THE ROLE OF STRATEGIC NICHES IN CREATING LARGE-SCALE APPLICATIONS FOR HIGH-TECH PRODUCTS

Learning from other industries and previous telecommunication systems how a market can be created

J. Roland Ortt

Faculty Technology, Policy and Management
Delft University of Technology
(The Netherlands)

14th International Conference Economics of Infrastructures
27th May 2011

TU Delft

Focus: Strategic niches

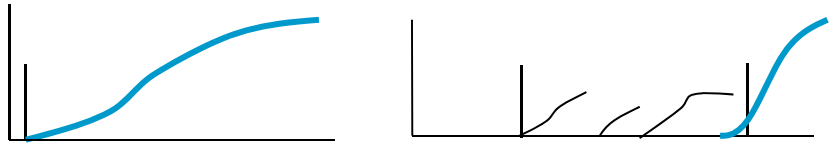
A niche is a combination of a specialized product for a small group of customers.

- A strategic niche is a niche prior to large-scale application of high-tech products.
- Contrast with a niche in mature market.

Example: Contraceptive pill first introduced to treat skin irregularities

Managerial relevance

What to expect when introducing a high-tech product?



2 scenario's
- Product mass market
- Product niche

(IAMOT 2007 paper; Ortt & Shah, 2007)

How to explore the market?

For managers it is important to realize that targeting niche applications can be an important initial step to create a mass market. Niches can form a transition path to reach a large-scale application (DeBresson, 1995).

Goal: To explore strategic niches, to explain their emergence and to indicate how to choose the proper niche strategy by analyzing the market.

Research questions and method:

(1) How often do strategic niches appear?
(2) How often do specific types of strategic niches appear?
(3) Do the number and type of strategic niches depend on the industry?

Research to describe phenomena:
Historical perspective: analysis 37 cases in 3 industries (quantitative analysis)

(4) What are the main causes that make strategic niches appear (in general)?
(5) What are the factors indicating when to apply a particular niche strategy?

Research to explain phenomena:
Managerial perspective: case-study, conceptual model (qualitative analysis)

(6) Niche-strategies and implications for telecom (radio) technologies

Scientific relevance

- Management lit: Different sub-disciplines theoretically describe niches
  - Marketing
  - Management of technology
  - Management of sustainable technologies

- Management lit: Case-studies empirically describe niches
  - Case-studies give anecdotal evidence about niche applications
  - Skewed sample of cases (electronics) in the literature

Author(s) Product	Market Applications
Mark, Chapman, & Gibson (1985) ▪Early computer (mainframe computer)	▪Complex calculation for ballistic missiles in military ▪Scientific application (universities/research agencies) ▪Business data processing for limited corporate customer ▪General business application*
Brown (1992) ▪Pocket calculators during 1970s	▪Engineers and scientists ▪accountants and other commercial users ▪general public* ▪school children*
Levinthal (1998) ▪Radial tires	▪High-performance sports cars ▪Replacement tires for mainstream car owners* ▪OEMs market of automobile manufacturers*
▪Video recorder	▪Broadcasting industry ▪Industrial and commercial users ▪Mass consumer electronic market*
Windrum & Birchenhall (1998) ▪Personal computer	▪Business with low-intensity computing needs ▪Designers/artists/musicians that demanded high quality graphics and multimedia) ▪Individual/ordinary users*

