Determinants of Innovation and Growth in the Seafood Sector

The Mira Szászy Research Centre for Maori and Pacific Economic Development and the National Institute of Water and Atmospheric Research (NIWA)

Images – courtesy of NIWA
Programme for the Day

9:00  Introduction and Project Overview—Dr Manuka Henare
9:30  Innovation in the Seafood Industry - Dr Andrew Jeffs—NIWA
10:00 Morning Tea
10.30 Economic Evidence - Dr Basil Sharp
11:00 Case Studies of Value Chain Innovation - Dr Jay Sankaran
11.30 Sustainable seafood industry innovation- best practice model-Dr Shantha Liyanage
12:00 Creating Wealth from allocated assets - an initial assessment of the TOKM allocation model -Dr Manuka Henare
12.30 Discussion
1:00  Lunch
Joint Research Venture

- Mira Szászy Research Centre for Māori and Pacific Economic Development, The University of Auckland Business School
- National Institute of Water and Atmospheric Research (NIWA)
- $1.4 million research grant funded by FRST
- 4 year project started in 2003
Aim

• To identify the determinants of growth and innovation in the seafood sector of New Zealand, with particular emphasis on its importance to Māori.
Purpose

• to promote the development of a culture of innovation that drives economic growth in the seafood sector. It also reflects the context of harvest limits and competitive global markets.
### Project Team

- **Dr Manuka Henare**  
  Principal Investigator
- **Dr Basil Sharp**  
  Principal Investigator
- **Dr Andrew Jeffs**  
  NIWA Scientist
- **Dr Jay Sankaran**  
  Associate Investigator
- **Dr Shantha Liyanage**  
  Associate Investigator
- **Dr Val Lindsay**  
  Associate Investigator
- **Dr Manley Begay**  
  Director Native Nations Institute at the Udall Centre, University of Arizona
- **Mr Waitai Petera**  
  Researcher and Project Kaumatua
- **Ms Julie Sibthorpe**  
  Business Librarian
- **Ms Kathy Henry**  
  Project Manager
Synopsis of research to date

• Case studies
  - Forms of innovation in value chains at a micro-level
  - Looking at exemplars – food, nutriceuticals

• Innovation occurring over time
  - Econometrics
  - Data Sets

• Review of aquaculture
  - Macro Level
  - Literature Review

• Full reports and articles available
  www.business.auckland.ac.nz/seafood
Outcomes

• Innovation website and library as a public resource
• Training courses for Māori and industry
• Public promotion of innovation in the seafood industry
• Assist seafood industry increase business innovation
Benefits to the industry

Helping the industry to grow by understanding and encouraging innovation driven economic growth

Identifying options and strategies for enhancing the value of Maori assets in the seafood industry

Identifying the factors that have contributed to innovation over the past two decades

Disseminating lessons learned from exemplary companies

Development of a framework for managing innovation in integrated aquaculture firms

Seek ways to further increase innovation and growth
Innovation in the New Zealand Seafood Industry

Dr Andrew Jeffs
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Ph. 09-375-2048
What is innovation?

OECD says:-

- Introduction of a new or significantly improved product or service
- Introduction of a new or significantly improved process within a business

Likely additions:-

- Introduction into a significant new market opportunity
- Introduction of a significantly improved organisational arrangement
Why is innovation important?

• Innovation is a key driver of economic growth; nationally, & for sector & individual business success

• Strong political & financial support from current Government – “Growth & Innovation Framework”
Can innovation be encouraged?

OECD says “Yes” through policy & funding:

- Industry-science relationships
- Industry/market networks – clusters
- Growing & directing people skills & know-how
- Fostering innovation investment
- Encouraging IP commercialisation
- Building international linkages & networks – markets & knowledge
What do we know?

Small amount of useful information on innovation in seafood industry overseas & New Zealand

Overseas: –

Limited scope & content – very little useful research models or comparative data – related industries (e.g. food) some useful material
What do we know?

