Building Innovation Capacity in a Research Hospital – The Techna Story

David A. Jaffray, Ph.D

Director, Techna Institute, University Health Network
Professor, University of Toronto

A partnership of:
University Health Network - Toronto

Toronto General Hospital
Princess Margaret Cancer Centre
Toronto Western Hospital
Toronto Rehabilitation Institute

BUDGET                  1.7 Billion
(Research $300M+)

STAFF                      12,000
(Research 2,700)

PATIENTS                11 million procedures annually
1 million outpatients visits annually

A Government Corporation with a Board from Industry
Modern Expectations of Healthcare

- Patient-specific, Customized Therapy
  - Personalized Cancer Medicine
- High Performance, Minimally-invasive Interventions
  - Success in terms of disease control and minimal toxicity
- Zero Tolerance for Errors/Mistakes ($6\sigma$)
- Efficient Execution within the System
- Customer Satisfaction/Patient-Centred Care
- Accountability/Access/Metric Reporting
- Access/Management of Personal/Family Health Record
- Rapid Evaluation/Adoption of Novel Methods
- Continuous Learning and Adaptation
Mandate for Innovating in the Hospital

• To address today’s and tomorrow’s health challenges, support is needed for research that will lead to groundbreaking discoveries and knowledge that can be translated quickly and effectively into improved health for Canadians, more effective health services and products, and a better health care system.

• Research hospitals are meeting these challenges by forming new, multidisciplinary, and solution-oriented research structures.
The Lifecycle for Health Technology Innovation

1 clinical-driven demand

academic clinicians (MD, RN, Ph.D., P.Eng, etc.) identifying the clinical and research needs

collaborative resources and expertise

2 tech solution development

rapid clinical deployment with partners

3 practice change

Though users play a central role in invention in many industries (Shah and Tripsas 2006), they are particularly important to health technology.
‘User as Innovator’

• Though users play a central role in invention in many industries (Shah and Tripsas 2006), they are particularly important to medical devices.
• Users account for 80% of all medical device innovations. *
• 3M has enjoyed commercial success from incorporating user-based innovation into its corporate strategy. (von Hippel, Thomke et al. 1999)
• Identify the ‘last long feedback loop: The one from the ultimate user community back to the start of the whole process’ as the ‘most neglected step in the innovation scheme’. *

‘User as Entrepreneur’

THE ACCIDENTAL ENTREPRENEUR:
THE EMERGENT AND COLLECTIVE PROCESS
OF USER ENTREPRENEURSHIP

SONALI K. SHAH¹ and MARY TRIPSAS²*
¹ University of Washington Business School, Seattle, Washington, U.S.A.
² Harvard Business School, Boston, Massachusetts, U.S.A.

“…define user entrepreneurship as the commercialization of a new product and/or service by an individual or group of individuals who are also users of that product and/or service.”

Figure 1. Classic model of the entrepreneurial process

Figure 2. Model of the end-user entrepreneurial process

What is Techna?

A research institute of the University Health Network, in partnership with the University of Toronto, focused on the accelerated development and exploitation of technology for improved health.

What will Techna Do?

- **Stimulate and facilitate the innovation lifecycle** through a continuum of clinically-driven innovation, technology/ process development, and translational research.

- **Shorten the time interval** from technology discovery and development to application for the benefit of patients and the health care system.

How is Techna Unique?

- **Beyond research** – engineering technology to address unmet clinical needs.

- **Network of partners** – actively engaging academics, clinicians, industry and government as partners in the development and deployment of novel health technologies.