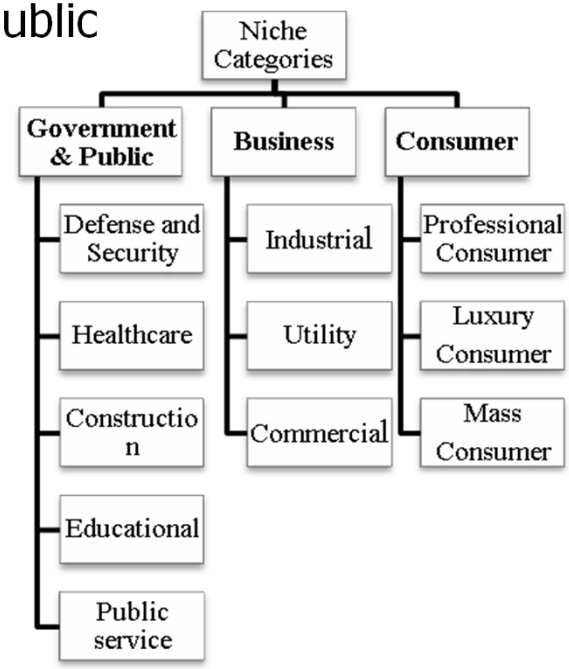
Literature

Anecdotal

Skewed

Categorization of niches

- Government & public
- Business
- Consumer



Sample: heterogeneous in time and industry

Industry Period	Chemicals, materials & metals	Pharmaceutical & healthcare	Telecommunication & media
Pre-1900	-Rayon -Nitroglycerine -Nitrocellulose -Celluloid	-X-Ray -Aspirin	-Telephony -Electrical telegraphy -Fax -Radio telegraph
1901-1945	-Nylon -Cellophane -Monel -Polytetrafluoro-ethylene	-Penicillin -Contraceptive pill -Arsphenamine -Insulin	-Electronic television -Radio telephony -Radio broadcasting
1946-1975	-Astroturf -Kevlar -Polyethylene terephthalate -Dyneema	-CT Scanner -Paracetamol -Methylphenidate -Polio vaccine -Minoxidil	-Fiber optic communication
Post-1975	-Glare	-Sildenafil/PDE5 -SSRI	-Bluetooth -SMS -Cellular telephone
Number of Products	13	13	11

RQ1a: How often niches?

27 of 37 high-tech products (73%) first introduced in (strategic) niches

10 (27%) directly introduced in a mainstream application

RQ1b: How many niches (per case)?

On average 2 niche applications prior to mainstream application.

(we tracked 72 successive niche applications for the 37 cases)

RQ2: How often specific types of niches?

business applications	(53%)
government applications	(33%)
consumer applications	(14%)

RQ3: Industry effect? (number and type of niches)

Niche category	Industry Type			Total
	Chemical, material & metals	Pharma-ceuticals & health care	Telecom & media	
Government	15 (21%)	-	9 (12%)	24 (33%)
Business	24 (33%)	-	14 (20%)	38 (53%)
Consumer	-	5 (7%)	5 (7%)	10 (14%)
Total	39 (54%)	5 (7%)	28 (39%)	72 (100%)

Main outcome

Number of niches differs significantly for industries

Type of niches differ significantly for industries

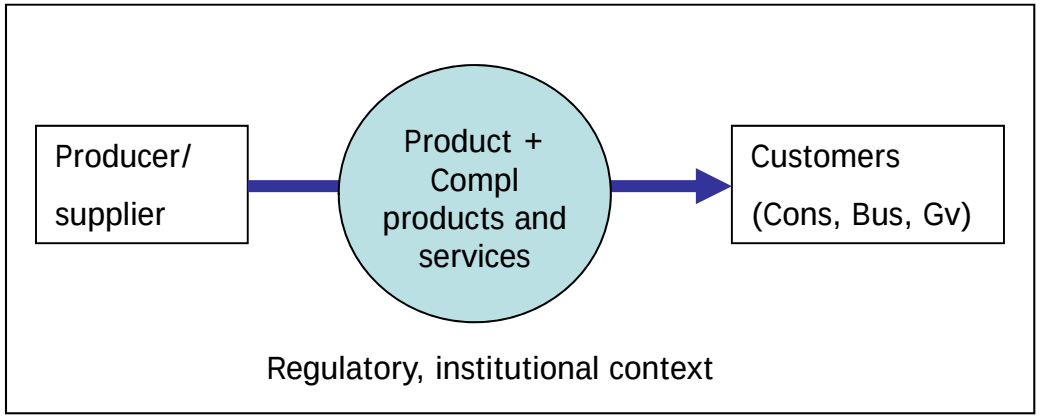
- Chemical & materials are introduced in government and business niches
- Pharmaceuticals & healthcare are introduced in the consumer niches (if in niches)
- Telecom and media are introduced in all three types of niches

RQ4: What causes the emergence of strategic niches?

Assumption 1: Niches appear when large-scale diffusion is blocked somehow.

Reformulated: What are the necessary conditions for large-scale diffusion (that, if not present, will block large-scale diffusion)?

