

Jobs impact of automation: Bigger than the thought leaders say it is

David Ticoll
CDO Conference May 2017

Common approach: labour substitution

- Prominent sources re labour market impact of automation:
 - Brynjolffson/McAfee (MIT, 2011) – *Race Against the Machine*
 - Frey/Osborne (Oxford 2013) – 47% of jobs at risk
 - Amtz/Gregory/Zierahn (OECD 2016) – 9% of jobs high automatability (but focus on tasks!)
 - McKinsey Global Institute (2017) – 47% of activity FTEs in Canada, 51% in US
- Methodological consistency: repeatable algorithm (automatable task characteristics)

Frey - Osbourne methodology

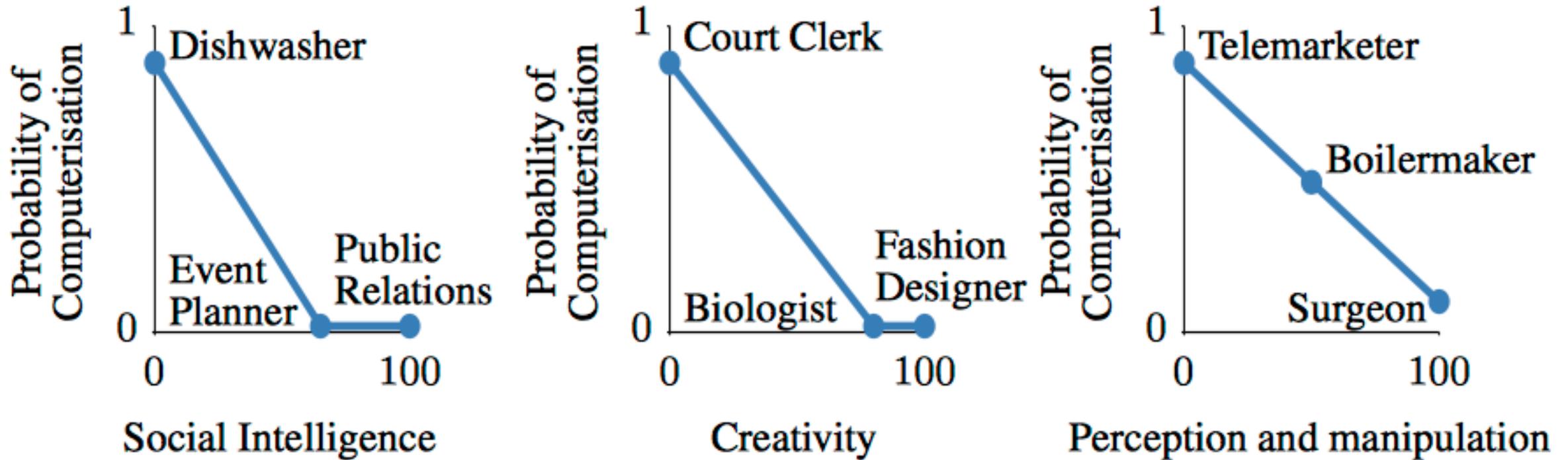


FIGURE I. A sketch of how the probability of computerisation might vary as a function of bottleneck variables.

McKinsey

Current technologies have achieved different levels of human performance across 18 capabilities

