Learning, Creating, and Using Cmaps: Successes and Challenges for Concept Maps as facilitative tools in corporations

Brian Moon

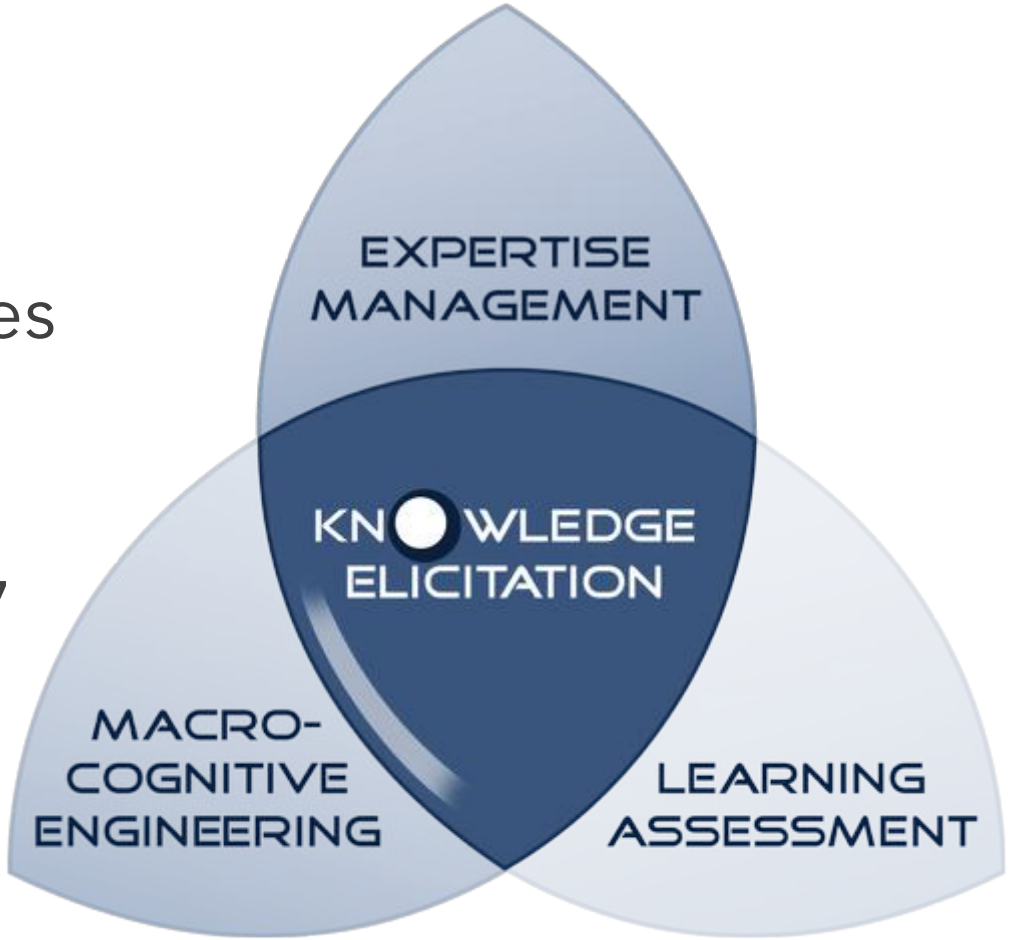
Chief Technology Officer

My Self

Background in social and cognitive sciences

Founded Perigean Technologies in 2007

8 employees



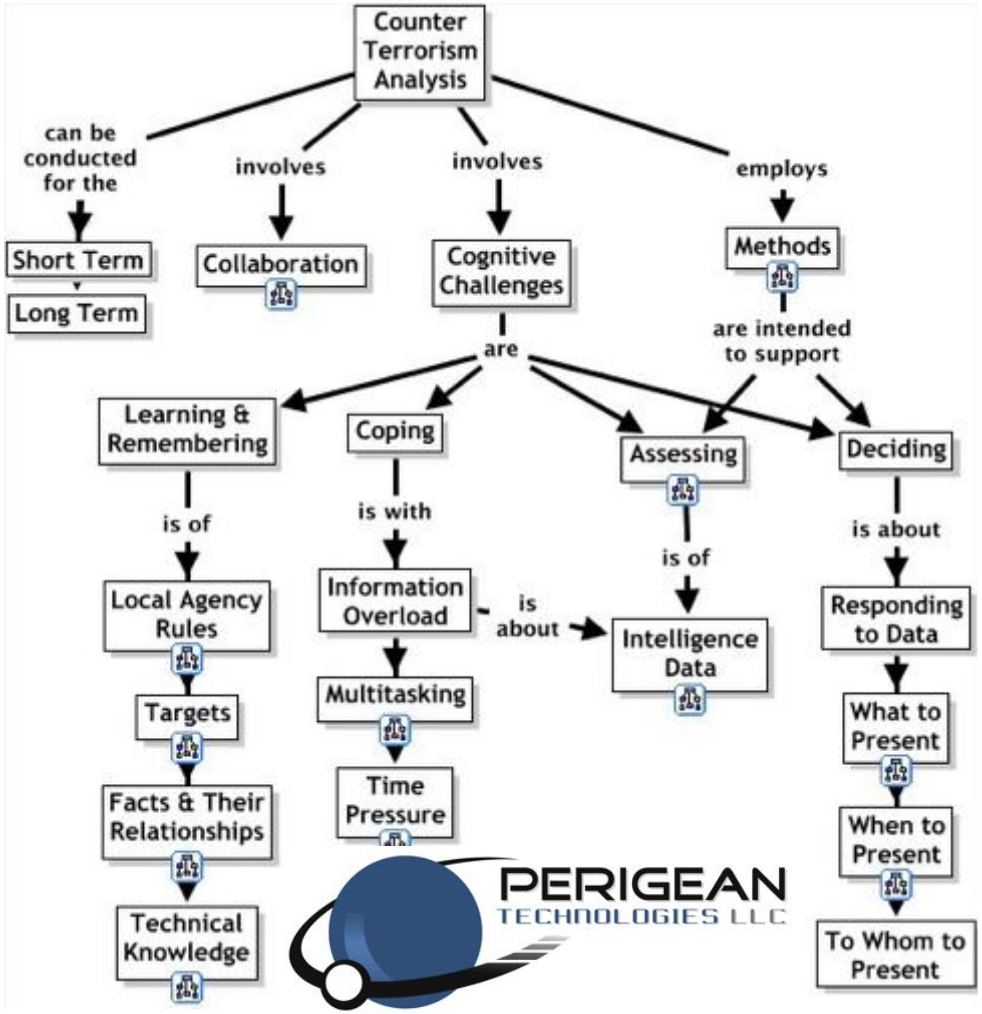
My Clients

Federal Government	Commercial
Prime Contractor	Numerous Fortune 5,000 companies
Advanced Distance Learning Initiative	Reliability*First*
Veterans Health Administration	Electric Power Research Institute
Army Research Laboratory Human Research and Effectiveness Directorate	Alion Science and Technology
	General Dynamics
Defense Advanced Research Projects Agency	Cognitive Training Solutions / Cognitive Performance Group
Federal Bureau of Investigations	Cognitive Medical Systems, Inc.
Sandia National Laboratories	Charles River Analytics
Joint Forces Command	Kutta Technologies, Inc.
Veterans Health Administration	Aurora Flight Sciences
Subcontractor	NAV CANADA
Central Intelligence Agency	TNO, The Netherlands
Intelligence Advanced Research Projects Agency	Klein Associates Division / Applied Research Associates
Marine Corps	Security Analysis and Risk Management Association
Office of Naval Research	National Contract Management Association
National Institute for Occupational Safety & Health	Federal Management Partners
	Indiana CPA Society
State Government	WBB Consulting
New York Power Authority	CACI
	Fredericksburg Regional Chamber of Commerce
Education	Strategic Knowledge Solutions
University of Edinburgh	
University of Mary Washington	
Vanderbilt University	

My Self

First exposure to Concept Mapping circa 2002

Robert Hoffman, IHMC



My Focus

Applied Concept Mapping:

1) The application of Concept Mapping to problem solving in the workplace

2) Adults

My View

My View

Concept Mapping and Concept Maps offer incomparable value.