Overseas: –

**Italy** – Over last decade seafood industry poor economic performance due in part to:-

- Resource depletion
- Lack of organisational innovation (forced wholesale/retail changes – price takers)
- Lack of product innovation
What do we know?

Overseas: –

**Norway** – Arctic char and salmon farming industries

• Good interaction between researchers & industry leads to commercial success for salmon but v.v. for Arctic char

**Norway** – Blue mussel industry

• Strong focus on biological/technological innovation for production
• Poor focus on market & product innovation
• Little organisational innovation – e.g. vertical integration
What do we know?

Overseas: –

Canada – rapid growth in aquaculture sector due to innovation (doubled in 5 years to >C$400m – mostly export).

Government innovation intervention – tax credits, clusters, R&D funding, enabling regulation, skills development, international linkages

Canadian government investment in salmon R&D returns 2:1 & 19:1
What do we know?

Overseas: –

Norway – Fish processing industry

- Low levels of process & product innovation despite excellent market opportunities due to:
  - Poor market & R&D connections
  - Poor external innovation connections
  - Conservative “wait & see” management
  - Innovation focused on process efficiency i.e., risk averse
What do we know?

Overseas: –

France – Fish processing industry

“Companies in the fisheries sector are mainly users and rarely producers of innovations…”

France – Fish processing industry

- Good levels of innovative activity measured
- Strong focus on product & process innovation
- Innovation focused on efficiency – risk averse
- Good external innovation connections
What do we know?

New Zealand: –

Small amount of relevant material from the last decade – mostly focused on research and development rather than innovation per se.

Also gross innovation indicators.
NZ Seafood Industry - Profile

- Fifth largest primary industry
- Fourth largest export earner $1.4b
- 50% seafood firms high export (>50% sales) vs 7% of all NZ firms
- About 90% of harvest exported to >80 countries
- Employs >26,000
- Growth – exports more than doubled in 20 years 7% p.a. for 20 years.
- Growth target of $2b by 2010
- Very high Maori stakeholding
Innovation in NZ seafood industry

Innovation Gross Indicator

Aquaculture Production Value
• 1975 - $10,000
• 2003 - $300 M

Very Strong Growth Faster than global average of 10% p.a.
Innovation in NZ seafood industry

Seafood Industry
Top 3 for Innovation

NZ Stats 2004

Innovation Rate = No. of firms introduced a product or process innovation in the last 3 yrs.
Innovation in NZ seafood industry

Research & Development Status

- High publicly funded research (includes industry levies) - $49 to 53M - 2003
- Low private R & D investment - $13 to 20M (1.5%) - 2003
- Mostly in-house innovation – 41% spending
- Poor linkages with science providers
- Most research on resource/environment – vital underpinning
- Scientific skills dominated by physical & biological systems
- High proportion of research expenditure on resource information - bureaucracy a major business obstacle
Innovation in NZ seafood industry

Innovation Status

- High innovation activity only 14% of firms no innovation spending, nationally 26%
- Seafood exports fourth highest level of value adding 72% vs Meat 51%, dairy 35%, fruit & veges 35%
- Value adding in seafood is not growing quickly
- Innovation management in seafood firms lacking – low levels of planning & skills
- Large companies funding most innovation
- Strong focus on production & process innovation, vs product & market innovation where there is often more value
Innovation in NZ seafood industry

Key Issues :-

• National seafood innovation capacity & spending is focused heavily on resource management not wealth creation
  – will need to be moved
  – skills shift takes time

• Poor industry & science provider networks & linkages, heavy reliance on in-house innovation
  – new models emerging
  – more need to be supported
Innovation in NZ seafood industry

Key Issues :-

• Industry focus on production & process innovation vs further down the value chain
  - industry management awareness

• High proportion of research expenditure on resource information & bureaucracy a business obstacle
  - Government needs to be brought on side

  - Industry needs to work together – good models e.g. Industry Development Framework
Innovation in NZ seafood industry

Key Issues :-

• Poorly developed innovation management processes & skills industry training & sharing of successful management models

• Relatively low industry investment in R & D, especially amongst small firms

   - need to look at cluster models or more effective help-schemes
Innovation in NZ seafood industry

Key Issues

Government & industry can expect excellent returns from investing in developing innovation in the sector

- Export & innovation experienced
- Maori stakeholding
- Well positioned globally
That concludes my two-hour presentation. Any questions?

