Value-Chain Innovation:
A New Zealand Example

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Abstract
Empirical research into innovation has tended to focus on secondary and tertiary industrial sectors at the expense of primary sectors such as agriculture and fisheries. Accordingly, we develop an in-depth case study of innovation in the value-chain of a leading, vertically integrated, export-oriented aquaculture company that is based in New Zealand.

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INTRODUCTION
The research reported here has been conducted under the aegis of an ongoing four-year project sponsored by the New Zealand (NZ) Foundation for Research Science & Technology (FRST) entitled, ‘Determinants of innovation and growth in the seafood sector.’ (The author is one of the investigators on the project.) One of the objectives of the project is to showcase success stories of value-chain innovation for the benefit of the NZ seafood industry at large.

Some preliminary definitions are necessary to help frame the ensuing discussion. For the present purposes, the value chain may be taken loosely as the chain of value-creating activities (both within and across enterprises). (In the original definition of Porter [1980], the value-chain refers to the sequential set of primary and support activities that a firm performs to turn inputs into value-added outputs for its external customers.) The operational definition of ‘innovation’ that is used in the present report is in accordance with the guidelines of the OECD (the definition is also used by Statistics NZ): innovation is the introduction of a new or significantly improved product or service to the market, or the introduction of a new or significantly improved process to a business (Fallow, 2004). Nevertheless, business developments/improvements typically reside on a continuum and/or span a spectrum. Therefore, it is important to not draw too fine a line between the developments of new product categories as opposed to product-range extensions or between process innovations as opposed to the continuous improvement of processes.

The broad objective of the strand of research into value-chain innovation is to induce insight into the conditions for successful innovation in the value/supply chain and furnish answers to a few key questions: What forms do innovations in aquaculture value chains assume? What factors underpin successful innovation, and what barriers need be overcome?

In light of this objective and research questions, we now report a case study of value-chain innovation in a leading NZ aquaculture company, NZ King Salmon (henceforth, NZKS), which is headquartered in Nelson, NZ. The choice of NZKS has been quite deliberate. First, the percentage of sales that is invested by NZKS in research and development (R&D) is more than that for most firms in the New Zealand aquaculture sector. Second, NZKS’s investment, as a percentage of sales, in the development of new products and new processes (both in manufacturing and distribution) as well as the development of new markets is comparable to that invested by larger aquaculture companies overseas. Third, NZKS is highly export-oriented, realizing over half its sales revenue as well as volumes from exports – which is entirely in keeping with the thrust of the FRST project of stimulating export-led growth in the seafood sector. Fourth, at the time of this writing, NZKS was one of the most profitable salmon farming companies around the world. (It must be noted that profitability at NZKS is not as subject to exchange rate fluctuations compared with other NZ exporters because a weak NZ dollar increases the cost of importing fish meal, which is a sizeable component of landed costs.) Fifth, since NZKS is highly vertically integrated, it offers a vista of innovation in the entire value-chain for a specific sector within the NZ seafood industry. The value-chain spans production (referred as ‘catch/farming’ by Iversen [2004, p. 42] in his sketch of the value-chain for seafood), processing, marketing, distribution, and service (e.g., traceability [Iversen, 2004]). As the ensuing review of the literature confirms, case studies that take such an end-to-end perspective of innovation in aquaculture are elusive: most focus primarily on either farming or new product development but not both. Thus, this ‘cradle-to-grave’ view of innovation is a major point of departure for the research reported here.

The final reason for the choice of NZKS was that the author had earlier been quite impressed by a case study on NZKS’s implementation that is hosted by istart.co.nz (NZ’s e-commerce portal) (Anonymous, 2001). This case study described the sound, ‘textbook’ manner in which
NZKS had chosen its ERP solution (Movex) in relation to its business process needs, which in turn were driven by its competitive strategy of differentiation through quality, delivery reliability, and customer service (El-Sawy, 2001, pp. 11-12). The then-GM (Finance & Corporate Services) observed, “When we looked at functionality we looked at it not so much from a systems point of view but from a business process viewpoint and we ranked the solutions in terms of importance” (Anonymous, 2001). In fact, for this pedagogical aspect, the case study had featured in an exam as well as an assignment for courses on business process design at the author’s institution. A sound understanding by NZKS of business-processes and the need for cross-functionality would suggest a process-focus in other processes as well, such as new product development, that are pertinent to innovation (Hammer & Stanton, 1999; Croxton et al., 2001).