- **Impact** – through clinical practice change, improved health outcomes, and a growing industry sector.
Founding Principles

1. **Engagement of Academic Clinicians is essential to innovation**
   - **Needs**: Identified in the clinical environment by physicians, nurses, allied health professionals, engineers,
   - **Diversity/Alternative Perspectives**: Multiple levels/types of clinical programs engaged in the institute to develop novel technologies and platforms
   - **Educate**: Integrates clinical training programs with an environment where innovation is the expectation

2. **Beyond discovery to collaborative development and implementation**
   - **Strength in Engineering and Applied Science**: IBBME, MBP, Physical Sciences
   - **Integrate/coordinate**: existing research assets and clinical programs from multiple disciplines throughout UHN/Toronto/Global Partners
   - **Impact through Practice Change**: Focus on the development of novel technologies for health and improvements to clinical practice

3. **Partnerships are essential for growth and deployment**
   - Encompassing training, expertise, facilities, commercialization and funding.
   - Actively engage health technology partners outside of UHN/UofT (i.e. other academics and industry)
   - Collaborate with industry to commercialize and apply technology

It is not about Techna’s IP, it is about innovation and practice change.
Initial ‘UHN/UofT-centric’ Operating Model

1. Ideas, needs, IP identified by Academic Clinicians (multidisciplinary)

2. Institute faculty establish academic project team; engage in grant writing, technology development; generate new IP, products, processes

3. Technologies, expertise sourced from external partners (academic or commercial)

4. Partners identified for commercialization of new technologies

5. New technologies adopted to and tested in clinical settings; Generate impact metrics: publications, patents, projects, products, payers

6. Practice change based on new technologies

UHN Academic Clinicians

Techna Faculty

University of Toronto

Institutional Partners

Industry Partners
Leadership Team

Institute Director
David Jaffray

Cores

Director, Research Faculty (Physical Sciences)
Paul Santerre

Director, Research Faculty (Clinical Sciences)
Kieran Murphy

Physical Science Lead
Igor Jurisica

Clinical Science Lead
Peter Rossos

Guided Therapeutics
David Jaffray

Jonathan Irish

Informatics & Communications Technology
Gang Zheng

Nanotechnology & Radiochemistry
Ur Metser

Photonics
Brian Wilson

Design & Engineering for Health
Joe Cafazzo

Cores

Director, Commercialization/TDC
Mark Taylor

Director, Engineering / Operations
Luke Brzozowski

Director, Clinical Process
Howard Abrams

Director, Knowledge Transfer
Nicole Harnett

Institute Director
David Jaffray

Director, Research Faculty (Clinical Sciences)
Kieran Murphy

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Director, Knowledge Transfer
Nicole Harnett
The Three Pillars of Techna

- Faculty
- Technology Development Team
- Infrastructure
Affiliated Faculty

Andres Lozano

Bernd Wintersperger

Robert Wu

Andrew Hope

Gordon Tait

Brenda Gallie

Tom Purdie

Leonard Tse

Narinder Paul

Teo Stanescu

Tony Easty

Kazu Yasufuku

Patricia Trbovich

Alex Jadad

Dheeraj Rajan

2012
<table>
<thead>
<tr>
<th>Affiliated Faculty</th>
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<tbody>
<tr>
<td>Dionne Aleman</td>
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<tr>
<td>Anthony Easty</td>
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<td>Alex Jadad</td>
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<td>Cynthia Menard</td>
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<td>Michael Sharpe</td>
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<td>Christine Allen</td>
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<td>Gabor Fichtinger</td>
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<td>Michael Jewett</td>
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<td>Narinder Paul</td>
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<td>Christian Veillette</td>
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<td>Jean-Pierre Bissonnette</td>
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<tr>
<td>Brenda Gallie</td>
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<td>Daniel Létourneau</td>
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<td>Thomas Purdie</td>
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<td>Michael Sherar</td>
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<td>Timothy Chan</td>
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<td>Justin Grant</td>
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<td>Shyh-Dar Li</td>
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<td>Gordon Tait</td>
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<td>Mojgan Hodaie</td>
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<td>Catherine Coolens</td>
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+ Strong outreach to Radiology at UHN – 60+ Radiologists

37 Affiliated Faculty
The Techna Environment

- Conventional Research Grants
- Industry Sponsored Research
- Development of Commercial Technologies
- Training for Graduate Students, Post-Docs
- Biomedical Engineering, Prototyping, Advanced Equipment & Facilities Access
- Commercial Technology Licensing and Spin-off
More than cottage-style R&D – Supported Innovation

