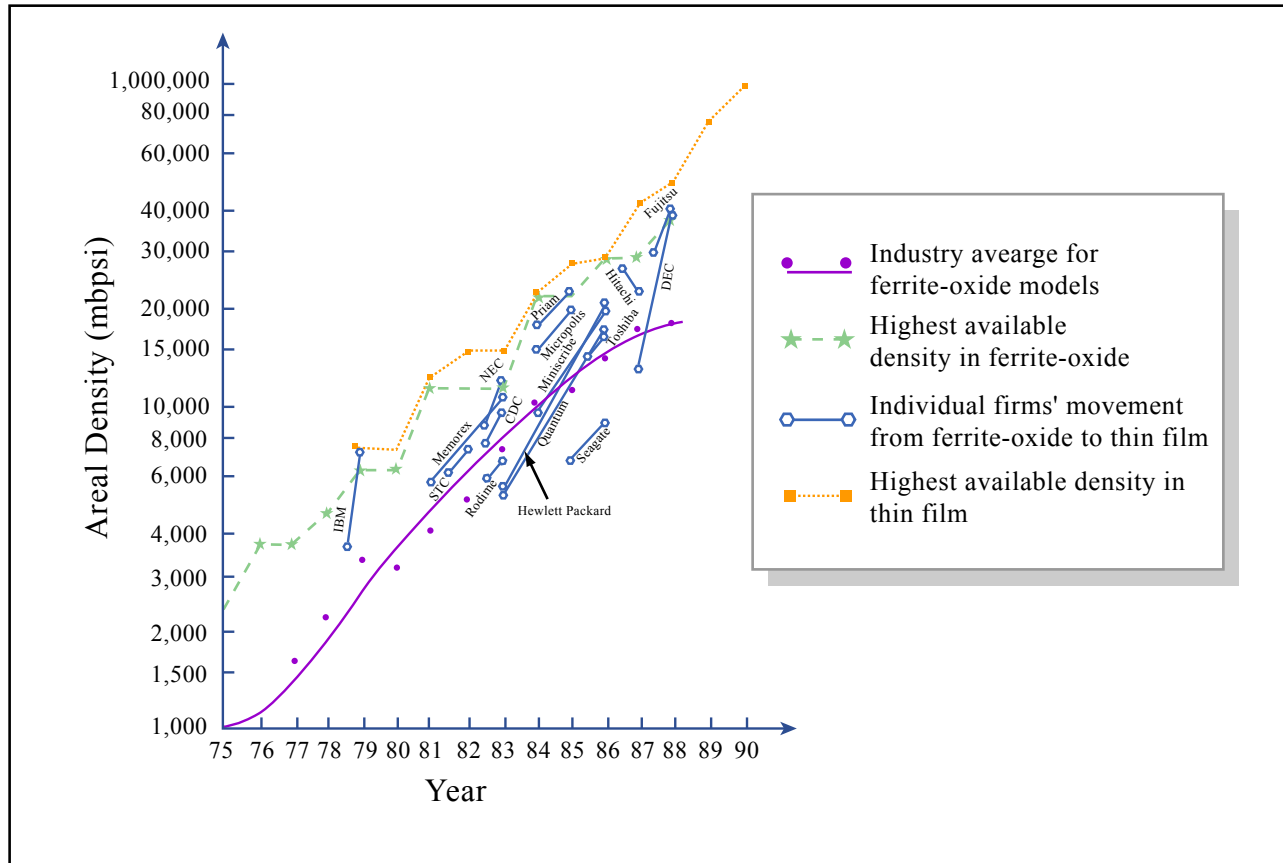


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The rate at which performance improves can vary dramatically