"What tool would you use now if you didn't use Concept Mapping?"

-London-based practitioner

My View

Application of Concept Mapping and Concept Maps has not yet achieved – *and may never achieve* – the desired potential: ubiquity.

"Now that CmapTools and training support are available (see: www.perigeantechnologies.com), we may see an acceleration in the application of concept mapping … to business problems."

-Novak, Learning, Creating, and Using Knowledge

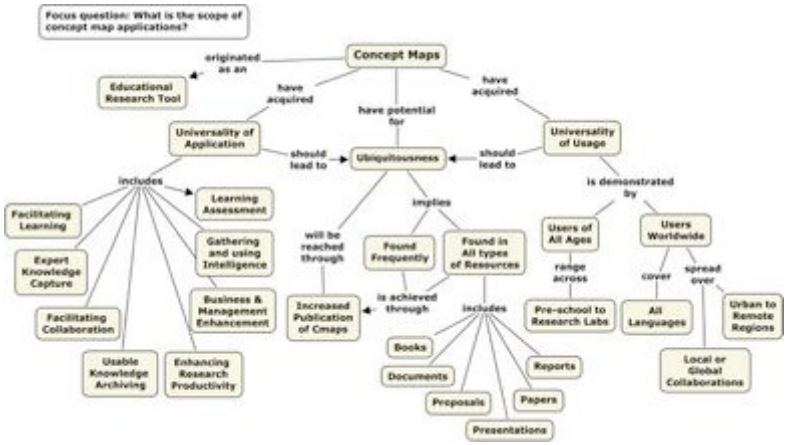
2nd Edition, p. 103

On ubiquity

Concept Maps: Making Learning Meaningful
Proc. of Fourth Int. Conference on Concept Mapping
Viña del Mar, Chile, 2010

THE UNIVERSALITY AND UBIQUITOUSNESS OF CONCEPT MAPS

Joseph D. Novak & Alberto J. Cañas
Institute for Human and Machine Cognition (IHMC), USA
www.ihmc.us



1 Introduction: The Origins and Evolution of the Concept Mapping Tool[1]

The concept map was developed as a response to the necessity by Novak's research group at Cornell University in the early 1970s to find a better way to represent children's conceptual understandings and to be able to observe explicit changes in the concept and propositional structures that construct those understandings, as part of a 12-year longitudinal study following a 2-year instructional period using audio-tutorial instruction in grades one and two (Novak, 1972). The research program was based on Ausubel's (1963, 1968) Assimilation Theory of cognitive learning, and an emerging constructivist epistemology that viewed knowledge as a human creation involving the construction on new concepts and propositions through the process of high levels of meaningful learning, as described by Ausubel, and Novak's Human Constructivist epistemology (Novak, 1993, 1998). While we found structured interviews to be useful in capturing children's understanding, it was difficult to discern specific changes in the children's concept and propositional ideas as they progressed through schooling. Working with a talented group of graduate students, Novak and his colleagues came up with the idea of transforming interview transcripts into a hierarchically arranged set of concepts and propositions representing the knowledge expressed in the interview. Mapping a child's interview transcript often revealed ambiguities not seen previously that required more careful listening to the interview tape to discern additional cues for the child's thinking. Thus was born the concept map tool for representing human knowledge.

"If concept maps are applicable to so many domains and are used by people of all ages, why is it that we don't 'run into' concept maps more often?"

