

CONVERGENT INNOVATION

*Modular Platforms for Scaling up What Packaging can
Contribute to Business Competitiveness and Healthy Diets
from Sustainable Food systems*

Laurette Dube

with Technical insights from Claire Sand, Packaging Solutions Inc. &
Strategic Business Insights from Enderson Guimaraes, Refresco Group

October 24 2019, Zurich
Food Packaging Forum



McGill

Centre for the Convergence
of Health and Economics

Agenda

- Convergent Innovation in the agri-food sector (product formulation, branding and ecosystem)
- Translational science foundations
- Use Case: Building supply and demand for food packaging solutions to endocrine disruption effects of BPA on child brain development for lifelong wellness



Food Convergent Innovation (FCI)

Transformational discovery & innovation platforms converging across disciplines and sectors, fostering the production, promotion and consumption of foods & beverages that sustain the health of the economy through the health of people and the health of the planet.

Laurette Dube et al, September 11 2019

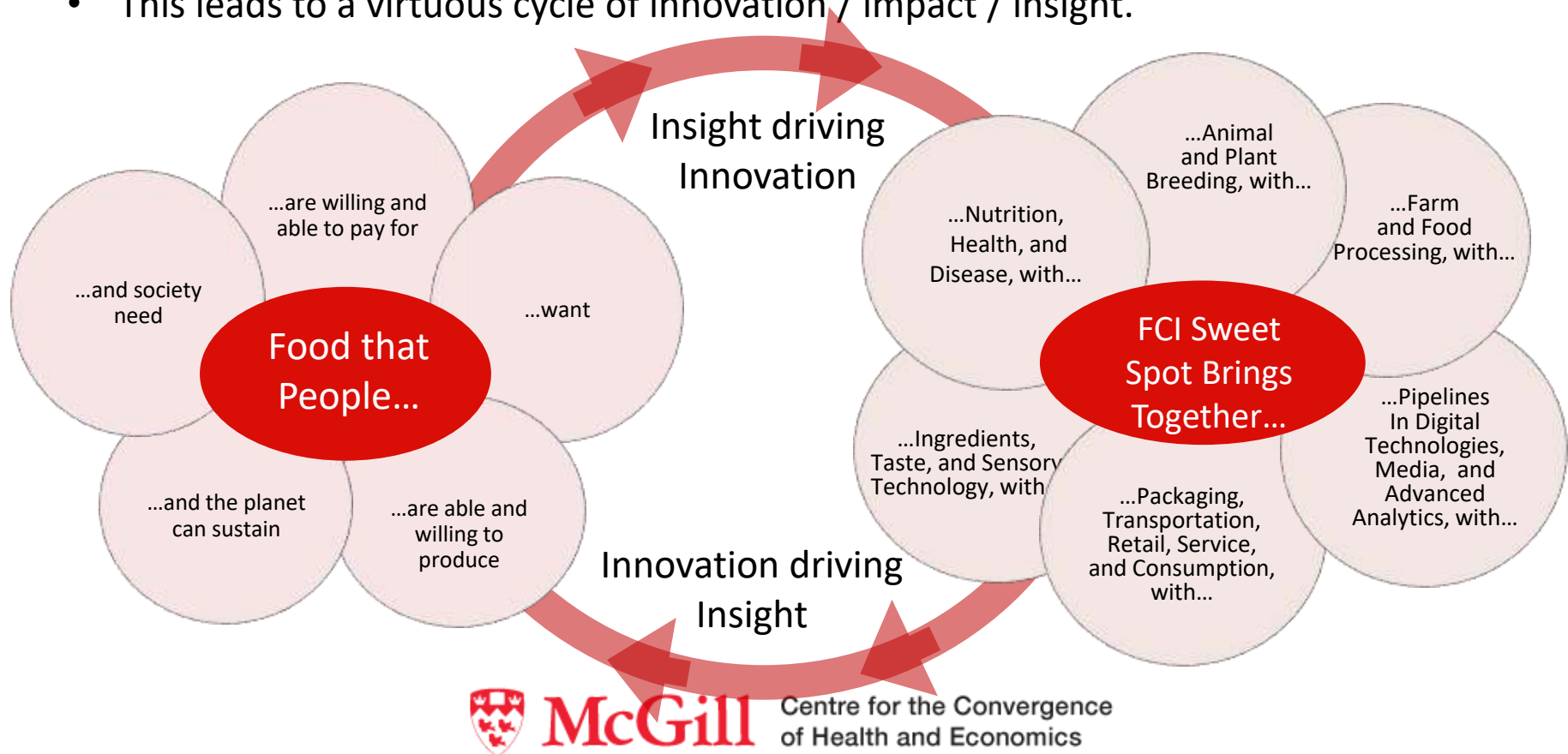


McGill

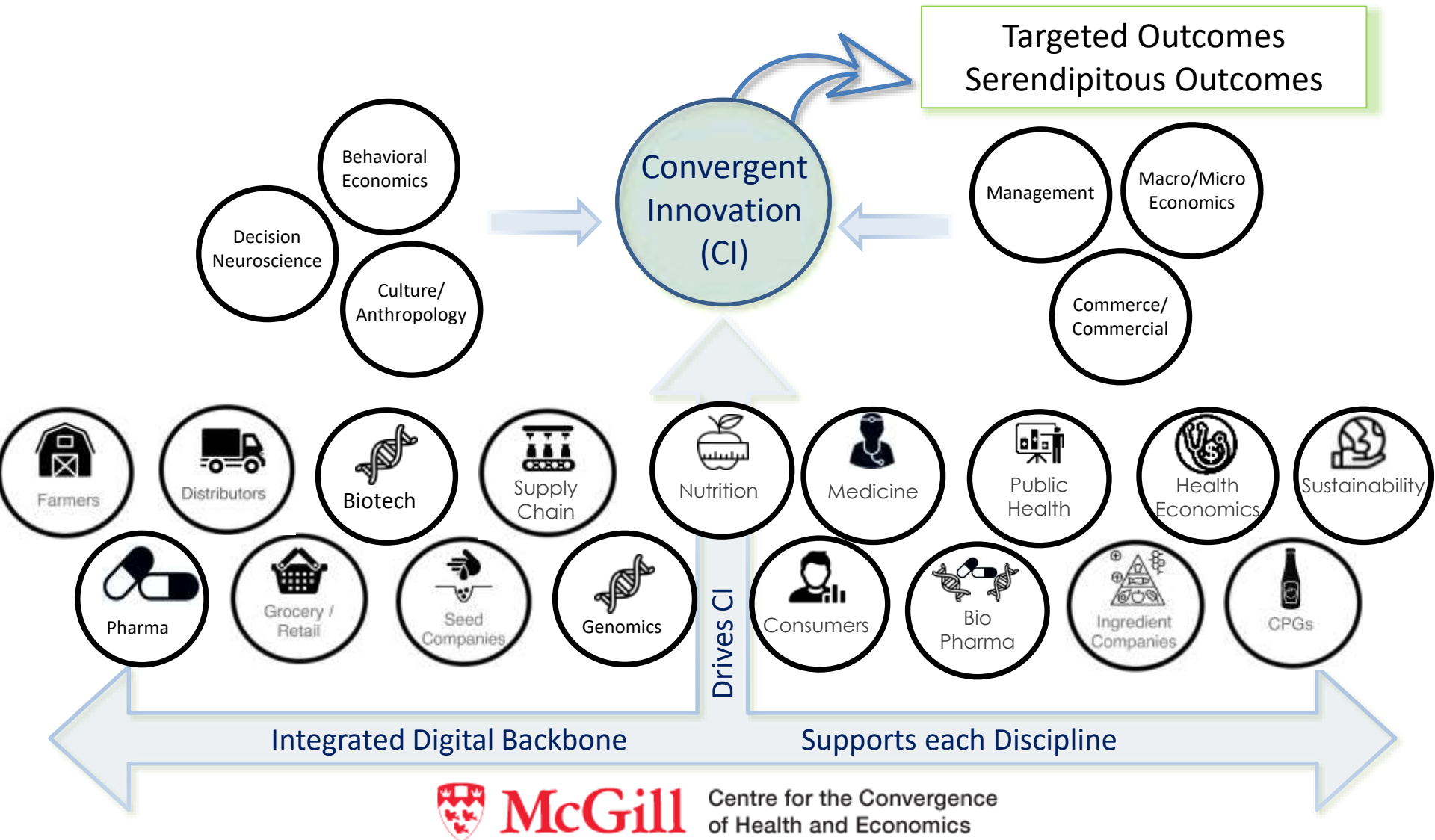
Centre for the Convergence
of Health and Economics

FCI is a behaviorally informed and AI-powered innovation approach that fosters a virtuous cycle centered on food at the convergence sweet spot

- Utilizing AI and other digital technologies facilitates, expands, and accelerates innovation for new products and new diets that hit the Food Convergent Innovation (FCI) sweet spot.
- This leads to a virtuous cycle of innovation / impact / insight.



Driving Convergent Innovation Through Modular Projects for Lasting Supply and Demand for Real World Solutions

