



*Knowledge Creation, Exchange and Output in
Collaborative Research Networks:
an evaluation of Genome Canada funded projects*

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“Probably no other branch of industrial activity causes as much managerial unrest and uncertainty as does research and development - due largely to the enormous difficulty of evaluating actual and potential economic contribution... The inapplicability of traditional methods of calculation creates an interest in discovering other ways of judging whether performance is good or poor.”

(Herbert A. Shepard 1956)



Genome Canada

- \$M800 investment as of 2004 with an additional \$M364 announced this past August
- Fund a range of projects in aquaculture, plant, animal genomics, proteomics, human health, etc.
- Stage I mandate = “build the assets” (2000-2004)
- Stage II mandate = “develop [the] asset for social and economic benefit” (2005-2009)



Managing IP / Knowledge

- Knowledge is fragmented and dispersed
- Knowledge creation is “being collectivized” (Ziman 1994)
- Requiring new institutions to “handle the transfer, acquisition and use of various forms of knowledge” (Phillips 2005)

collaborations



Collaborations...

■ What?

- » Concept not well understood
- » "...elusive concept to define and measure" (Katz & Smith 2000)
- » Corporate partnerships, teams, interpersonal collaborations, strategic alliances, joint ventures or PPPs (public-private partnerships)...

■ Why?

- » To access to external resources / knowledge (inc. funding)
- » To build upon existing knowledge
- » To create new knowledge
- » To disseminate / share knowledge



Collaborations...

- Collaborations = complexities (knowledge, time, place, people, practice and institutions)
 - » challenges in management/practice
 - » need to balance the interests of partners (public and private)
 - » increase access to and manage knowledge and intellectual property (FTO) (minimize TCs)
 - » “work side by side”



Collaborations...

- How to evaluate GC Funded Projects?
 - » Shepard: “Start with the system...”

Unit of Analysis = “The Network”



Social Network Analysis (SNA)

- Powerful tool “...for explaining variances in resources, social behaviour and socio-economic outcomes.” (Wellman as cited in PRI/SSHRC/StatsCan 2004)
- Actors and actions are independent units
- Ties between actors are “channels” for flows of knowledge



GC Case Studies...

- **Genome Canada funded projects...**
 - » **Functional Genomics of Abiotic Stress (FGAS)**
 - *Funded 2001; “contrived”*
 - *stresses in wheat and canola*
 - *21 agents geographically dispersed across 5 provinces*
 - » **Functional Pathogenomics of Mucosal Immunity (FPMI)**
 - *Funded 2002; “organic”*
 - *disease and immunity to microbial pathogens*
 - *8 agents geographically distributed across SK and BC*



Using SNA to evaluate GC projects

- Factors = knowledge, time, place, people, practice and institutions
- Methodology:
 1. Point-of-award analysis
 - » *provides a 'picture' for KMC (static / snapshot)*
 - » *Quantitative/qualitative*
 2. Pre-award analysis
 - » *historical evolution of social structure*
 - » *Quantitative/qualitative*
 3. Post-award analysis
 - » *Point-of-award onwards*
 - » *Short term network output*