Did you intend the presentation to be incomprehensible, or do you have some sort of rare "PowerPoint" disability?

Are there any questions about the content?

There was content.
Econometric Analysis:
Results to date
December 2004

Dr Basil Sharp
The University of Auckland
Business School
Department of Economics
Objective

• Describe likely sources of innovation and growth

• Quantify high level changes in technology and growth from 1992 through 2002

• We report on results to date using rock lobster fishery as case study
Approach

• Used Annual Enterprise Survey data collected by Statistics NZ
• Confidential enterprise-level data for potting, lining, trawling and aquaculture
• Econometric estimation of gains in efficiency using cross section comparisons and technological change using time series
Background to Rock Lobster

- Pattern of landings characteristic of newly exploited fisheries:
  - 1945: 90 vessels landing 9 t per vessel
  - 1968: 1,217 vessels landing 9 t per vessel
  - 1981: 970 vessels landing 4.7 t per vessel
- 1976/78 FIB survey results (unfortunately lost)
- 1980 declared controlled fishery
- Introduced into QMS 1990.
ITQ Framework

Demand for quota

Price

Little info. on value

Non commercial allowance

TACC

TANC

TAC

P*
Initial Comments

• Scope to increase profit in rights based fishery:
  – Search for alternative technologies and innovations that lower costs
  – Innovations that add value to product

• Costs influenced by state of stocks *viz.* the vulnerable biomass.
Review:
Technical Change and Innovation

1. Institutional Foundations:
   QMS works to foster innovation by
   – signaling inefficiencies and potential
   – Reduces uncertainty around investment
   – Fosters continuous change
   – Impetus rests with industry
   – Levels playing field

2. Government incentives and innovation
   – Evidence not encouraging
3. Organizational structure

– Firm size – e.g. Schumpeterian hypothesis that larger firms innovate more than smaller

– More complex in a multilateral trading environment:
  • Empirical evidence attributes integration to concern for supply assurance
  • Theory not as supportive of integration to achieve supply assurance, suggests balance between network externalities (gains from trade) and transaction costs (costs of contracting)
4. Process and product innovation:
   - Process: allocate input mix so as to lower average cost
   - Product: invest in product beneficiation that enhances consumer demand
   - Most likely see complementarily of innovation:
     • Suggests that product (demand enhancing) and process (cost reducing) innovation will be implemented together
## Biomass, TACC & Harvest

<table>
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<tr>
<th>Year</th>
<th>B</th>
<th>TACC</th>
<th>% caught</th>
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<tbody>
<tr>
<td>1992</td>
<td>431</td>
<td>3616</td>
<td>85</td>
</tr>
<tr>
<td>1993</td>
<td>452</td>
<td>3265</td>
<td>82</td>
</tr>
<tr>
<td>1994</td>
<td>569</td>
<td>2913</td>
<td>95</td>
</tr>
<tr>
<td>1995</td>
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<td>1999</td>
<td>1046</td>
<td>2927</td>
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</tr>
<tr>
<td>2000</td>
<td>994</td>
<td>2849</td>
<td>96</td>
</tr>
</tbody>
</table>

Note: Biomass (B) is an average of vulnerable biomass estimates available – not for the entire fishery
Rock Lobster Fleet