Techna Operations, Engineering & Commercialization

Institute Director
David Jaffray

Director, Operations & Engineering
Lukasz Brzozowski

Techna Network Coordinator
Tracey Lui

Core Facilities Team

Engineering Team

Administrative / Grant Writing Team

Director, Commercialization
Mark Taylor

Contracts Mgmt / Proj. Mgmt / Commercial Engineering Team

More than cottage-style R&D – Supported Innovation
Commercial Relationships are Central to TECHNA’s Model

Traditional University-type license
- “Fire and forget”, very early stage, little validation

Traditional ‘NERF’ Sponsored Research
- Rarely results in successful commercial relationship

‘Commercial’ Sponsored Research
- Results in successful commercial outcomes almost 100%

License and Co-Development
- Tech. developed and early validation at UHN
- Frequently solves a hospital problem, implemented clinically
- Industry prod. dev., UHN co-dev, testing and/or validation

License and Product Co-Development
- Our most successful relationships
- UHN responsible for prod.-dev, test, validation, product support
- Mostly s/w, i.e. UHN creates go-to-market source-code product

Product Specification
- Industry (prod-dev) plus UHN (know-how, testing, validation, clinical implementation)
**Techna’s business model focuses on self-sustainability**

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**Full productization services** include project management; key opinion leader academic clinician engagement; software development and engineering; hardware development and engineering; human factors and usability testing; process definition; Validation and Verification (V&V); clinical protocols; training protocols; clinical analysis; knowledge transfer; technical regulatory analysis; CSA certification; regulatory analysis (health agencies); reimbursement analysis; market analysis; Web design and development; ISO13485 setup for projects and startups; Financial services, portfolio management and accounting for startups.
Experience in Medical Device Commercialization: Toward A Self-Sustained Model

Identify commercial perspective on technology innovation at the earliest stage (i.e. pre-invention, out-reach)

Create early embedded innovation teams for peer-review and valuation (clinician + technology expertise + engineering)

“De-risking” by moving along critical path toward clinical use and “maximizing value” by assembling the opportunity

Leverage exceptional institutional and partner (internal and external) resources to demonstrate value and remove risk.

Engage industry through tailored solutions to address missing components, investment, and path to market

Engage partners with a “spin-in” philosophy (i.e. IP-source agnostic, other institutions, industry)

A balance between “spin-off” and “spin-in”.

Mark W. Taylor  
P.Eng, M.Sc., MBA  
Director of Commercialization - TECHNA  
Sr. Bus. Dev. Officer - UHN TDC
Techna-related Commercialization Activity
(5-yr deal flow)
What types of ‘products’ do Techna’s faculty create?
The Lifecycle for Health Technology Innovation

1. **Clinical-driven demand**
   - Academic clinicians (MD, RN, Ph.D., P.Eng, etc.) identifying the clinical and research needs

2. **Tech solution development**
   - Collaborative resources and expertise
   - Rapid clinical deployment with partners

3. **Practice change**
Perfexion Image-Guided Radiation Therapy System

• >$1M investment from Elekta for collaborative development of the IGRT system at UHN
• System allows patients to be treated without a stereotactic frame
• Currently in productization phase: Release Q2 2014
• UHN advantages: Regulatory guidance from Elekta; work with R&D group of multinationals to assure compliance with their device
• Elekta advantages: Experienced academic clinicians and scientists in design and first use in humans at PMH/UHN
• Advantages for all: Product aligned with clinical need; Continued collaboration after commercialization
Image-guided radiosurgery

- Project start
- Specifications

Collaboration with Elekta Stockholm - Per Nyland, Per Carlson
A tri-use facility based on a single, mobile 1.5T magnet and state-of-the-art delivery platforms (HDR, C-arm Linac).
MRgRT Workflow Development

IGRT-guided pre-localization of MR Imaging FOV
Confirmation of delivery viability
Reference CBCT for MR-guidance

Robotic control of MR, table and Shielding System
Linear motion of magnet over patient.
RT present for movement.
Pre-stored MR configuration from MR-simulation Stage

Critical time specification (<90s) from end of imaging to beam-on.
Image processing (distortion correction, calibration) and planning (adaptation).
Generation of couch or machine adjustment.
Modified Couch Sub-system