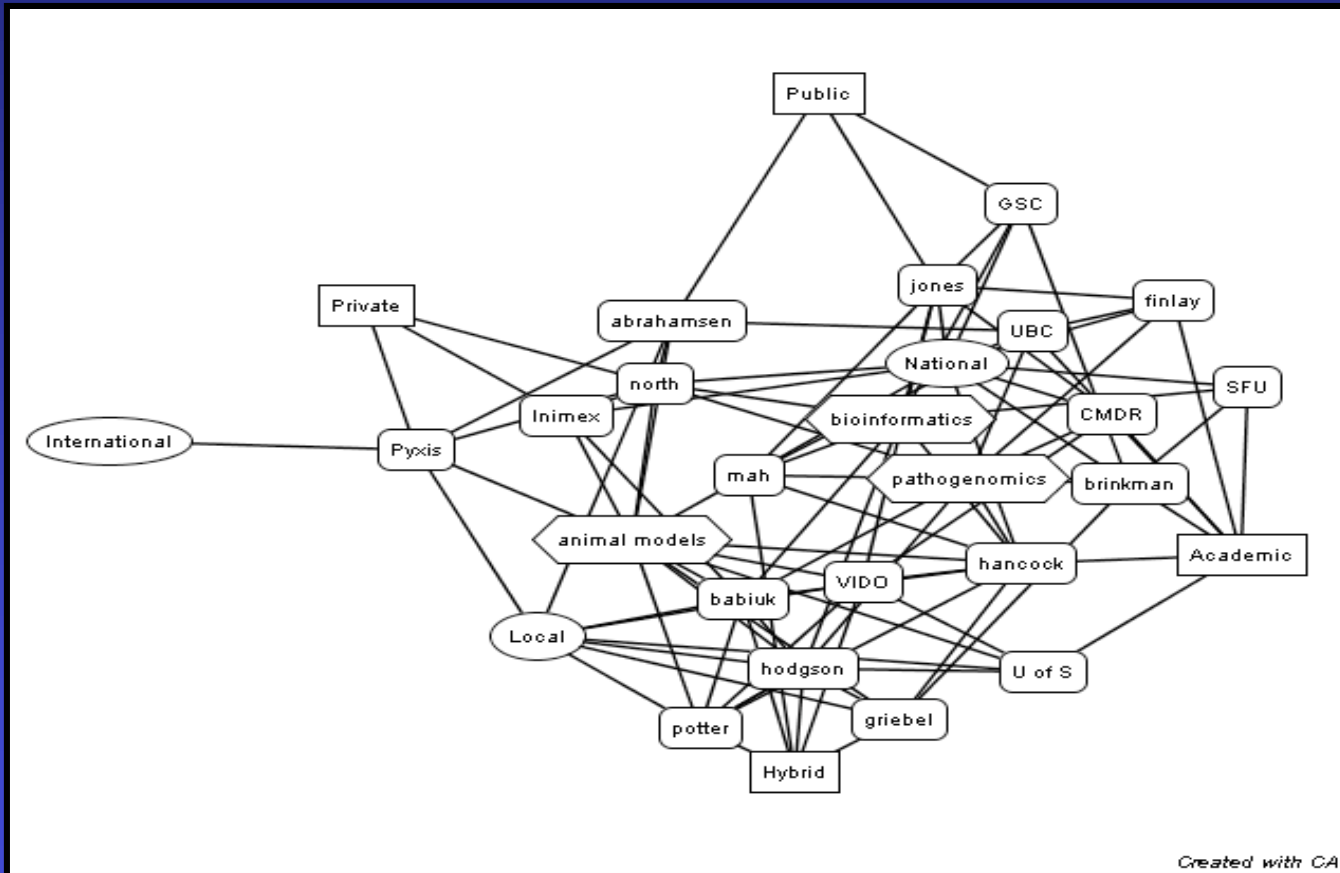
1. Point-of Award (PoA) Analysis

- SNA visualization to view network structure at PoA
- Agent-to-agent relationships = binary
 - » Ties between agents = organizational linkages, joint research arrangements, links to sub projects, etc.
- Knowledge Management capacity (network centralization measures):
 - » Measured through a family of network centralization measures
 - » # paths, path lengths between agents, power of agents based on location, connections, etc within the network

 - » Knowledge Flow Capacity
 - » Network Cohesiveness
 - » Intra-network Connectedness