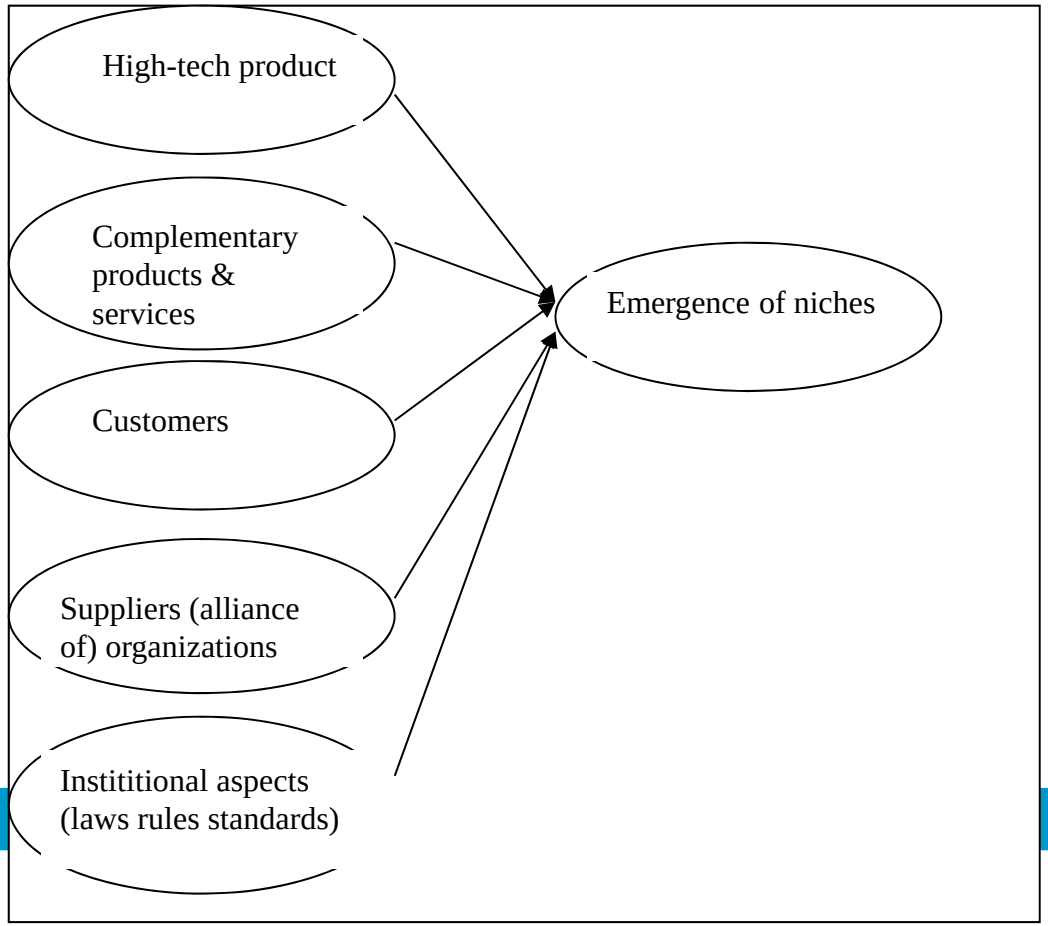
Factors
Product
Complementary products and services
Producers/ Suppliers
Customers
Regulatory/ institutional environment



Factors based on findings reported in IAMOT 2008 (Ortt & Delgoshaie, 2008)

RQ4: What causes the emergence of strategic niches? (Cont'd)

If one or more necessary factors for large-scale diffusion are lacking → Niches are likely to emerge prior to large-scale diffusion



Method:

1. For each case where niches appeared we identified the combination of factors that blocked large-scale diffusion

Biases: hind-sight bias, myopia towards the pre-specified model

2. For each case where large-scale diffusion appeared after first intro we checked whether all necessary factors were in place

TU Delft

RQ4: What causes the emergence of strategic niches? (Cont'd)

1. For case where niches appeared we identified the combination of factors that blocked large-scale diffusion

Dyneema (Chemicals, materials & metals)

Product was incomplete (Production)
Dyneema, an ultra strong fiber, was first created in 1964. The production was rudimentary (stirring with a stick in a solution). Knowledge how to produce the fiber on an industrial scale was lacking until 1976-78. Before that time, the fiber was spun in small quantities in a lab and samples were used for surgery.

Supplier considered product as outside mission
The ultra-strong fiber Dyneema was outside the mission of the Dutch chemical company DSM. The company was powerful and big but the commercialization of the fiber was delayed because of a lack of interest of the company. Sources: Mulder (1992); Hongu and Phillips (1997).