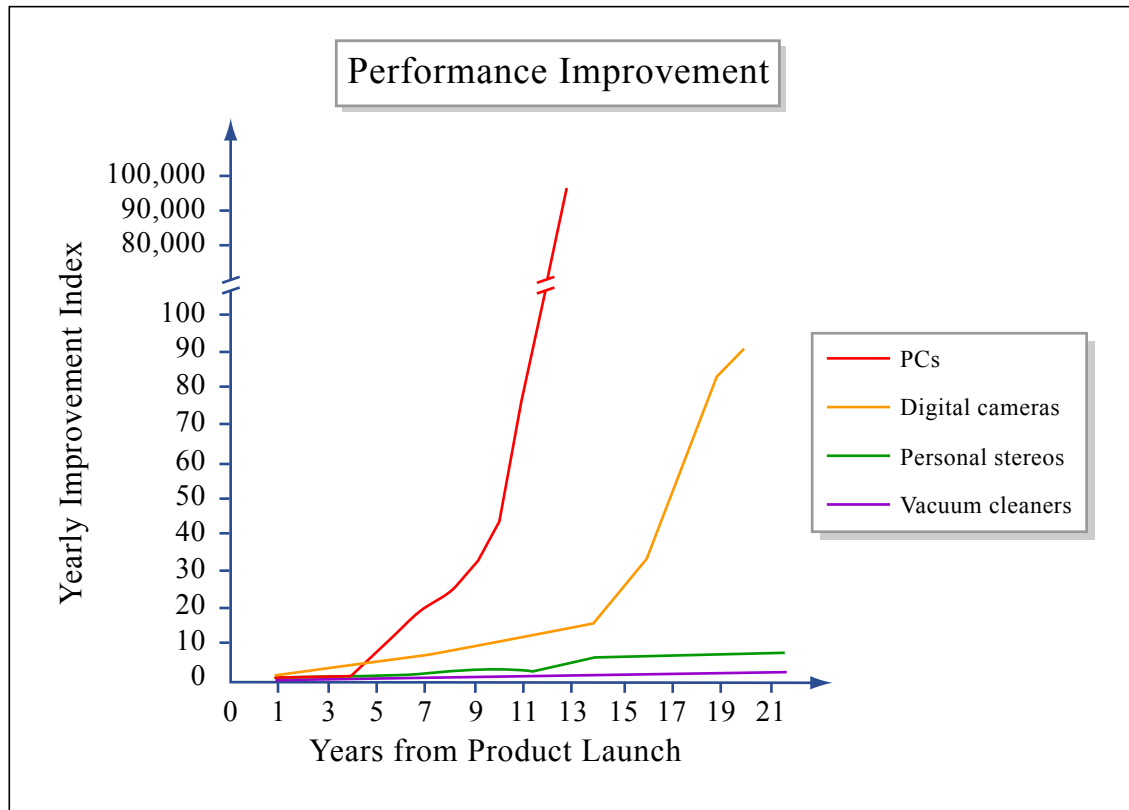


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Users' needs are diverse, and they change over time, and in response to technological innovation

- Heterogeneous - actual or potential users and customers have a range of different needs - jobs they want done - and value they put on getting those jobs done
 - may be related to demographic characteristics
 - but not necessarily, so that in many cases other bases of segmentation may be more useful
- Exogeneous - what users and customers want changes over time in response to, amongst other things, their own changing circumstances and broad societal shifts
- Endogeneous - users and customers' beliefs and behaviour also change in response to technological innovation - new possibilities



But it's not easy to get them to adopt novel products that embody innovative technologies

