Competencies in adoption and use of digital technologies: AR/VR, 3D printing/digital fabrication, and digital analytics

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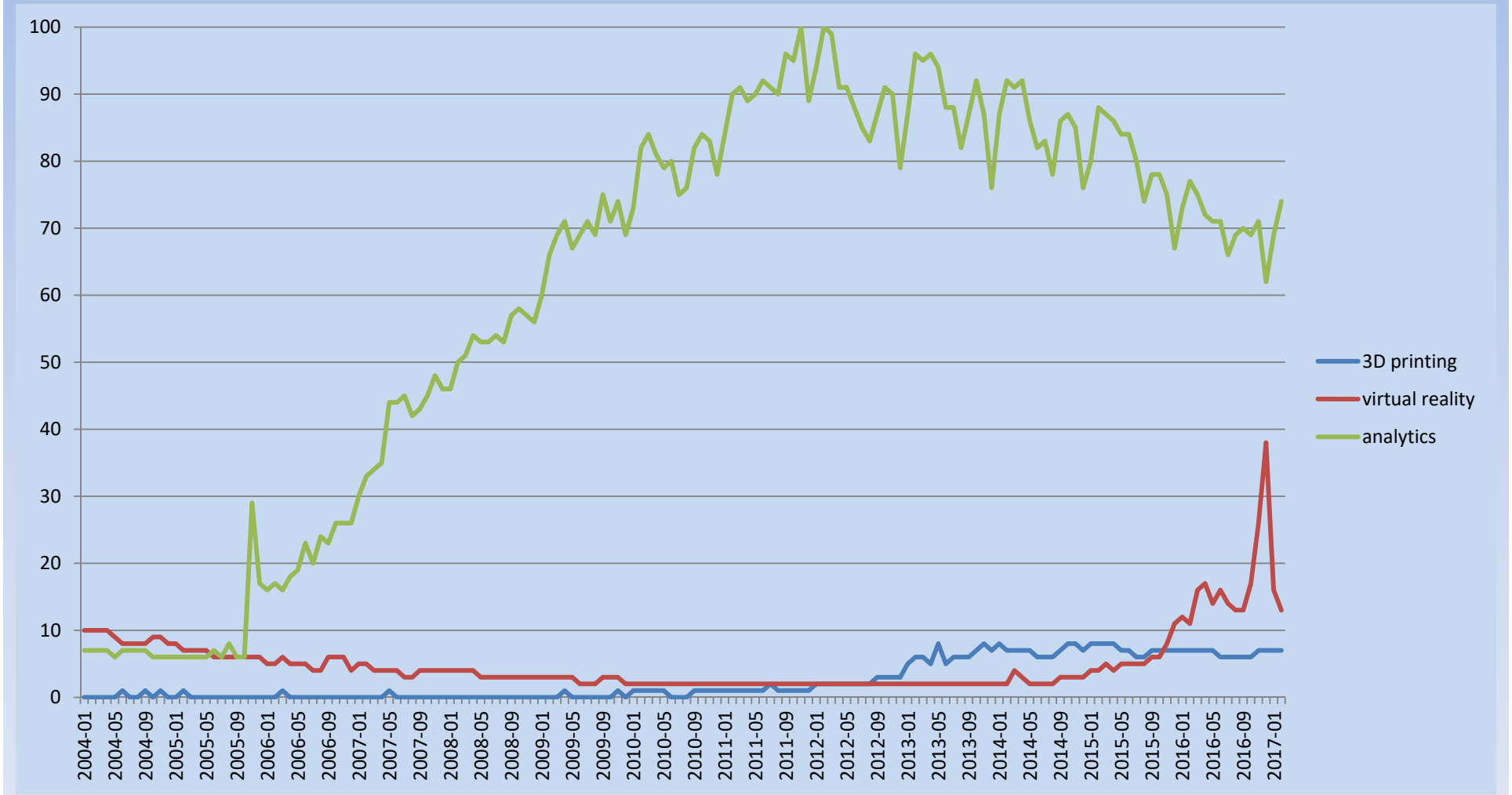
- What are competencies?
- Meitzner-Kamprath competencies framework (professional, methodological, personal-social competencies)
- Applying the Mietzner-Kamprath framework to job descriptions in three tech areas
- Origins and development of technology-related competencies: insights from interviews and focus groups

Relative salience of virtual reality, 3D printing, and analytics in worldwide news

(according to Google)



