A National Network for Advanced Food and Materials

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I will discuss how we've tried to link food, health and agriculture in Canada, which has been a challenge. The Networks of Centers of Excellence (NCEs) was a program established by the Federal Government in 1989 with the goal of mobilizing Canada's research capability. The government realized that, because the country is so broad geographically, a mechanism was needed to link expertise and build critical mass in certain areas to "mobilize Canada's research talent in the academic, private and public sectors and apply it to developing the economy and improving the quality of life of Canadians." Funding comes from the federal granting agencies that are equivalent to the NIH and the NSF in the United States—the Canadian Institutes of Health Research and the Natural Sciences and Engineering Research Council—as well as from the Social Sciences and Humanities Research Council, and Industry Canada, which is a federal government department with the mandate of adding economic benefit to Canada.

The NCEs are now focused on four broad areas (Fig. 1). I contribute to the *Advanced Foods and Materials Network* (AFMNet) under the aegis of *Health, Human Development and Biotechnology.* Because of the success of those original networks, the federal government has launched other multidisciplinary, sector-driven programs with the underlying theme of doing transformative research (*e.g.* Fig. 2).

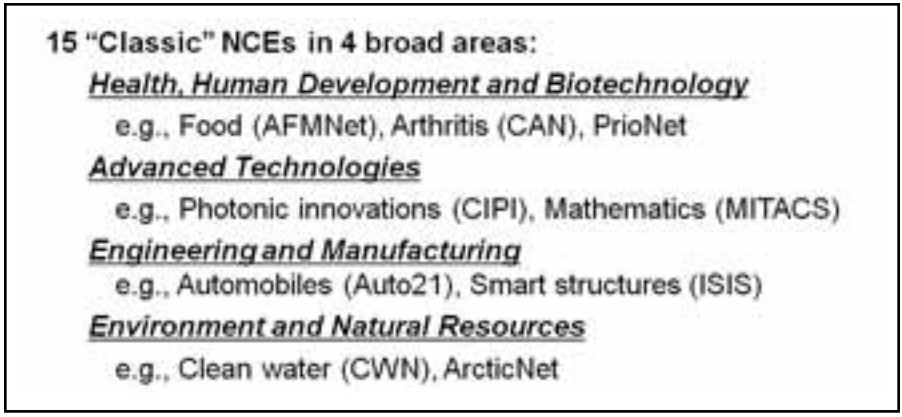

Figure 1. Networks of Centers of Excellence (NCEs):
Canada-wide networks linking universities, public and private sectors.

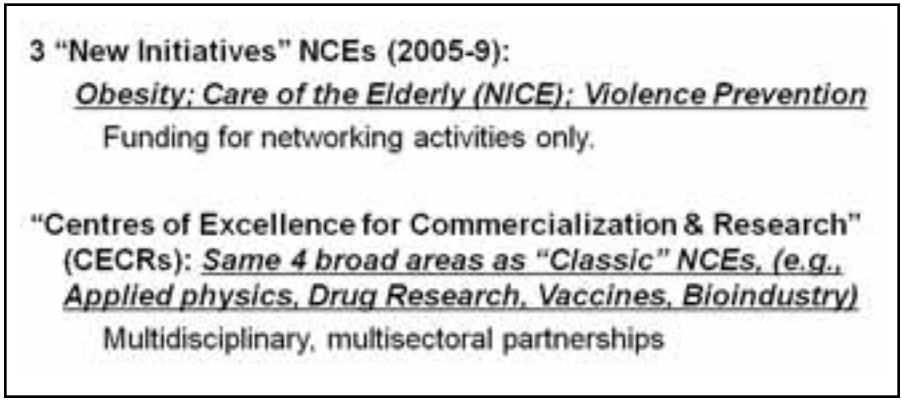

Figure 2. Other NCEs.