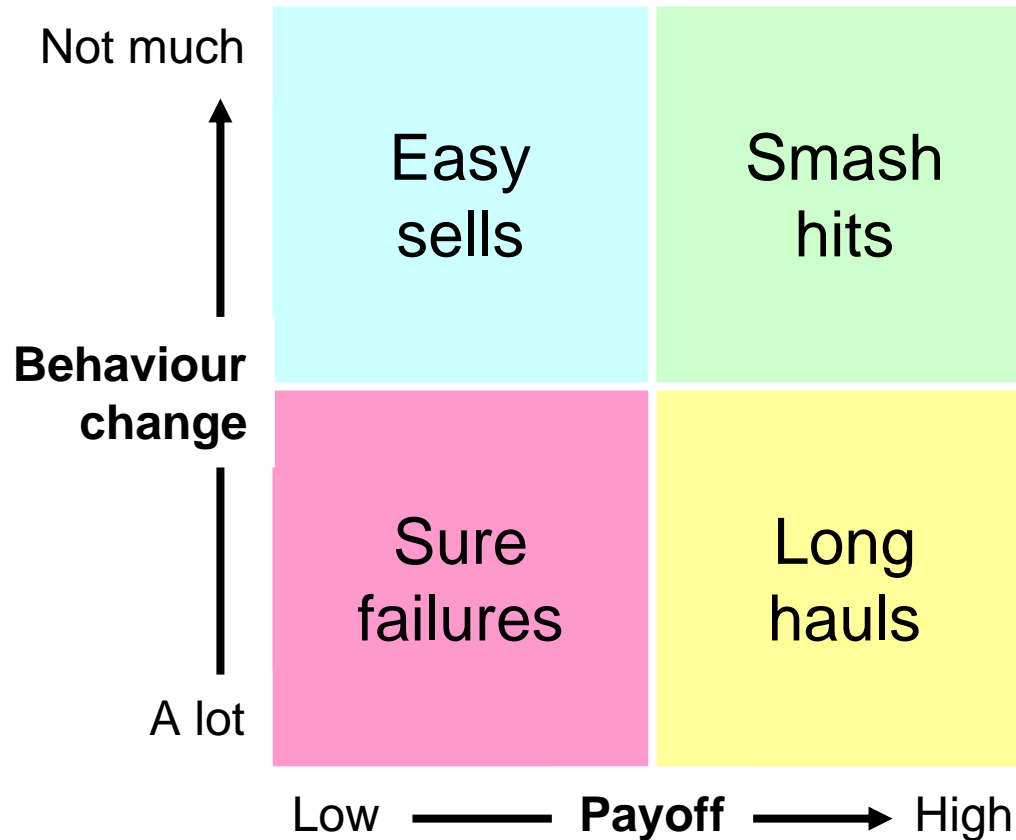
- Most customers most of the time are loath to change their behaviour
 - requires investment of time and effort
 - involves uncertainty and can induce anxiety
- And are (necessarily) unfamiliar with novel products
- Novel products almost always involve trade-offs
- They evaluate products based on **perceived** value, relative to products they already use to do a job, and are overly sensitive to dis-benefits - “loss aversion”