■ Below median ■ Median ■ Top quartile

	Automation capability	Capability level ¹	Description (ability to ...)
Sensory perception	Sensory perception	Median	Autonomously infer and integrate complex external perception using sensors
Cognitive capabilities	Recognizing known patterns/categories (supervised learning)	Top quartile	Recognize simple/complex known patterns and categories other than sensory perception
	Generating novel patterns/categories	Below median	Create and recognize new patterns/categories (e.g., hypothesized categories)
	Logical reasoning/ problem solving	Below median	Solve problems in an organized way using contextual information and increasingly complex input variables other than optimization and planning
	Optimization and planning	Top quartile	Optimize and plan for objective outcomes across various constraints
	Creativity	Below median	Create diverse and novel ideas, or novel combinations of ideas
	Information retrieval	Top quartile	Search and retrieve information from a large scale of sources (breadth, depth, and degree of integration)
	Coordination with multiple agents	Below median	Interact with others, including humans, to coordinate group activity
	Output articulation/ presentation	Median	Deliver outputs/visualizations across a variety of mediums other than natural language
Natural language processing	Natural language generation	Median	Deliver messages in natural language, including nuanced human interaction and some quasi language (e.g., gestures)
	Natural language understanding	Below median	Comprehend language, including nuanced human interaction
Social and emotional capabilities	Social and emotional sensing	Below median	Identify social and emotional state
	Social and emotional reasoning	Below median	Accurately draw conclusions about social and emotional state, and determine appropriate response/action
	Social and emotional output	Below median	Produce emotionally appropriate output (e.g., speech, body language)
Physical capabilities	Fine motor skills/dexterity	Median	Manipulate objects with dexterity and sensitivity
	Gross motor skills	Top quartile	Move objects with multidimensional motor skills
	Navigation	Top quartile	Autonomously navigate in various environments
	Mobility	Below median	Move within and across various environments and terrain

All based on currently demonstrated technology

% of time automatable:

- Canada: 47
- US: 46

Example occupations

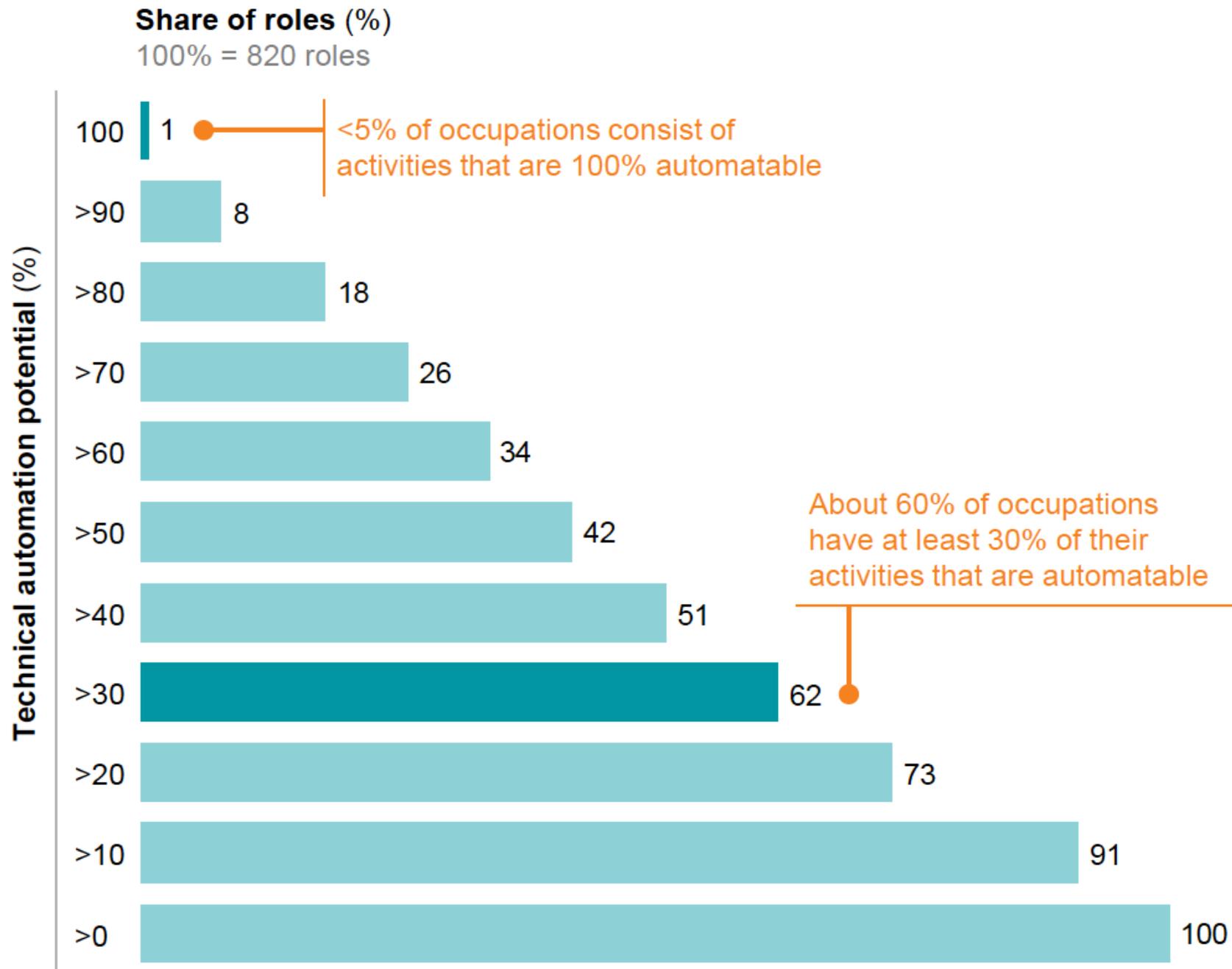
Sewing machine operators,
graders and sorters of
agricultural products