Point-of-Award = FPMI

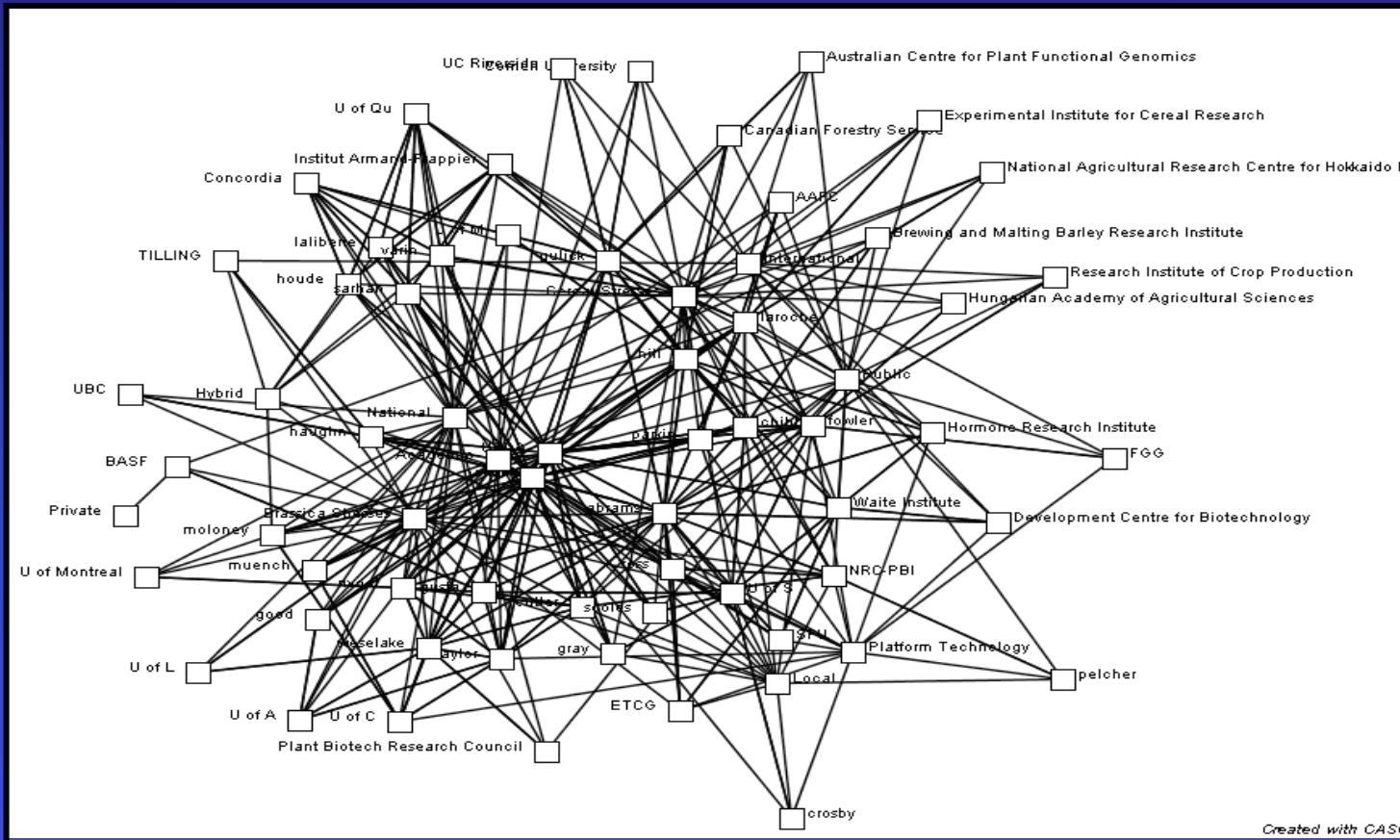


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Point-of-Award = FGAS



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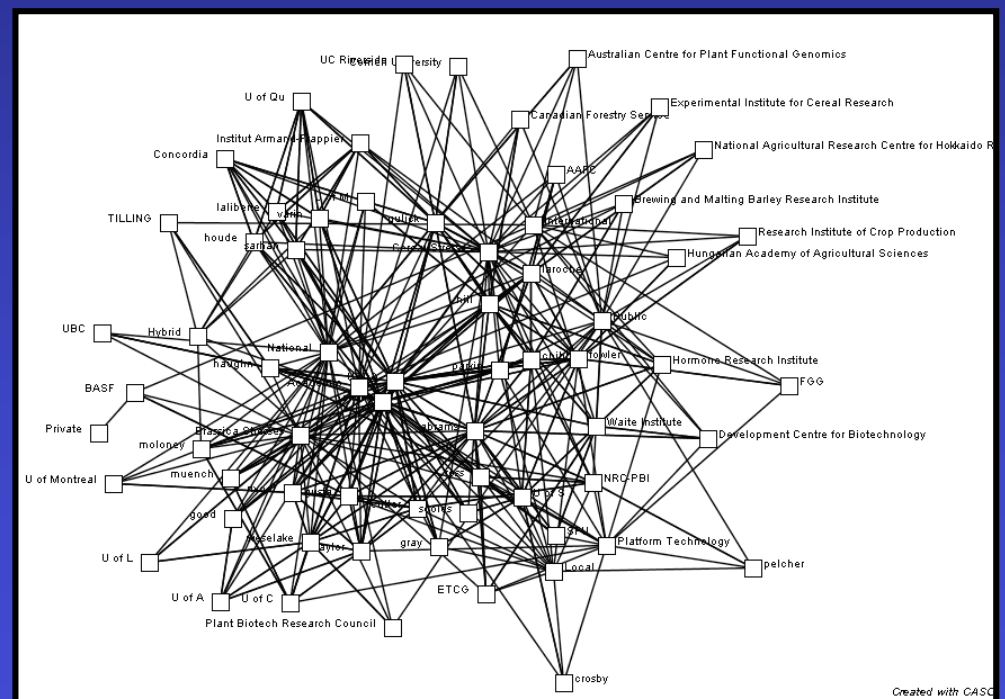
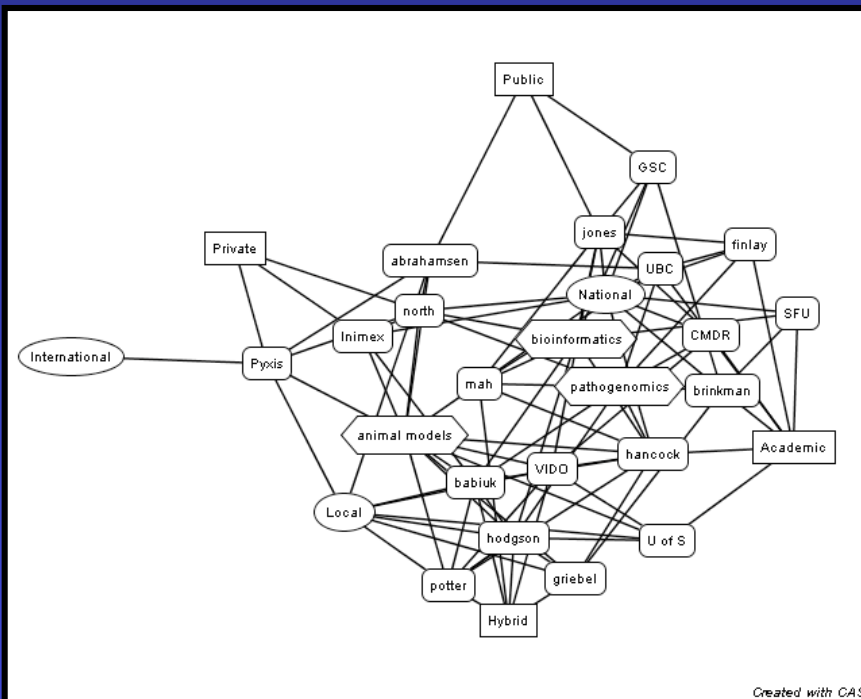
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Point-of-Award Network Structures

FPMI

FGAS



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PoA Comparative Analysis: Knowledge Management Capacity

	FPMI	FGAS
Network Type	Organic	Contrived
Density	8.8%	9.1%
Knowledge flow capacity	++	--
Network Cohesiveness	++	+-
Intra-network connectedness	++	+-



2. Pre-Award Analysis

- Objective: evolution of network structure and knowledge management capacity
- Density of collaborative activity in terms publishing, patenting
 - *1985 – PoA (in 5 year intervals)*
 - » Output of activities normalized by network size
 - » Comparison of capacity
 - *density of collaborative activity*
 - *output normalized by network size*
 - *Measures are compared between projects of interest and with ORA sample network database*



