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The Saskatoon Biotechnology Cluster:
A modern research entrepot

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Biotech Clusters

- More than 22 biotechnology-based clusters operating in OECD countries
  - Most integrate bio-med and ag-bio research
  - All linked to specific ag-bio product(s)
  - All depend on international mobility of knowledge and skilled labour
- Saskatoon represents innovative community model with possible international application

Outline

- Are clusters self-contained or are they entrepots?
- The structure of the Saskatoon cluster
- Lessons
- A cluster in transition

Innovation characteristics

- Changed significantly from old R&D based linear models
- Now demand driven, knowledge-based chain-link process involving different types of knowledge (4: why, what, how and who)
- Increasing focus on non-rival innovations
- Rapid creative destruction

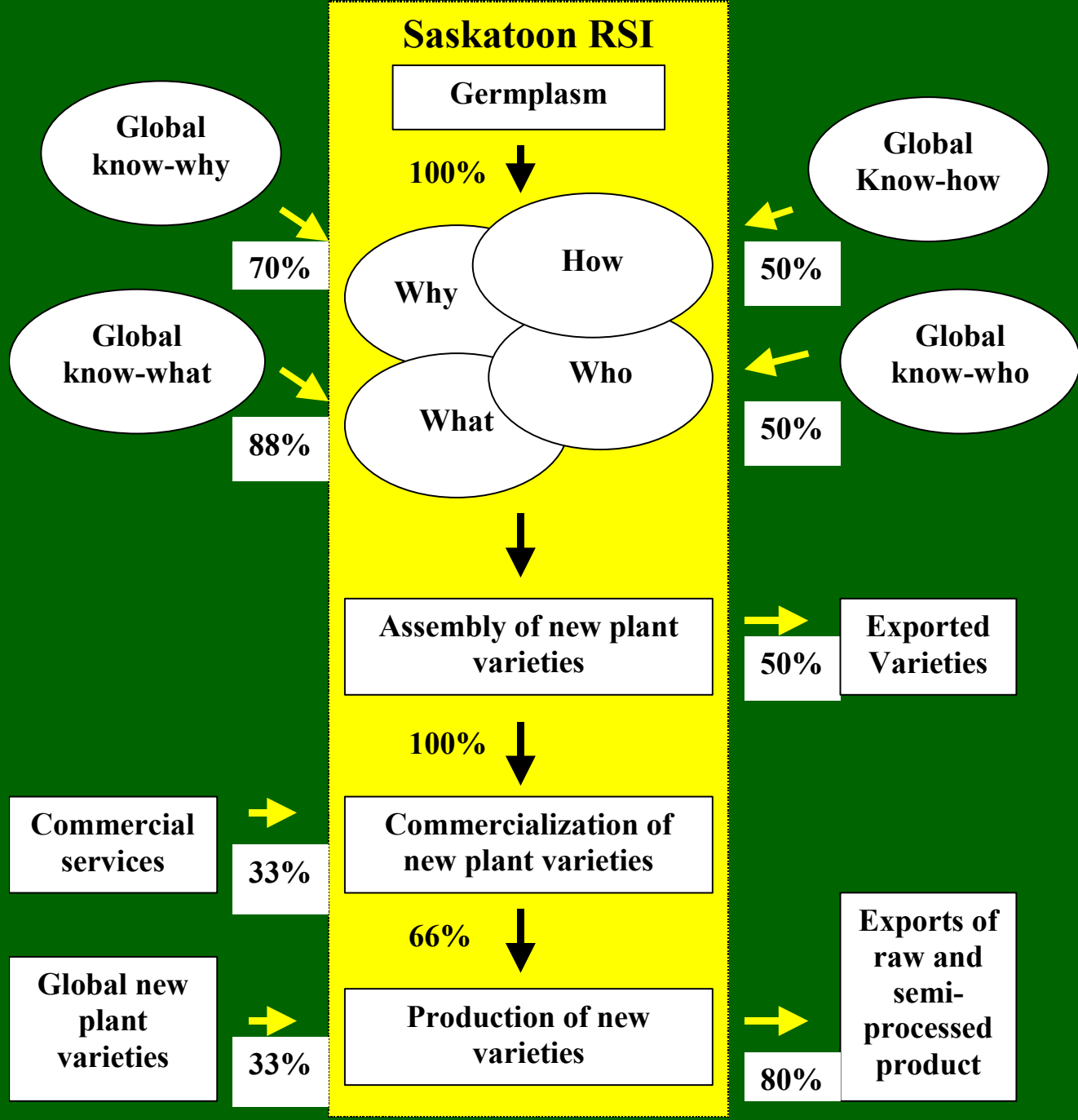
An innovation entrepot

- Using the chain-link, 4-knows model of innovation suggests innovative communities may operate like a classical trade entrepot
  - most inputs are imported tax free
  - value is added locally
  - semi-finished outputs are exported for further processing and distribution to final consumers
  - local community linked to rest of world