For the above reasons, NZKS was believed to be an ideal candidate for an in-depth case study of value-chain innovation. Further, the organization proved to be extremely accessible.

The paper is organized as follows. We first review the relevant literature before describing the methodology for the case study. We subsequently present the case study that we have organized along a few major themes: the link between innovation and strategy at NZKS; R&D (Research & Development) at NZKS; perspectives of innovation at NZKS; and innovation & development processes at NZKS [the last two themes are omitted here for reasons of space]. We conclude with a summary of insights that we can ‘takeaway’ for further research.

**LITERATURE REVIEW**

Research into innovation in aquaculture per se is quite scant, and one perforce expands the scope of one’s literature review in the context of research of the present kind. One means of expanding the scope is to look at broader subject-domains, e.g., innovation in food industries (not just seafood) that might subsume some aspects of innovation in aquaculture (e.g., new product [food] development). Traill & Grunert (1997) featured several case studies of product and process innovation in the food industry, one of which was Royal Greenland A/S for which the most important product category was prawns (Harmsen & Traill, 1997).

Another means of expanding the scope of the review is to examine related product-categories and/or industries (e.g., perishables such as cut-flowers [Anonymous, 1995] or other process industries in NZ such as forestry [Wilson & Sankaran, 2001] or dairy [Stevenson, 1997]) and draw parallels that might apply to aquaculture. A third means is to look at resources on aquaculture (e.g., Heen, Monahan, & Utter [1993]) that might feature a limited discussion of innovation, possibly in the context of new product development within the marketing function (e.g., Shaw, 1993, which is a chapter in Heen et al. [1993]).

Even such an expanded literature review may not be very fruitful. Indeed, research into innovation in the food industry itself (not just aquaculture) has been deemed to be scant possibly because of the low intensity of R&D in the industry (Grunert et al., 1997, p. 7; Harmsen, 1996, as cited in Harmsen et al., 2000). The food industry has in fact been characterized as being a major ‘carrier’ industry, i.e., a downstream consumer-oriented industry that adopts widespread use of new technologies that are developed in upstream, high-tech industries such as electronics, advanced materials, and biotechnology (Christenden et al., 1996, as cited by Grunert et al. [1997, p. 7]). From the case studies of product and process innovation reported in Traill & Grunert (1997), Harmsen et al. (2000) induced a model of innovation success in what they deemed ‘low-tech’ (i.e., food) companies. The model features the interplay of three constructs, namely, product orientation, process
orientation, and market orientation, and their impact on innovation and thereby firm performance.

Some studies touch upon innovation, to a greater or lesser extent, while addressing the farming end of the aquaculture value-chain (Aarset, 1999; Asche et al, 1999; Engle, 2003). Asche et al. (1999) elaborated the environmental problems encountered in Norwegian salmon (also known as Atlantic salmon) aquaculture; their discussion of innovation was principally with reference to combating these problems (pp. 25-27). While reviewing catfish aquaculture in the US, which is the most successful aquaculture business in that region, Engle (2003) noted technological innovations that have increased yields by increasing land-use efficiency. She argued that market-oriented agribusiness approaches to catfish marketing would become the order of the day to offset the difficulties on the production side. These difficulties include rising input costs that outpace productivity gains as well as increased financial risk and declining real profit margins that have stemmed from the increased use of debt capital, which in turn has resulted from the intensification of catfish production over time.

In an interesting comparative analysis, Aarset (1999) contrasted the booming Norwegian salmon farming with the hitherto commercially unsuccessful farming of Arctic char. His comparison is apposite to this paper because Arctic char stands in similar contrast with Norwegian/Atlantic salmon as king salmon (also known as Chinook salmon): it is viewed as a niche product based on high quality and price in relation to Norwegian salmon which, by the late 1980s, was “losing its status as an exclusive commodity, due to the industry’s excessive expansion” (Aarset, 1999, p. 183). Aarset attributed the relative failure of Arctic char farming partly to the tendency to import technological solutions from salmon farming, and thus implicitly treat the two as identical (1999, p. 184). He believed that the main problem with Arctic char farming was the comparatively inferior linkage between research and industrial activity.