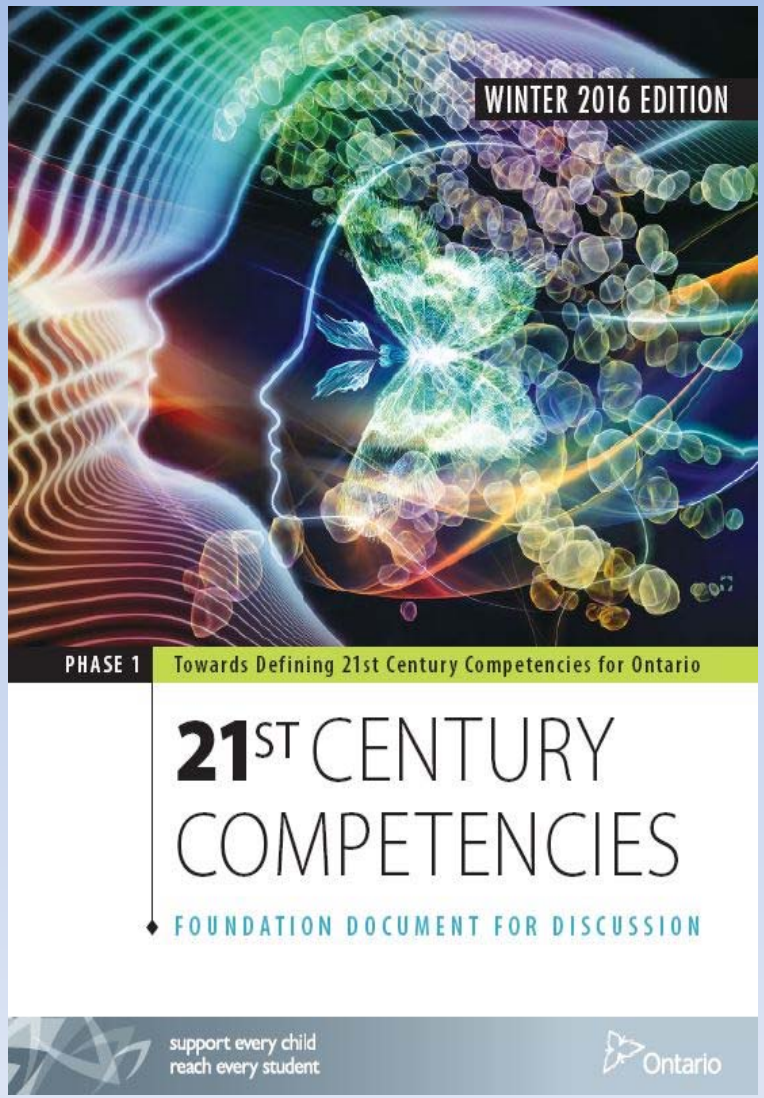
competencies

- The concepts *competence* and *competencies* are very frequently used in HR, strategy, psychology, and educational literature
  - "A competency is …. a coherent cluster of knowledge, skills and attitudes which can be utilized in real performance contexts" (Mulder 2014).
  - "Professional competence is seen as the generic, integrated and internalized capability to deliver sustainable effective (worthy) performance (including problem solving, realizing innovation, and creating transformation) in a certain professional domain, job, role, organizational context, and task situation" (Mulder 2014).
- Competencies must be observable, measurable, and outcome-based.
- Competence-based education has been an educational philosophy for the past 50 years.
- A strong selling point is the idea that a **focus on competencies can improve the effectiveness of education and training offerings in support of employability and adaptability.** An understanding of competencies leads to an understanding of architecture of learning.

competencies

- Unfortunately, no conventions have been established about how to operationalize competency as a construct
  - Although there is general recognition of tripartite framework:
    - cognitive competence (for knowledge)
    - functional competence (for skills)
    - social competence (covering attitudes and behaviors)
- Competency frameworks address specific jobs or occupations, not technologies (for which certification is used to signal skill)

- The Ontario Government has proposed six 21st century competencies:
  - Critical thinking and problem solving
  - Innovation, creativity, entrepreneurship
  - Learning to learn/self-awareness
  - Collaboration
  - Communication
  - Global citizenship