Number of vessels


Number of vessels
Catch per Unit Effort
Change in Seasonality

![Graph showing the change in seasonality from 1990 to 2003 for June and November.]
Econometric Evidence

• Data
  – Enterprise level
  – 1992-2000 period
  – Total costs, wages, capital, intermediate inputs, revenue
  – Vulnerable biomass
Summary Statistics
Evidence

• Summary statistics 1992-2000:
  – Average output increased
  – Labour units decreased
  – Output per labour unit increased by 70%
  – Capital-labour ratio doubled

• Comments:
  – Gains in productivity of labour
  – Output per unit capital not so clear - why?
Efficiency Gains

• Aim examine production efficiency at two points in time
  – 1993 and ten years later in 2002
• Look for evidence of changes in the distribution of estimated efficiency between the two periods.
Stochastic Production Function

• Basic idea:
  – Random shocks beyond fishers control e.g. weather,…
  – Variations in technical efficiency

• Technically efficient producer operates on production frontier

• Inefficient producer: could produce same with less of at least one input or use same inputs and produce more of one output.
Model

• Output = f(labour, capital, other inputs)
• Years 1993 and 2002
• Estimate of technical efficiency (TE) of each producer $i$ given by
  – $TE_i$ which ranges between 0 (inefficient) and 1 (completely efficient)

• What do we find?
Summary of Results: signs and significance

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>1993</th>
<th>2002</th>
</tr>
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<tbody>
<tr>
<td>Constant</td>
<td>(+) 1%</td>
<td>(+) 1%</td>
</tr>
<tr>
<td>Labour</td>
<td>(+) n.s.</td>
<td>(+) 5%</td>
</tr>
<tr>
<td>Capital</td>
<td>(+) 1%</td>
<td>(+) 1%</td>
</tr>
<tr>
<td>Other inputs</td>
<td>(+) 1%</td>
<td>(+) 1%</td>
</tr>
</tbody>
</table>
Distribution of Efficiency

[Bar chart showing the distribution of enterprise efficiency for years 1993 and 2002. The x-axis represents enterprise efficiency, ranging from 0.30 to 0.90, and the y-axis represents the number of enterprises. The chart illustrates the comparison between the two years, with 2002 shown in gray and 1993 in black.]
What Can we Conclude?

• Mean level of efficiency improved from 0.735 to 0.796 and is statistically significant
• Reject null hypothesis that 1993 and 2002 have equal variance
• In 2002 we find no evidence of relationship between output share technical efficiency
Stochastic Cost Function

- Rather than looking at output we focus on costs over period 1992 through 2000

- Look at behavior of costs for evidence of technical change and innovation

- Estimate cost function
  - Cost = c(w,q,b,t)
  - Where
    - w = price of labour, capital etc.;
    - q = output
    - b = biomass
    - t = year
Rate of Technical Progress
Outcomes

• Industry has produced strong efficiency gains and sustained technological change
• Industry innovates within the QMS and in the absence of direct government incentives
• Results suggest product and process innovation are complementary
• Future gains will be in the area of product innovation for example ....
Product Innovation
Future Research

• Continue modeling work for other sectors:
  – Lining
  – Trawling
  – Processing

• Application of different modelling platforms e.g. DEA, index number approaches
Value-chain innovation: Two case studies

Dr Jay Sankaran, December 13, 2004
Value-Chain Innovation

• Research questions
  - What forms do innovations in seafood industry supply chains assume?
  - What factors underpin successful innovation?
  - What barriers need be overcome?
  - More generally [in light of the public-good nature of the research], how can innovations in the value-chains for seafood be stimulated?

• A key objective: showcase exemplars.
Two Case Studies

• NZ King Salmon
  - Integrated niche aquaculture firm focusing on a single species (king salmon)


  - “Value-chain innovation: A New Zealand example,” accepted for presentation at the Quality, Innovation, Knowledge 2005 conference

Continued..