Iversen (2004) also touched upon innovation in the context of strategic options that were available to the Norwegian seafood industry in the light of globalization. He gave examples of the increasingly dispersed nature of the value-chain for Norwegian seafood. Iversen also noted the need for differentiation by processors through branding, new product development, as well as the supply of more valuable fish.

**METHODOLOGY FOR THE CASE STUDY**

A thorough review of the relevant literature on value-chain innovation in the seafood industry and like industries was conducted prior to fieldwork. Two online resources (NZKS’s website [www.kingsalmon.co.nz] as well as the write-up on NZKS’s implementation of Movex™) were also closely studied. Altogether, these various sources furnished an initial set of 36 themes to explore in the context of innovation within the company as well as the external value-chain; about two-thirds of the themes focused on the former. However, given the exploratory character of the research and the single-site nature of the study, the research process was purposely kept open.

A field trip to Nelson, NZ, was undertaken for conducting in-depth interviews with executives of NZKS. Snowball sampling was used to identify informants: a key respondent (the GM of Sales & Marketing, who oversaw new product development) was first interviewed for almost four hours, spread across two sessions. (This GM had in the first instance been referred by the GM of Aquaculture.) The interviews focused primarily on new product development and, to a lesser extent, on accompanying new process development, besides R&D. The author also had a brief discussion with the Chief Executive along with this GM.
During the interviews, the GM of Sales & Marketing suggested that the GM (Corporate Services & Finance) would be able to shed additional light on topics such as accounting for R&D. After an interval of a day for reviewing the tape-recorded interviews with the GM (Sales & Marketing), and augmenting the initial set of questions with questions that emerged from these interviews, the author held a second round of interviews. The first interview in this round was with the GM (Corporate Services & Finance) and lasted about two hours. The GM (Manufacturing) was also present in this interview; he was able to throw light on the continuous improvement program in place at NZKS and for this reason, also beckoned the Process Systems Engineer, who was able to participate for a portion of the interview. After the Process Systems Engineer conducted a plant-visit, the author held a closing interview with the Market Services Manager to tie up loose ends regarding innovations in distribution including packaging, handling, etc. During data analysis and preparation of the research report, several other issues arose which were clarified in depth by the GM of Sales & Marketing.

The interview transcripts were analysed using established techniques of qualitative data analysis (Strauss & Corbin, 1998). Specifically, concepts (such as ‘criteria for screening new product ideas’) were induced and defined in relation to their included indicators (which are events or happenings that fit into the concepts). Such emergent concepts were iteratively redefined, modified, and enlarged in the face of additional data. These concepts were then classed under overarching categories; thus the concept, ‘criteria for screening new product ideas,’ was subsumed under a category labelled the ‘new product development process.’ The case study that features in this paper is an elaboration of some of the various categories.

The author then sent the case study write-up to the key informants for their comments and feedback, which was quite positive by all accounts and which eliminated any scope for misrepresentation and misinterpretation. Thus, the goal of respondent validation was served (Bryman, 1989, pp. 164-166). Naturally, all potentially sensitive information has been masked in the following description. (Five respondents, all at the level of middle and senior management feature in the description, and they are identified as R1 through R5.)

BACKGROUND TO NZKS
As the istart.co.nz case study noted, NZKS was formed in 1996 with the privatisation and merger of New Zealand's two largest salmon companies: Southern Ocean Seafoods Ltd and Regal Salmon Ltd (Anonymous, 2001). NZKS is a wholly-owned subsidiary of Oregon Group Ltd, which is ultimately owned by the Tiong Group. NZKS has an annual turnover of more than $50 million and employs more than 330 staff. It accounts for 80 per cent of New Zealand's total production of farmed king salmon, also known as Chinook salmon or Pacific king salmon, and 40 per cent of world production. The company has four salmon farms, two hatcheries and processing facilities (at Nelson) including a ready-to-eat factory.

STRATEGIC FOCUS
It is instructive to understand innovation at NZKS against the backcloth of its competitive strategies and bases for competition. NZKS has chosen to focus on one species, king salmon (Oncorhynchus tshawytscha), whereas many of the large salmon producers worldwide farm Atlantic salmon, which is easier to manage (for instance, Atlantic salmon tends to be faster growing and is a more efficient converter of feed into flesh).