Linac, Table, and MR Coupling

Analyses and Summary

• Agreement between simulation and experiment wrt field map & forces

• Patient table & linac in MR field (IMRIS labs): Acceptable Force
• Magnetic fringe field at the Linac head: $< 20 \, \text{G}$
• Impact on MR imaging field: Full Shimming (40 cm DSV)

COMSOL Multi-physics FEM simulations

PI: T. Stanescu
MRgRT Suite

Table at Linac Isocentre

MR at Imaging Location
GTx: A novel RF ablation system

- Novel ablation coil designed to treat larger (> 3 cm) tumours.
- Higher operating frequency (27.1 MHz) + coil geometry produce heat generation throughout coil
  - Less dependence on thermal conduction to achieve complete coagulation.
  - Greater ability to overcome local perfusion.
- Nitinol coil deployed percutaneously via straight cannula.

McCann, Sherar, Murphy, Davidson et al.
Automated Breast Cancer RT Planning

Assuring quality, reducing costs, enabling science.

*Licensed to Raysearch Labs, Stockholm

Automated: ~4 Minutes; >1700 Cases Completed

PIs: T. Purdie/M. Sharpe
GTx: Fusing Surgery + Radiation Therapy

TRACKING: EM Sensors

OPTICAL CALIBRATION

REGISTRATION

Orthogonal Slices showing scope position

Real Endoscope Image

Virtual Overlay

Weersink, Irish, Hope, et al.
GTx + Nano: Enhanced Image-guided Surgery

*Bae KT, Radiology: 256 (1), 2010
Rabbit VX2 Buccal Mucosa Model: Fluorescent Imaging of Primary and Metastatic Lesions

Zheng, Muhanna, Irish, Yazafuku, Allen, Jaffray (submitted)
ICT: Apps for Diabetic Teens

bant

a diabetes app for the eTeen

PI: Cafazzo, PhD PEng
Techna also supports the deployment of novel research technology within the hospital.
1. IBM Life Sciences Discovery Centre
2. STTARR
3. GTx Laboratory
4. UHN Microfabrication Centre
5. NanoMedFab Facility
6. Healthcare Human Factors Test Lab
7. Centre for Global eHealth Innovation
8. Cyclotron/Radiochemistry Lab
9. PET/MR Center
10. TRIGOR A
11. TRI Machine Shop
12. MRgRT Facility
13. PMH Machine Shop
14. MC-78 Machine Shop
15. ECTI Cleanrooms
16. PET/CT Centre
17. MEG Facility
18. 7T MRI

+ National and International partners.
Design of a new endoscope by TECHNA engineers

Optical design completed by Institut National d'Optique

Manufacturing components at ECTI cleanrooms

Manufacturing hardware at PMH machine shop.

Preclinical testing of prototype at GTx Lab

Testing prototype at Human Factors Lab

Human trials in GTx OR

Commercialization
## Techna: Building the Molecular Imaging Program

<table>
<thead>
<tr>
<th>Infrastructure Build-out</th>
<th>Innovative Trials with Known Agents</th>
<th>Trials with Novel Probes</th>
<th>Research Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facility Construction</td>
<td>[Image] No hypoxia</td>
<td></td>
<td>[Image] Threshold Pharmaceuticals</td>
</tr>
<tr>
<td></td>
<td>Terry Fox Hypoxia Program</td>
<td></td>
<td>[Image] Canprobe</td>
</tr>
<tr>
<td></td>
<td>and US NIH/CIHR QIN Grant</td>
<td></td>
<td>Industry partnerships High impact funding success</td>
</tr>
</tbody>
</table>

**Milestone:** Cyclotron acceptance; On track for production in Q4 2014
Techna: Enabling Molecular Image-guided Surgery

Academic-Industrial Partnership
Building the Advanced OR for Cancer Patient

Dual Source-Dual Energy CT
(Siemens Definition FLASH)

Robotic Cone-Beam CT
(Siemens Artis ZeeGO)

Core Leader: Irish
Emerging role in the development of technological solutions for the needs of the hospital’s clinical and research agenda.
From Health Systems to Learning Health Systems