- MacLab NZ.
  - Farms and processes mussels for making stabilized mussel extracts and Lyprinol®.
  - (In progress.)
Why is NZ King Salmon suitable?

• High percentage of sales invested in R&D.
• Investment, as a percentage of sales, in the development of new products, new processes, and new markets comparable to larger aquaculture companies overseas.
  - Overseas companies invest more in ‘pure R.’
• NZKS is highly export-oriented (> 50%).
• In the top 1-2% of salmon farming companies.
• Offers a ‘cradle-to-grave’ vista of innovation.
• Manner of choosing an ERP system.
The Link between Innovation and Corporate Strategy

- Company’s focus on a hard-to-farm species (King Salmon).
  - Premium in markets (e.g., Japan) increases with value-addition.
  - Greater premiums through packaging and branding product

- Differentiation through quality and reliability of supply

- Desire to get away from the see-sawing nature of commodity markets
  - Hence, greater need for new product development.
- Focus on bottom-line/revenue growth rather than volume growth.
A Process Model of Value-chain Innovation at NZ King Salmon.
“Pure R” VS “D”

• Drivers of production research.
  - Slow maturation of king salmon.
  - Seasonality of maturation cycles.
  - The very location of value-addition: the fish farm.
    ★ Easier to add value to a lower-cost product than a higher-cost product.
• Drivers of developmental research.
  - Difficulty of farming King Salmon!
    ★ By-product utilization (high marginal returns).
    ★ Criticality of not destroying value once harvested, given the long cycle times for production.
Lessons to learn from NZ King Salmon

• R&D pays off!
• Innovation needs to be clearly driven by and aligned with competitive strategies.
  - The process model of innovation would be relevant for integrated niche aquaculture firms.
• Need to create a culture of innovation.
  - Pursuing ideas from the coalface, serendipity.
• Customer/market-focus in new product development (NPD): locate NPD in Sales & Marketing, strong links between R&D and marketing.
• Cross-functionality in the R&D effort.
MacLab NZ: Innovating through nutraceuticals
Background & Motivation

- MacLab NZ was cited by respondents at NZKS.
  - A demand-driven supply chain

  - Part of a value-chain for nutraceuticals and functional foods that require high-tech R&D.

    * A functional food is “any foodstuff enhanced by additives and marketed as beneficial to health and longevity;” the additives may be ‘nutriceuticals.’

  - Biotechnology is the reason; functional foods account for less than 1% of the total food and drinks market in Germany (and Europe) but 19% of all innovations in that market in Germany in 1999-2000 (Menrad 2003, p. 182).
Background & Motivation, contd.

• Marine biotechnology has huge unrealized potential

• Functional foods have been launched mainly in the soft drinks, confectionery, dairy, bakery, and baby food market-segments (over 90% of innovations of functional foods in the food and drinks market in Germany)
  - Other segments (including seafood) account for 38% of all innovations but less than 10% of functional food innovations

• Hence, research questions are:
  - How are innovations of marine-based nutraceuticals realized?
  - How can NZ seafood/aquaculture companies add value beyond catch/farming in the production of nutraceuticals?
MacLab NZ

- One of NZ’s largest mussel farmers and processors, farms mussels in the Coromandel and Nelson, and processes them in Nelson to make stabilized mussel powder extract.

- The powder is sent to Uncle Ben’s that makes functional food for dogs (EXELPET ARTHRI-CARE™)

- Further processing.
  - Powder is sent to Germany (and NZ) for extracting lipids through a supercritical fluid extraction process.
  - Lipids are encapsulated and sold as Lyprinol® capsules.
Extensive Collaboration in the Value-chain

- Share-farming, joint-venture agreements with local iwi/hapu

- Pharmarlink Marketing Australia provides marketing, distribution, and production oversight services

- Research links with RMIT and other universities

- Flavex Natureextrakte in Germany extracts lipids (as does Extract Solutions that is based in Richmond)