In turn, the focus on one species is related to NZKS’s strategy of vertical integration. Besides retaining the benefits from value-creation, the company is able to guarantee quality and reliability by owning and controlling every state of production. However, NZKS has not
pursued vertical integration when economies of scale cannot be realized, an example being the production of fish-meal, which is presently imported from Chile and to a lesser extent, Tasmania.

The focus on king salmon enables NZKS to maintain a point of difference in the market. As R1 remarked, “King salmon is a highly regarded, well-reputed species to go to the market with. And it is something they want to buy and is in scarce supply; so we get a premium for our product. You can grow Atlantic salmon anywhere in the world at low cost; [the farmers of Atlantic salmon] can fight it out at the low price that they can get for it.” Consequently, NZKS seeks to create and operate in niche markets for its species in the markets in which it competes against Atlantic salmon such as Australia, Japan, and North America. Since NZKS accounts for 40 per cent of the world’s production of farmed king salmon, it is able to set its own price depending on how much it wants to sell; NZKS is able to command a sizeable premium over Atlantic salmon in overseas markets (e.g., Japan). The premium increases with the extent of value-addition, which provides an incentive to NZKS to strive to take the differentiation of product right to the end of the supply chain.

As one would expect, there are varying degrees of value-addition at NZKS depending on the number of stages that product flows through in the processing facility. Highest forms of value-addition are represented by products such as smoked salmon. The next level down in terms of value-addition would be value-added portions or pieces of salmon (e.g., salmon kebabs). Salmon fillets and cuts represent, as R1 put it, “are somewhere between a value-added product and a raw commodity.” The benefits, from a marketing perspective, of downstream processing are the ability to realize greater premiums through packaging and branding product.

In keeping with the differentiation from Atlantic salmon, NZKS has also “deliberately got away” from the low-cost, frozen-food, commodity market. R1 noted, “When you are competing with the frozen product typically for an industrial processor, you are competing against Norway and Chile with the cheapest possible salmon out there. Most often, they just lump together Chinook and Atlantic salmon. So it is not that happy for us to be in a frozen market.”

The strategy of differentiation has been facilitated by increasing quality discernment on the part of end-consumers in Japan and latterly, Australia. In NZ, consumers are already familiar with quality product, as witnessed in the poor reception accorded to Canadian imports of salmon products. In Japan, the emergence of labelling laws is working to NZKS’s favour.

An element of NZKS’s strategy that is related to its differentiation from commodity markets is the reduction of its exposure to commodity cycles. Allied with the avoidance of commodity cycles is NZKS’s attempt to make its supply chain more demand-driven, i.e., growing more fish in “response to a potential perceived demand as opposed to growing more fish so that we can go out and sell it somewhere.” As a result, NZKS has sought to focus on bottom-line/revenue growth rather than volume growth whilst ensuring reasonable tonnage for economies of scale for its vertically integrated business. In turn, such growth necessitates a “reasonable amount of investment in the development of new products and new processes in the factory, new distribution, market development, etc.”
RESEARCH AND DEVELOPMENT (R&D) AT NZKS

In the course of the interviews with R1, he distinguished between “pure R,” which refers to production research, and “D,” which includes new product development (NPD).

PRODUCTION RESEARCH

Production research at NZKS refers broadly to developing better ways of growing fish (“raw material”) in terms of increasing volume, achieving consistency of supply, and/or lowering production costs and thereby enhancing bottom-line profitability. One strand of production research entails the design of fish to meet particular business/market needs. Market needs could be quality attributes (colour, oil, texture, etc.) that are fed back to the aquaculture team by Sales & Marketing. Business imperatives would be faster growth of fish, better conversion of feed into flesh, and the ability to “fill the pipeline in the off-season from about mid-February to about mid-June.”

This consistency of supply of raw material could also be enabled by influencing the maturation of salmon through for instance hatchery technology or broodstock selection whereby, as R1 explained, NZKS “selects fish for rapid maturation by searching through the breed stock.” Likewise, NZKS could opt to deploy fish variously in different farms that had different biological characteristics. Feeding regimes are yet another lever for influencing maturation.