Now

Science
Insights poorly managed

Evidence
Evidence poorly used

Care
Experience poorly captured

Missed Opportunities, Waste, and Harm

Best Care at Lower Cost
The Path to Continuously Learning Health Care in America

Mark D. Smith, MD, MBA, Study Chair
From Health Systems to **Learning** Health Systems

Continuous Learning, Best Care, Lower Cost

- Care
- Patients
- Clinicians
- Communities
- Science
- Evidence

**INSTITUTE OF MEDICINE**
**OF THE NATIONAL ACADEMIES**
QIPCM- Quantitative Imaging for Personalized Cancer Medicine

Applied Imaging Physics

Develop and test methods for reproducible imaging

Imaging, Collection, and Storage

Dedicated team, defined methods, and common repository for imaging data.

Imaging in Clinical Trials Capacity

Imaging-specific sub-contractor for data collection, storage, and analysis for clinical trials.

A Facility and Team to Enable Advanced Imaging in Clinical Trials
QIPCM - Quantitative Imaging for Personalized Cancer Medicine

Supporting Imaging in Clinical Trials

1. Centralized Imaging Storage and Archival Platform
   - Ability to store of anonymized DICOM images and imaging derivatives in a centralized location.
   - Secure remote access to data for multiple users to view and analyze data.
   - Specialized software tools for image analysis

2. Procedures and Tests for Trials
   - Accreditation services for imaging equipment
   - Commissioning of image and analysis protocols for clinical trials.

3. Image Analysis Services
   - Dedicated analysis team to analyze images

QIPCM - 5 Staff, Medical Physics Oversight; Grant and Industry Funded
Canada
• Cross Cancer Centre, Edmonton, AB
• London Health Sciences Centre, London, ON
• St Joseph’s Healthcare Hamilton, Hamilton, ON
• Odette Cancer Centre, Toronto, ON
• Princess Margaret Cancer Centre, Toronto, ON
• Toronto General Hospital, Toronto, ON

United States
• UCLA, Los Angeles, CA
• The Angeles Clinic, Los Angeles, CA
• Columbia University Medical Center, New York, NY
# QIPCM - Quantitative Imaging for Personalized Cancer Medicine

<table>
<thead>
<tr>
<th>Total # of Trials on the QIPCM Platform</th>
<th>19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trials currently active</td>
<td>11</td>
</tr>
<tr>
<td>Trials providing funding to QIPCM</td>
<td>5</td>
</tr>
<tr>
<td>Trials that are multi-institution</td>
<td>4</td>
</tr>
<tr>
<td>Trials using QIPCM analysis service</td>
<td>13</td>
</tr>
<tr>
<td>Patient exams on platform</td>
<td>236</td>
</tr>
<tr>
<td>Images on platform</td>
<td>2,031,408</td>
</tr>
<tr>
<td>Storage Capacity*</td>
<td>5.2 TB*</td>
</tr>
<tr>
<td>Total number of peer-reviewed publications</td>
<td>7</td>
</tr>
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</table>

* Expanding to 60 TB in Spring 2015
Cancer Informatics Solution

- Objective: Build a Cancer Informatics Architecture to Support Clinical Care and Research
- Focus on Data Model and Clinical and Researcher Engagement
- Build within the extended Techna engineering team

$10M – internal funding – looking for industry and academic partners
Integration Challenge

Personalizing cancer medicine will only be advanced in institutions that can integrate multiple biomarkers, accurate records of high quality treatment, and robust outcomes records.

H&N

- OS\textsuperscript{-} HPV,p16: 20% (Shi 2009),
- DFS\textsuperscript{-} FAZA-PET: 33% (Mortensen 2012)
- LRC\textsuperscript{-} RT Compliance: 20% (Peters 2012)

Prostate

- bPSA\textsuperscript{-} IGRT: 25% (deCrevosier 2005),
- bPSA\textsuperscript{-} pO2: 25% (Milosevic 2012),
- bPSA\textsuperscript{-} Metformin: 10% (Zannella, 2014)

NSCLC

- LC\textsuperscript{-} FDG-PET Response: 40% (DeRuyescher, 2012)
- OS\textsuperscript{-} CT Feature: 10% (Aerts 2013)
- OS\textsuperscript{-} RT Technique: 25% (Liao, 2010)
- RadPneum\textsuperscript{-} Cardiac Fn: 2.6 OR (Nalbantov, 2013;
Cancer Informatics for Discovery and Care

Current Focus:
Develop ‘Contextualized Interface’ for High Quality Outcomes Data Collection

Driving the feedback loop between clinical care and research

Milestone: Novel clinician-optimized interface in beta deployment.
What about spin-outs?
Techna-Associated Start-Up Activities

Medical imaging innovators providing a unique and disruptive fluorescence based technology platform to revolutionize wound care management at the point of care.