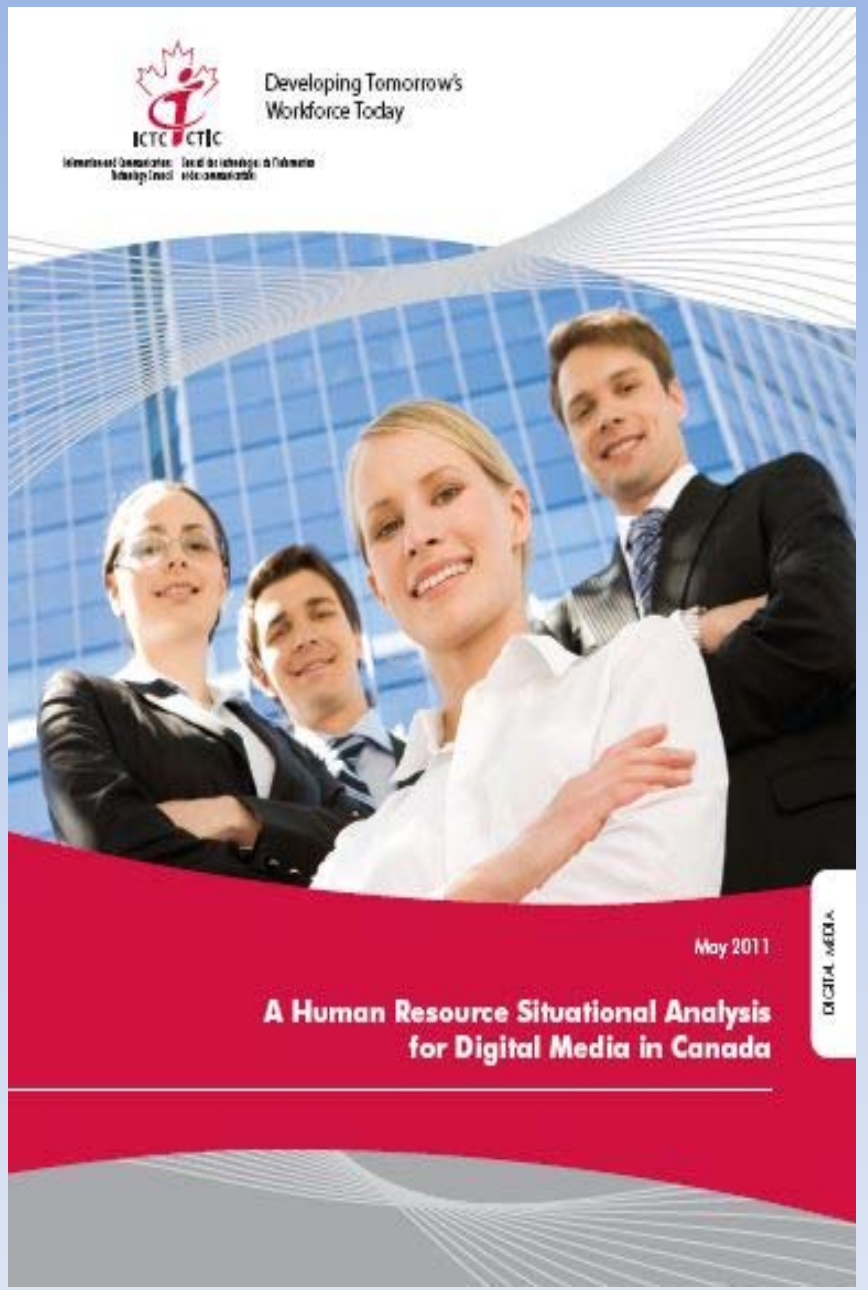
Information and Communication Technology Council (2011): Recommendation #2 – Development of Competency Based Profiles for the Critical Occupations for Digital Media

• **ICTC recommends the development of Competency Profiles** (industry validated occupation profiles), using ICTC's Competency Profile Model.

"These competency profiles will provide a nationally recognized set of competencies for the five key occupations in Digital Media, that are necessary for industry and education to effectively collaborate on to ensure that industries skill requirements are being met."

"ICTC recommends the development of a Domain Knowledge Area (DKA) for Digital Media that utilizes the framework and process developed for eHealth competency profiles. The DKA will capture the **critical competencies** that are required for employees to work in the field (domain) of Digital Media **that are above and beyond their technological competencies. In other words, what competencies allow ICT workers to apply technology in the content-rich field of digital media**?"