- At the same time, businesses (full of technologists) tend to underestimate the switching costs, and overestimate the potential benefits

John Gourville, “Eager Sellers and Stony Buyers”, Harvard Business Review, June 2006, pages 98-106





So we find ourselves with eager sellers and stony buyers



John Gourville, "Eager Sellers and Stony Buyers", Harvard Business Review, June 2006, pages 98-106





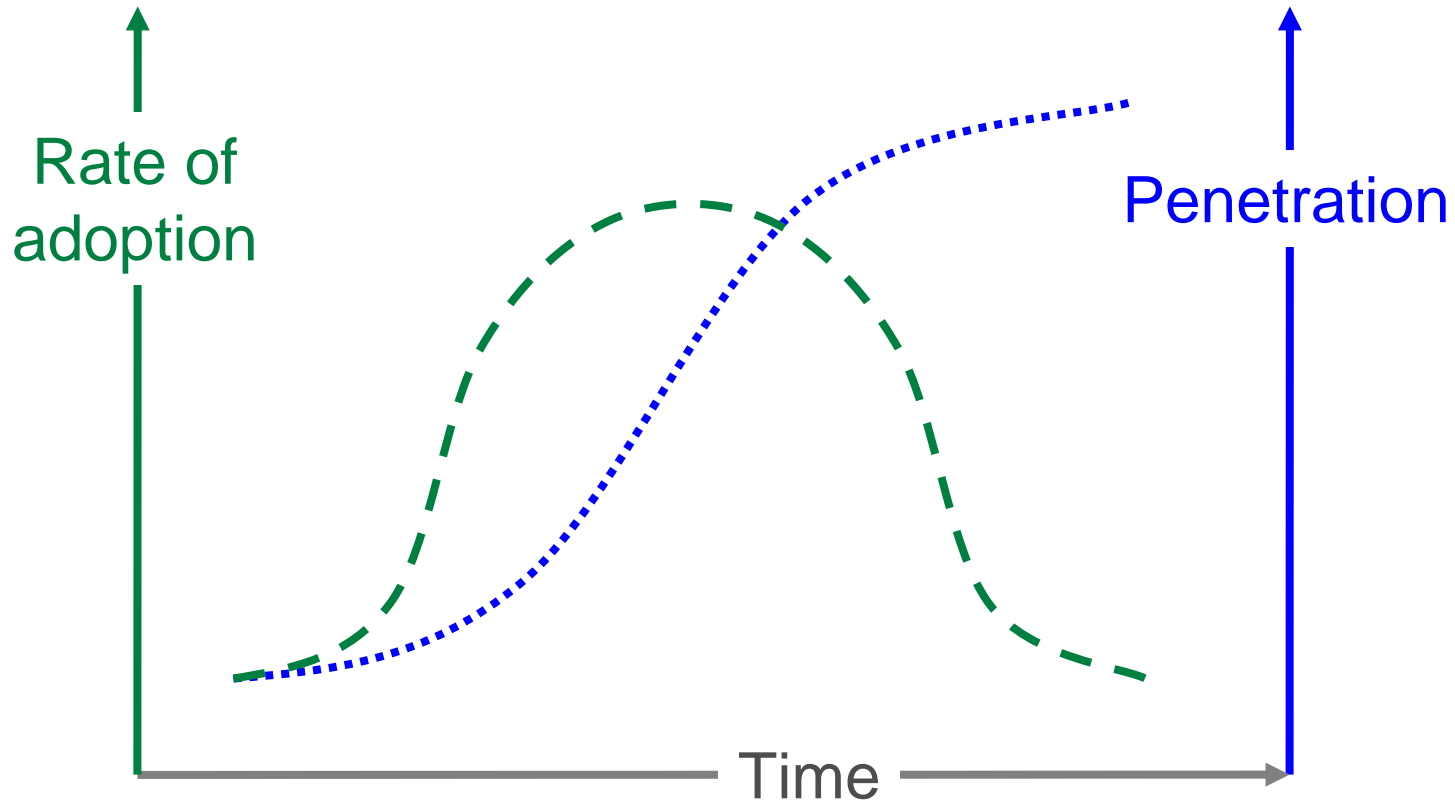
Over time, however, successful innovations diffuse amongst users and get widely adopted