AFMNet

We submitted an application to the federal government for a multidisciplinary grant with the intent of bringing together researchers who traditionally hadn't worked together for a couple of days to develop a research project that was different from what we were already doing. Out of that process we received a million dollars to work on a project on biofilms, involving computer simulation, mathematical models, biochemistry, *etc*. This became one of the seeds for our network. Another contributory factor was a failed application; we applied to the provincial government for a broadly multidisciplinary grant, which, I believe, was ahead of its time. The application, written by food scientists and nutritionists, was reviewed by a medical panel whose view of food was simply something that you eat three times a day to satisfy requirements. At that time, there was a call for proposals by the

NCEs to build a program in food and health. Food was becoming increasingly important for the agricultural community in terms of how to add value; there was a surge of interest in functional foods and nutraceuticals; there was also a call for proposals involving social scientists. Our timing was good.

Also at that time, I was fortunate to sit on a Royal Society panel that looked at food biotechnology in Canada, the only food scientist on the panel of twelve, comprising ethicists, lawyers and ecologists. From that experience, I gained an appreciation of the importance of consumer and ethical issues, and the relevance of social science.

We submitted a successful application and began work in 2003. Networks of Centers of Excellence have a defined maximum lifetime of 14 years. We are in the process of finishing up our first 7 years and are applying for renewal. We get $5.6 million[1] a year from the program, which in some countries isn't a lot, but it helps leverage money, one of the intents of the network. It links academia, government, industry and not-for-profit organizations (Fig. 3). Seventy researchers are involved, at twenty-two Canadian universities. Our big claim to fame are the people involved, what we call "HQP" (highly qualified personnel), which includes students—undergraduate and graduate—post-docs and technical staff. We support 100 to 150 people and have forty-four industry partners. We have about $3.5 million dollars in cash or in-kind contributions as matching funds with the $5.6 million. Our federal and provincial governments are involved, as I said, as are some not-for-profits, and some foreign organizations are also involved. The whole intent is to build critical mass in specific areas.

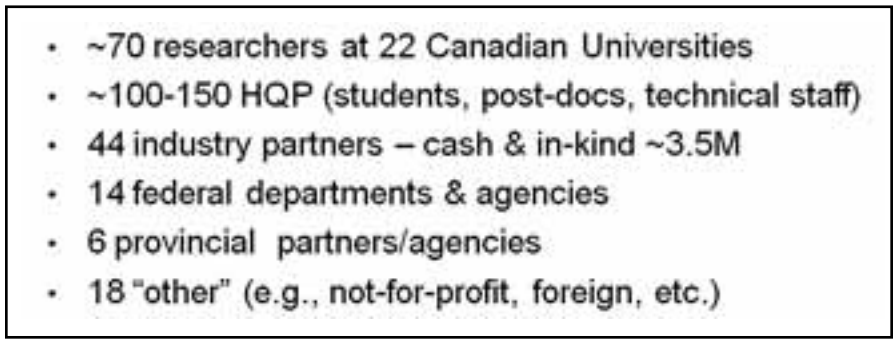

Figure 3. AFMNet NCE.

We started off with three interrelated topic areas, with the tag-line of "atom to application," *i.e.* using bench research to market commercially viable products or technologies (Fig. 4). We set up a topic specifically for social scientists—on regulation, policy and consumer health—with the rationale that if our products/technologies fail to meet regulatory approval then our research would have no tangible results. We engaged social scientists, ethicists and policy people from the outset in order to understand the challenges of getting over the regulatory hurdle.

[1]Dollar amounts in this chapter refer to Canadian currency.

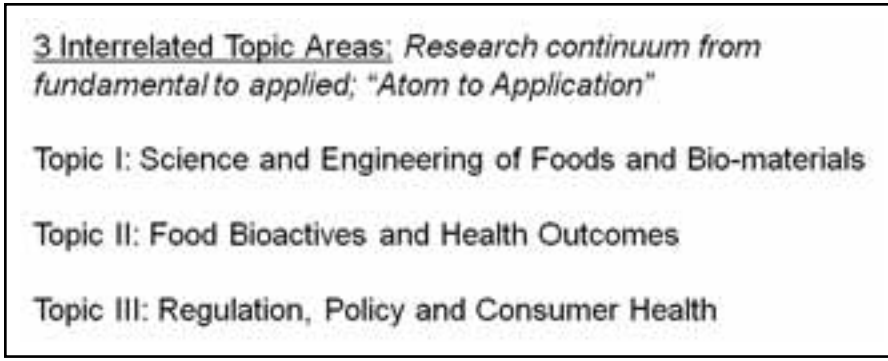

Figure 4. Original research programs.