AQUA – Automated Quality Assurance platform for radiation therapy, radiology, surgery, and radiochemistry.

Medlantis - The Medlantis mandate is to provide online access to high quality and contemporary professional and student education materials.

NanoVista – Multi-modal liposomal contrast agents for preclinical and clinical applications.

Companion Healthcare – High-performance veterinary imaging and intervention company with a commitment to advancing our understanding of disease.

iRT Systems – German start-up for Integrated Quality Monitor product development and distribution.

With others in development.
TECHNA and The Funding Portal collaborate to build funding opportunities.

- Anywhere, anytime
- 7000 investment sources in one place
- $2.2B in CDN funding open to healthtech
- Focus on investment-grade verticals: radiotherapeutics
- Easily extended into select EU markets
Summary

• Research hospitals need technological mastery to create and enable innovation.
  – Direct and indirect byproducts.
• Techna has been created to facilitate and stimulate technology-related innovations in healthcare.
  – Strong evidence of demand and results.
• Key role in translation and productization, as well as, hospital-wide engineering and clinical-research architecture.
  – Building a research hospital ‘from the inside out’.
ICT: Patient Reported Outcomes in Orthopedics

Data: 05-14-2012

Profile

Subject ID: 001003

Age: 59

Gender: FEMALE

Procedure: PRIMARY RIGHT HIP REPLACEMENT

DOS: 05-28-2003

Health Problems

Coronary artery disease, Heart failure, Stroke, High cholesterol, Other medical problems, 2. Do you currently smoke cigarettes?

SF36 Scores

WOMAC Scores

DADOS System – PI: Viellette
ICT: Patient Reported Outcome Kiosk (oncology)

DART - Distress Assessment and Response Tool

PI: Rodin
Home Office and Commercialization Environment

Techna Offices
Located in the Historic Banting Institute on the U of T Campus
Medical Technology Innovation Houses
# Techna’s ‘Role’ in the Medical Device Pipeline

<table>
<thead>
<tr>
<th>Leading Entity</th>
<th>Stage</th>
<th>Time</th>
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</thead>
<tbody>
<tr>
<td>Techna, Industrial Partner</td>
<td>Pre-launch product preparation</td>
<td></td>
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<tr>
<td>Industry, VCs, Accelerators</td>
<td>Launch</td>
<td></td>
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<tr>
<td>Industrial Partner, Techna</td>
<td>Post-launch improvements</td>
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</tbody>
</table>
# Techna’s ‘Value Add’ in the Medical Device Pipeline

<table>
<thead>
<tr>
<th>Leading Entity</th>
<th>Stage</th>
<th>Invention</th>
<th>Optimization</th>
<th>Pre-market evaluation</th>
<th>Post-market evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universities, Discovery-oriented institutions</td>
<td>Techna</td>
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<tr>
<td>EXCITE</td>
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<td>OHTAC</td>
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</table>

**Progress**
Medtech Product Lifecycle

Modified Couch Sub-system

Linac, Table, and MR Coupling

Analyses and Summary
• Agreement between simulation and experiment wrt field map & forces
• Patient table & linac in MR field (IMRIS labs): **Acceptable Force**
• Magnetic fringe field at the Linac head: < 20 G
• Impact on MR imaging field: **Full Shimming** (40 cm DSV)

**COMSOL Multi-physics FEM simulations**
IQM - Integral Quality Monitor

Idea, Patent, License, Build, Market,…

PIs: M. Islam, R. Heaton, et al.