- *Probit* adoption
 - potential users or customers weigh costs and benefits
 - heterogeneity of preferences mean that different users or customers adopt at different times
- *Epidemic* adoption
 - adoption limited by availability of information
 - as potential users and customers become aware of what it does and how to use it, they will adopt
- *Information cascades* and *path dependence*
 - a technology becomes established, it works and is better, and its features well known, legitimizing it
 - once established, network effects take over

Paul Geroski, “Models of technology diffusion”, Research Policy, 2000 pages 603-625

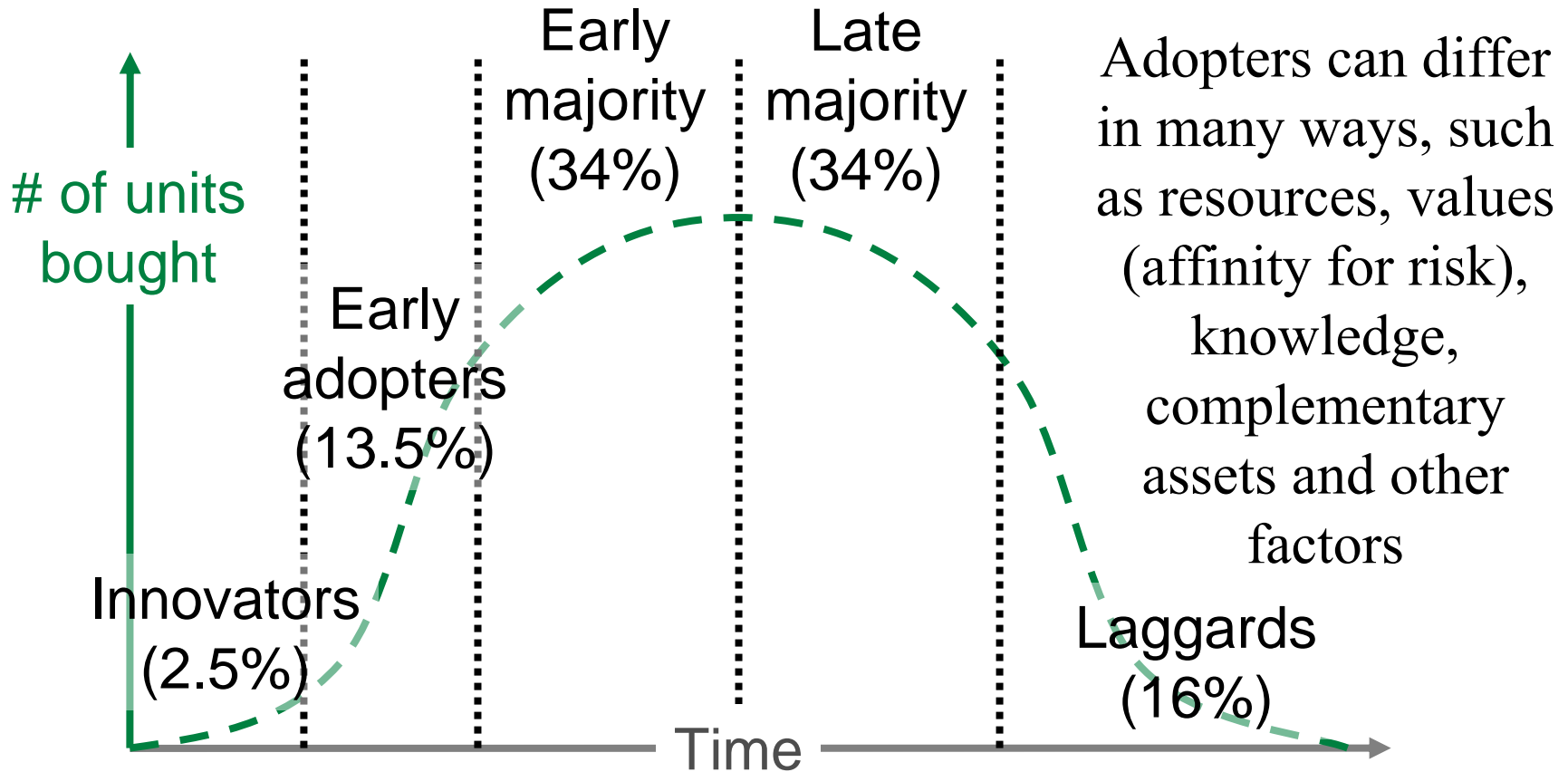


Diffusion of innovations





Everett Rogers' work categorized potential users or adopters into five categories