Stock clerks, travel agents,
watch repairers

Chemical technicians,
nursing assistants,
Web developers

Fashion designers, chief
executives, statisticians

Psychiatrists, legislators



“Pessimistic” re automation potential?

- Incomplete on the face of it
 - Many jobs have declined or disappeared without being automated
 - These include occupations likely “below median” on McKinsey’s automation susceptibility scale
 - Horseshoe makers
 - Pulp & paper workers
 - Investigative journalists
 - Professional photographers
- Overlooked: Impacts of business innovation and changes to core technology, with impact across a sector’s ecosystem

Alternative model: Core ecosystem technology (CET) assessment

A new model: Core ecosystem technology (CET) labour market impact assessment

- Employment impact (technology + business innovation) =
 - Sum of labour...
 - Substitution
 - Obsolescence
 - Impact of technology change
 - Offshoring/outourcing
 - Economic viability
- Above functions
 - Distinct
 - Ecosystem, task & role specific
 - May overlap in a specific task/role case
- CET analysis is complicated:
 - Requires identification & analysis of entire ecosystems
 - Non-substitution effects vary considerably and are sector ecosystem specific

Hypothetical example: vehicle automation

- **Mobility users (labour substitution)**

• Transport truck drivers	261,775
• Taxi, limo drivers	48,545
• Delivery & courier drivers	90,075
• Mail, postal, courier workers	<u>92,825</u>
	493,220

- **Complementary sectors (labour obsolescence)**

• Auto dealers & distributors	195,160
• Auto rental & leasing	16,600
• Gas stations	52,300
• Auto service & body shop	166,100
• Insurance agents & brokers (x.25)	16,550
• Police officers (x.25)	<u>20,000</u>
	496,710

- **Competitors (economic unviability)**

• Public transit, hotels, airlines	???
------------------------------------	-----

- **Mobility tech providers (core technology change)**

• Auto manufacturing	125,000
----------------------	----------------

Automation of ad-taking & placement

THE COLLAPSE OF NEWSPAPER CLASSIFIEDS

Total print classified advertising revenue, Canadian daily newspapers, 1995-2015 (\$millions)



Source: ThinkTV (TVB Canada)

The Canadian Media Guild has tracked layoffs and buyouts for the past few decades. When non-news companies are excluded, the total is in the order of **12,000 positions lost, more than 1,000 of them in the last year alone**. Unifor's 46 media bargaining units had **1,583 members in 2010 but only 1,125 by early 2016**. The CWA estimates it had about **400 editorial members in 2016, a decline of about one-third from 2010 and more than two-thirds since the early 1990s**.