Saskatoon's R&D entrepot

- Centre of a globally competitive canola oilseeds complex
  - imports inputs (e.g. basic knowledge and patentable technologies)
  - adds value (e.g. breed, commercialise, produce, market new varieties)
  - exports output (more than 80% of output goes to ROC and ROW; superior good)

The Saskatoon biotech cluster



Research phase:

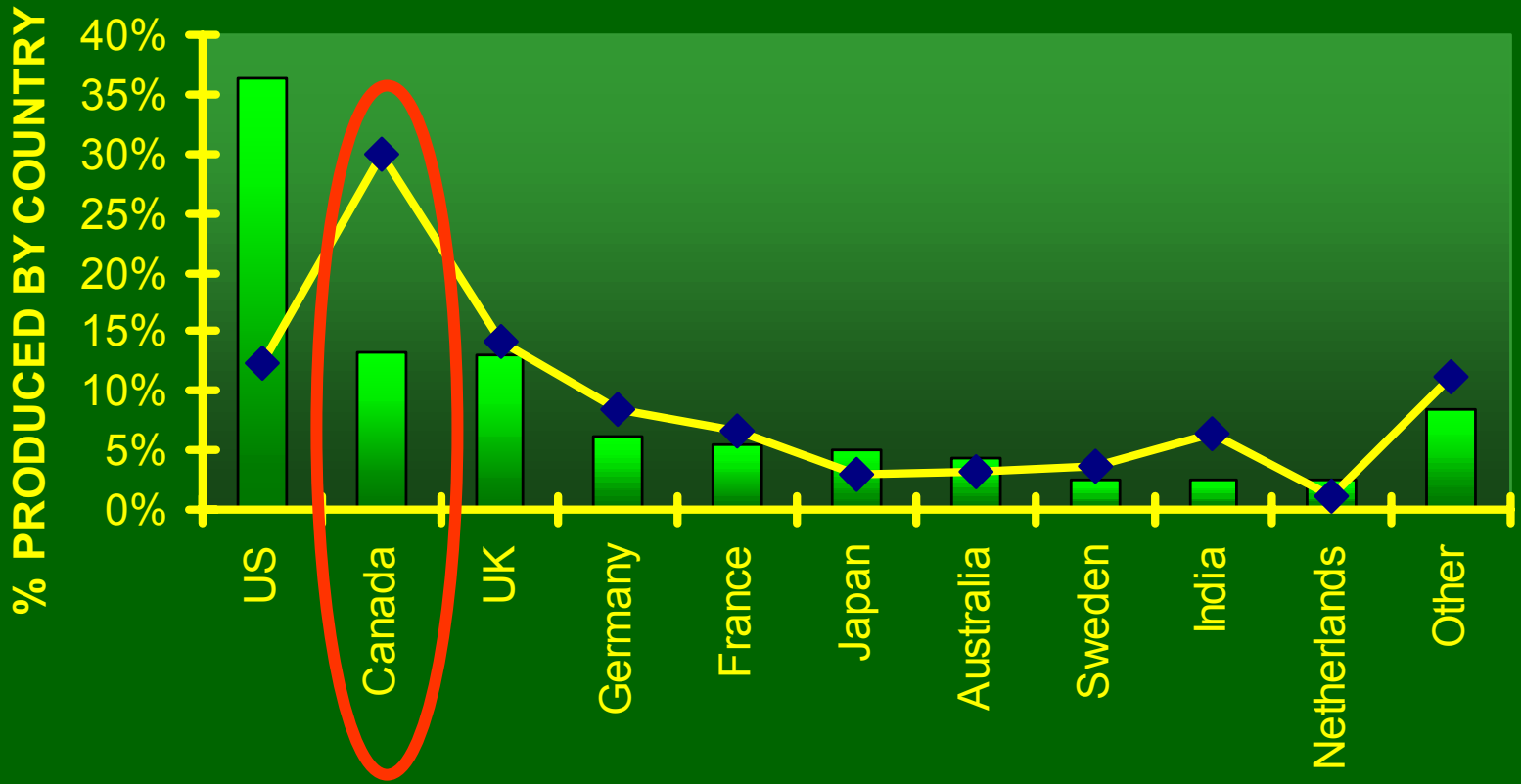
- Result of globally based, locally accessed research materials:
  - Saskatoon has significant but not overwhelming role in generating know-why important base
  - Little local proprietary know-what in Saskatoon
  - Significant know-how and know-who in community
- Different communities for different elements

Canola research communities

- Peer review creates global communities
  - 28,800 authors in 3,816 organisations in 107 countries produced inputs
  - approximately 6,900 authors in approximately 1,500 organisations in 79 countries worked on canola
  - only 69 scientists in 40 institutions in 9 countries produced 31% of the work; for specific elements, only 1-2 scientists key

Know-why knowledge

(articles) Sources (bar) and uses (line)



Global Sources of know-what technology (patents)

	Technology		Product		Total
	Public	Private	Public	Private	patents
Total	66	220	37	311	634
Residence of inventor:					
Canada	32	18	13	12	75
Other	34	202	24	299	559

Source: Canadian Patent Database, December 1999.