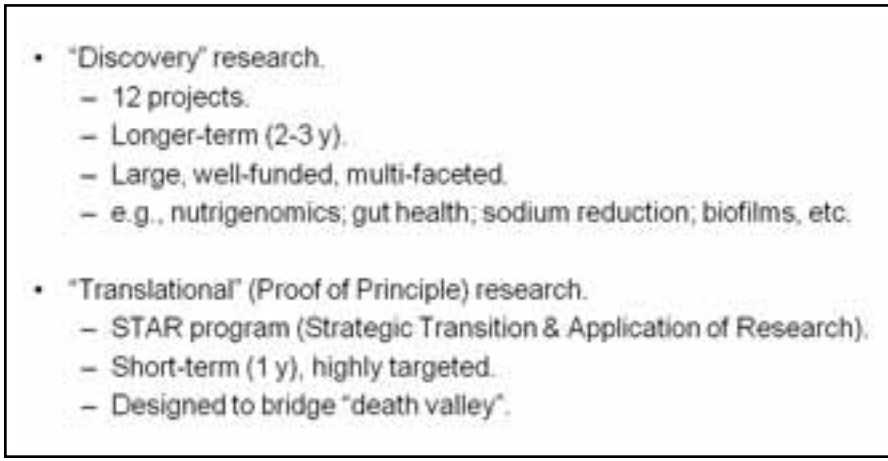

Figure 5. Research programs.

We have two major research programs (Fig. 5). "Discovery" projects have a 2–3 year lifetime, each with funding of ~$1 million dollars; current areas of focus are nutrigenomics, gut health, sodium reduction, biofilms, *etc*. The "Translational" program comprises Strategic Transition of Application of Research (STAR), which covers the proof-of-concept gap. Traditionally, funding agencies finance good fundamental science. On the other hand, industry often is looking for products or technologies to buy, whereas the developmental, proof-of-concept stage is unaddressed. It's a difficult area in Canada, as in other countries, for which we decided to provide funds.

Funding requirements are shown in Figure 6. Each project involves individuals from at least two disciplines—we encourage more—and two different organizations. Also required is a financial contribution from at least one partner who will be the receptor of the product potentially resulting for the research. As an example, a nutrigenomics project involving nano-encapsulation of folic acid fits these criteria: colleagues at seven institutions are collaborating, with funding from four partner companies.

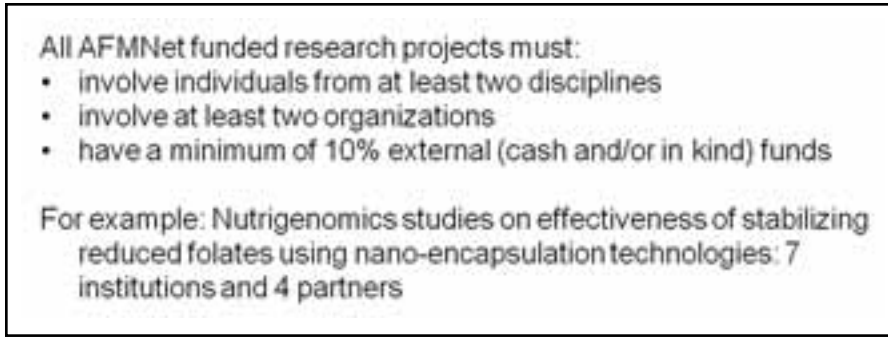

Figure 6. Funding requirements

Figure 7 lists some of our current projects, from polymorphisms to nutrigenomics, again biofilms, identification of bioactives, to sodium. Social scientists are involved in most of the projects, but we also have a specific social-science project, examining consumer issues. Led by a colleague of mine at the University of Guelph, Spencer Henson, they are monitoring 2,000 people in Guelph, who are demographically representative of the Canadian population. This consumer group is used to monitor progress and development in several of our projects. In the sodium project, for example, they were being used to determine what sort of platform consumers would be comfortable with.