On ubiquity

- ✓Knowledge representation
- ✓Format, and some method, but few constraints
- ✓Difficult to do well
- ✓Little training
- ✓Crap / Brilliance

On ubiquity

- ✓Extensive hyperlinking
- ✓Knowledge representation
- ✓Format & more constraints
- ✓Difficult to do well
- ✓Little training
- ✓Crap / Brilliance

On ubiquity

Unconstrained

Constrained

My Intent

Show you my work

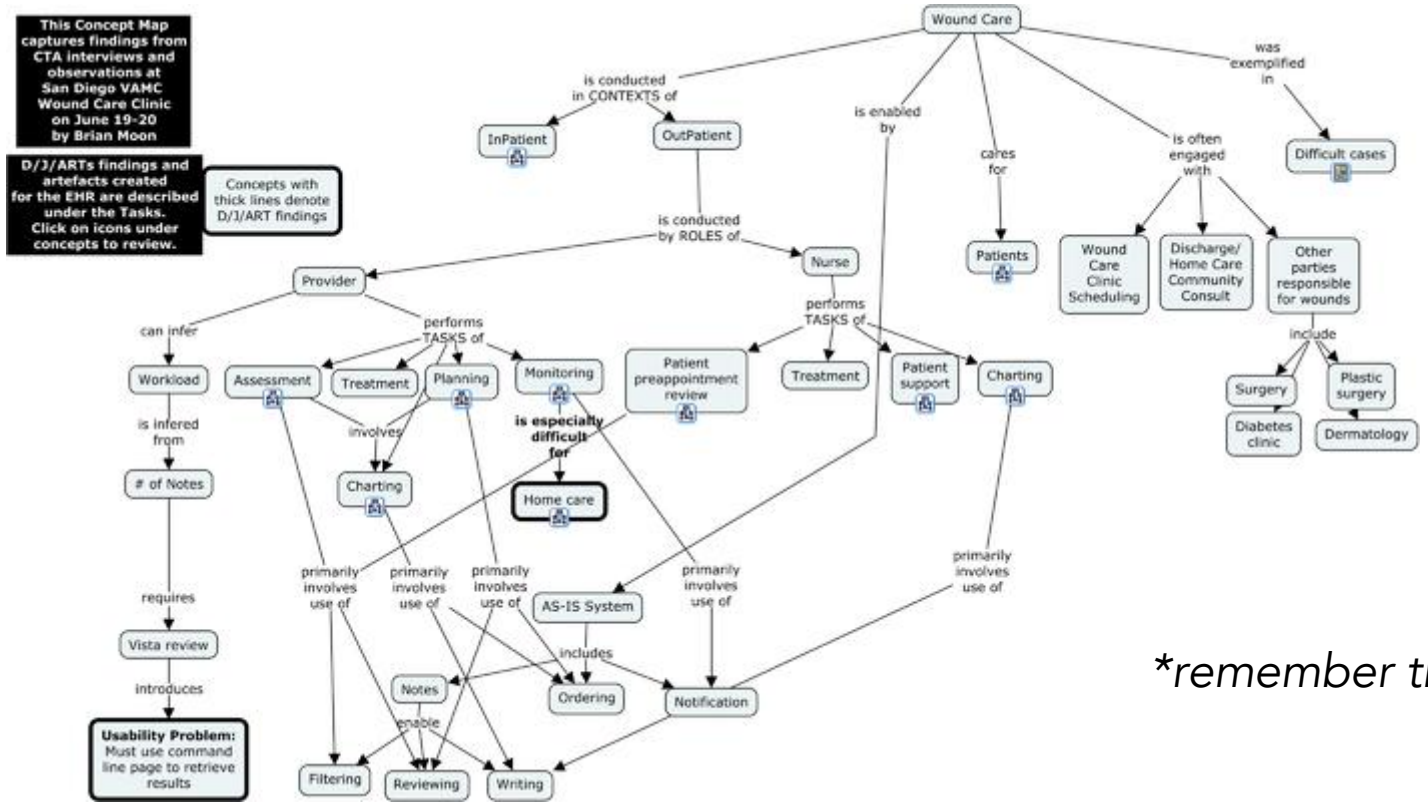
Offer honest assessment

Suggest visions

Controversial statements will be red.