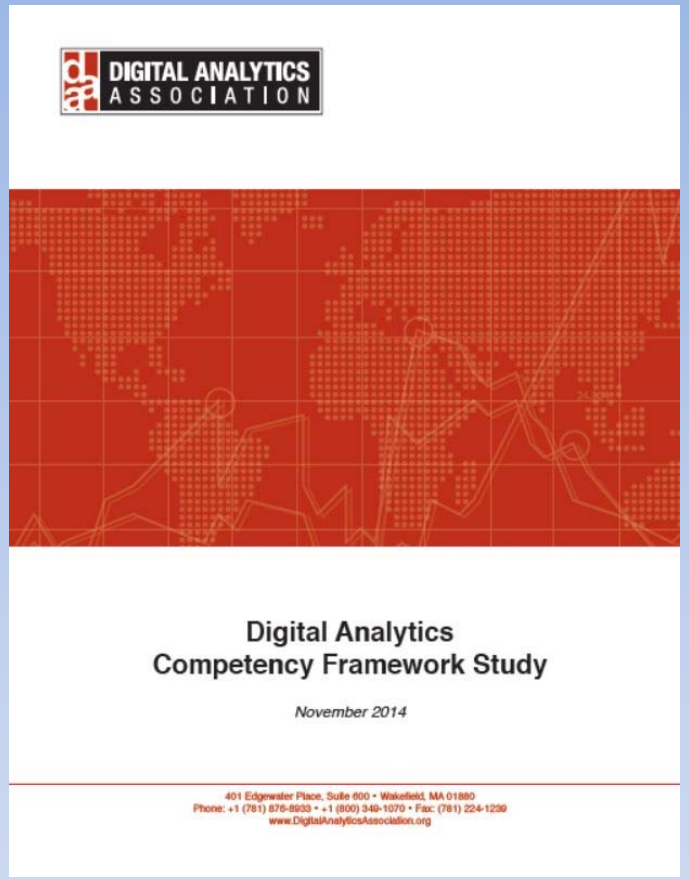
"The development of these standard profiles also provides the foundation from which the National Occupation Classification (NOC) system can be modified or added to as required. This work will enable the digital media industry to **rely on competencies that may be considered as talent-based interpretations of business needs and add value by communicating what people must know to help the business succeed."**



Digital Analytics Association Competency Framework Study (2014)

- Followed steps required of a credentialing or licensing program

- Industry panel conducts:
  - Job (not occupation) analysis, in this case on the basis of a Delphi study. Identifies competencies and knowledge/skills/attributes (KSAs) at three levels of expertise.
  - Validation by practicing professionals via online surveys
  - Calculation of competency/KSA weights



Design and build reports using tools (e.g., Web analytics tools, Excel, Tableau) to monitor business performance.	01010100	0.01
Knowledge of:		
a. Business objectives	01010101	3.04
b. Metrics and KPIs	01010102	3.33
c. Analytic and reporting tool capabilities	01010103	3.11
Skill in:		
a. Generating reports from analytic tools	01010104	3.13
b. Basic data visualization	01010105	2.91
c. Automating or creating efficiencies in reporting	01010106	2.43
d. Clarifying the purpose/use/audience of the report, identifying the best KPIs and supporting metrics, and creating a lean report that fulfills the business need and does not contain "noise"	01010107	2.91
e. Stakeholder management and expectation setting	01010108	2.41

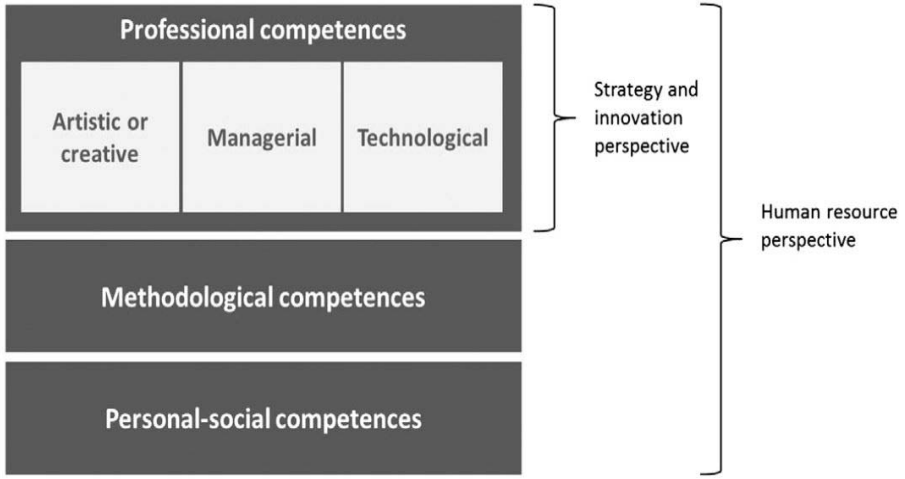


Fig. 1. Competence layer model for creative industries.