Pulp & Paper Manufacturing				
	2000	2013	Change	% Change
Employment	115,700	62,692	-53,008	-46%
Wages & salaries	\$5,221,169,000	\$3,235,468,000	-1,985,701,000	-38%
Income/employee	\$45,126.78	\$51,608.95	6,482	14%

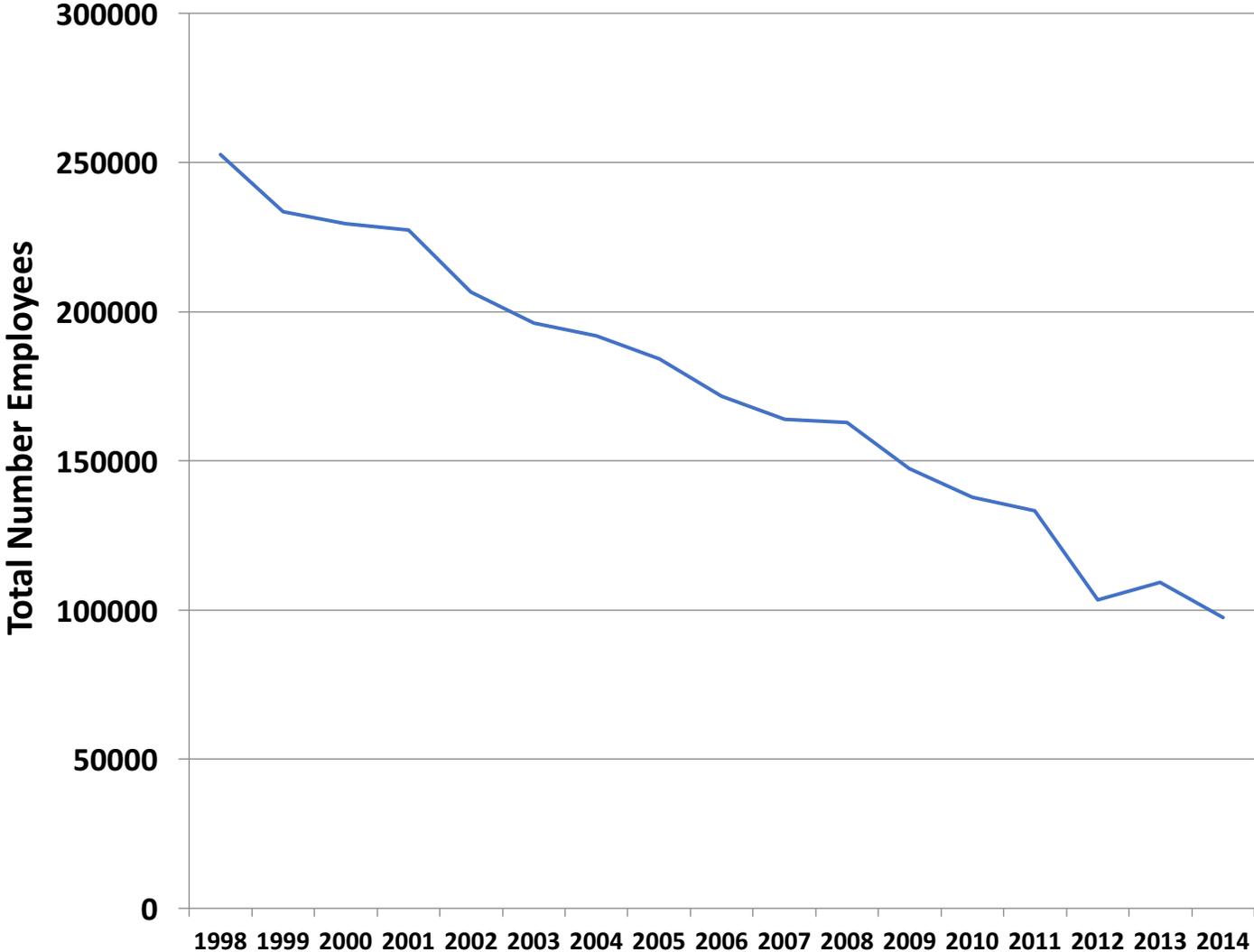
Table displays, in millions of tonnes, the production volume of newsprint, printing and writing paper, and wood pulp for each year between 2005 and 2015.