Everett Rogers, "Diffusion of Innovations", 2005



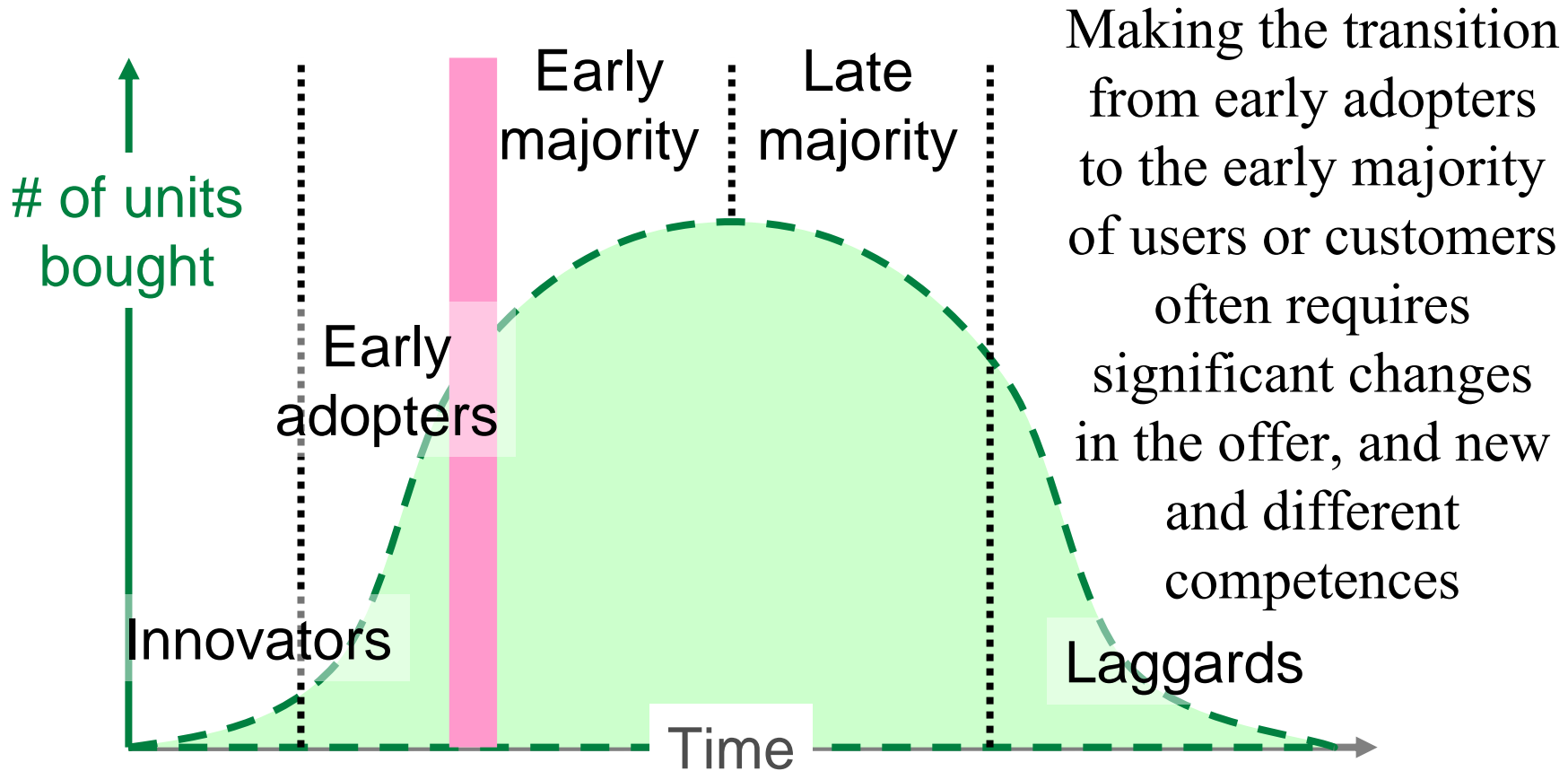


Everett Rogers identified five product-based factors that governed the rate of diffusion

- Relative advantage - the degree to which a product is better than the product that it replaces
- Compatibility - the degree to which a product is consistent with the users' context, in particular their values and experiences
- Complexity - the degree to which a product is difficult to understand and use
- Trialability - the degree to which a product may be experimented with on a limited basis
- Observability - the degree to which product usage and impact are visible to others



Geoffrey Moore's chasm focuses on *psychographic* characteristics of users or customers