Jurgen Oellig
Current Priorities

• Developing a pipeline to accelerate medical device product development and evaluation – ‘Accelera’ initiative.

• Continued faculty development and support for Techna ‘phenotype’ – innovation, translation, commercialization.

• Driving toward sustainability through commercialization revenues.
IQM - Integral Quality Monitor

IQM is fully integrated into the clinical workflow...

...no user interaction required
IQM - Integral Quality Monitor

Simple detection of any beam or dose related deviation

Spatially sensitive Large-Area Ion Chamber

Independent verification of the final beam product

Highly sensitive to clinically relevant errors
IQM - Integral Quality Monitor

Test sites – global impact.

Launching at ESTRO – Barcelona 2015
**The Funding Portal Joint Venture**

**TECHNA** and **TFP** collaborate under JV to operate a platform linking investment-ready ventures to optimal funding sources within government, capital and private financing markets.

**TECHNA** benefits from a domestic and increasingly international platform for advancing funding applications and ventures into co-development, financing and customer markets. Techna contributes subject-matter expertise, stakeholder networks and core funding.

**TFP** benefits from a flow of qualified applicants and issuers that it can advance into public and private sector funding and investor markets. TFP contributes its proven platform, enabling technology, IP, regulatory compliance, and personnel to secure funding for the Portal’s users.

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**Dr. David Jaffray**

**Teri Kirk, CEO**

**Partnering Opportunities**

[thefundingportal.com/healthtech]
Techna’s business model focused on self-sustainability

Full productization services include project management; key opinion leader academic clinician engagement; software development and engineering; hardware development and engineering; human factors and usability testing; process definition; Validation and Verification (V&V); clinical protocols; training protocols; clinical analysis; knowledge transfer; technical regulatory analysis; CSA certification; regulatory analysis (health agencies); reimbursement analysis; market analysis; Web design and development; ISO13485 setup for projects and startups; Financial services, portfolio management and accounting for startups.
Commercialization metrics

43 Invention Disclosures*
29 Licensing Opportunities

10 Patents**
7 Licensed Products

$330K in royalties
4 Start-ups

* Includes those under review and with decision to proceed
** Includes those expired, pending, and provisionally granted
TORONTO GENEREAL HOSPITAL

PRINCESS MARGARET CANCER CENTRE

TORONTO WESTERN HOSPITAL

TORONTO REHAB

**BUDGET**
- $1.7 billion
- Research: > $300M

**STAFF**
- 12,000
- Research: 2,700

**PATIENTS**
- 11 million procedures annually
- 1 million outpatients visits annually
The Three Pillars of Techna

Faculty

Technology Development Team

Infrastructure
Leadership Team

Institute Director
David Jaffray

Director, Engineering / Operations
Luke Brzozowski

Director, Research Faculty (Physical Sciences)
Paul Santerre

Director, Research Faculty (Clinical Sciences)
Kieran Murphy

Director, Commercialization/TDC
Mark Taylor

Director, Clinical Process
Howard Abrams

CORES
Informatics & Communications Technology
Igor Jurisica

Physical Science Lead
recruiting
Gang Zheng

Clinical Science Lead
recruiting
Ur Metser

Guided Therapeutics
recruiting
Jonathan Irish

Nanotechnology & Radiochemistry
Brian Wilson

Photonics
recruiting
Joe Cafazzo

Design & Engineering for Health
recruiting
Technology Development Team
UHN – TDC Recent MedTech Commercialization Activity

YEAR OF ORIGINAL DISCLOSURE
# Commercialization Metrics

Techna has been highly successful in attracting commercial and academic deals and development projects and has secured **$16M in external funding from industry sponsors and grants**. This means that **for every $1 spent from the PMCF funds, Techna has leveraged $4 from external funds**.