Mietzner & Kamprath competence framework for creative professionals

(Creativity & Innovation Management, 2013)

semantic mapping of competencies from job descriptions

AR/VR Jobs – professional competencies

AR/VR jobs – methodological competencies

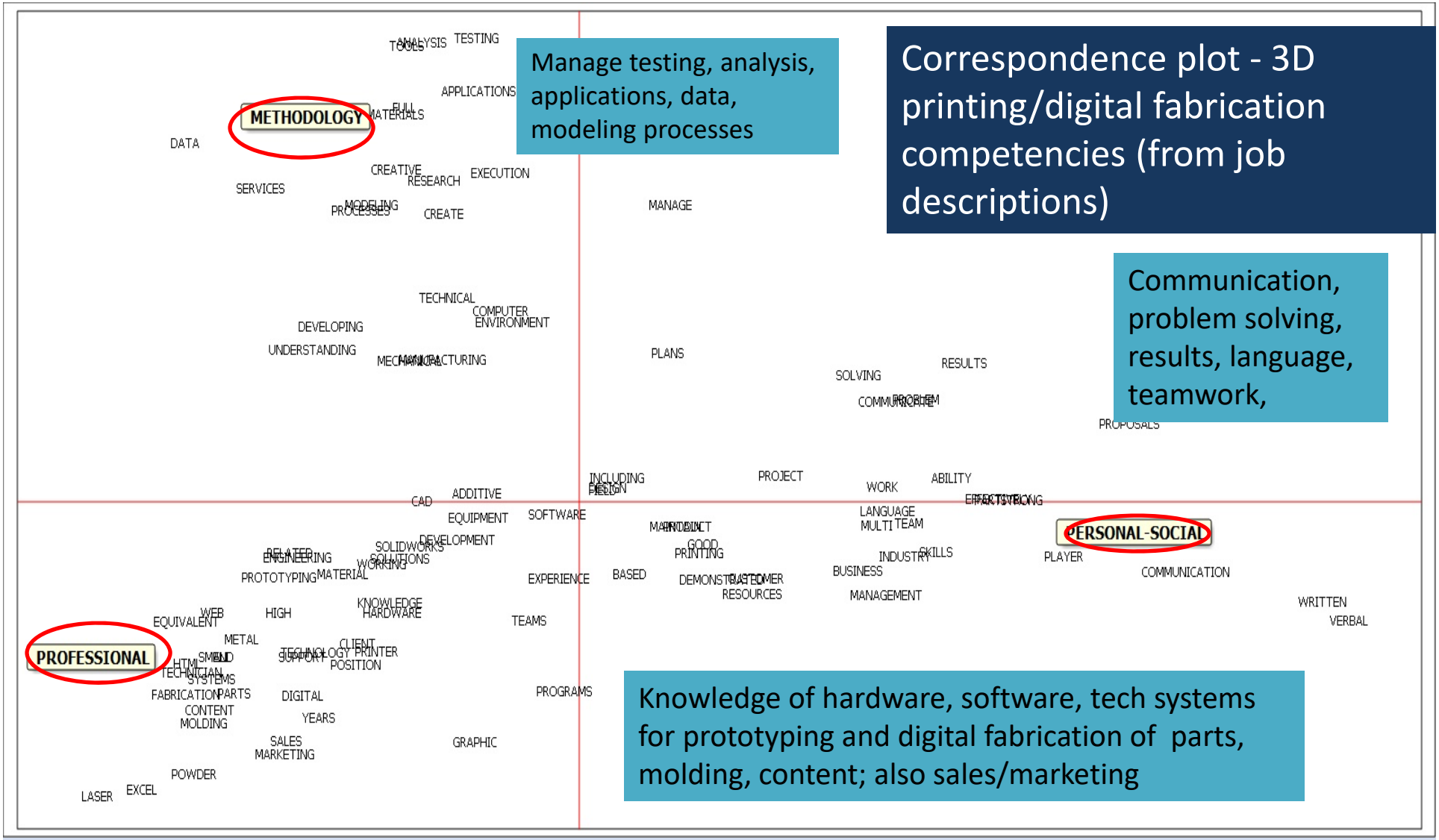
AR/VR jobs – personal/social competencies

Collection of 36 online job descriptions in each of the tech areas under investigation