As a result, the rate at which new technologies diffuse can vary widely

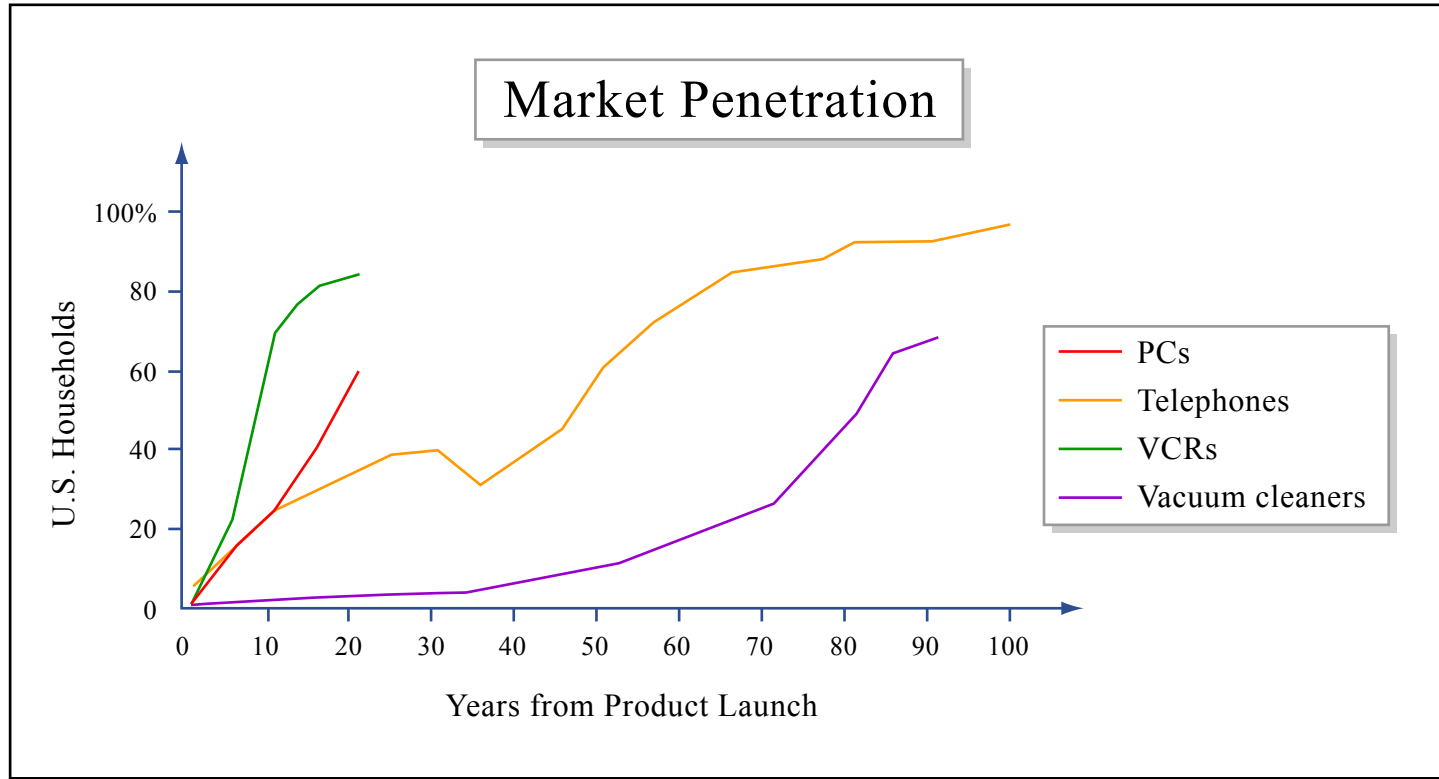


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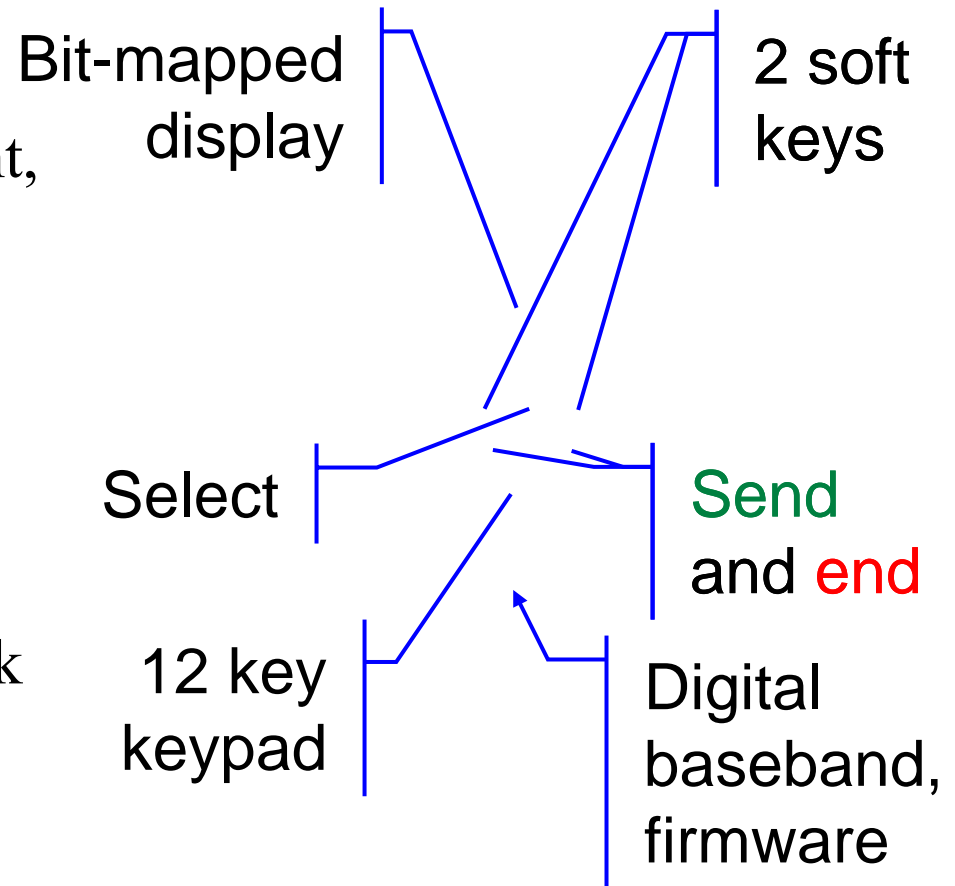
Together, these two phenomena often result in a characteristic industry life-cycle