My Work

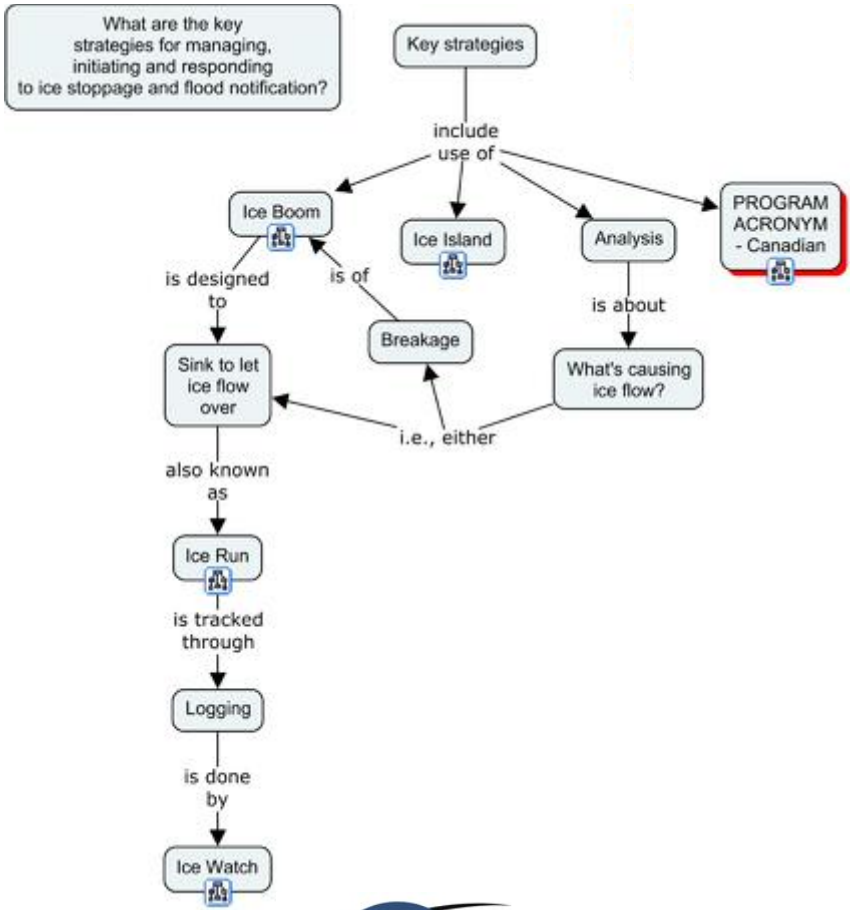
Concept Mapping as an enabler



**remember this one*

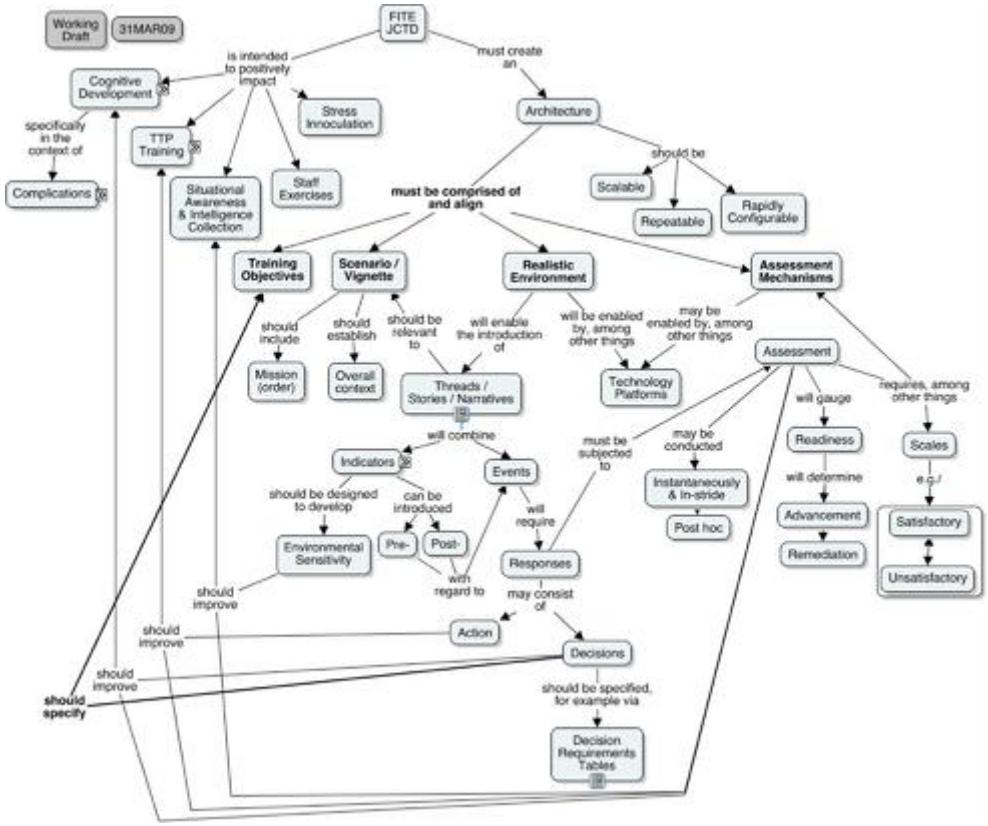
My Work

Concept Maps as products



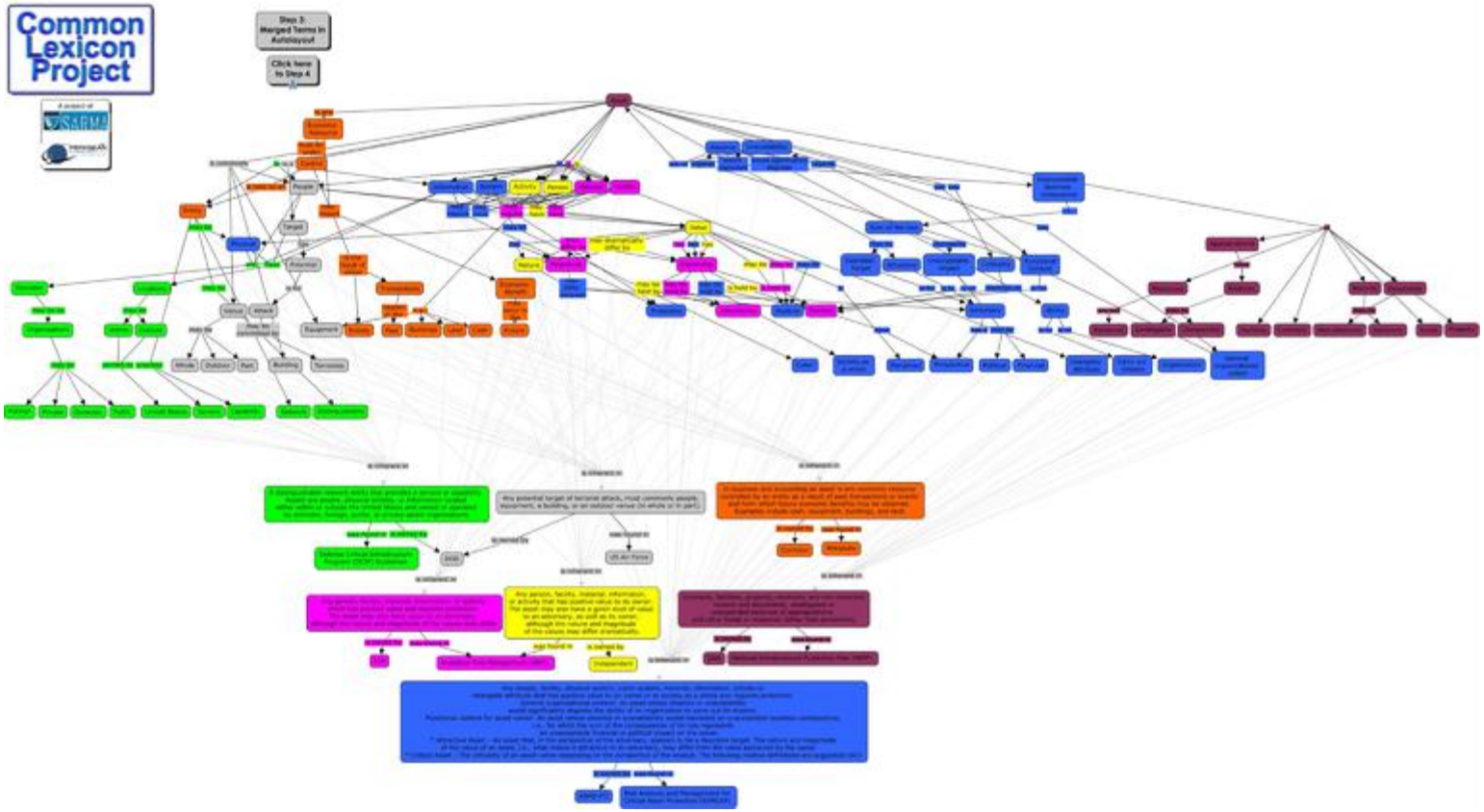
My Work

Concept Maps as artefact



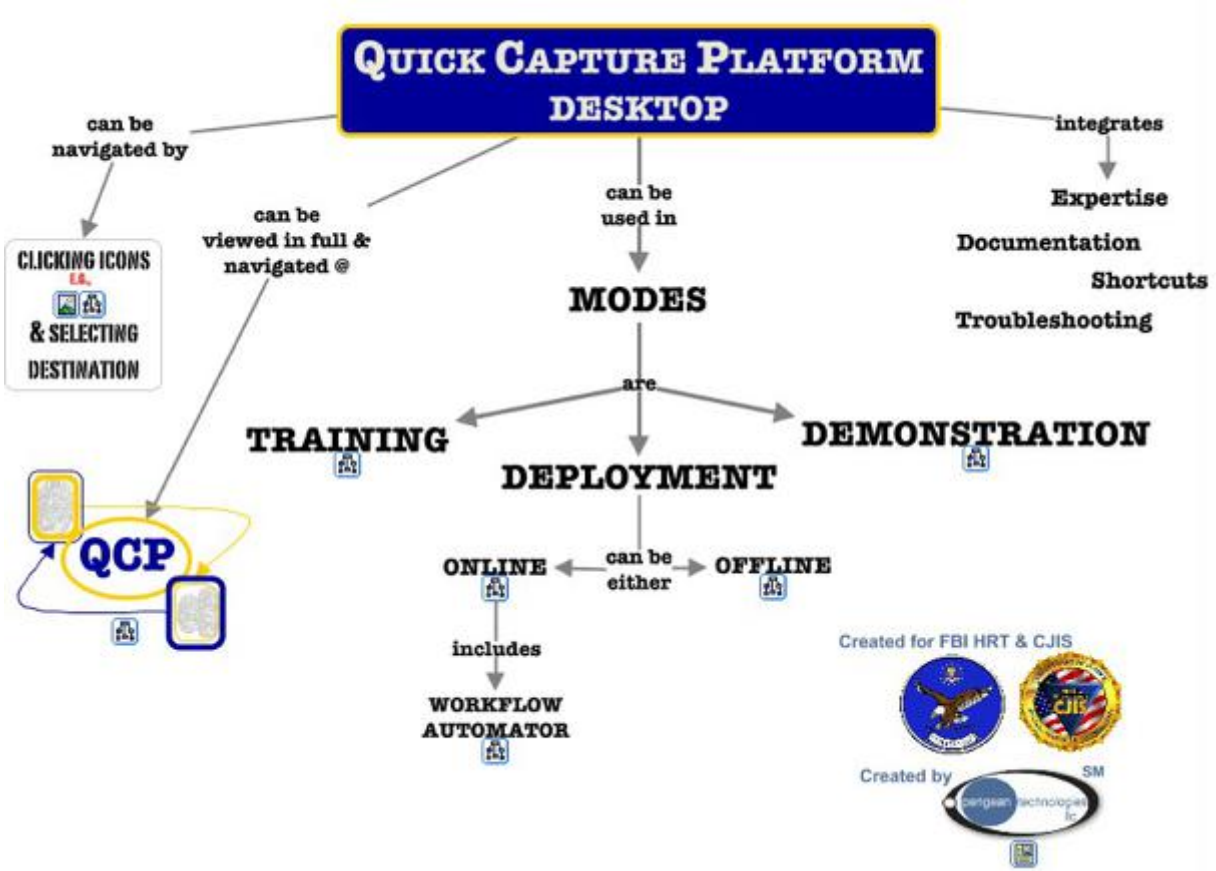
My Work

Concept Mapping for analysis



My Work

Concept Maps as interfaces



My Work

Training in Applied Concept Mapping