Year	Newsprint	Printing and writing paper	Wood pulp
2005	7.77	6.71	25.31
2006	7.12	6.11	23.44
2007	6.64	5.95	22.11
2008	5.99	5.27	20.37
2009	4.38	4.43	17.10
2010	4.64	4.07	18.54
2011	4.38	3.77	18.34
2012	3.87	3.31	17.15
2013	3.97	3.47	17.25
2014	4.01	3.26	17.25
2015	3.50	3.04	16.84

Pulp & Paper Manufacturing

	2000	2013	Change	% Change
Employment	115,700	62,692	-53,008	-46%
Wages & salaries	\$5,221,169,000	\$3,235,468,000	-1,985,701,000	-38%
Income/employee	\$45,126.78	\$51,608.95	6,482	14%

Employees in select photography subsectors United States 1998-2014



Number of employees:

1998	252,648
2014	97,471

Net decline: 155,177
% Change : -61.4%

Select photography subsector job losses

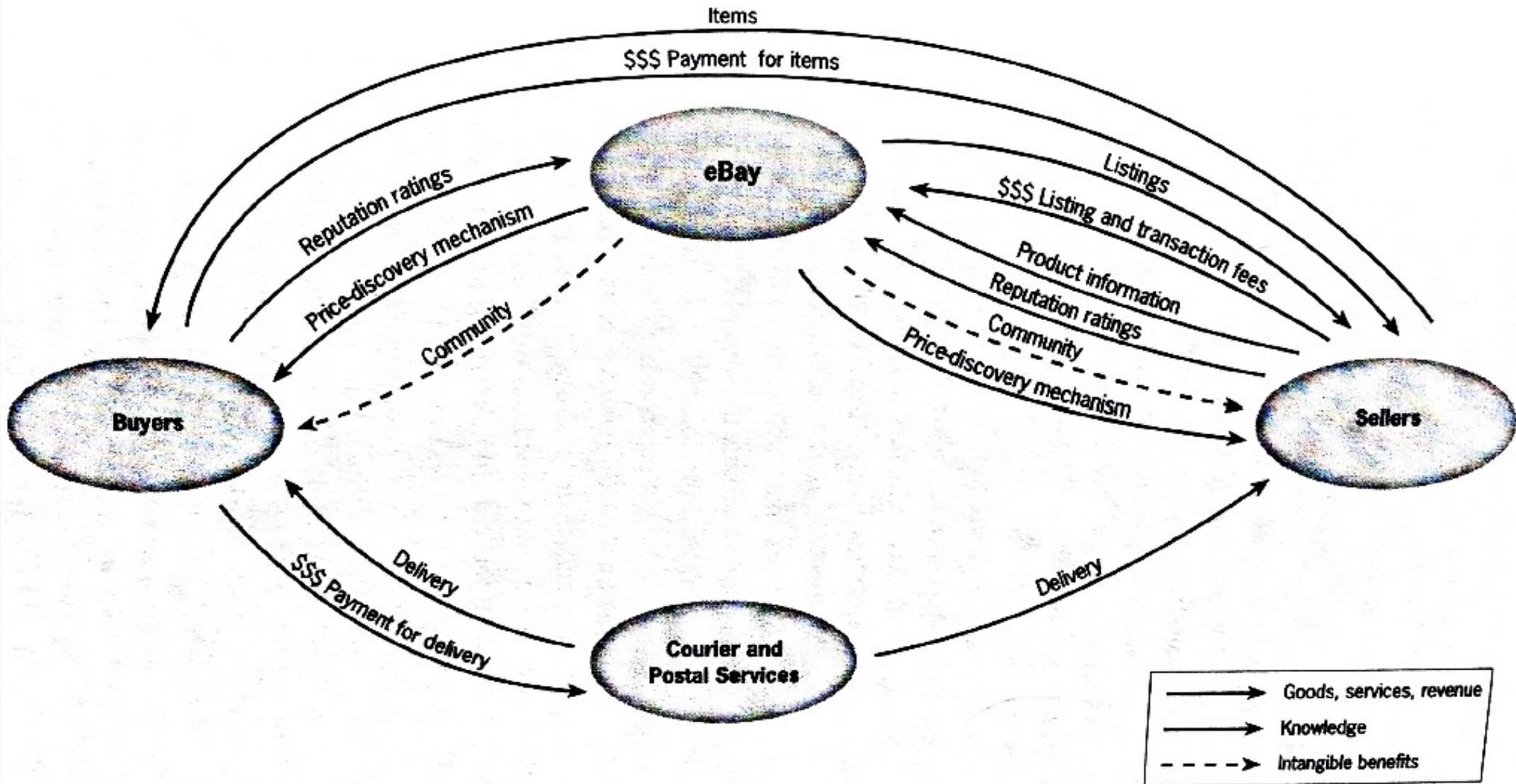
Photography Industry Subsectors (based on NAICs codes)	Employed 1998	Employed 2014	Job losses	% change 1998-2014
Photofinishing labs	57,140	6,884	50,256	-88.0%
Photographic film, paper & chemical mfg	36,942	10,992	25,950	-70.2%
Photographic/copying equipment mfg	24,566	5,130	19,436	-79.1%
Photo portrait studios	62,811	44,571	18,240	-29.0%
Electric lamp bulb & part mfg, including photo	16,156	4,626	11,530	-71.4%
1 hour photofinishing services	15,102	774	14,328	-94.9%
Photographic equipment & supplies whsle	21,787	13,638	8,149	-37.4%
Commercial photography	18,144	10,856	7,288	-40.2%
Total	252,648	97,471	155,177	-61.4