	Early ferment	Dominant design emerges	Incremental innovation	Maturity	Eclipse or renewal
Demand Opportunity	Lead users, early adopters - high payoff, low switching costs	Early mainstream - usability, cost more important	Mainstream customers - soft factors, aesthetics	Saturation, segmentation, customization	
Business Ecosystem	Many entrants - diverse business models	Decisive battles for leadership	Intensifying competition, early consolidation	Fierce competition, consolidation around majors and minors	
Technological Infrastructure	Make it work - innovate on performance, diverse integrative designs	Figure out the optimal architecture, drive down costs, make it easy to use	Broaden the offer, rationalize the portfolio, build up complementary assets	Develop broad portfolio, build platforms, search for new options	



Dominant design

- After a technological innovation and a subsequent era of ferment, a basic architecture that becomes the accepted market standard
- Dominant designs may not be better than alternatives nor innovative
- They have the benchmark features to which subsequent designs are compared





The relative speed with which technology and demand co-evolve results in different scenarios

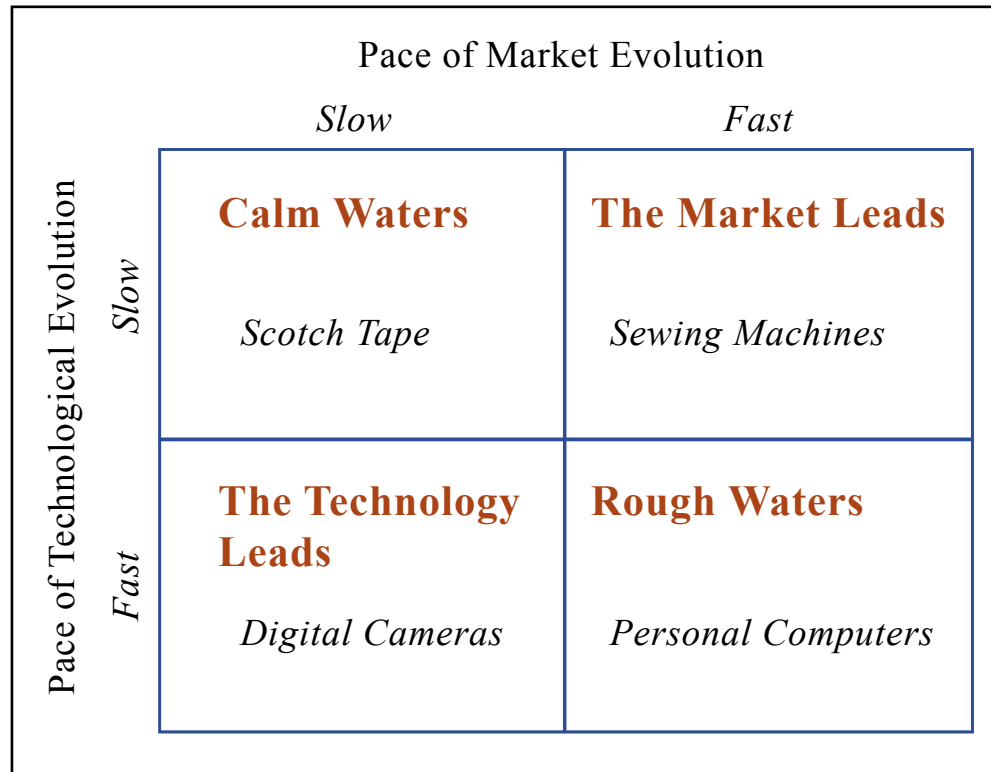


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...and determines how likely a business is to be able to achieve first-mover advantage

The Situation Your Company Faces	First-Mover Advantage		Key Resources Required
	Short-Lived	Durable	
Calm Waters	<i>Unlikely</i> Even if attainable, advantage is not large.	<i>Very likely</i> Moving first will almost certainly pay off.	Brand awareness helpful, but resources less crucial here
The Market Leads	<i>Very likely</i> Even if you can't dominate the category, you should be able to hold onto your customer base.	<i>Likely</i> Make sure you have the resources to address all market segments as they emerge.	Large-scale marketing, distribution, and production capacity
The Technology Leads	<i>Very unlikely</i> A fast-changing technology in a slow-growing market is the enemy of short-term gains.	<i>Unlikely</i> Fast technological change will give later entrants lots of weapons for attacking you.	Strong R&D and new product development, deep pockets
Rough Waters	<i>Likely</i> A quick-in, quick-out strategy may make good sense here, unless your resources are awesome.	<i>Very unlikely</i> There's little chance of long-term success, even if you are good swimmer. These conditions are the worst.	Large-scale marketing, distribution, production, and strong R&D (all at once)

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