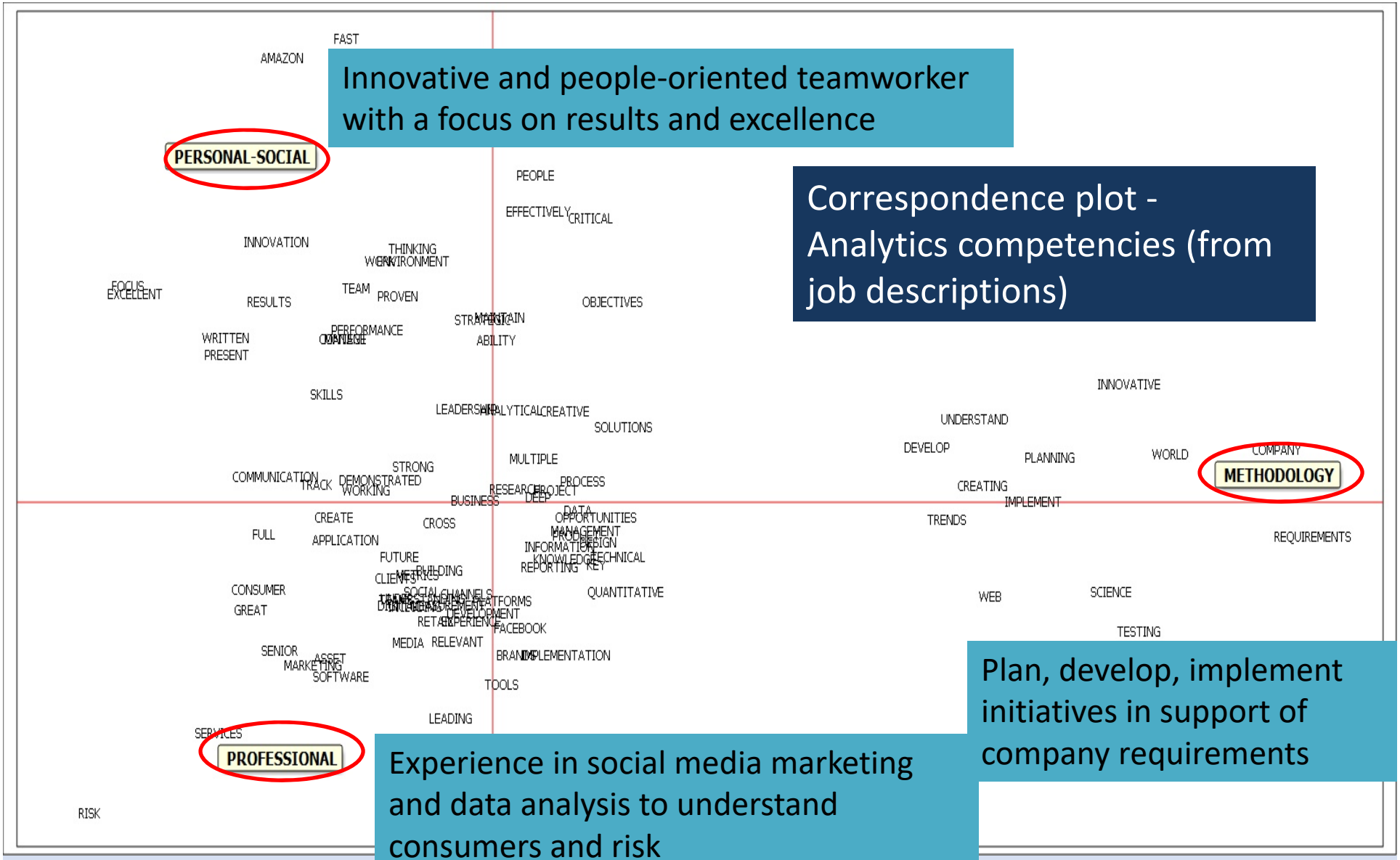
Coding in NVivo for each of the three groups of competencies

semantic mapping of competencies

- Extraction of competency descriptors from job ads and syllabi at the sentence level
- Creation of dictionaries of competency descriptors in QDAminer, a text mining software tool
- classification and retrieval of text (job descriptions, interview transcripts) using dictionaries of competencies