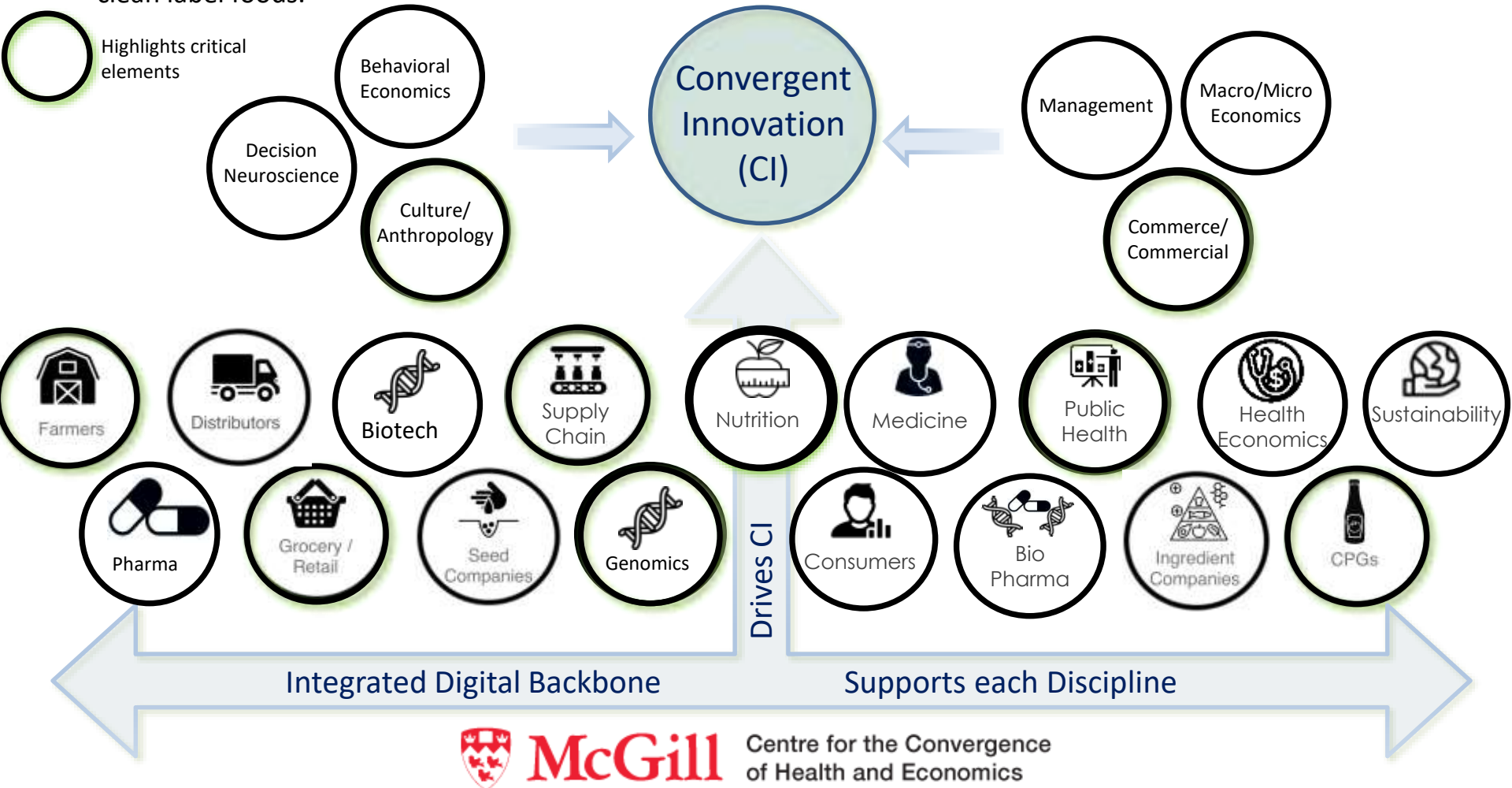


McGill

Centre for the Convergence
of Health and Economics

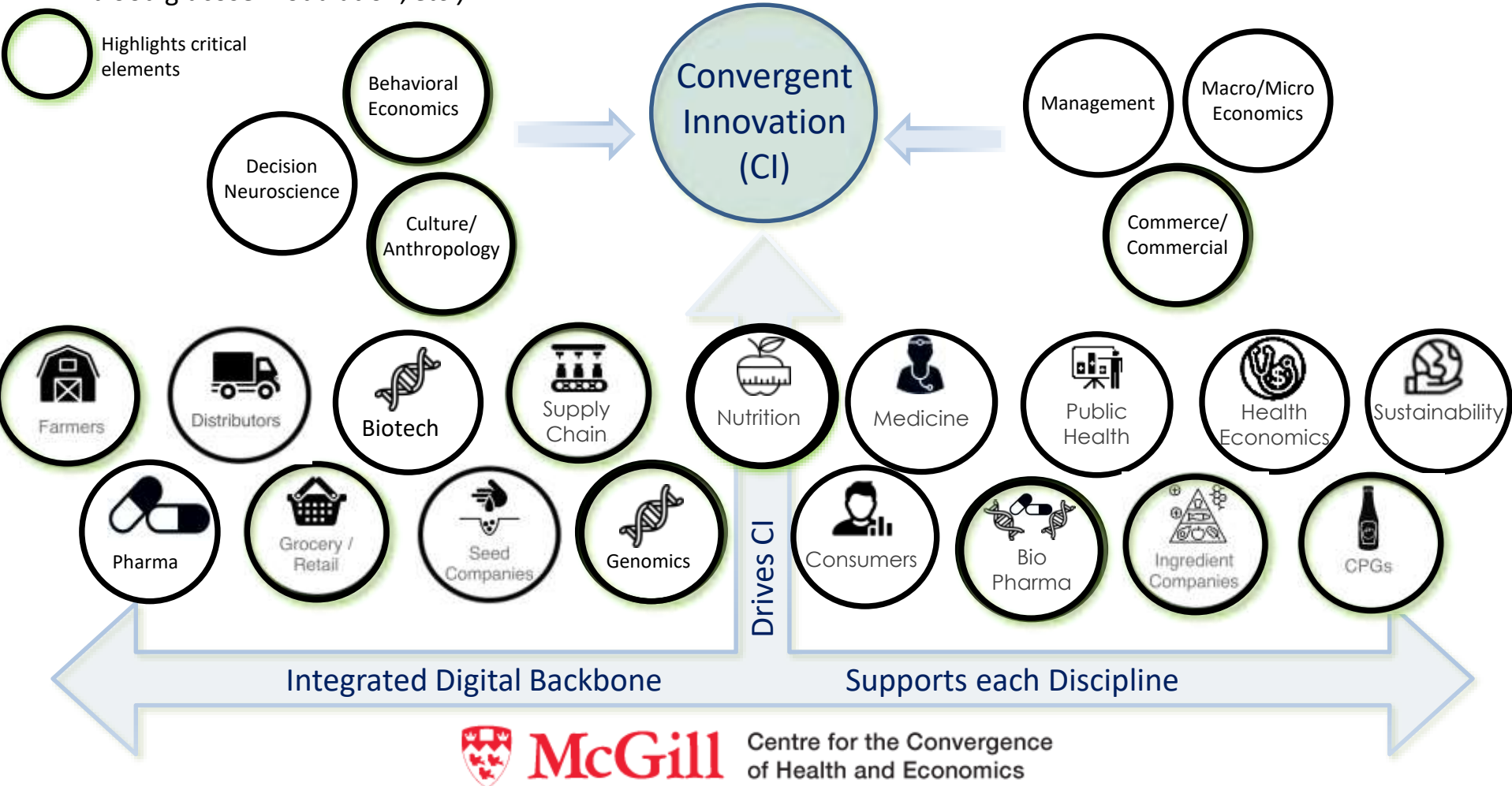
Case Study FCI-Quebec: Inventory of natural ingredients allowing a clean label with improved shelf-life and food quality.

Shared information across food industry sectors (dairy, bakery, meat, ingredients, fruits and vegetables, *etc.*) mapped needs to available and novel natural ingredient and process solutions, enabling extended shelf-life for clean label foods.



Case Study: Chewpod delivery system with natural ingredients lead to product innovation in functional chewable category

Using Chewpod patented delivery systems and partnering with other food/ingredient companies, developed new Food/Natural health products delivering bioactives for oral absorption for targeted consumer benefits (anti-stress, blood glucose modulation, *etc.*)



Pepsico: Reduction of Share of Legacy Brands to 10% of Global Business with Award-Winning Sustainability Strategy (Mehmood Khan, 2019, former Pepsico Vice Chairman)



delve

McGill | DESAUTELS



McGill

Centre for the Convergence
of Health and Economics

The Time May be Ripe for Bridging Investments and Innovation on Both Sides of the Social/Commercial to Build Supply and Demand for Healthy Foods and Diets Around the World



McGill

Centre for the Convergence
of Health and Economics

Mother Food International: A Global Enterprise of Local Businesses for Economically Viable Solution to Mother and Child Nutrition

MotherFood[®]
international

2016

MotherFood International is dedicated to nourishing pregnant and lactating women and their infants



McGill Centre for the Convergence of Health and Economics

MotherFood[®] Partners & Advisors:

Strategy: McGill Centre for the Convergence of Health and Economics McKinsey & Company

Nutrition: Pulse Canada sight and life gain

Data: DataKind SOLVE for INTERESTING

Product Development: Jockey Rose Hill ACQUADE INTERNATIONAL RGC COFFEE GUTTA PIPPO

Flavors: JOE & BEEF COFF FIRMENICH

McGill Centre for the Convergence of Health and Economics

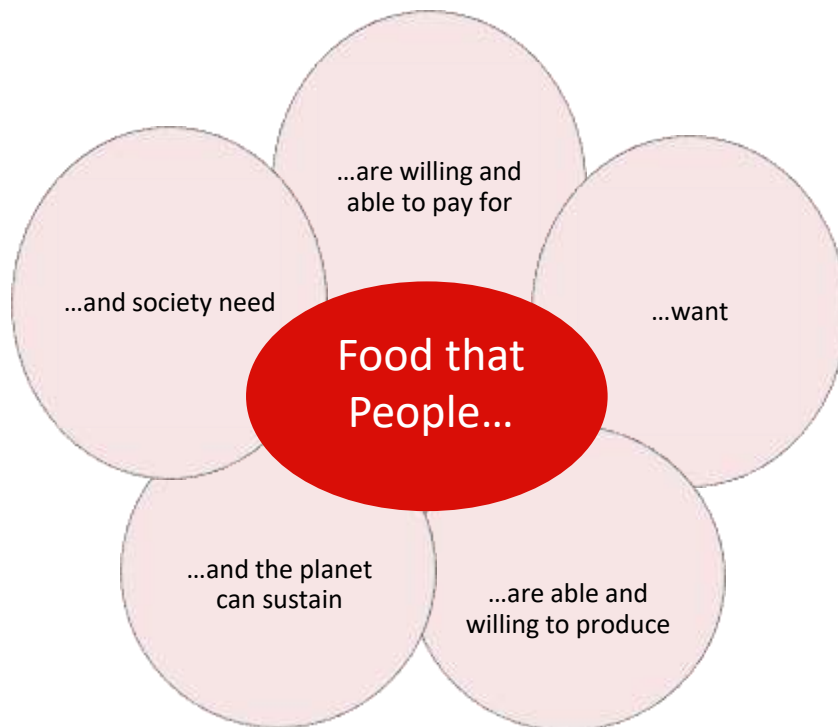


McGill

Centre for the Convergence of Health and Economics

Canada Food Policy: Innovating, Branding and Commercializing Agri-Food Products, Processes and Systems at the FCI Sweet Spot on Domestic and International Markets

FCI SWEET SPOT



BRAND CANADA

It is about understanding & leveraging the claims behind "the brand"