Knowledge Transfer

Most university researchers are not interested in intellectual property (IP). They are passionate about doing research but, when it comes to protection of IP or commercialization issues, many will say, "Don't bother me with that. I need to get a paper out." Once a scientific discovery is announced at a conference or in a published article, it is publicly disclosed and companies will no longer be interested in developing it as a commercial entity. Another issue in Canada is that different universities have different IP policies. In some cases, the IP belongs to the university and sometimes the IP belongs to the individual researcher. At Guelph we just transitioned from university-owned to investigator-owned. We learned this lesson from the University of Waterloo, where the Blackberry originated. They returned IP back to their faculty, which has benefited the university in spades. Also, IP is valued differently by tenure and promotions committees at different institutions; how many published papers are equal to a patent?

One of the things we have done for our network is to introduce an educational program called R2B, *Research to Business*. A team of experts holds workshops—a venture capitalist, a scientist turned entrepreneur, an IP/patent lawyer, a financial expert, a person from the University-Industry Liaison Office, and a business development director—organizes workshops to educate our researchers and our HQP on these issues. Most interest is shown by our students and postdocs because they are more open to opportunities to take their research to the next step.

Do apolipoprotein E polymorphisms influence risk of cognitive decline by modulating omega-3 fatty acid metabolism?	Melanie Plourde Stephen Cunnane
Engineering the oil binding capacity and rheological properties of nanocrystalline fat networks structured using high shear fields under non-isothermal conditions	Gianfranco Mazzanti Alejandro Marangoni
Examining the impact of diet and the intestinal microbiome on gut health and general well-being	Brent Selinger Martin Kalmokoff
Nutrigenomic studies on the effectiveness of stabilizing reduced folates using nano-encapsulation technologies	David Kitts
Bacteria Biofilms and Foods: Nanotechnology-based strategies for the detection, characterization and remediation of bacterial contamination of foods and food processing surfaces	John Dutcher
Biopolymer based controlled release systems for biomedical applications	Wankei Wan
Creation of a new fish-peptide/n-3 PUFA-based functional food for the treatment of obesity and type 2 diabetes moving towards nutrigenomics-based personalized nutritional interventions	Andre Marette
Dietary peptide- and amino acid-based interventions to improve human gut health and immunity	Yoshinori Mine
Salt, science and society - a collaborative approach to salt reduction in processed foods	Derick Rousseau
The AFMNet Consumer Monitor: Tracking consumer attitudes towards new products for health and wellbeing in Canada	Spencer Henson
The traceability and authenticity of foods from analytical and consumer perspectives	Nicholas Low
Toronto nutrigenomics and health study	Ahmed El-Sohemy

Figure 7. Discovery projects—2009

STAR Program

The STAR program is basically proof-of-concept funding at up to $150,000 per year, to act as seed money (Fig. 8). Some of our STAR projects are listed in Figure 9. Bioactives and polysaccharides are going to be used as platforms, hopefully for nutrient delivery. Other projects cover shellfish poisoning on the east coast of Canada to value-added processing of wheat bran.

- Exploit research results and developments (IP) that promise to advance knowledge and technology transfer in emerging areas related to foods and bio–materials research by supporting Proof of Principle and Knowledge Mobilization projects which are of benefit and relevance to the social and economic health of Canada
- Funding up to $150,000/project (1 year) is available

Figure 8. Strategic Transition and Application of Research (STAR) Program.

Mine	Identification of bioactive peptides in egg yolk digests
Aluko	Antihypertensive properties of novel pea protein hydrolysate product
Nelson	Molecular and biological approaches for improved prediction and control of post harvest decay in pome fruit
Fudge	Manufacture of high performance renewable fibres from hagfish slime thread
Dutcher	Highly branched bacterial polysaccharides that assemble into nanospheres with unusual surface properties
Gill	Bacterial destruction of amnesic shellfish toxin
Guzman	Nutrigenomic approach to understanding cardioprotective mechanisms
Friel	Bioactives in human milk
Vasanthan	Value added processing of wheat bran

Figure 9. STAR Projects.