RQ4: What causes the emergence of strategic niches? (Cont'd)

2. For each case where large-scale diffusion appeared after first intro we checked whether all necessary factors were in place

Paracetamol (Pharmaceutical & healthcare)

All necessary conditions were in place at time of first market introduction. But,
Accidents during trials because of mistakes rather than inherent unsafety of the medicine, did cause a blockade in the innovation process for more than half a century (Bertolini et al., 2006)!

Polio medicine (Pharmaceutical & healthcare)

All necessary conditions were in place at time of first market introduction. But,
One batch of vaccine (for trial) was produced wrongly, causing the death of several children in the US (McGrew, 1985; Drutz and Ligon, 2000; Blume, 2005). The powerful organization managed to have multiple batches of vaccine produced by different factories. Only one batch caused problems and that observation helped explaining the accident and prevented the blockade of large-scale diffusion.

Learning points

- Accidents or unexpected events have a hardly predictable effect on patterns.
- Factors blocking large-scale diffusion can also lead to extension of the innovation phase and a delay of the first intro in stead of strategic niches.

RQ5: What are factors indicating when to apply a particular niche strategy?

Observation: Necessary conditions for large-scale diffusion do not suffice to indicate the particular niche strategy that should be adopted!

Factors
Product
Complementary products and services
Producers/ Suppliers
Customers
Regulatory/ institutional environment

→

Different causes for a lack of customers require different niche strategies

1. Lack of knowledge
2. Lack of spending power
3. Lack of need

Reformulated: What are the underlying causes that affect necessary conditions for large-scale diffusion?

RQ5: What are factors indicating when to apply a particular niche strategy? (Cont'd)

What are underlying causes that affect necessary conditions for large-scale diffusion?

1. Knowledge of technology is lacking
2. Knowledge of applications is lacking
3. Socio-cultural aspects (norms and values)
4. Economic aspects, resources and strategic interests of stakeholders
5. Accidents or (unexpected) events

These causes do affect a limited number of necessary conditions

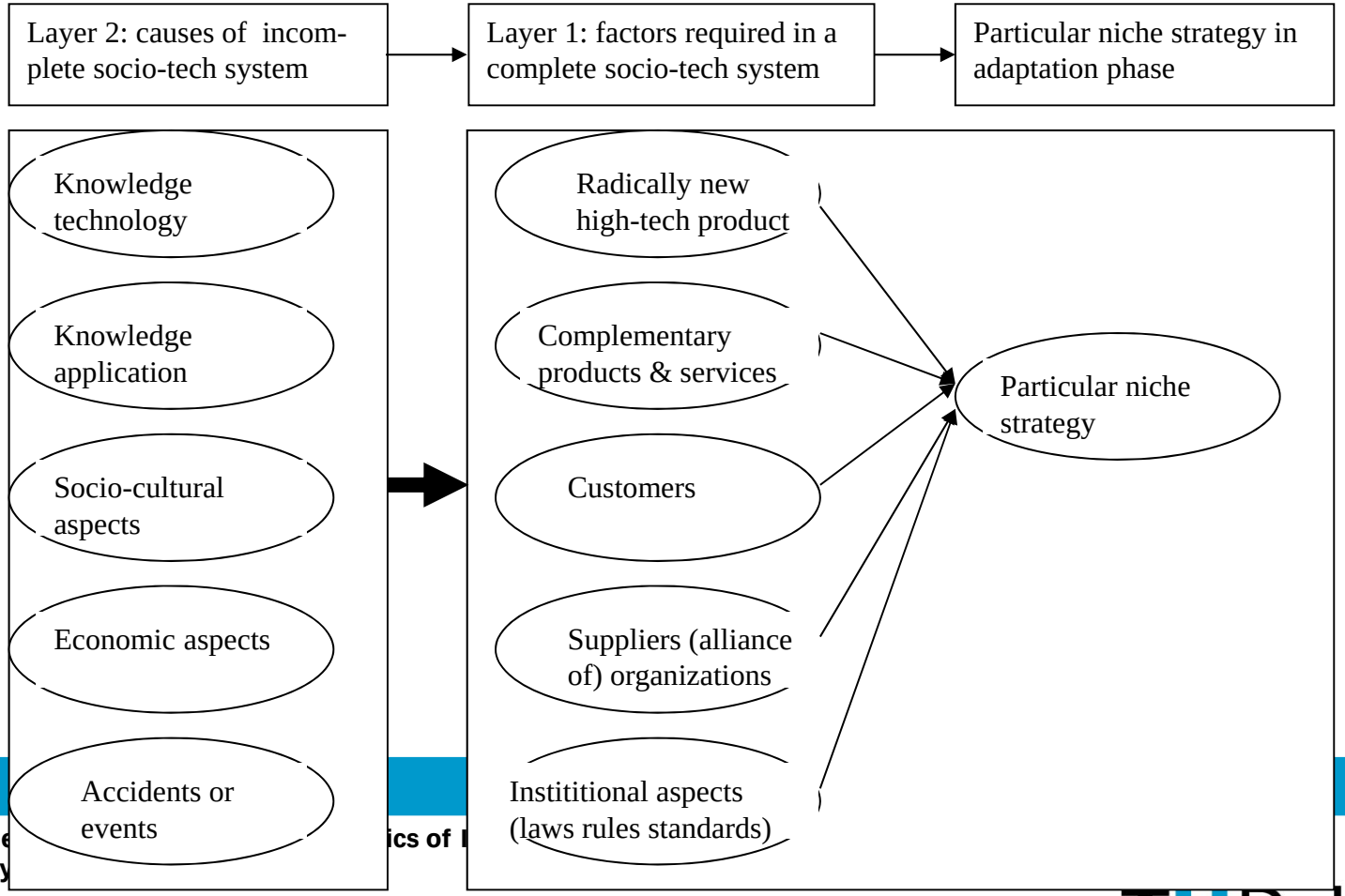
e.g. Lack of knowledge of technology primarily affects the availability of products or complementary products and services