Trusted
Safe *Quality*
Sustainable
Reliable
Clean

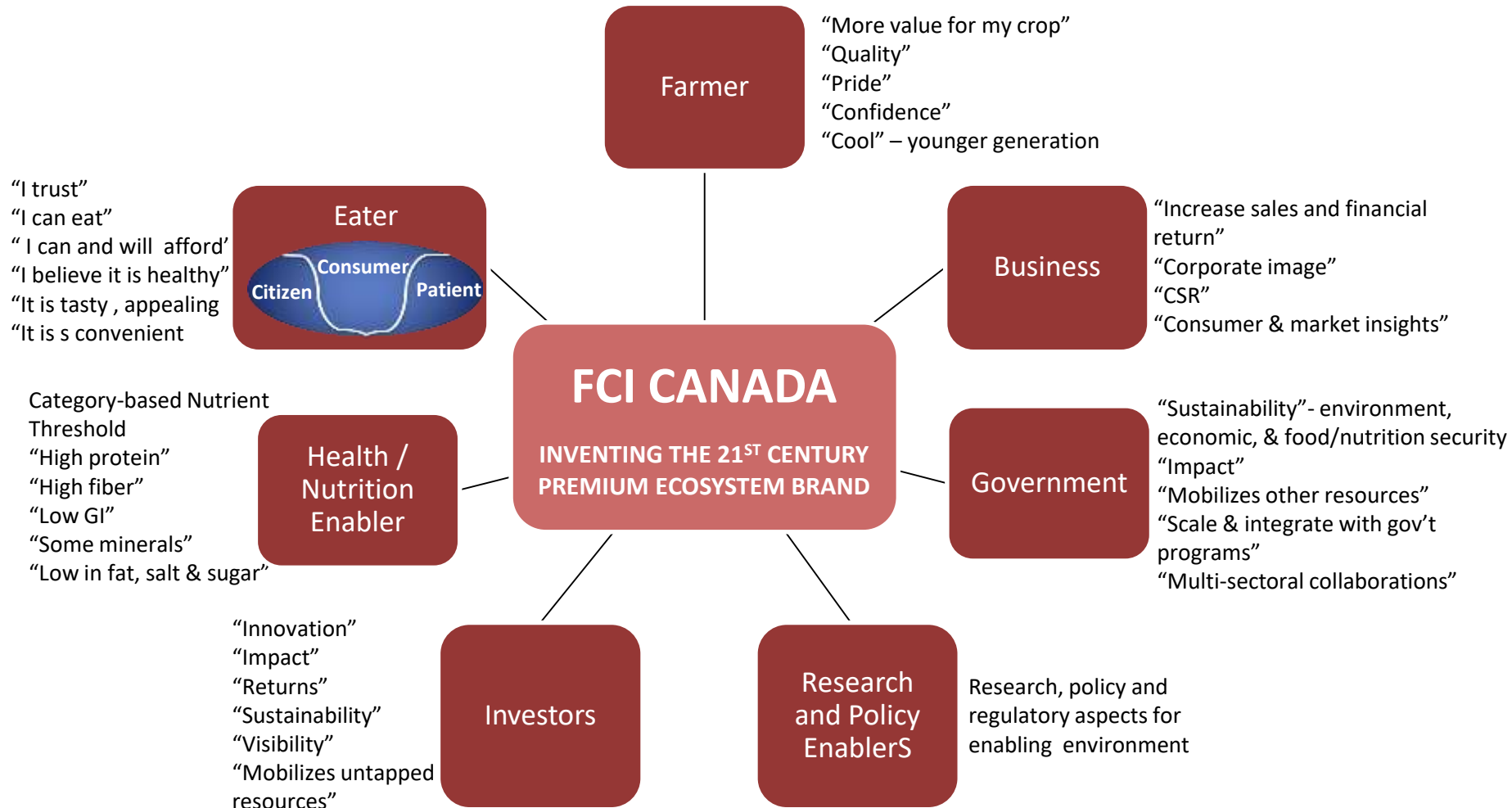
Canada food brand project



McGill

Centre for the Convergence
of Health and Economics

A 21ST CENTURY PREMIUM ECOSYSTEM BRAND FOR INDIA AND THE REST OF THE WORLD



We are building the food convergent innovation ecosystem from a robust base - initially 3 core capabilities with a variety of partners in a connected world.

- There are a number of ongoing initiatives, cross-leveraging learnings from each.

Capabilities	Partners	Geographies
Integrative Digital Backbone (Connect People, Organizations, Knowledge, and Data) Behavior-Context-Market-Industry Insights and Trends, Research (S&T) Support (Precision Retailing) Industry, technical and strategic advice & support to action (FCI Grand Support Accelerator)		FCI Global
	Academic Partners Digital & Data Partners Action Partners	FCI Canada
		FCI Quebec
		FCI Montreal
		FCI Ghana
		FCI India



McGill

Centre for the Convergence
of Health and Economics

Translational Science Foundations



McGill

Centre for the Convergence
of Health and Economics

Breaking the 1st Industrial Revolution Codes for Economic and Social Value Creation and Breaking Complexity in 4th Industrial Revolution Bite-Size Action

ANNALS OF THE NEW YORK ACADEMY OF SCIENCES

Issue: *Paths of Convergence for Agriculture, Health, and Wealth*

Convergent innovation for sustainable economic growth and affordable universal health care: innovating the way we innovate

Laurette Dubé,^{1,2} Srivardhini Jha,^{2,3} Aida Faber,^{1,2} Jeroen Struben,¹ Ted London,⁴ Archisman Mohapatra,⁵ Nick Drager,^{2,6,7} Chris Lannon,² P. K. Joshi,⁸ and John McDermott^{8,9}

This paper introduces convergent innovation (CI) as a form of *meta-innovation*—an innovation in the way we innovate. CI integrates human and economic development outcomes, through behavioral and ecosystem transformation at scale, for sustainable prosperity and affordable universal health care within a whole-of-society paradigm. To this end, CI combines technological and social innovation (including organizational, social process, financial, and institutional), with a special focus on the most underserved populations. CI takes a modular approach that convenes around roadmaps for real world change—a portfolio of loosely coupled complementary partners from the business community, civil society, and the public sector. Roadmaps serve as collaborative platforms for focused, achievable, and time-bound projects to provide scalable, sustainable, and resilient solutions to complex challenges, with benefits both to participating partners and to society. In this paper, we first briefly review the literature on technological innovation that sets the foundations of CI and motivates its feasibility. We then describe CI, its building blocks, and enabling conditions for deployment and scaling up, illustrating its operational forms through examples of existing CI-sensitive innovation.



McGill

Centre for the Convergence
of Health and Economics

Convergent Innovation (CI)

Integrated Target Outcomes:
Economics - Equity - Social - Health - Environment



- CI framework bridges science, policy, and action through digital innovation, human agency, and social capital to alleviate the constraints and accelerate real world solutions to grand challenges through convergence:
- between natural, life, social and engineering sciences that historically have had each of these spheres as respective domains;
- between health, social, and economic systems that still divide modern society in structuring how science is translated into products, services, programs or other innovations to support individual and society;
- between public, private and civil society actors in each of these systems;
- between the various scales at which mechanisms, actors, and institutions are operating.



Bringing Systems Sciences to Embrace Some of the BtS Complexity of Real World Behavior

A systems science perspective and transdisciplinary models for food and nutrition security

Ross A. Hammond^{a,1} and Laurette Dubé^b

^aCenter on Social Dynamics and Policy, The Brookings Institution, Washington, DC 20036; and ^bMcGill World Platform for Health and Economic Convergence, McGill University, Montreal, QC, Canada H3A 1G5

Edited by Prabhu Pingali, Bill and Melinda Gates Foundation, Seattle, WA, and approved March 30, 2012 (received for review June 10, 2011)

We argue that food and nutrition security is driven by complex underlying systems and that both research and policy in this area would benefit from a systems approach. We present a framework for such an approach, examine key underlying systems, and identify transdisciplinary modeling tools that may prove especially useful.



Complexity and Systems Science Framework for Food Choice, Eating Behavior and their Environmental, Health and Economic Outcomes

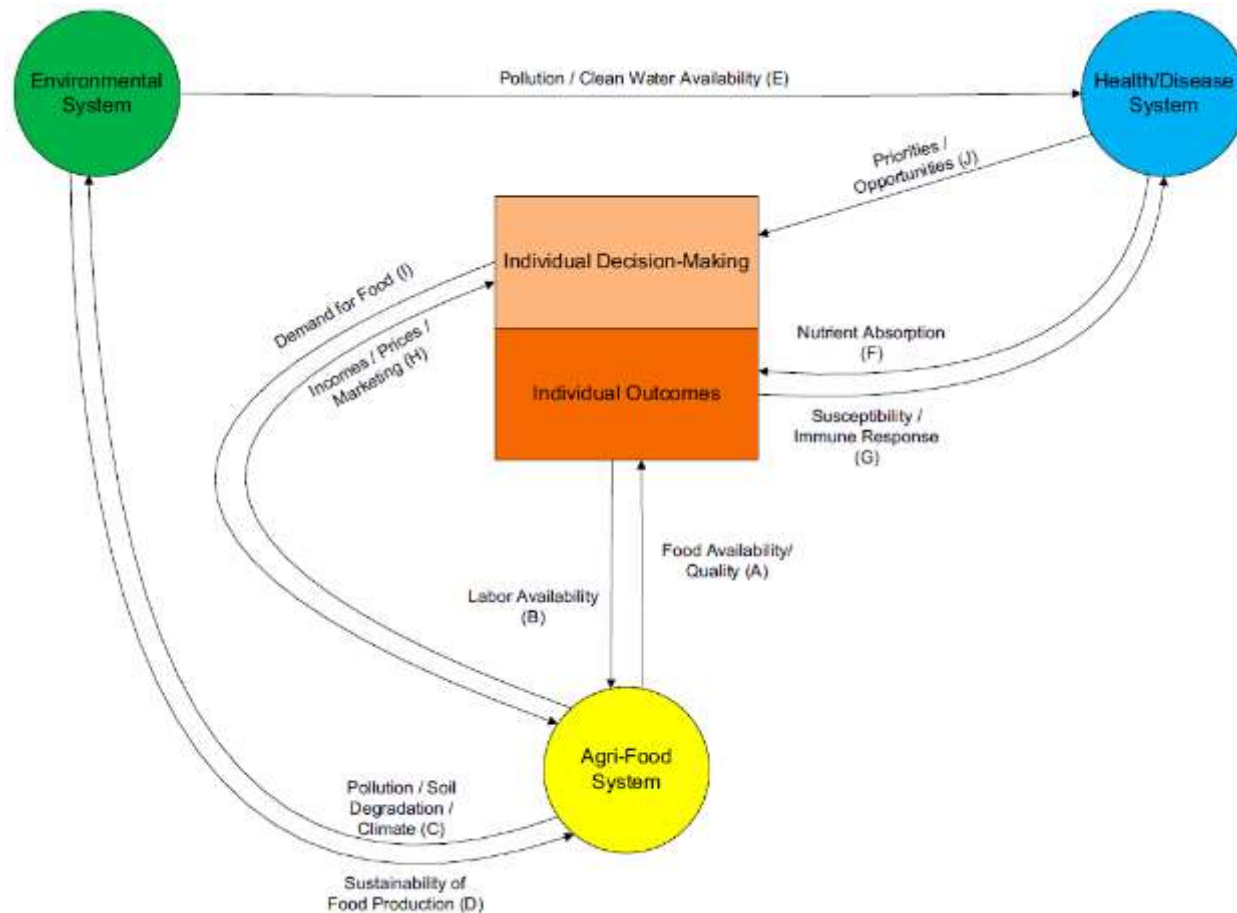


Fig. 1. A systems framework for food and nutrition security.