This has been possible through partnerships with over **40 industry partners** and creating proprietary products and interventions for licensing opportunities and/or start-up launches.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invention Disclosures*</td>
<td>43</td>
</tr>
<tr>
<td>Patents**</td>
<td>10</td>
</tr>
<tr>
<td>$330K in royalties</td>
<td></td>
</tr>
<tr>
<td>Licensing Opportunities</td>
<td>29</td>
</tr>
<tr>
<td>Licensed Products</td>
<td>7</td>
</tr>
<tr>
<td>Start-ups</td>
<td>4</td>
</tr>
</tbody>
</table>

* Includes those under review and with decision to proceed
**Includes those expired, pending, and provisionally granted
**Metrics**

**CLINICAL ENGAGEMENT**
Techna engages multiple levels & types of clinical programs to develop novel technologies or solutions

- 15 Leaders
- 37 Affiliated faculty
- 3.5 Faculty

**PARTNERSHIPS & GRANTS**
Techna partners with industry & academia for sponsorships, grants, revenue growth & commercialization

- 40 Industry partners
- $16 M Funds attracted to UHN by Techna
- 4 to 1 Leverage ratio of external to Foundation funds

**SERVICE OFFERINGS**
Techna leads and manages complex MedTech productization projects and programs in a hospital setting

- $12 M Value of projects managed
- 25 Ongoing projects managed
- 37 Members of Core Operations and Technology Development Team
- 230% Annual team growth in 2 years
FACILITIES & RESOURCES
Techna provides coordination, commissioning & operations support for research and innovation facilities & infrastructure

10 Facilities & resources

$100M Value of facilities & resources

GLOBAL NETWORKS
Techna communicates and collaborates with international medical technology institutes multi-national companies

12 Global MedTech Innovation & commercialization centres

2015 Host of International MedTech Institutes Meeting

10 Multi-national companies

EDUCATION & OUTREACH
Techna provides ongoing education, training and engagement to its members & community

30 Techna Rounds

3 Techna Symposia

~1400 Techna Round & Symposia Participants
Medtech Product Lifecycle
3-7 yrs, $10-$100M in capital

Compared to Pharma the Technology ‘Pipeline’ is a mess.

Pharma: Long, but ‘straight’.

Devices: It depends
# Devices vs. drug technologies

## Different Technologies, Culture and Perspectives

<table>
<thead>
<tr>
<th>Disciplines</th>
<th>Medical devices</th>
<th>Drugs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Engineering, materials;</td>
<td>Biology, chemistry;</td>
</tr>
<tr>
<td></td>
<td>Engineers</td>
<td>Scientists</td>
</tr>
<tr>
<td>R&amp;D model</td>
<td>Technology development;</td>
<td>Research;</td>
</tr>
<tr>
<td></td>
<td>Systemic, rapid product dev</td>
<td>Slow, trial &amp; error prod</td>
</tr>
<tr>
<td>User interface</td>
<td>Device-user-patient</td>
<td>Drug-patient</td>
</tr>
<tr>
<td>Effecting Outcome</td>
<td>User knowledge and skills</td>
<td>Active ingredients</td>
</tr>
<tr>
<td>Domain of impact</td>
<td>Local effects</td>
<td>Systemic effects</td>
</tr>
<tr>
<td>Lifecycle</td>
<td>Development – short (3-7 years; $10-$100M)</td>
<td>Development – Long (&gt;10 years, $1-$2B)</td>
</tr>
<tr>
<td></td>
<td>Use - short</td>
<td></td>
</tr>
<tr>
<td>Risk</td>
<td>Lower – Proof point occurs at</td>
<td>High – first proof point</td>
</tr>
<tr>
<td></td>
<td>later stage ie, clinical</td>
<td>at Phase 1</td>
</tr>
<tr>
<td></td>
<td>validation, proven regulatory</td>
<td></td>
</tr>
<tr>
<td></td>
<td>pathway</td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>Essential</td>
<td>Nominal</td>
</tr>
<tr>
<td>Facility Planning</td>
<td>Critical</td>
<td>Minimal</td>
</tr>
<tr>
<td>Technical support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recurrent Operation</td>
<td>Essential for durable devices</td>
<td>Nominal</td>
</tr>
<tr>
<td>Budget</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EXISTING ARCHITECTURE
BLUEPRINT OF FUTURE ARCHITECTURE

1. Patient record is complete and integrated
2. Safe and appropriate access to patient record
3. Effective & efficient capture and extraction of data
4. Research in design
5. Leverage and maintain internal innovation capacity