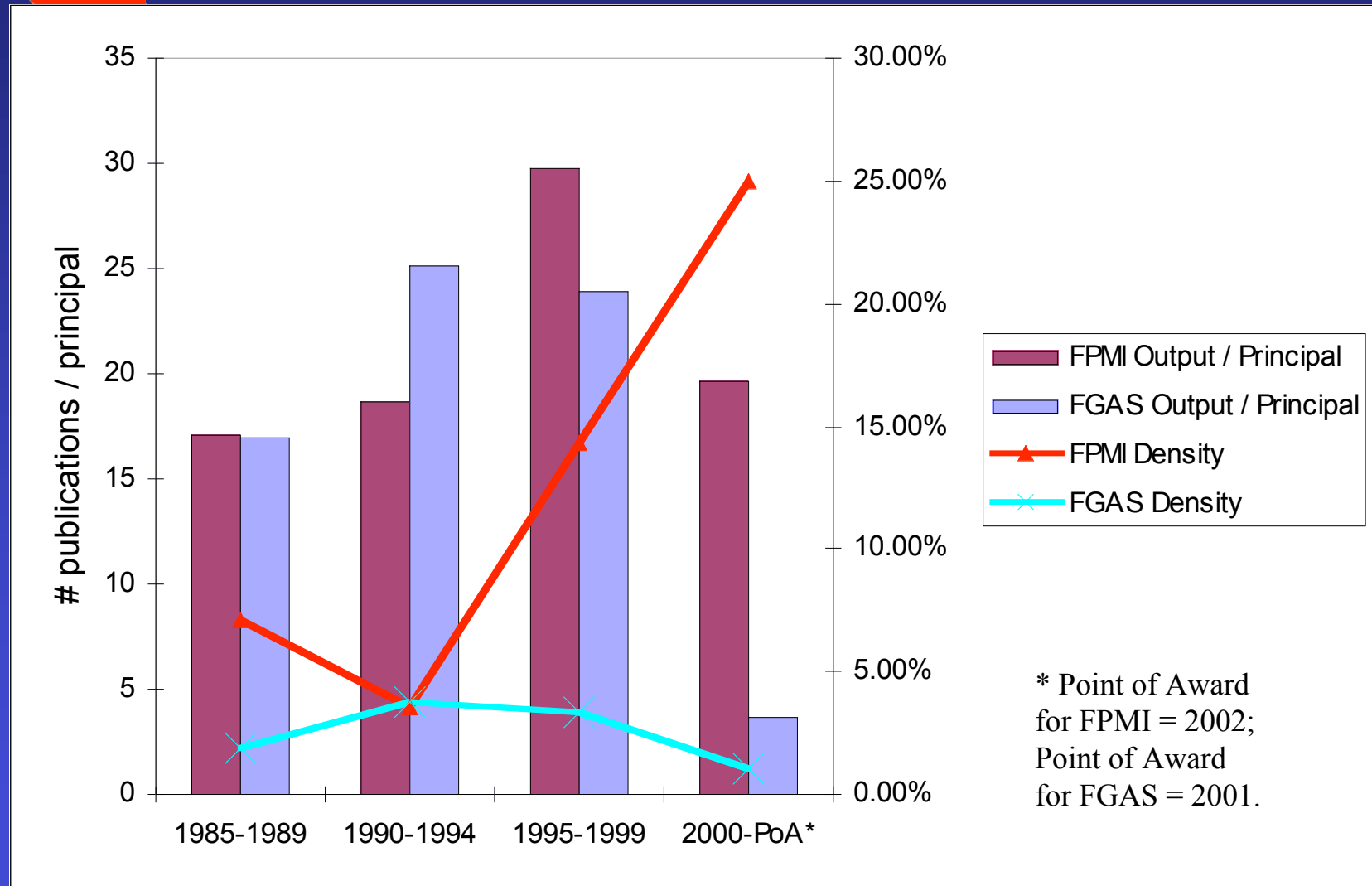
Density of Pre-Award Co-Publishing Activity by Time Interval

	FPMI	FGAS
Density of Collaborative Network Activity		
1985-1989	7.1%	1.9%
1990-1994	3.6%	3.8%
1995-1999	14.3%	3.3%
2000-point of award*	25.0%	1.0%

* Point of Award for FPMI = 2002; Point of Award for FGAS = 2001.