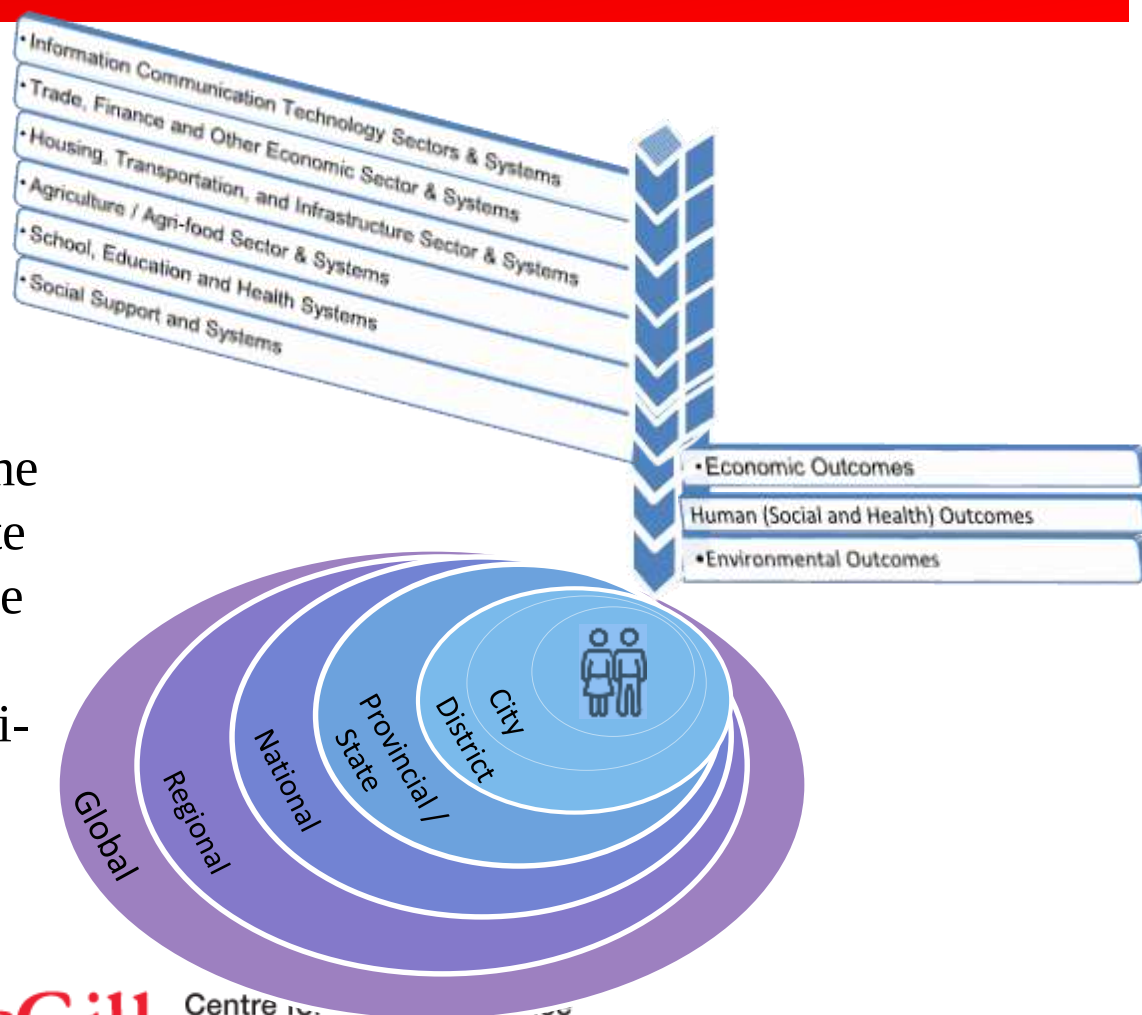


McGill

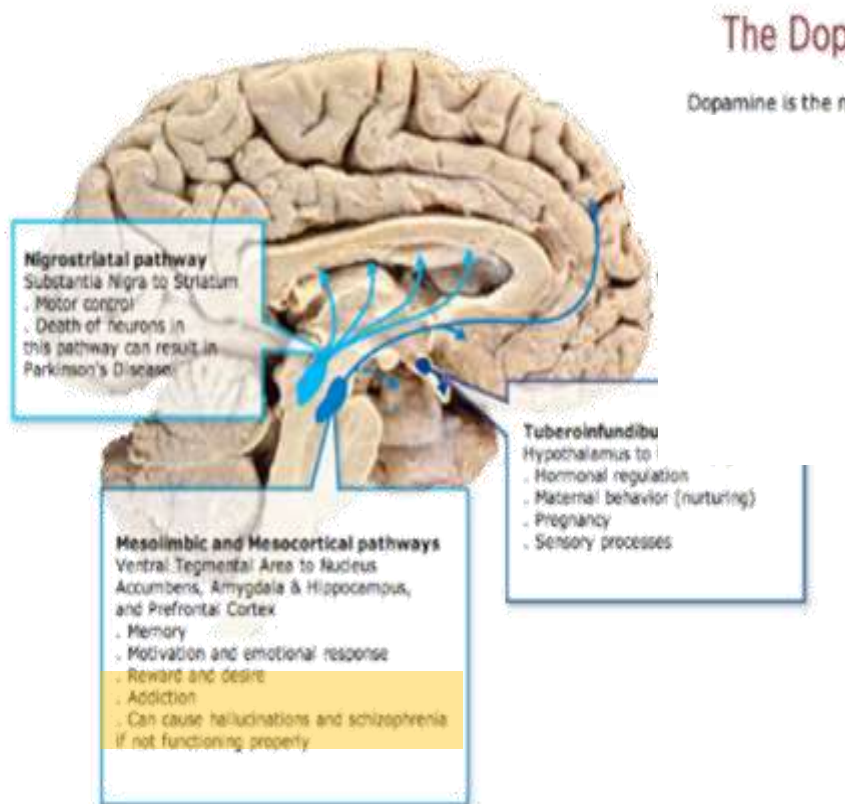
Centre for the Convergence
of Health and Economics

Convergent Innovation: Keeping Individuals at the Center of MultiScale Social and Economic Innovation, Operation and Policy Systems that Individually and Collectively Target Convergent Outcomes

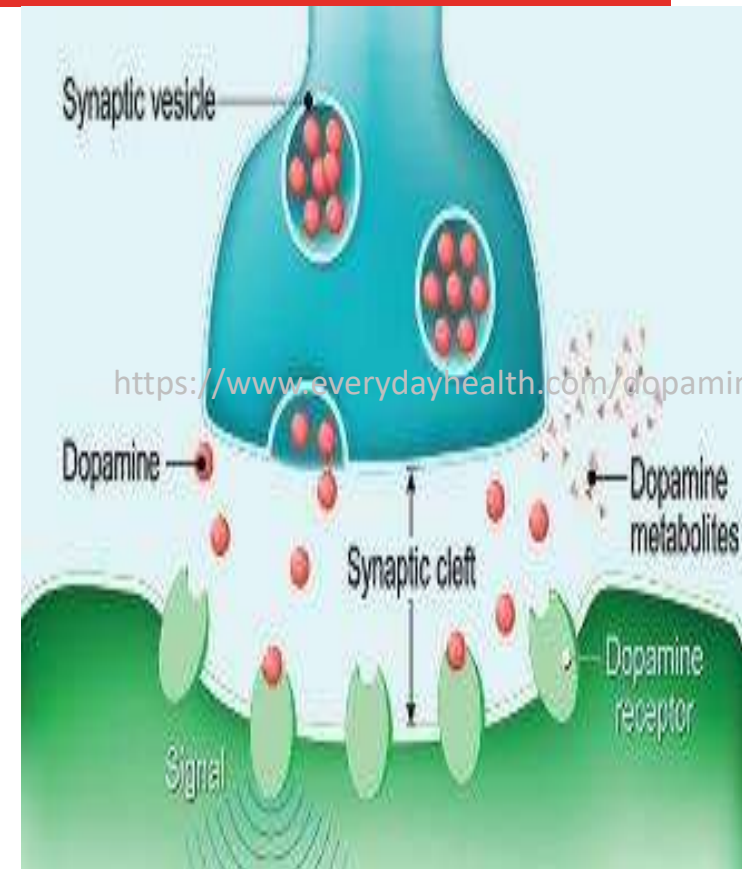
- The complexity is clear.
- The solution is not to solve for all variables at once but rather to converge on those areas where we have clear strength, experience, current capability and a right to win, allowing time for development of the requisite knowledge in those areas where these are lacking.
- The long term vision is a multi-level ecosystem system for convergent innovation



Dopaminergic Gene and Brain Systems as Regulators of Behavioral Responses to Internal and External Environment



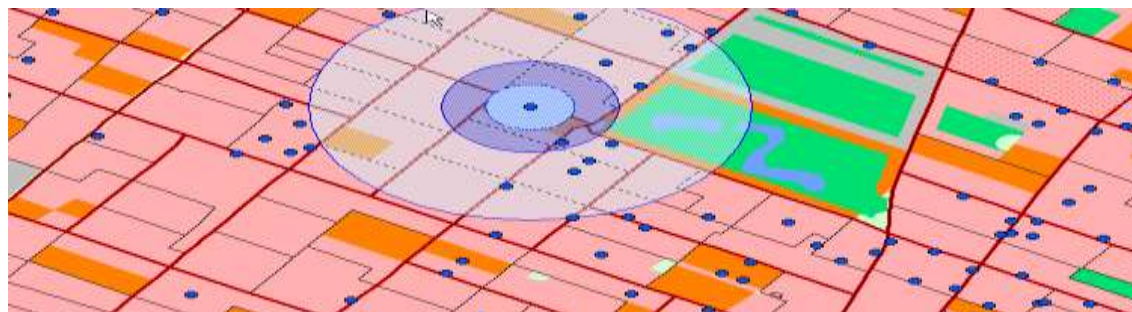
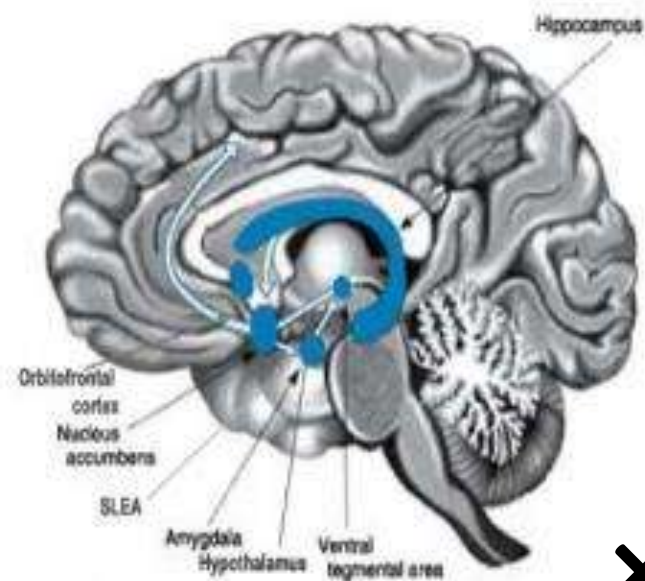
<https://medlibes.com/entry/dopamine-pathways>



McGill

Centre for the Convergence
of Health and Economics

Food Choice and Eating as Neurobehavior: Characterizing and Improving Real World Environment



McGill

Centre for the Convergence
of Health and Economics

Building Supply and Demand for Real-World Solutions to Endocrine Disruption Effect on Child Brain Development



Endocrine Disruptors

Thaddeus T. Schug, Anne F. Johnson, Linda S. Birnbaum, Theo Colborn, Louis J. Guillette, Jr., David P. Crews, Terry Collins, Ana M. Soto, Frederick S. vom Saal, John A. McLachlan, Carlos Sonnenschein, and Jerrold J. Heindel

Within the past few decades, the concept of endocrine-disrupting chemicals (EDCs) has risen from a position of total obscurity to become a focus of dialogue, debate, and concern among scientists, physicians, regulators, and the public. The emergence and development of this field of study has not always followed a smooth path, and researchers continue to wrestle with questions about the low-dose effects and nonmonotonic dose responses seen with EDCs, their biological mechanisms of action, the true pervasiveness of these chemicals in our environment and in our bodies, and the extent of their effects on human and wildlife health. This review chronicles the development of the unique, multidisciplinary field of endocrine disruption, highlighting what we have learned about the threat of EDCs and lessons that could be relevant to other fields. It also offers perspectives on the future of the field and opportunities to better protect human health. (*Molecular Endocrinology* 30: 833–847, 2016)