DEVELOPMENT OF NEW PRODUCTS

One strand of NPD at NZKS is the development of new products that meet market needs. Examples of these needs include simplicity (e.g., use by children) and convenience. Corporate clients (e.g., airline caterers) could have specific needs with regard to functionality (e.g., for the NZ food/quick-service market) or size, as R1 explained: “In the catering industry in New Zealand, there are some particular dimensions of sliced smoked salmon that some food-service operators need to have.”

From the perspective of value creation, an important class of new products derives from the innovative use of by-products. An example is cocktail nibbles that are obtained by smoking the fins of fish and packing them. Likewise, salmon tails are also now processed into smoked products. Mince that is made from fish frames is another example of by-product utilization.

Finally, a more minor form of NPD would be range extensions and/or development of variants (e.g., new pack-sizes).

DEVELOPMENT OF NEW PROCESSES

At NZKS, the development of new products is often accompanied by the development of new processes as well. An example of this is gravlax, wherein the salmon is marinated in the traditional Scandinavian manner in sugar, salt and spices and then flavoured with finely chopped green dill leaf. However, NZKS has come up with its own variants on that over the years, whereby there isn’t as strong a need to disguise the flavour with dill.

While process development is often driven by product development, the introduction of new process technologies can in turn also enable NPD. An example at NZKS is the deployment of automated cutting and slicing machines that were purpose-built by a local manufacturer for NZKS. Besides increasing product quality, labour efficiency, and yield, the machines “opened doors to different sliced configurations for customers,” as R3 put it. R4 cited this technology as an example of process innovation: “We took something, modified it, and made something in the top of the South Island [of NZ] that no one else was quite doing and that
was a step change in our view, in the quality of our slices… The innovation there was to change the actual cutting process.”

Process innovation can also arise independently of the development of new products. A good example is steam pasteurisation for which NZKS has filed patents. The benefits from steam pasteurization compared to the earlier practice of chlorinating fish in water baths include: labour efficiency; reduced input costs (i.e. no need for chlorine); improved health and safety; improved wholesomeness and food acceptability; increased naturalness of the process; and the elimination of risks that are associated with biological outbreaks as well as the resources that are needed to manage those risks.

Such innovations represent “step changes” that R4 explained “NZKS couldn’t have achieved … with continuous improvement, with operators concentrating more.” R1 described the continuous improvement programme at NZKS as finding “new ways of making the same product but in a more efficient or safer or more profitable [manner].” Several other more minor process developments were subsumed under the continuous improvement programme, such as in packaging/material-handling. For instance, NZKS has begun to use cardboard boxes in lieu of polystyrene bins to service some of its larger wholesalers for a variety of reasons that are not limited to cost-efficiency. Another example of a process development that could be subsumed under the umbrella of the continuous improvement programme is the use of electric forklifts in lieu of gas forklifts. The benefits from electric forklifts include a lower cost of operation, improved safety (no fumes), greater compactness, and greater versatility on site.

“PURE R” VS “D”

The relative expenditure on production research as opposed to developmental research is an interesting and strategic variable at NZKS. In the first instance, this question arises precisely from NZKS’s vertically integrated structure, namely, its ownership of both production and processing arms. Further, the two strands of research have somewhat (but not entirely) different drivers. Thus, one driver of production research at NZKS is the slow maturation of king salmon.

The seasonality of maturation cycles, when contrasted with the business imperative of year-round supply of immediate fresh chilled salmon, is another driver for production research. As R1 explains, “Unfortunately salmon being the biological organisms that they are, [they] have a season. What we are trying to do is either suppress the maturation so that we can harvest for a longer period of time or accelerate the maturation so that we can bring them into a time of the year when they wouldn’t normally be big enough or ready enough to harvest.”

Another interesting driver for production research is the very location at which such research adds value in the value chain: the fish farm. As R1 clarified, “If the guys on farms can do some research … to get their costs down, it will be benefit the rest of the supply chain. So if we start with a lower cost for material from which we want to develop new products, we are all better off.”