We also have a targeted program in which rapid infusions of $150,000 are available to quickly address emerging issues. Matching industrial funds of 20% are expected. The first request for proposals was for the development of a "DNA barcode" system for identification and authentication purposes. For example, work by the FDA and the Canadian Food Inspection Agency has revealed that 20% of tuna sold in Japanese restaurants is actually tilapia.

Business Model

Something that may be foreign to academics is our adoption of a business model, which is a combination of "blue sky"[2] and strategic research, using a highly consultative process to determine our theme areas. Early engagement of our public and policy researchers is critical. A request for quarterly reporting was very unpopular with researchers. However, we developed a relatively easy on-line system comprising ten questions, to provide a sense of how projects are progressing and, thus, facilitate success. And we can use it punitively, if we have to. We strongly encourage regular meetings with partners, with reports back to us. This system allows us to make early "go"/"no go" decisions. As in the business world, if failure is inevitable it is better to fail early because diligence is required on how we spend our money. Sustainability is also part of the business plan: can the network be maintained without the lifeline of funding from the government?

Governant Structure

I chair the research-management committee, which looks after the day to day operations (Fig. 10) and I report to a board of directors, comprising a variety of people including venture capitalists. An international scientific advisory board has been wonderful in providing insight into topical areas, including identification and authentication.

Figure 10. Network governance.

Improving Communications

Communications have been a subject for discussion at this conference. You can write an excellent grant to finance scientific research, but unless political elements are addressed, successful funding may be elusive. We took it upon ourselves to engage in an active outreach program through communication by producing a magazine, *ADVANCE*, which achieves several things. It engages journalism students in helping us to write about the research

[2]Research that has no immediately apparent commercial applications.

that we do as a network, and convey it to the public. I often say that one of my greatest challenges as a scientist is telling a class of grade-3 students what I do as a scientist, in language that they understand. Our intent with this magazine is similar. We send it to our members of parliament, our Senate members, our provincial partners, and all of our NGOs and researchers, with the intent of educating people on our activities, including helping our politicians understand what we are doing as a network.

We also work with a number of groups, including dieticians, the George Brown Chef School in Toronto, and healthcare providers. In conjunction with the George Brown School a 2–3-day workshop has been developed for family physicians and research chefs. The intent is for physicians to understand the components that contribute to food's nutritional quality and functionality because nutrition education is missing from many medical curricula.

We are working also with the Canadian Medical Association and have an insert in their magazine, *Health*. The mother of one of our scientists saw this magazine in her family doctor's office and reported, "Oh, I read about your research"; *Health* had replaced a 5-year-old *National Geographic* magazine in the waiting room. However, this was a tough nut to crack. The concept of using food as a preventative measure rather than as disease-treatment mechanism was something that the Canadian Medical Association apparently viewed as a challenge to future employment.

Figure 11. International Food Research Collaboration—objectives.

We launched the International Food Research Collaboration (Fig. 11) at the 2009 Institute of Food Technologists meeting. This fosters partnerships around the world, allowing access to information and sharing resources; it's a portal, providing access to the R&D community globally to find out who's doing what, strategic directions, potential synergies and, hopefully, reducing redundancies which otherwise are common. Wouldn't it be nice if we all collaborated, particularly in terms of research and training? Our initial members are in Australia, New Zealand, Greece and other countries in Europe, and Japan (Fig. 12). At a recent meeting in Paris, we talked to a number of potential partners and we are in discussions with a biocluster in Japan. We welcome other partners in this international endeavor.

Figure 12. International Food Research Collaboration—early members.

Strategic Directions

Food and health are our primary considerations as are nanoscale science and technology, traceability/authenticity, and the all-important regulatory aspects and consumer attitudes. Figure 13 illustrates how we view our organization, as a facilitator and a portal.