Endocrine Disruptors: Past Lessons and Future Directions

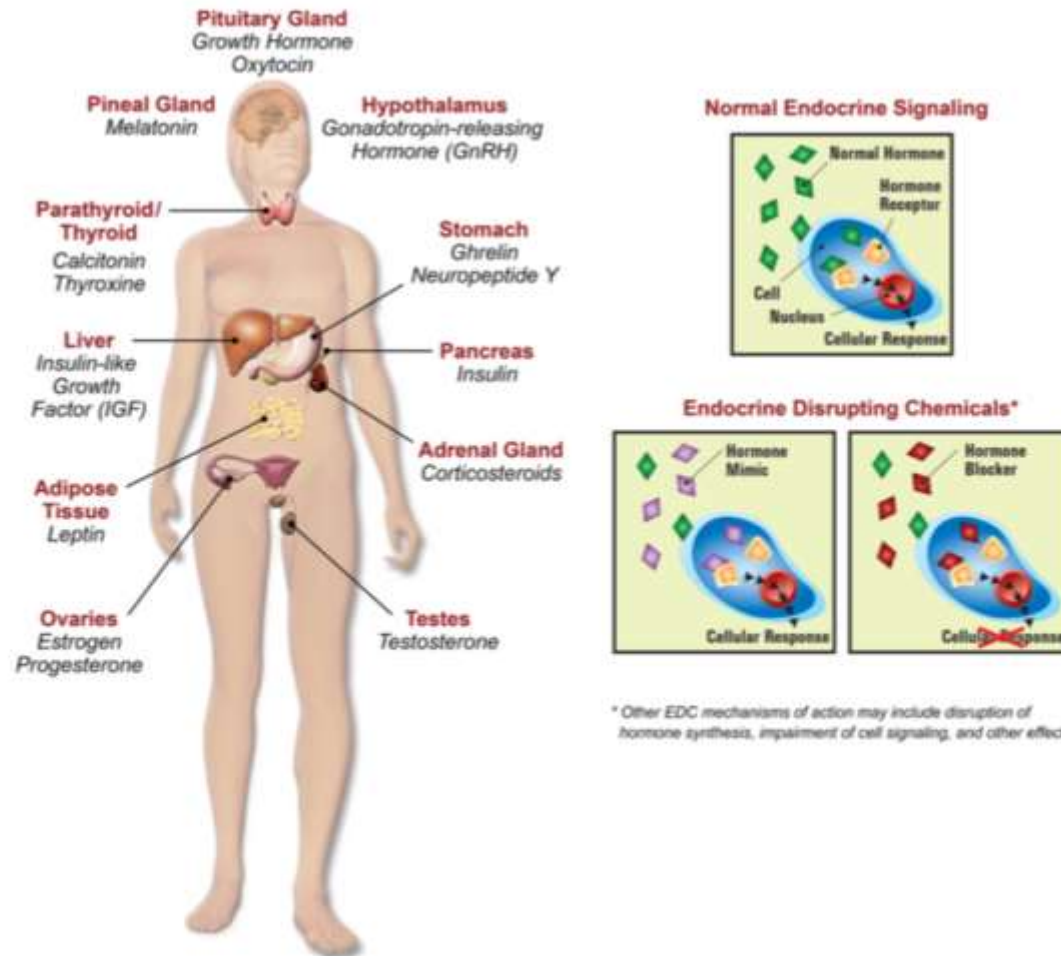


Figure 1. Other EDC mechanisms of action may include disruption of hormone synthesis, impairment of cell signaling, and other effects.

Endocrine Disruptors: Past Lessons and Future Directions

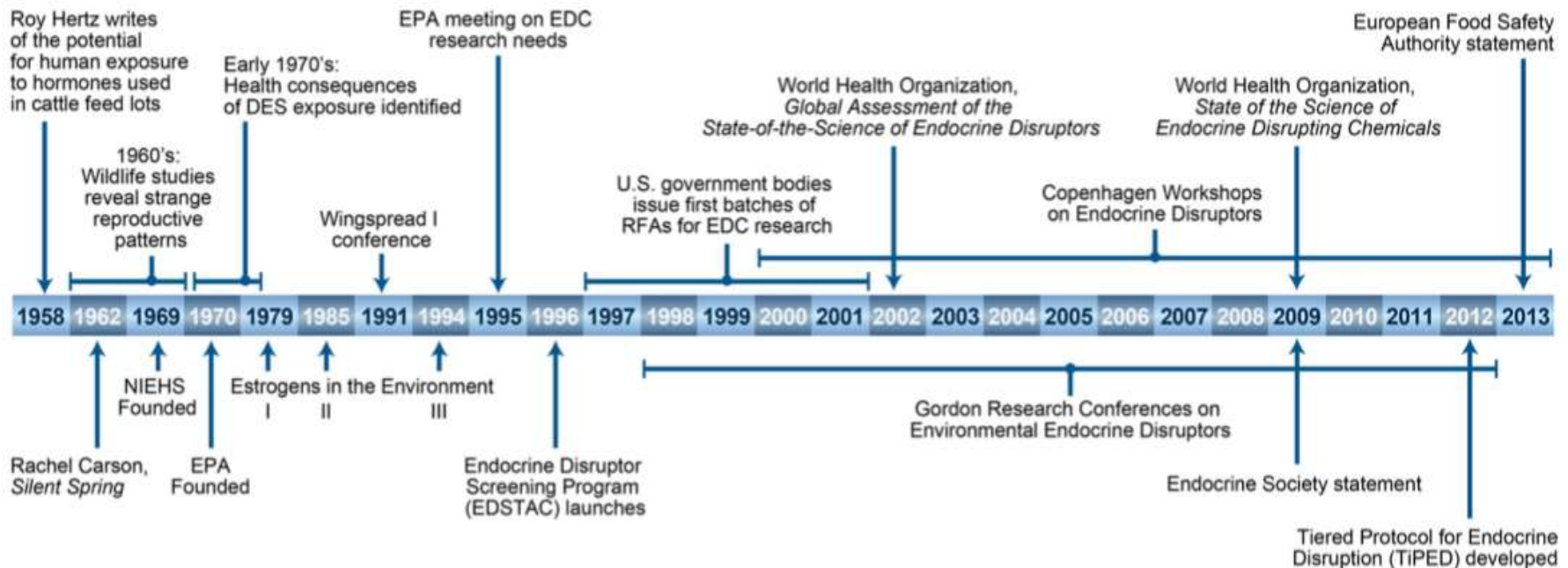


Figure 2. Milestones in the development of the EDC field.

Estradiol and the Developing Brain

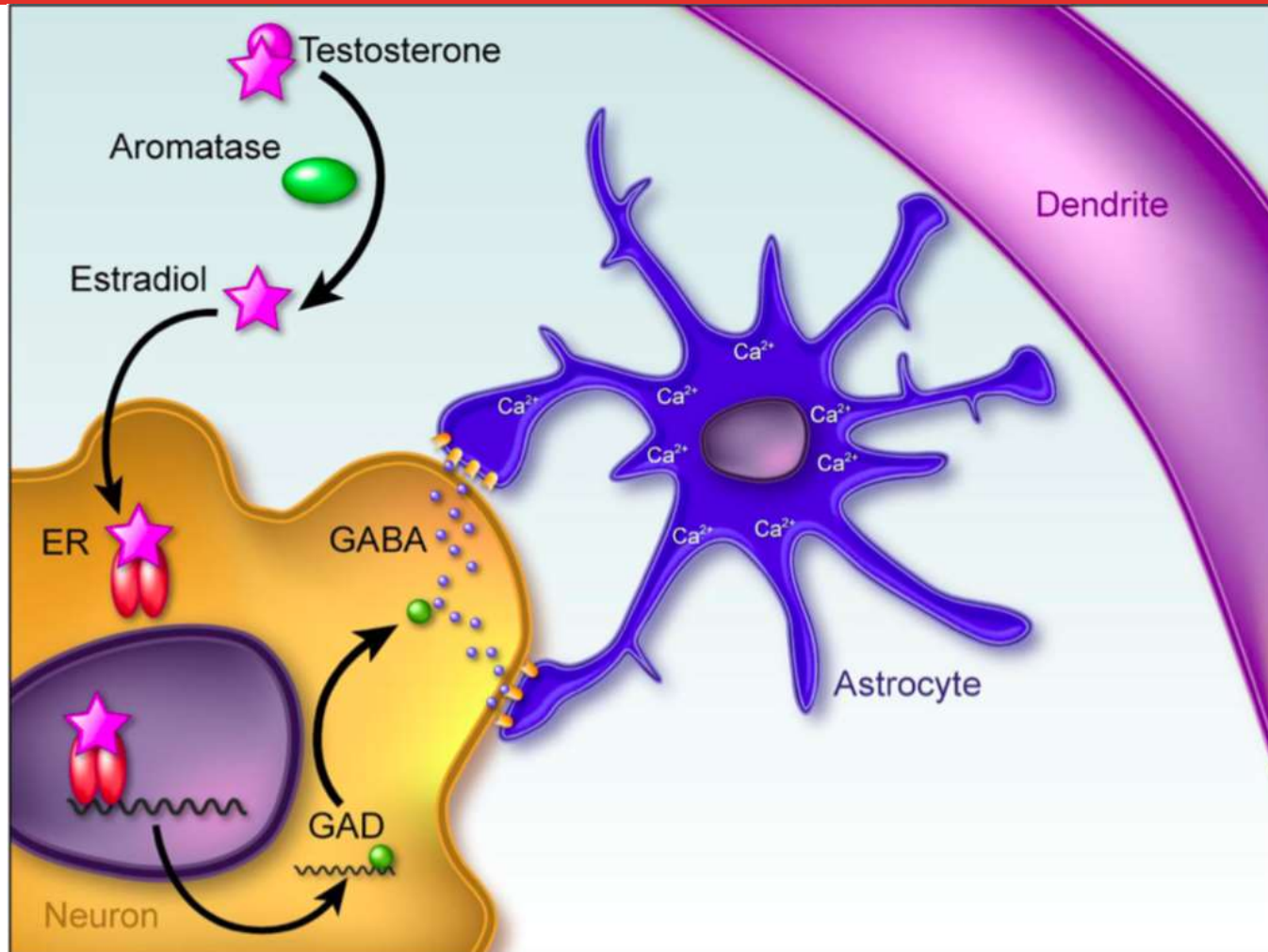
Margaret M. McCarthy

Abstract

Estradiol is the most potent and ubiquitous member of a class of steroid hormones called estrogens. Fetuses and newborns are exposed to estradiol derived from their mother, their own gonads, and synthesized locally in their brains. Receptors for estradiol are nuclear transcription factors that regulate gene expression but also have actions at the membrane, including activation of signal transduction pathways. The developing brain expresses high levels of receptors for estradiol. The actions of estradiol on developing brain are generally permanent and range from establishment of sex differences to pervasive trophic and neuroprotective effects. Cellular end points mediated by estradiol include the following: 1) apoptosis, with estradiol preventing it in some regions but promoting it in others; 2) synaptogenesis, again estradiol promotes in some regions and inhibits in others; and 3) morphometry of neurons and astrocytes. Estradiol also impacts cellular physiology by modulating calcium handling, immediate-early-gene expression, and kinase activity. The specific mechanisms of estradiol action permanently impacting the brain are regionally specific and often involve neuronal/glial cross-talk. The introduction of endocrine disrupting compounds into the environment that mimic or alter the actions of estradiol has generated considerable concern, and the developing brain is a particularly sensitive target. Prostaglandins, glutamate, GABA, granulin, and focal adhesion kinase are among the signaling molecules co-opted by estradiol to differentiate male from female brains, but much remains to be learned. Only by understanding completely the mechanisms and impact of estradiol action on the developing brain can we also understand when these processes go awry.