Interestingly enough, the very difficulty of producing raw material is also an impetus for developmental research at NZKS! While contrasting NZKS with other seafood companies that have easier access to raw material (e.g., by hunting and gathering), R2 observed, “I think [the reason] we invest so much in growing our product [is] there is quite a long cycle time involved - 18 months, 2 years 2 ½ years depending on which strategy your fish is coming out of the water. Then once it is out of the water, within a few hours you can destroy the value of that product. So we have needed to be quite smart in what we have done and the way we have developed the processes. And also there isn’t really anybody else doing what we are
doing in the way that we are doing it for us to look to and say, ‘Who is the leader and who should we follow.’ We have had to be quite creative ourselves. So, yield is very important to us because of the cost of getting the fish out of the water in the first place. There’s [quite a significant dollar amount per] kilo being invested into it and somebody can just lose [a sizeable percentage] by slicing it the wrong way.”

As a result of the high cost of the raw material, R3 observed, “There has been quite a push for looking at the by-product streams and trying to add value to those.” The high marginal returns of by-product derivatives (e.g. cocktail nibbles) are another incentive for increased utilization of by-products; R3 clarified that the input costs of these by-products “are carried by the [main] product stream and you can get gains there.”

As already noted, a general thrust for developmental research at NZKS is its focus on revenue/bottom-line growth in lieu of volume growth, reflecting, as R5 put it, the recognition that value-addition is the long-term “means to survival … in this kind of industry.” While R1 remarked that NZKS “have always had the same view and vision” with regard to the imperative and importance of developmental research, the realization of the vision could, in reality, be tempered by extraneous factors, such as industry recession.

**SUMMARY**

We have described value-chain innovation at NZKS in relation to production (of raw material, i.e., whole king salmon), processing, marketing, and distribution. NZKS would appear to be a particularly appropriate company to study given the business imperatives of investment in both production research and developmental research. On the other hand, industries that are characterized by a ‘hunting and gathering’ approach to catching fish may not invest as much in production research, continuous improvement programmes, or process innovation.

Another aspect that sets NZKS apart in terms of the intensity of its R&D effort relative to other NZ seafood companies is its focus on differentiation away from commodity markets. This focus is heightened by the prevalence of a related species that is considerably easier to farm (Atlantic salmon).

From our case data, we have induced a process model of value-chain innovation (the model is not shown here). The model clarifies how innovation and development (in the form of both production research and research into new product development [including by-product utilisation], besides process innovation and continuous improvement programmes) ultimately proceed from the competitive strategies of NZKS, and enhance the firm’s bottom-line performance. Such a model would be particularly relevant to integrated niche aquaculture firms, such Icy Waters Ld., which has become the premier Arctic char facility in the world (NRC, 2001). Thus, the case study of NZKS has the potential for analytic generalizability (Yin, 1994).

While developing a revised model of innovation success in low-tech companies (e.g., the food industry), Harmsen et al. (2000) elaborated on three types of company orientations (i.e., core competencies), namely, product, process, and market. They believed “a company will mainly be driven by one of the [three] orientations,” which would also influence and direct the acquisition of the remaining supplementary competencies (p. 159).

Our data from NZKS are seemingly discrepant with the findings of Harmsen et al. (2000) in that no one possible orientation is clearly more dominant than the other two; rather, the process and product orientations are intertwined. This departure in turn can be attributed to both the niche nature of the industry (i.e., king salmon as opposed to Atlantic salmon) and the
vertically integrated nature of the firm (which arose partly due to a lack of external competencies).

On the basis of the findings from NZKS, a few propositions may be tentatively advanced as a ‘takeaway’ for further research into seafood companies. Depending on the locus of a firm in the value chain, some propositions may not be appropriate, i.e., a company that solely harvests, say, mussels, may not engage in new product development that uses mussels as raw material.

1. Greater the strategic focus on differentiation away from commodity markets, greater the investment in new product development.
2. Greater the strategic focus on differentiation through quality and delivery reliability, greater the investment in new process development and continuous improvement.
3. Greater the cost of harvesting a unit of raw material, greater the investment in R&D in by-product utilization.
4. Greater the cost of harvesting a unit of raw material, greater the effort involved in the continuous improvement of processing and distribution.

[The following may be applicable only for aquaculture.]
5. Longer the maturation cycle of the species, greater the investment in production research for that species.
6. Greater the seasonality in the maturation cycle of the species, greater the investment in production research for that species.

REFERENCES