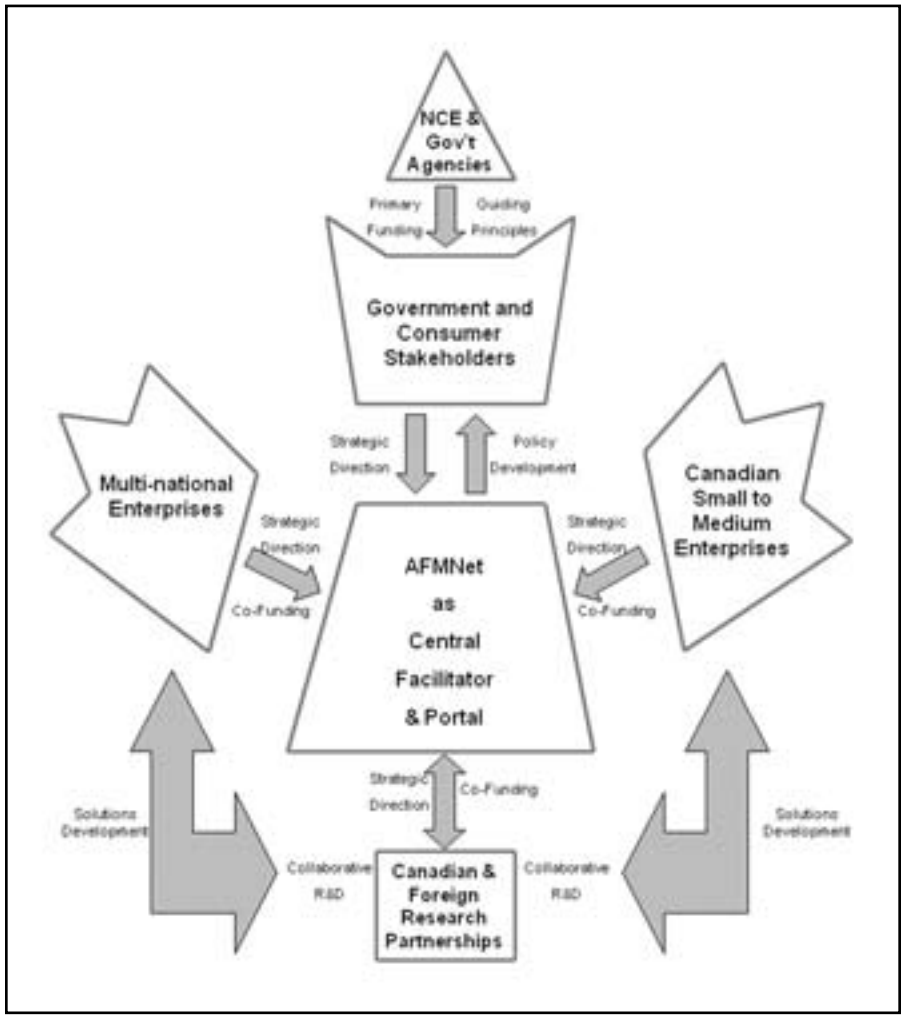

Figure 13. AFMNet's strategic role.

Rickey Yada received his PhD from the University of British Columbia in 1984. He has been a faculty member at the University of Guelph since that time, serving as chair of the Department of Food Science and as the assistant vice president for research in agri-food programs. He is a professor in the Department of Food Science, has a Canada Research Chair in food protein structure, and is the scientific director of the Advanced Foods and Materials Network.

Dr. Yada has served on numerous research awards panels and committees. Among other activities, he is on the Nanoscience Advisory Panel for IFT, is former president of the Canadian Institute of Food Science and Technology and the chair-elect for the Scientific Council of the International Union of Food Science and Technology. He was editor-in-chief of the *Food Research International Journal* from 1992 to 1998, is the North American editor for *Trends in Food Science and Technology* and serves on editorial boards for several other journals.

Yada has authored over 140 refereed publications and several book chapters. He is a fellow of the Canadian Institute of Food Science and Technology and of the International Academy of the International Union of Food Science and Technology.