Estradiol and the Developing Brain



Moving toward technological solution: Estrogenicity Assessment of a New Food-Contact Coating and the Bisphenol Used in Its Synthesis

Ana M. Soto, Cheryl Schaeberle, Mark S. Maier, Carlos Sonnenschein, and Maricel V. Maffini

ABSTRACT: Consumer concerns about exposure to substances found in food contact materials with estrogenic activity (EA) have created substantial demand for alternatives. We assessed the potential EA of both a new bisphenol monomer used to synthesize polymeric coatings for metal food-contact applications and the nonintentionally added substances (NIAS) that may migrate into food. We evaluated tetramethyl bisphenol F (TMBPF) using *in vitro* and *in vivo* assays. We extracted the polymeric coating using food simulants ethanol (50% v/v) and acetic acid (3% w/v) and measured migration using tandem liquid chromatography (LC)/mass spectrometry (MS) and LC time-of-flight MS for TMBPF and NIAS, respectively. We also tested migrants for EA using the E-SCREEN assay. TMBPF did not show estrogenic activity in the uterotrophic assay and did not alter puberty in male and female rats or mammary gland development in female rats. Neither TMBPF nor the migrants from the final polymeric coating increased proliferation of estrogen-sensitive MCF7 cells. TMBPF did not show estrogen-agonist or antagonist activity in the estrogen receptor-transactivation assay. TMBPF migration was below the 0.2 parts per billion detection limit. Our findings provide compelling evidence for the absence of EA by TMBPF and the polymeric coating derived from it and that human exposure to TMBPF would be negligible.



From Technological to System-Level Innovation and CI Ecosystem Building

*Meaningful increases in sustainable packaging and decreases in food waste and endocrine disruption are **attainable by reconsidering the value chain processes** that define how food goes from farm to fork*



Packaging Innovation Within Agri-Food Supply Chains: Illustration Intelligent Packaging

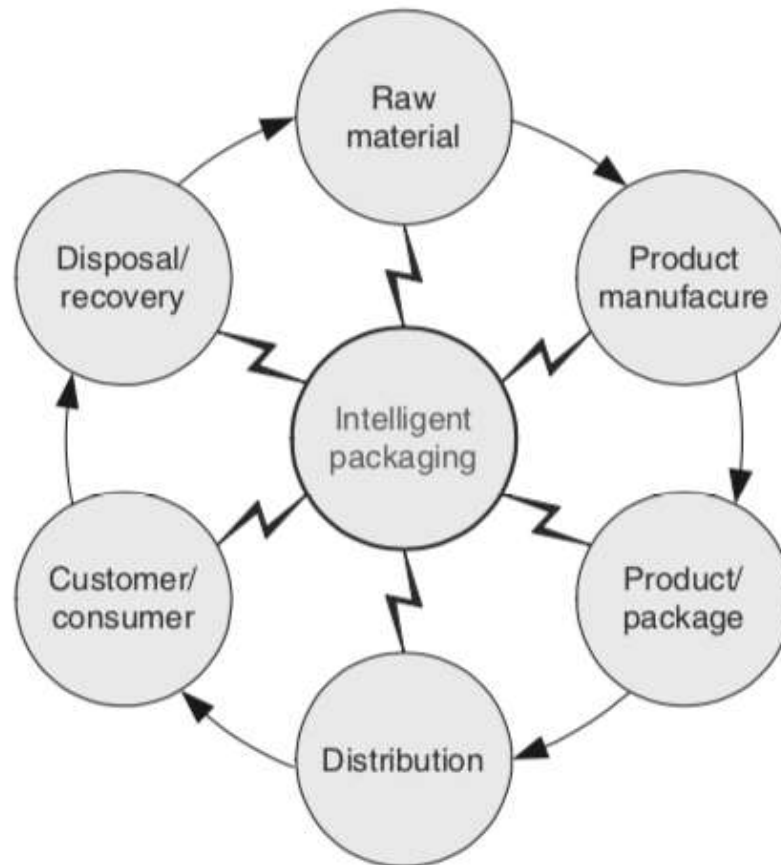


Fig. 8.1 Material flow  and information flow  in the food supply chain cycle.

Traceability in Packaging to enhance food safety and quality

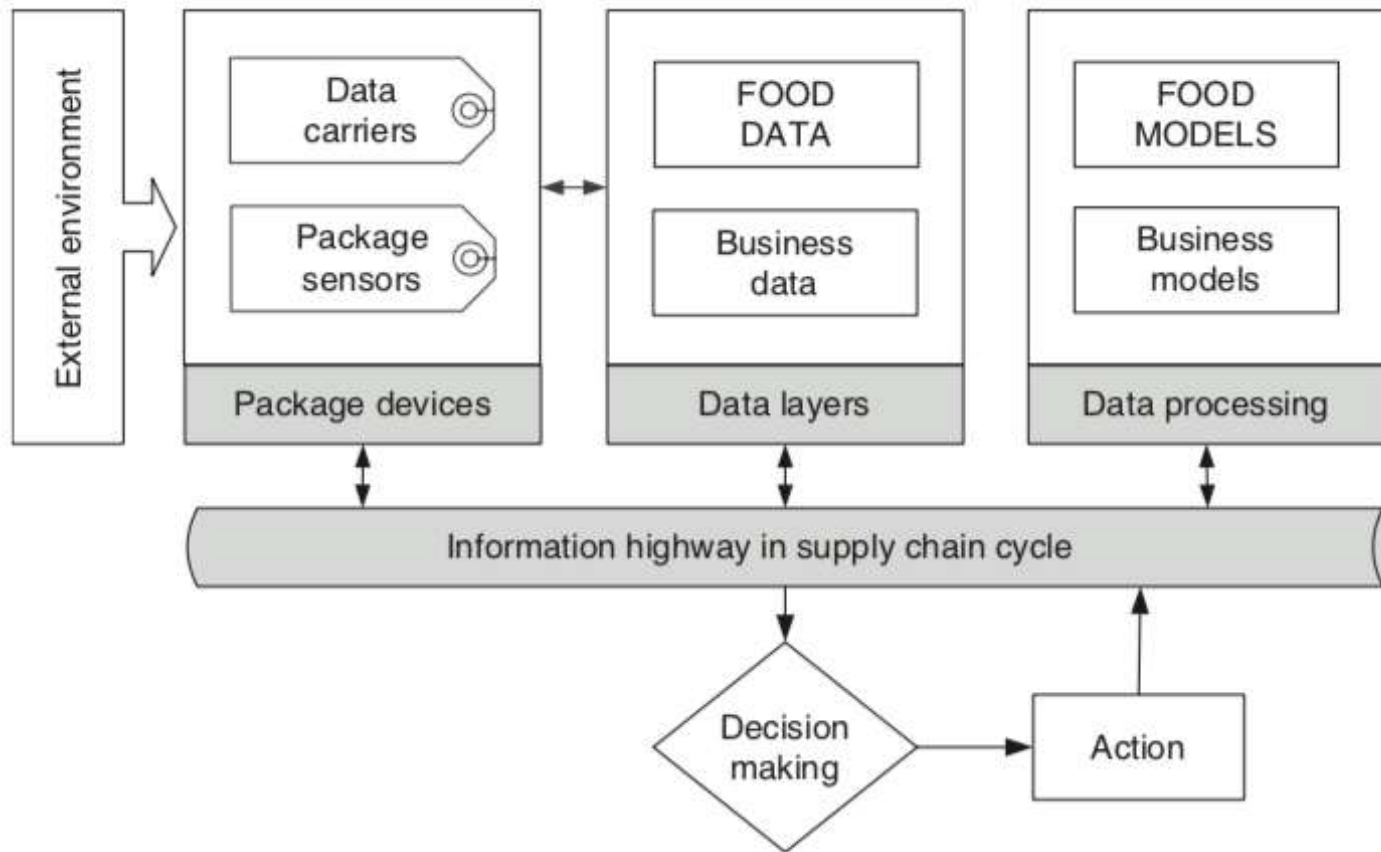


Fig. 8.2 Conceptual framework of intelligent packaging system. Reproduced from Yam *et al.* (2005) with permission from Wiley.

Packaging to enhance food safety and quality

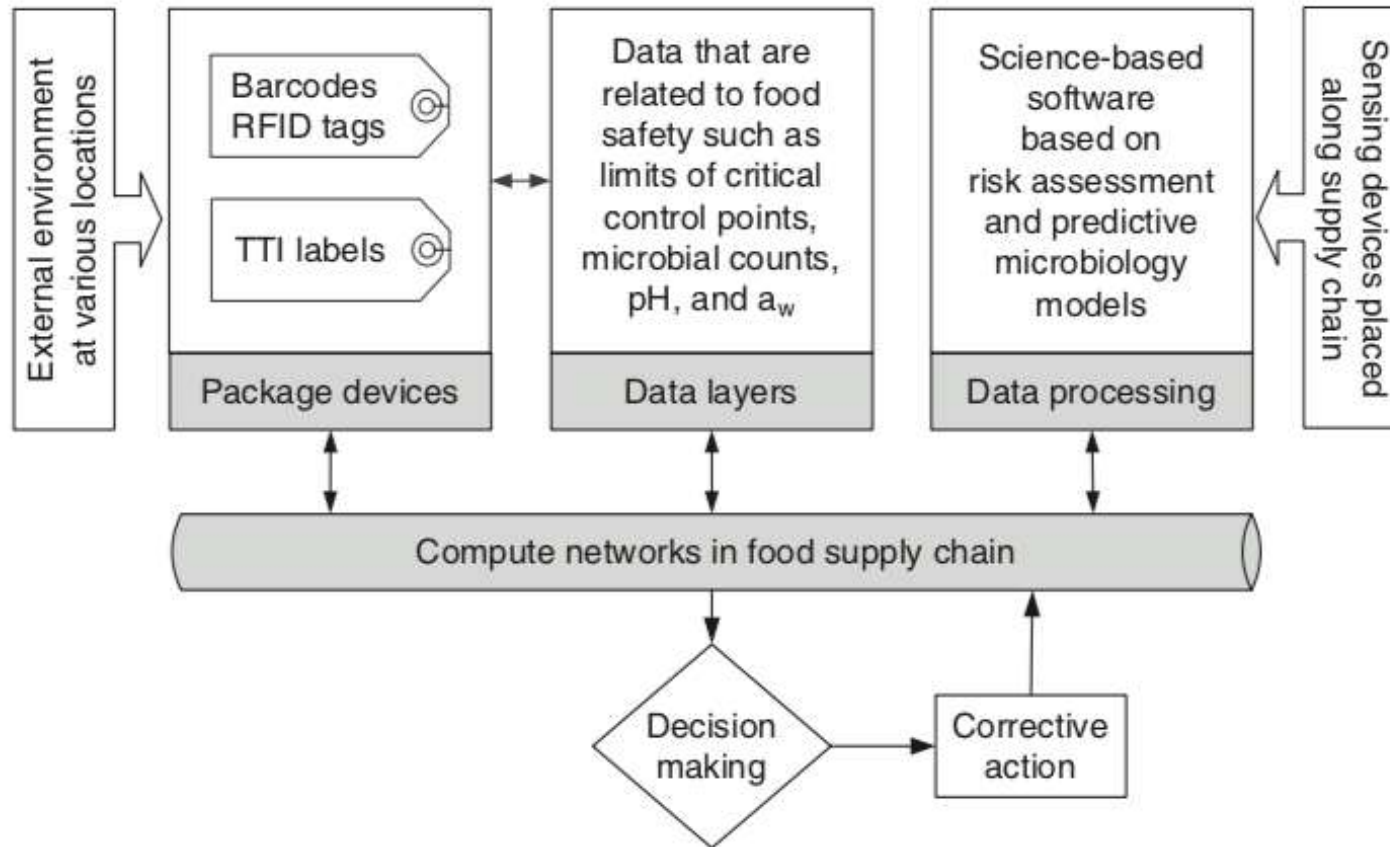


Fig. 8.3 An example of intelligent packaging and HACCP system. Reproduced from Yam *et al.* (2005) with permission from Wiley.