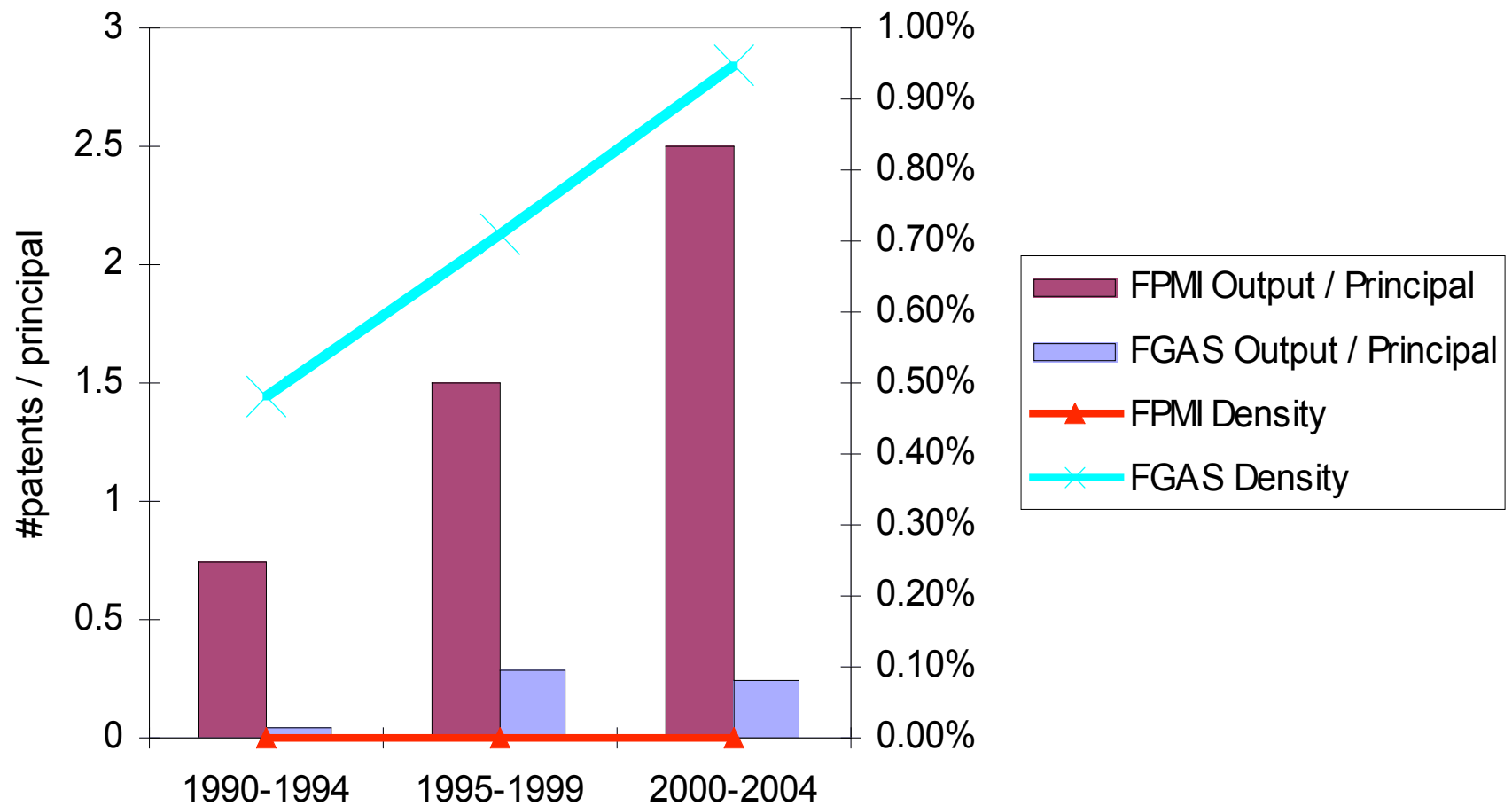


Pre-Award Publishing Activity by Time Interval (normalized by network size)





Pre-Award Patenting Activity by Time Interval (normalized by network size)





Summary of Pre-Award Performance Knowledge Exchange & Knowledge Creation

	Publications		Patents	
	Density KXΔ	Output KC (normalized)	Density KXΔ	Output KC (normalized)
FPMI	High	High	n/a	High
FGAS	Moderate	Moderate- High	High	Low



3. Post-Award Performance

	FPMI (n=8) (2003-2004) (output per principal)	FGAS (n=21) (2002-2004) (output per principal)
Abstracts/posters/seminars	2.87	n/a
presentations	5.50	2.00
publications (network-based)	2.13	1.24
publications (total)	19.00	6.19
patent applications	1.25	0.43
trained personnel	5.62	1.14
awards	3.63	n/a
Spin-off activity	0.25	0.05
Funding (CFI, NSERC, CIHR)	\$3,701,405	\$212,651



Conclusions, Limitations and Implications

- SNA is an effective (partial) tool for analyzing and projecting performance
- Limitations of data set
- Proxies for density and output are partial indicators
- Patenting and publishing activity do not tell the whole story
- Needed:
 - » ROI
 - » In-depth analysis of agent-to-agent relationships