Each combination of underlying cause affecting particular necessary condition can be tackled with a specific niche strategy

e.g. Lack of knowledge of technology primarily affects the availability of complementary products and services requires a niche strategy in which product is used in standalone mode without complementary products and services.

RQ5: What are factors indicating when to apply a particular niche strategy?

What are the underlying causes that affect necessary conditions for large-scale diffusion?



RQ5: What are factors indicating when to apply a particular niche strategy? (Cont'd)

What are resulting niche-strategies?

Conditions: knowledge of technology to make industrial product is lacking

1. Apply product to demonstrate the technical principle (as a toy or scientific marvel)
2. Apply incomplete product for high-need niches (e.g. medical app)

Conditions: knowledge of technology to make complementary prod/services is lacking

3. Apply product in stand-alone mode (e.g. telecom)

Conditions: knowledge of application is lacking among (potential) customers

4. Apply product in knowledgeable lead users niche (e.g. scientific community)

Conditions: knowledge of application is lacking among (potential) suppliers

5. Explore alternative niches in a deliberate niche exploration strategy

....

RQ6: Typical telecom niche-strategies

Niche-Strategy	Cases	Issue
Stand-alone or local niche strategy	Telegraphy (railway signalling) Telephony (contact telegraphy office)	Infrastructure lacking at first
Emergency first niche strategy	Radio telegraphy (military, police) Mobile telephony (security)	Regulation is blocking large-scale diffusion
Demo principle niche strategy	Telegraphy Television (1925-1930)	Technology is immature and application is unknown
Explore the market niche strategy	3G, 4G mobile telephony services	No clue about actual demand
Hobby niche strategy	Radio broadcasting (music for ship) Telephony (music telegraph operators)	No clue about demand or use, lack of users with equipment
Exploit unexpected niche strategy	SMS	It was not intended as a customer services.

Limitations:

- Just 3 industries
- Many cases, but more are needed

1 Chemicals, materials and metals
2 Pharmaceuticals and healthcare
3 Telecommunication and media

Discussion effect of the sample on results

- Pharmaceuticals & healthcare cases are atypical:
  limited number of niches.
- This effect of this industry is (probably) overweighted
  actual length of adaptation phase and no of niches is probably larger

Scientific and managerial implications:

- Niches are an important step towards large-scale production/diffusion (75% cases). On average 2-3 niches are explored in the market prior to large-scale prod/dif
- Type and number of niches are highly industry-specific.
- Strategic niches emerge when one or more of five necessary conditions are not met.
- The type of niche strategy that should be adopted to create a large scale market depends on the combination of five underlying causes and their effect on the necessary factors
- Several niche strategies can be distinguished, each of which is appropriate in specific conditions (i.e. particular underlying cause has an effect on particular necessary factor)

Telecom is one of the most difficult industries to introduce an innovation!

Future research:

1. More cases (49, including electronics)
2. Quantitative models relating the characteristics of the market to emergence of (specific) niches
3. Qualitative assessment of the different niche-strategies (per industry).

Thank you!

Questions?

Suggestions?