Workforce Changes in the Maturing Information Technology Industry

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KanREN’s Problem

• The **growing need to connect more** and more sites to the “network” generates needs for **more network staff**.

• **Existing staff** moving on to “greener pastures” are **difficult to replace**.

• Percentage of skilled, but **repetitive work** rising compared to the “unique solution”.

• As the network becomes a “utility”, the need for **consistency and uniformity** outweigh the need for **innovation and uniqueness**.
Is This Unique to Us?

• After discussion with colleagues at other state/regional networks, it was clear **others had similar issues** to varying degrees.

• It seemed something bigger was at play -- as if this were a type of “**growing pain**” as our R&E networks and the **industry** itself **matures**.

• Research began to see if other industries, **historically**, showed **similar trends**... The results are **significant**.
The Search for Solutions

- Two different tracks of study almost immediately emerged:
  - **Historical** experiences of other fast-growth industries
  - **Sociocultural** practice of occupation
Early US History

From the earliest days of the United States, the scarcity of skilled artisans lead to a culture that rewarded innovations in mechanization and production volume over classical workmanship.

“Necessity, who is the mother of invention.”

-- Plato, The Republic,
Birth and Growth of and Industry

• During the eras that followed, a typical pattern emerged in the evolution of industries:

• *Ideas, concepts and technology* merge to produce a new product or service. It is a time of opportunity.

• *As the industry grows*, the focus shifts from technical innovation to operational stability.

• *As the industry matures*, the need for operational stability and consistent production becomes the most important element.
Practical Definitions of Workers

- **Craftsman** - Knowledge and experience combined to synthesize new and changing solutions within their field. Autonomous workers with the ability to make decisions about what needs done and how to get it done.

- **Operatives** - Very specialized workers who perform repetitive tasks over and over again. Their work is easily defined and measured. Typically, operatives lack the breadth of experience and knowledge to direct their own work (little autonomy).
Practical Definitions of Workers

- **Laborer** - Mostly unskilled, perform tasks requiring little or no specialized training and education. Work output is easily measured. Their labor adds value, not their skill and knowledge.

- **Manager** - Specifically skilled at managing people and their work, while often promoted from the “working” ranks, technically, the ability to perform the work of their workers is not required.
Early Years - Craftsmen are Key

- All industries begin with a heavy reliance on craftsmen when the industry is just starting out.
- Craftsmen’s skill and the work of laborers create the work product.
- The autonomy of the craftsmen require significantly less formal management.
- During these times, craftsmen are directly producing the product/service.
The Industrial Revolution(s)

- Snapshot *examples throughout* US history from various fast-growth industries:
  - Railroad
  - Iron/Steel
  - Textile
  - Automotive
Reliance on Craftsmen

- In 1893, the Pullman Co. had a workforce size between 4400 and 4800. Approximately 3/5 were craftsmen. As Pullman grew and automated, this ratio dropped significantly.

- In 1891, 40% of the newly established auto industry production workers were craftsmen. By 1917, the Ford Motor Co., due to new mass production techniques, craftsmen only comprised 22% of the workforce.
Rise of the Operative

• The number of operative workers grow as an industry matures, develops.

• In early industries, the need for more operative workers came from two changes:
  • Addition of supplementary operations that also maintains core craft processes (ex: brass industry adds workers to make thimbles)
  • Direct substitution of specialized tasks (ex: new machines replace 1 wood crafter with 200 factory workers to make cabinets, e.g.)
Operatives Dominate

- In auto industry overall, by 1923, 65% of production force is “operative” with 9% craftsmen, 9% laborers.

- Result of mass production

<table>
<thead>
<tr>
<th>Year</th>
<th>Ford Motor Co.</th>
<th>Craft</th>
<th>Oper.</th>
<th>Unskill.</th>
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<td>1910</td>
<td>31.8%</td>
<td>29.5%</td>
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<td>38.6%</td>
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<td>1913</td>
<td>28%</td>
<td>51%</td>
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<tr>
<td>1917</td>
<td>21.6%</td>
<td>62%</td>
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<td>16.4%</td>
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</table>
Rising Laborer class as well

- Example: Building trades
- Presence of laborers rise by 408% between 1870-1910.
  - Growth rate is more than double that of construction labor force as a whole
  - Skilled trades are slowing as building materials are becoming pre-fabricated in the mills and factories. Actual labor at the job site is unaffected thus labor grows
Conclusions from History

• As industries mature, fewer craftsmen are required -- typically as a result of improved mechanization/automation.