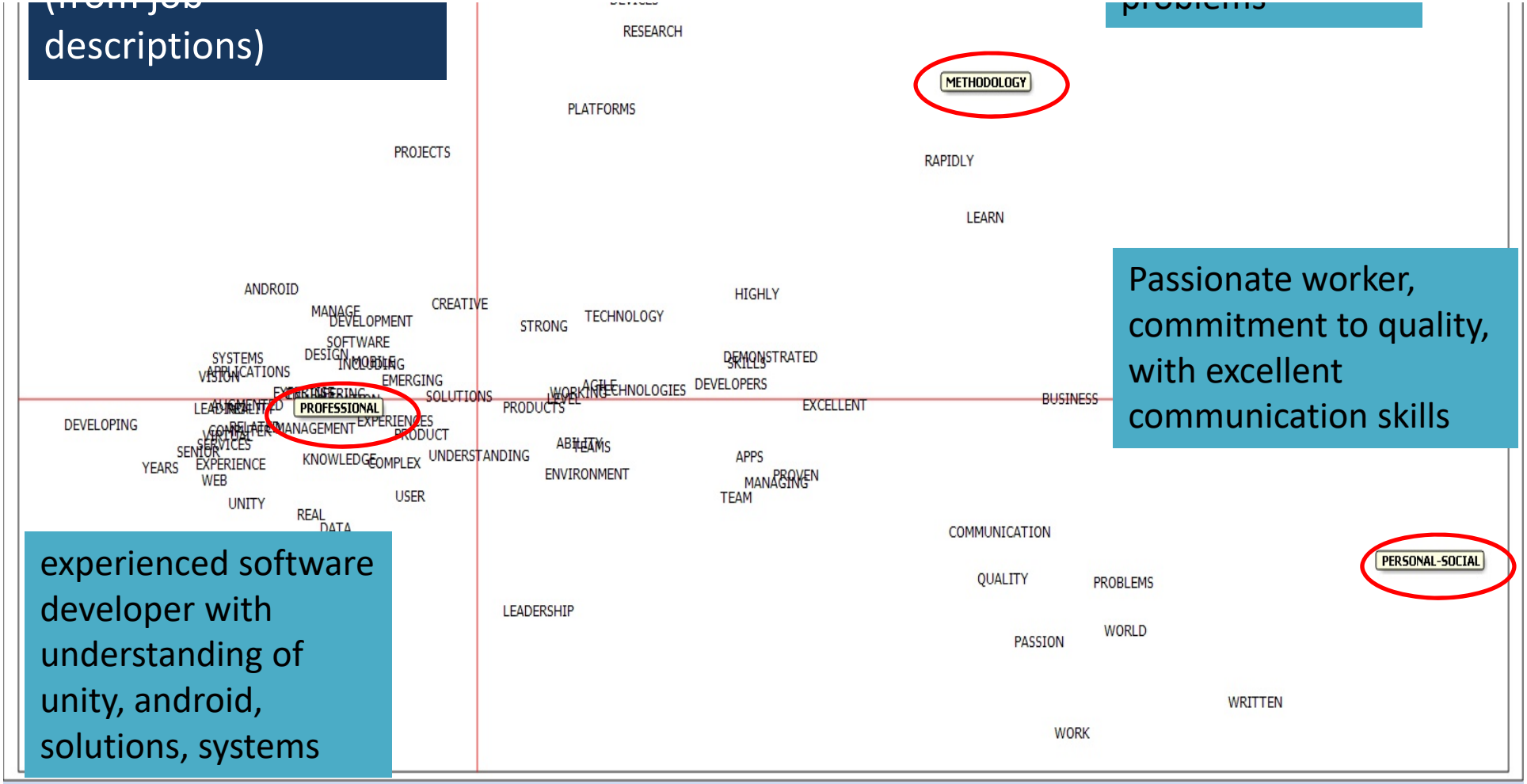


Example of tech skills required of a co-op student programmer in a 3D software company: Languages: Visual Studio 2013 or Newer ; VB.Net; C#.Net; Familiarity with Visual Basic 5.0/6.0; Web Technologies: HTML, XML, Web Services; Database: MS Access, MS SQL Server Management Studio 2008 or higher; SQL Queries; Stored Procedures; Functions; Operating Systems: Windows, Linux knowledge an asset; Tools: .NET, MS Office, Visio; Programming the API in the following would be an asset: SolidWorks or other CAD solid modeling system; DriveWorks; Microsoft Office; SQL Server 2008 or newer; CRM systems such as NetSuite, SalesForce, MS Dynamics



Example of Methodology requirements for a Manager, Market Insights: “Experience in managing a broad spectrum of research methodologies (brand health and equity tracking, U&A, Segmentation profiling, packaging/shelf impact testing, decision tree analysis, MMA, concept testing, etc).”

descriptions)



Passionate worker, commitment to quality, with excellent communication skills

experienced software developer with understanding of unity, android, solutions, systems