Intelligent packaging to enhance food safety and quality

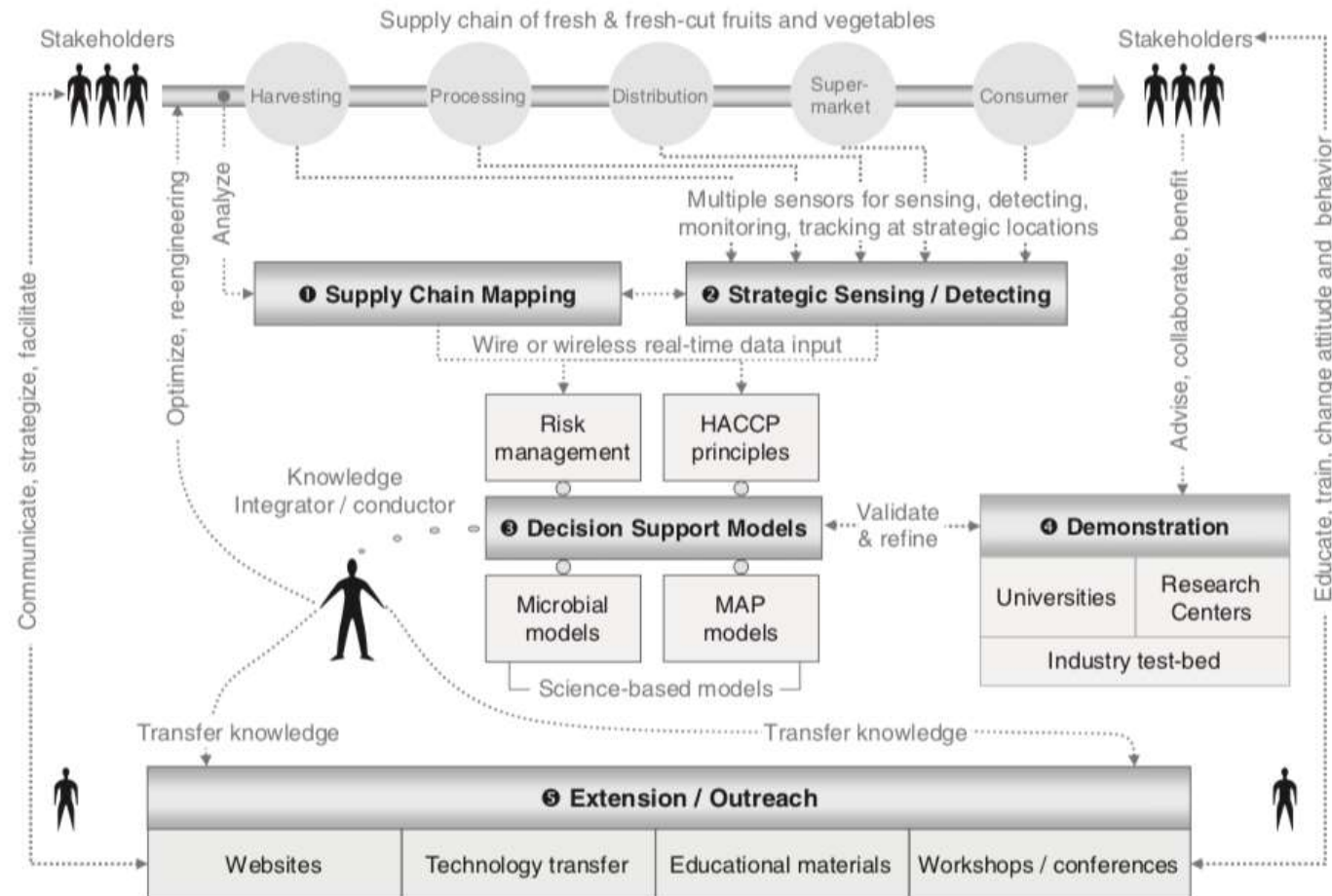


Fig. 8.4 Conceptual framework of intelligent decision support system.

Intelligent packaging to enhance food safety and quality

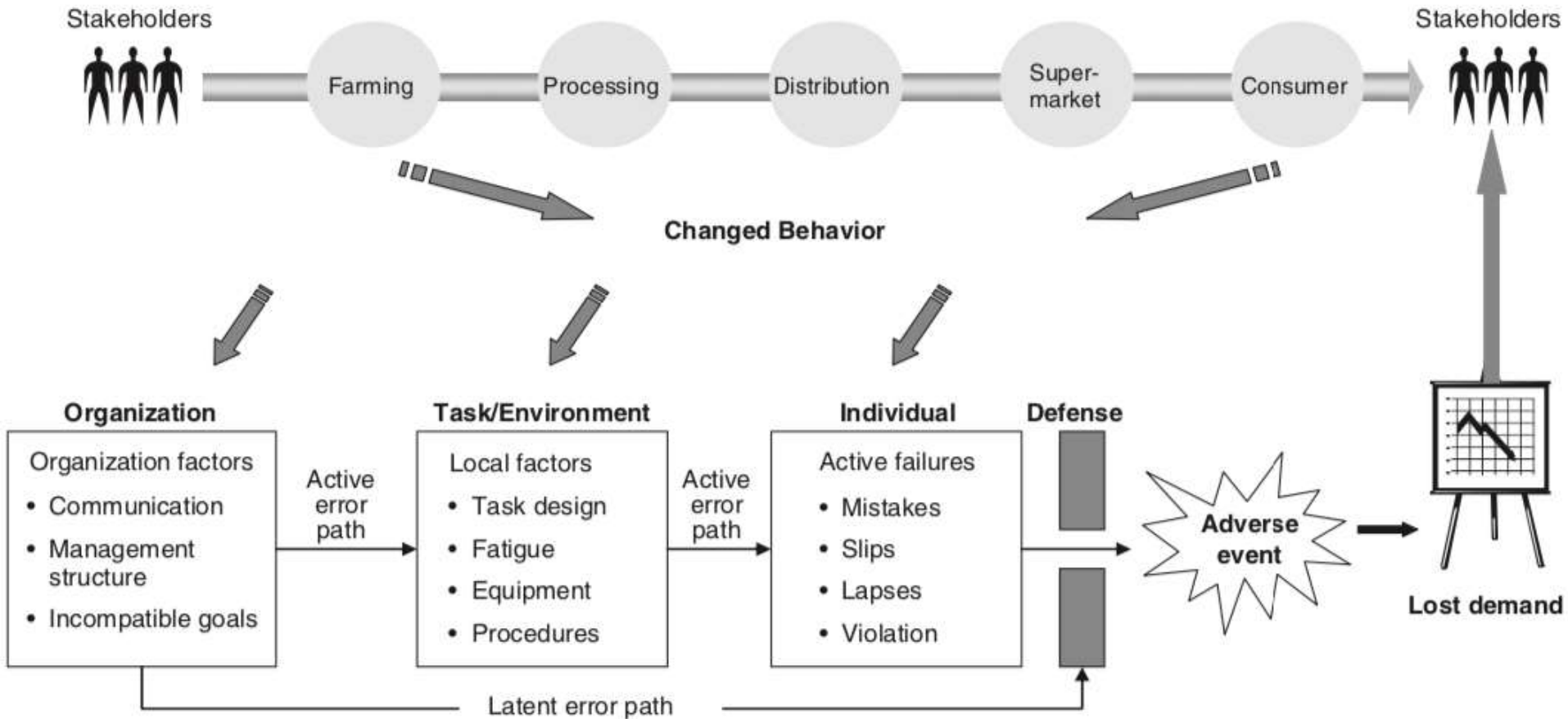


Fig. 8.6 Model adapted for food safety risk management (adapted from Reason, 1995).

Bridging Networks and network resources in CI Ecosystem Building for Supply and Demand