- A pharmaceutical company makes the capsules.
The Discovery and Development of Lyprinol®

- First-generation GLM extracts (1974-)

- Second-generation, stabilized GLM extracts
  - Initially sought ‘hard’ evidence of mussel potency but...
  - Ended up with a technique for making stabilized mussel powder extract

- Identification and extraction of active fractions.
  - In-vitro testing
  - Progressive purification of extracted fractions
  - In-vivo testing
  - Protocols for commercial extraction through a process that has since been patented
Ongoing Developments

• Difficulties in securing resource consents; deep-water farming

• Bartering arrangements with other mussel processors

• Leveraging capacity at the various links

• New product development
  - Selling whole *raw* mussels that are *stabilized* (hence, the goodness remains).
Lessons to learn from MacLab NZ

• A strategic planning approach is ill-suited for managing the innovation of nutraceuticals using biotech

• Need for an entrepreneurial perspective in the early stages (Mark-Herbert, 2004); convergent thinking in the latter stages.
  - Open-mindedness, flexibility, tolerance of ambiguity, withholding of judgment.
  - Need to be in there for the long haul

• Regulatory uncertainty, the credibility of labelling claims, and unclear pricing mechanisms are major challenges.
  - Functional foods are classified as ‘foods,’ not drugs

• Need for extensive collaboration (e.g., with biotech firms); food firms might struggle to adjust.
  - In-house R&D may not be viable.
<table>
<thead>
<tr>
<th>Value-chain Attribute</th>
<th>NZKS</th>
<th>MLNZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of product</td>
<td>Food</td>
<td>Functional food/Nutraceutical Commoditized</td>
</tr>
<tr>
<td>Nature of ‘raw material’</td>
<td>Niche</td>
<td></td>
</tr>
<tr>
<td>Nature of value-chain</td>
<td>Vertically integrated</td>
<td>Prevalence of long-term relationships and exclusive trading arrangements</td>
</tr>
<tr>
<td>Geographic distribution of value-chain</td>
<td>More concentrated</td>
<td>More dispersed</td>
</tr>
<tr>
<td>Nature of IP</td>
<td>Intangible, not fully patented</td>
<td>Patented</td>
</tr>
<tr>
<td>Primary locus of bio-tech research</td>
<td>Farming</td>
<td>Processing/Extraction</td>
</tr>
</tbody>
</table>
Convergence of competitive strategies of NZKS and MLNZ

- Both focus on a single ‘core product’ and derivatives
- Both value-chains differentiate through product quality
- NZKS and MLNZ differentiate from commodity markets through value-addition
Sustainable Seafood Industry Innovation- Best practice models

Associate Professor Shantha Liyanage
Shantha.liyanage@auckland.ac.nz
(Seafood Industry Workshop, Wellington, 13 December, 2004)
Innovation Best Practice Models

• Promote business development
• Stimulate sustainable development in marine and aquaculture resources
• Create employment – related industry
• Build human capital – knowledge drivers
• Manage technology and resources –
  - Novel ways of producing, processing, managing and sustaining industry practices
  - Quality, marketing and consumers

• Training and education
  - Industry and Government personnel
  - production of educational materials for aquaculture, Deep sea and inshore fisheries.
NZ in World’s context

• “World Bank estimations, the production of farmed fish will outstrip the production of beef by 2010”.