Example of overall competency statement for an Android Application Architect: “Demonstrated passion for leveraging technologies to solve business problems, end-to-end development of quality software products, and the desire to make a difference Results driven professional who can partner with a world-class team that designs and develops next generation mobile apps, highly scalable, secure and reliable, deployed over a large customer base Self-motivated with a go-getter attitude and excellent analytical, verbal, and written communication skills Ability to work independently with minimal supervision, possess resourcefulness, complex problem-solving capability, ability to learn rapidly to take advantage of new concepts and technologies Proven success working closely with, managing or being managed by peer-level developers in Agile Scrum teams in a distributed team

Findings from focus groups and interviews in the creative/cultural sector 1

- Digital tech learning is tool-based. In AR/VR and digital analytics, the tools are primarily software. Tools are constantly changing.
  - We have identified the current hardware and software tools in each tech group
  - Many technical courses are available online through private providers
  - Access to current tools is often a challenge, hence the emergence of specialized diffusion centres: DIY, makerspaces, hubs, infrastructure in higher education institutions

Findings from focus groups and interviews in the creative/cultural sector 2

- Learning on the job and self-teaching are essential skills development pathways
- Development of the personal-social and methodological groups of competencies requires experience in practice (production) environments
- Individuals with experience are in very high demand
- Meetups, master classes, industry events, firms with projects are key learning and knowledge trading sites
- For entry level hires few public job postings, mostly word of mouth

Findings from focus groups and interviews in the creative/cultural sector 3

- Training and recruitment
  - Digital fabrication
    - Proficiency with design software is very important - design is more challenging that actual fabrication
    - Critical thinking and problem solving are the most important skills
    - Must be passionate, flexible, hungry to experiment, ready to take a risk.
    - Hire based on attitude and evidence that applicants have tried to learn on their own and make projects
    - New hires must have willingness to do menial jobs at the beginning but gain exposure to all aspects of the business
    - Need to teach office etiquette on the job
    - New hires have little understanding of accounting or entrepreneurship although these skills are essential in the long term
    - Most engineering graduates have high expectations about what they will make straight out of school. Small companies cannot guarantee high salaries and bonuses
    - MacGyver and Scottie are the iconic workers

Findings from focus groups and interviews in the creative/cultural sector 3

- Training and recruitment
  - AR/VR
    - Easier to work with colleges than universities because of approaches to IP
    - 20% success rate with recruitment from colleges; most students brought on for internships don't have what it takes to continue in VR
    - Technical skills: employee needs to be incredibly intelligent, ready to work 60 hour weeks to solve a problem
    - Need to prove you're an autodidact, come to an interview with a project, an example of something you've built
    - Show an ability to work through a problem
    - Interviews include a challenge component
    - No one comes in with business acumen but you learn as you go
      - "If you prove yourself in those settings you will also get to come along to VC meetings, see other sides of the industry"
    - Social skills: employees needs to work well under pressure, get along in an office environment, present well to potential investors.
      - A perfect syllabus would be four parts programming, one part business modelling to understand future scenarios and two parts social skills
    - Post-secondary institutions can offer project-based courses so that students come out of school with proof of what they can do, experience working on real problems

Findings from focus groups and interviews in the creative/cultural sector 3

- Social media analytics
  - Skills are becoming more sophisticated
  - People like to see social media as democratic but certifications are increasingly offered (including by Google) that are lengthy and intense
  - Difficult to create an academic program to train people in social media analytics because a curriculum would be outdated as soon as students graduate. BrainStation (in Toronto) and Lynda (online) are good sources for courses
  - Very hard for post-secondary institutions to keep up with the specific tools
  - Digital natives have an advantage, having grown up using social media platforms. If you can't execute content on social media you shouldn't be applying to work in the field
  - Academic background in business, marking, communications or even sociology and anthropology can be useful. Need to be able to write and have critical thinking skills. People who have worked in hospitality know how to deal with people
  - Personality is important in office culture.
  - Good judgment is important because there is so much data available that you have to be able to figure out what metric is relevant to the client
  - one company has developed a formal internship program where participants shadow professionals involved at every stage in the process

Implications for educational practice and policy

- Access to current production tools is vital
  - Not just for current students but also for entrepreneurial or underemployed workers
  - Not just for community colleges
- Project-based learning experiences are vital
- Internships and coop placements are also valuable
- Public support to lower the cost of frequent training for independent workers would be money well spent
- Support for acquisition of experienced tech workers may be necessary

Thank you