• Efficiencies are gained by employing highly specialized operative workers to perform repeated tasks very efficiently.

• Output of the industry requires more stable, repeatable, process-driven methods in order to scale to larger quantities and reduced productions costs.
Sociocultural Practice of Occupations

- **Occupations** are generated and re-made over time in response to cultural/community needs.

- The **community** establishes requirements to regulate the occupation:
  1. **Requirements are codified**; must be met by novices before practicing independently.
  2. Level of codification depends on potential risk to the community.
Expertise

- **Expertise**: the ability to resolve novel, non-routine problems within a particular environment.

- Experts can accomplish this because an expert has:

  1. A breadth of knowledge that is conceptual, and transcends procedural knowledge.

  2. **Experience** which allows them to quickly and effectively categorize information that makes response to problems faster and more accurate.
Necessary Expertise/Barriers to Entry

- Medical Doctor:
  - Many, many years of advanced formal education
  - Government regulated licensure required
  - Extreme training, including endurance
  - Very costly
  - Work output subject to extreme scrutiny
Necessary Expertise/Barriers to Entry

- Aircraft Mechanic (Airliner):
  - Post-secondary formal education required
  - Government regulated certification
  - Specific training required by the aircraft manufacturer
  - Work output highly regulated by multiple checks/and balances due to potential risk
Necessary Expertise/Barriers to Entry

• Appliance Repairman (non-refrigeration):
  • No post-secondary education required
  • Trade-school or vendor certification
  • No government licensure or certification
Realities of Expert Workers

- **Maturation of industry** shows the rise of the semi-expert, the **operative worker**, and the increased reliance on both operatives and laborers using better **machines and processes**.

- In **mature industries**, the experts cannot be expended in actual production. **Experts** (in this case, the craftsmen) find **roles in setting up and organizing** the work and machines -- a role **ancillary to actual production**, yet prerequisite to it.
Networking Workforce Changes

- Many **new** networking workers **do not have** the same level of **education** and/or the record of **previous accomplishment** of the predominant worker of the “early days”.

- **Early innovators** and implementers often had **science, engineering or math** degrees, and had already shown **success** in a career field.

- **New entrants** into our field often have some post-secondary education and one or more **vendor certifications**.
What Happened to our Experts?

• Many still exist, but have been promoted into higher level, often administrative positions.

• As our industry matures, many areas have less technical challenge than they used to. Those seeking the “frontier” are finding it elsewhere.

• Drawn away to private industry for higher pay and benefits -- Is the commercial world becoming more attractive? Is R&E work becoming less attractive?
Effects of Workforce Changes

• **New entrants** have procedural knowledge, but often **lack** the **conceptual knowledge** more predominant in the earlier generation of workers.

• **New workers** are often less autonomous workers with more need for direct supervision and oversight from management.

• Fewer entrants are craftsmen. More are operative workers, **fueled in specialized procedural knowledge by vendor certification and lack of formal education and experience**.
Effects of Workforce Changes

• New entrants, as operative workers, have a greater **expectation** of formal **on-the-job training**.

• **Less emphasis** is placed on **conceptual skills** (how the protocol works) than on procedural knowledge (how to turn on the protocol)

• Greater emphasis on **workplace structure** and stratification is required.
Effects of Workforce Changes

- As industry grows, more specialized workers become part of the machine -- the “shirtmaker” becomes a “factory worker”, and the people become less personally invested in their craft.

- The current market is supplying us with predominantly operative workers, but R&E networking is supposed to be innovative and at the leading edge -- we need a higher percentage of craftsmen than the commercial world.
Changes in the Dominant Worker as our Industry Matures

<table>
<thead>
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<th>Innovators</th>
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<th>Maintainers</th>
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The Information Utility

Changes in the Dominant Worker as our Industry Matures
Conclusions

- The evolution of a fast-growth industry is largely the same throughout history.
- The need to increase production, efficiency and stability (reliability) requires changes to the workforce.
- Fast-growth industries often outpace the ability for our society to re-build occupations for the industry.
Conclusions

• Our R&E network is fundamentally different from typical commercial networks - we are expected to be more innovative.

• The workforce “supply” is tailored for the commercial segment, and this is what “we” have to work with.

• R&E networks will have to find more creative ways to acquire and retain skilled craftsmen (experts) as their availability decreases.
Thank You

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