Methodological considerations

What do these ecosystems have in common?

- Mobility: *pilot* shift from human to automated pilot
- Newspapers: *ad placement* shift from human to automated
- Photography: *image capture* shift from analog to digital
- Another example: shipping container (ie not just digital technologies!)
 - Shipping: *packing organization* shift from ad hoc to standardized
- Common feature: shift in a core ecosystem technology (CET)
 - CETs are rare and special
 - Business web/ecosystem analysis required

FIGURE 2-1 eBay Value Map



Factors of labour market change, e.g. self-driving cars

- **Labour substitution.** Significant labour substitution for Canada's 500,000 professional drivers (light & heavy freight, taxi/limo, transit) and operators of mobile services (e.g., street cleaning and garbage collection). New jobs may arise for vehicle cleaners & travel assistants (eg for elderly & disabled passengers).
- **Core technologies.** Shift from steel to ICT & lightweight bodies could reduce labour demand and facilitate offshoring. Electric vehicles will need less routine maintenance (no oil changes!). Demand for oil and gasoline will decline. Labour demand – up for information technologists, down for upstream/downstream oil sector employees and car mechanics.
- **Transaction costs & disintermediation.** Mobility services that use their own fleets will deal directly with consumers. They will disintermediate car dealers, automotive lending and leasing services, insurance, etc. In the process, they will reduce transaction costs for consumers.
- **Positive/negative externalities.** A positive externality of automation will be improved safety and traffic self-management. This will reduce the need for jobs in auto body shops, policing, and accident-related medical services. It will also reduce availability of organ transplants.
- **Economic viability.** As private ownership declines, the traditional automotive aftermarket will be challenged. On the other hand, a new mobility app aftermarket could arise.
- **Ripple effects.** Victims of job losses have less to spend, affecting employment and incomes across a variety of sectors. This applies to both commercial (fewer truck drivers mean less spending at truck stops) and consumer outlays.

A new model: Core ecosystem technology (CET) labour market impact assessment

- Employment impact (technology + business innovation) =
 - Sum of labour...
 - Substitution
 - Obsolescence
 - Impact of technology change
 - Offshoring/outourcing
 - Economic viability
- Above functions
 - Distinct
 - Ecosystem, task & role specific
 - May overlap in a specific task/role case
- CET analysis is complicated:
 - Requires identification & analysis of entire ecosystems
 - Non-substitution effects vary considerably and are sector ecosystem specific

The future of work

- Where do jobs come from?
 - Subsistence → industrial economy
 - 4 industrial revolutions
 - Steam/cotton/agriculture
 - Electricity, engine, mass production, plumbing, medicine, etc.
 - Electronics, ICT
 - AI, machine learning – decline of work?
- Canada – grounds for optimism
 - Small population
 - Educated
 - Demographics
 - Export oriented
 - Public policy