• NZ 1.2 billion ($800 million in exports) industry with over 26,000 jobs (2003)
World fisheries production

Top Producers in 2000

- China – 17 million tonnes
- Peru – 10.7
- Japan – 5.0
- USA - 4.7
- Chile – 4.3
- Indonesia – 4.1
- Russian Fed. 4.0
- India – 3.6
- Thailand – 2.9
- Norway – 2.7
- Iceland -2.0 (Source: FAO, 2004)
Capture Fisheries Production

• Anchoveta - 11.3 million tones
• Alaska pollock – 3.0
• Atlantic herring – 2.4
• Skipjack tuna – 1.9
• Japanese anchovy- 1.7
• Chilean jack mackerel -1.5
• Largehaed hairtail -1.5
• Chub mackerel -1.5
• Capelin -1.5
• Blue whiting -1.5 (Source: FAO, 2004)
Fishery Production in the Oceania Source: FAO – Into the next millennium, Fishery Perpective, 1999
Aquaculture Production in the Oceania
Source: FAO – Into the next millennium, Fishery Perspective, 1999
Figure 21: Australian fisheries production from 1995-96 to 1999-2000.

Innovation Framework

- People and Entrepreneurial Capability
- Organisational/Institutional Capacity
- Processes
  - Cost Efficiency
  - Time
  - Placement
- Product and Services
What is sustainable innovation?

• Taking an idea to market

• “An innovation ......is a new or significantly improved product (good or service) introduced to the market or the introduction within your enterprise of a new or significantly improved process. The innovation is based on the results of new technological developments, new combinations of existing technology or utilisation of other knowledge acquired by your enterprise.” Oslo Manual, OECD, 2002
Defining Innovation

Some of the notable definitions are:

- “The development and exploitation of new combinations and unexplored technologies” Schumpeter, 1934

- “A social / cultural process which is inherently complex, chaotic and unpredictable” Quinn, 1992

- “The product of a systematic and rational search for opportunities” Drucker, 1985
Types of Innovation appropriate to the sector

- Incremental
- Radical
- Architectural
- Modular
Incremental Innovation

• Incremental-innovation that allows the existing products to remain competitive
  - E.g. improvements to fishing gear, boats, nets
Radical Innovation

- Radical-innovation that renders existing products and processes noncompetitive
  - E.g.-change in fishing methods – Bottom trawling to something else??
Modular Innovation

• Innovation that changes only the core design concepts of a technology innovation.
  - Change the core design concept without changing the product’s architecture
Architectural innovation

- Innovation that changes only the relationship between the components of a system.
  - It involves the reconfiguration of an established system to link together existing components in a new way.
Radical
Technology-intensive
Absorptive Capacity is Low
High R&D Inputs
Under-deployed solutions
Technology Driven rather than People driven

Modular
Optimization
Tactical goals in sync
Well-managed organization
Performance monitoring
Continuous feedback

Incremental
• Chaos
• Mismatches between technology and Business consideration
• Limited understanding of business process
• Poor communication business/technology/R&D
• Business divergence

Architectural
• Business requirements not met by Technology
• Insufficient technology resources and skills
• Organization in catch-up mode
• Diminishing competitiveness

Technological Opportunities
Market Opportunities
Innovation Capability Issues for the Sector (1)

- Source of new knowledge – leading players and knowledge reservoirs

- Access to knowledge – significant players and sources of knowledge (e.g., life science, product, market, and management capability)

- Access to product and process development capability - technology transfer and balance of payment information

- Capacity to absorb and exploit new knowledge (knowledge, institutional, and management)
Innovation Capability Issues for the Sector (2)

- Competitive, market segmentation, niche markets and entrepreneurial behaviour
- Related industry capabilities
- Regulatory environment
- Networks, knowledge communities and the process of collaboration
Seafood innovations in Canada

• Innovation framework- environmentally sustainable and commercially successful
• Building smaller, more self-reliant and entrepreneurial industry
• Accommodating various users – eg. recreational fishery
• Managing ongoing fluctuation in fisheries resources
# Innovation Matrix

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Part of Study</th>
<th>Knowledge</th>
<th>Product</th>
<th>Process</th>
<th>Mktg</th>
<th>Researchers</th>
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<td>Global environment &amp; trends</td>
<td>Capture</td>
<td>Aquaculture</td>
<td>Processing</td>
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<td>Firm-level (survey / networking)*</td>
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<td>Seafood enhancement activities</td>
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