Location of know-how
(field trials 1988-95)

Australia	1
Canada	**267**
Total EU	180
- France	69
- UK	48
US	49
Total	497

Location of know-who
(canola research jobs, 1998)

Canada	**50%**
- of which Saskatchewan	**31%**
EU	30%
US	10%
Australia	3%
Rest of world	7%

Research magnets

	Stars	Near Stars
Canada	13	25
- of which Saskatoon	***3***	***8***
Australia	0	1
Europe	13	9
Japan	3	1
US	0	4
total	29	40

All have global reach and collaborations

Commercialization phase

Rapid uptake of product result of local communities:

- Pro-supply national regulatory system
- Extensive regional farm supply chain (coops, commodity groups
- Sophisticated farmers in region
- Accepting marketing channels nationally

Search for causes of cluster

- ISI analysis (1996-7)
- Surveyed canola research firms worldwide (1997-8)
- Surveyed Saskatoon biotech employees (1998)
- Census runs (1998)
- ScienceMap™ (2000)
- AAFC contract to do survey (2002-4)

Public institutions key

- Public provides much of the soft infrastructure for communities:
  - Governments provide standards, IPRs, regulations, infrastructure, grants, etc.
  - University provides trained workers
  - NRC and AAFC provide know-how and know-who for processes and breeding
  - NRC hub (platform) for technology adaptation and adoption; local base for spinoffs

Centripetal forces in the canola industry

	N = 28	%
Proximity to competitors/ partners	14	50%
Access to labs, etc	4	14%
Access to skilled labour	7	25%
Location of key scientists	5	18%
Access to market	6	21%
Role of government	5	18%

Local training

The Saskatoon-based canola labour market				
	Diploma	BSc	MSc	Phd
total #	88	235	67	73
Sask as %	82%	66%	43%	27%
Can as %	98%	91%	84%	64%
US	1%	2%	6%	10%
Europe	0%	4%	7%	18%

Labour market thickness

Relative importance of job and community features as they affect mobile employees										
1 = key; 5 = least	PHD (n=25)					Masters (n=45)				
	1	2	3	4	5	1	2	3	4	5
Other employers	22			1	2	39	2	1	2	1
Type of work	17	2				13	12	1	1	1
Salary and benefits		9	4	2	1	5	9	11	2	
Taxes			2		1			1	2	3
Cost of housing			1	2				3	3	

Local market structure

- Industry accepted collaboration as base
- Farmers adopted technology
- Wholesale trade partnered
- Co-ordinated industry response (e.g. CCC, SCGA...)

Measures of success

- World firsts:
  - NRC Agrobacterium t. gene-splicing technique (1980s); now main system
  - New promoters developed (1990s)
  - Almost all new trait canolas introduced in Canada first (4 HT, novel oils) and HT Flax (1999) (1995-2001)
  - Faster adoption in Canada than ROW
- C$1B gross benefit--$300M in Canada

Local rewards

- Production and exports concentrating around innovation communities
  - Saskatoon captures 31% of research jobs globally; Canada 50%
  - Saskatchewan accounts for 10% of global production; Canada accounts for 20% of global output and 60% of exports
  - Fewer competitive countries
- First mover premiums

Policy lessons

- **Know why:** nurture two-way international flows of knowledge
- Know what: need IPRs; encourage MNEs
- Know how/who: nurture thick labour markets; acquire/sustain critical mass of research; develop and maintain open-platform institutions and networks to facilitate collaborations; partner with existing supply chain

Whither Saskatoon?

- Success based on strong private investment:
  - by Monsanto, AgrEvo, Limagrain, SWP
  - but all reorganized and have at least partly divested canola research
  - Dow only remaining major player
  - no net gain or loss in Saskatoon
- Base for cluster shifting from input trait canola to broader set of traits/products

Next wave

- Infrastructure:
  - CLS/Synchrotron ($150M) in 2004
  - NRC $15M condo facility
- Gemomics projects:
  - 2 canola projects (abiotic stress, VEC) = $25M
  - 2 VIDO projects (animal, human) = $30M
  - AAFC project (plants) = $10M
- So far, all supply push from public sector

What is going right?

- Projects all open platform (esp at know-why stage)
- Have IPR plans (will they work with collaborative structure?); role for MNEs
- Accelerated labour market development (VCB)
- Unclear how will link to existing supply chains

Conclusions

- Entrepot model provides insights into innovation communities
- Public role vital but not simply as a provider of funds
- Policies must not support self-sufficiency--otherwise will be self-defeating
- Transition/evolution of cluster base uncertain