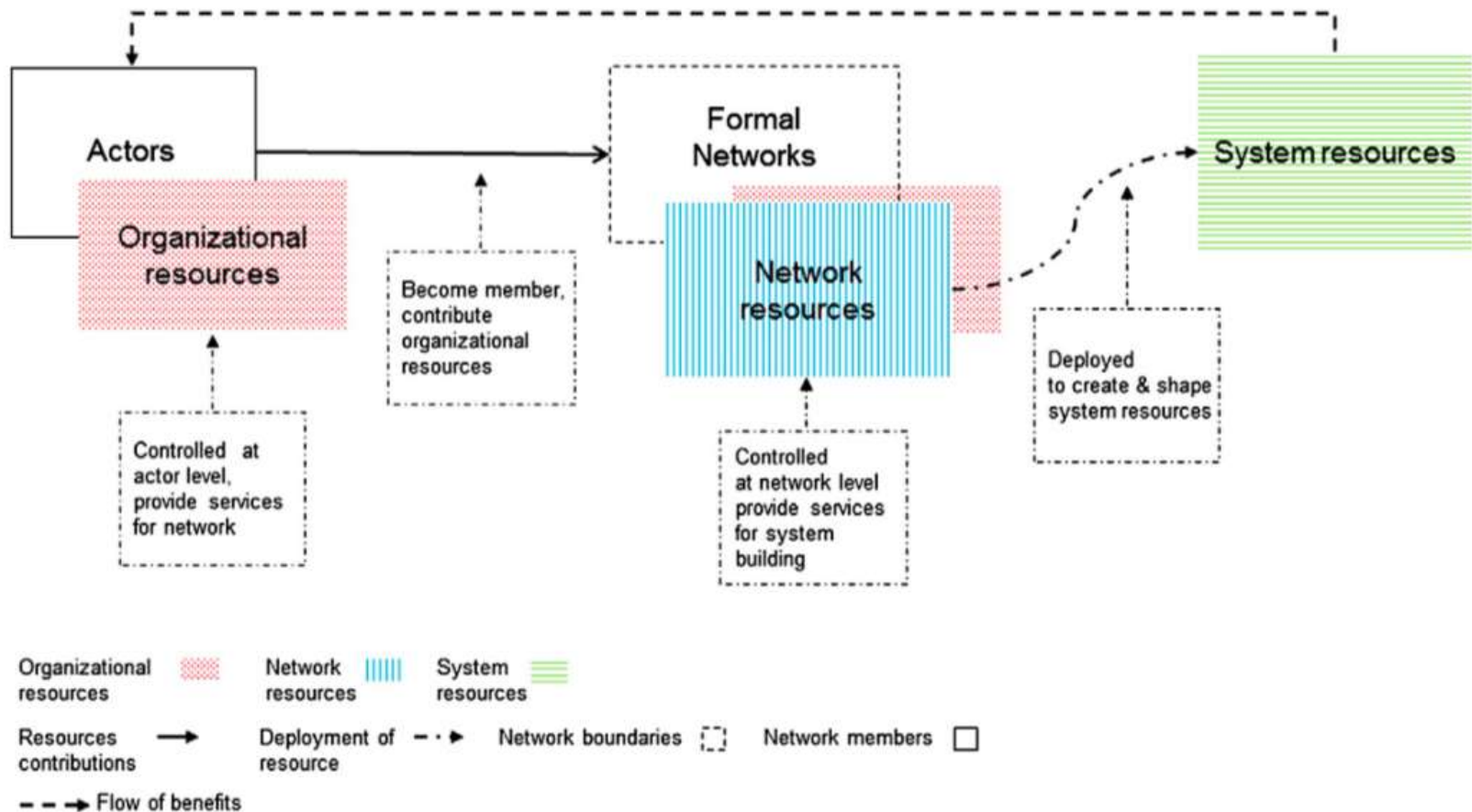


Fig. 1. Analytical framework.

Creating CI Ecosystem: How resource constellations affect the strategies of system builders

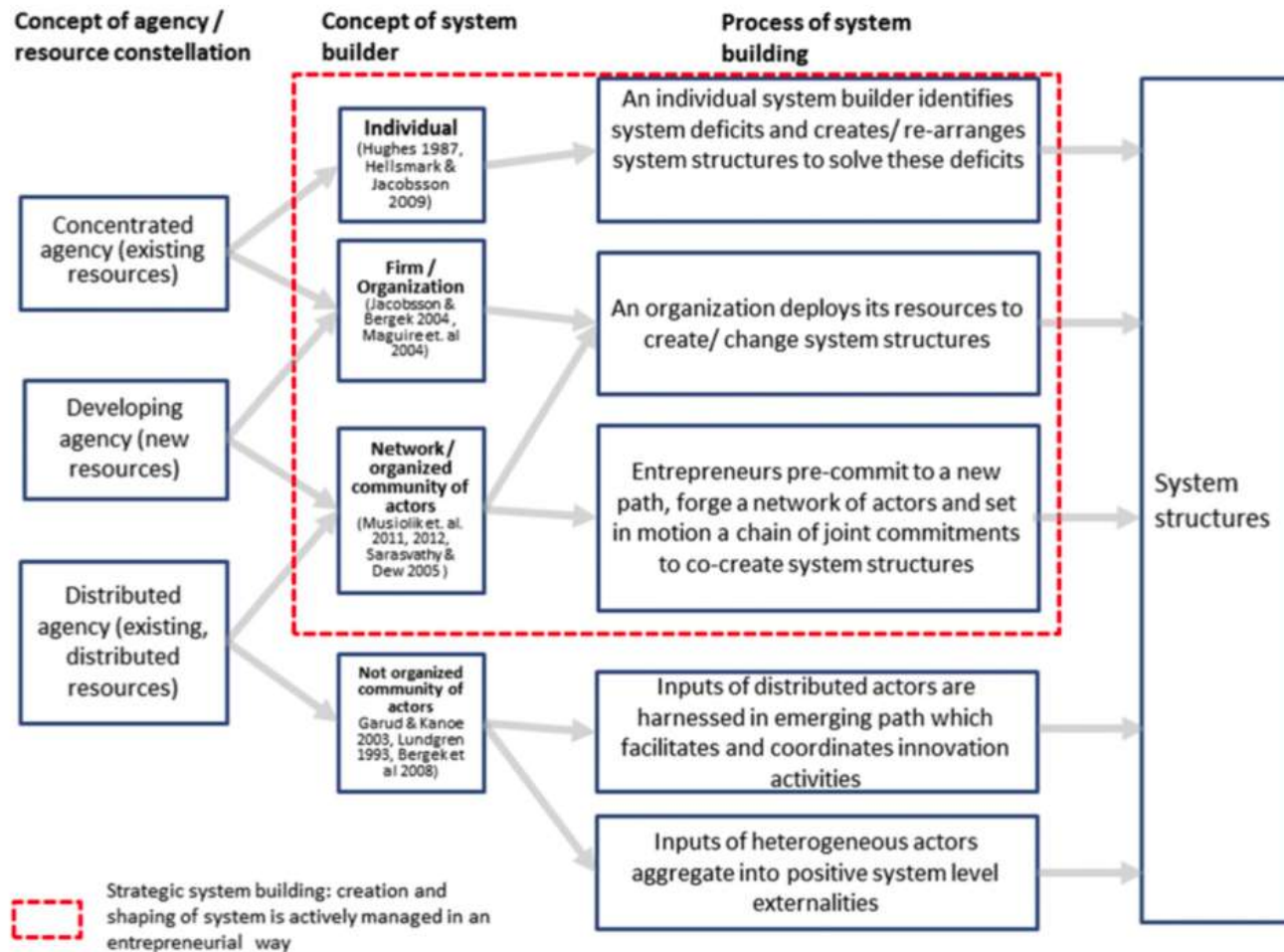


Fig. 1. Delineation of strategic system building.



McGill

Centre for the Convergence
of Health and Economics

Informal institutions matter: Professional culture in Agriculture, Food, Material and Health/Medicine

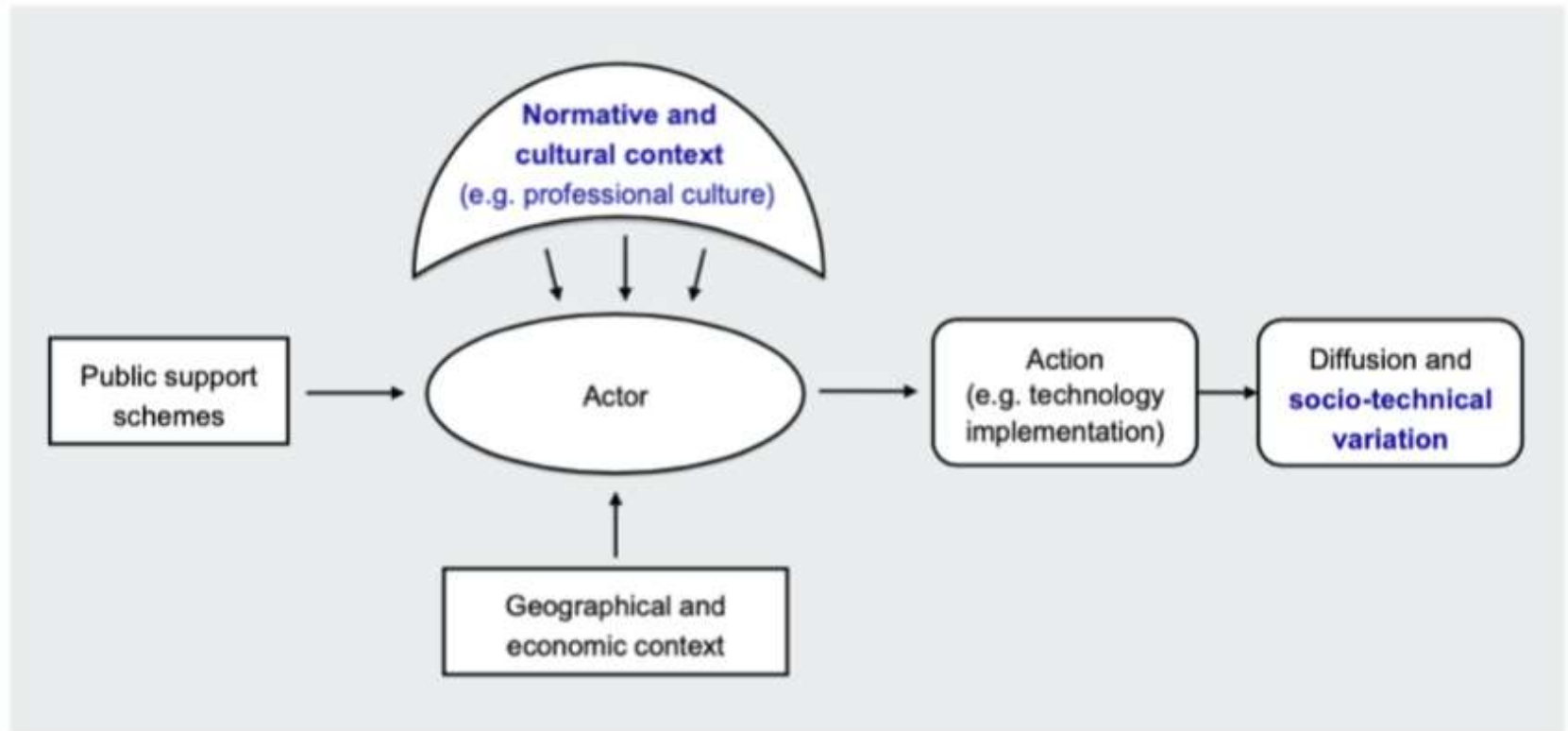


Fig. 1. Framework for the analysis of determinants of diffusion and socio-technical variation. (For interpretation of the references to color in the text, the reader is referred to the web version of this article.)

Summary

FCI ecosystem:

Engage Many players, many hands.
Focused goals, targeted outcomes.

- Bringing together the key players essential for success: universities, companies with global reach, companies closely linked to their communities, research institutes, entrepreneurial startups.
- Imagine what can be achieved.



International & national companies

- R&D departments
- Shared facilities
- Joint activities

Research institutes

- Strategic and applied research
- Pre-competitive & confidential projects

Universities

- Education and training
- Fundamental and strategic research

Spin-offs / SMEs

- End-to-End Lean and Agile Innovation
- Entrepreneurship

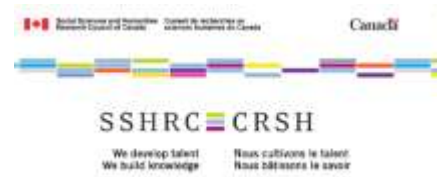


McGill

Centre for the Convergence
of Health and Economics

Brain-to-Society/ Convergent Innovation Team at MCCHE

Peer reviewed research



Key Team Members



Laurette Dubé



Patricia P. Silveira



Robert D. Levitan



James L. Kennedy



Spencer Moore



Yu Ma



Michael Meaney



Andre Portella



Jian Yun Nie



Alain Dagher



Lesley Fellows



Shawn Brown



Nathan Spreng



Nathan Yang



Daiva Nielsen



Susan Carnell



Catherine Paquet



Baerbel Knauper



Alan Evans

Thank you!

laurette.dube@mcgill.ca



McGill

Centre for the Convergence
of Health and Economics