Suggestive linking phrases

Causal	Classificational	Nominal	Property	Explanatory	Procedure or Method	Event	Uncertainty or Frequency
can lead to	involves	which are/is	consists of	explains	is followed by	becomes	always
causes	is a type of	is a, is	has	reasons for	produces	evolves to	may or may not
requires	types of which are	i.e.	has feature	requires	done by		sometimes is
because	includes	for example, e.g.	has defining feature		is a way to do		is more likely
	categories	referred to as	has property		results in		can be
	examples	such as	have		demands		often is
	is a kind of				prompts		usually is
							rarely is

©2009 R.R. Hoffman

CMAP ology sm

Basic Protocol

- Selecting relations exercise

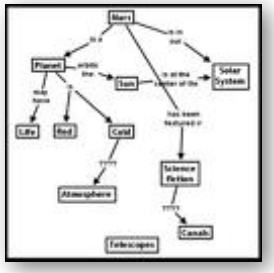
Concept	Relation	Concept
Mexico	contributes to	Drug Traffic
Mexico	suffers from	Drug Traffic
Drug Traffic	comes from	Mexico
Drug Traffic		Mexico

Doctors /_/ Nurses Academia /_/ Applied Research
Nurses /_/ Doctors Applied Research /_/ Academia

Applied Concept Mapping introduction

Basic Protocol

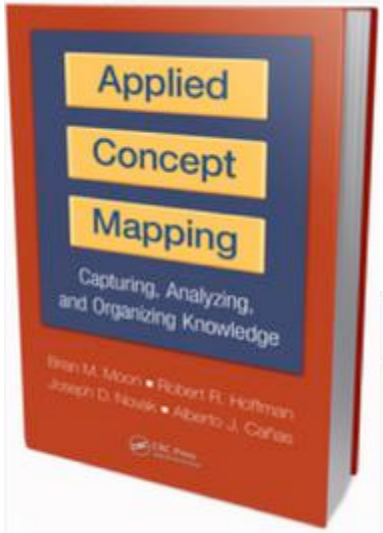
- Elicit links to form propositions
  - Describe the nature of the relationship
  - Short and concise phrase
  - Suggested categories

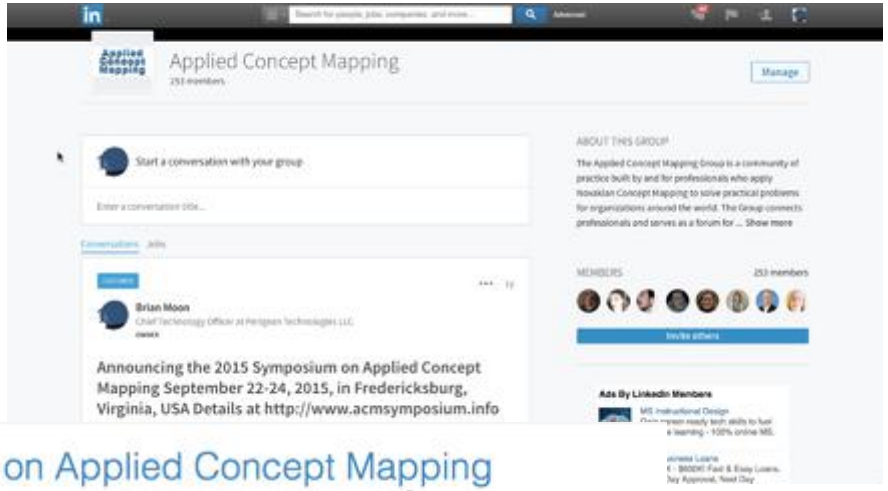


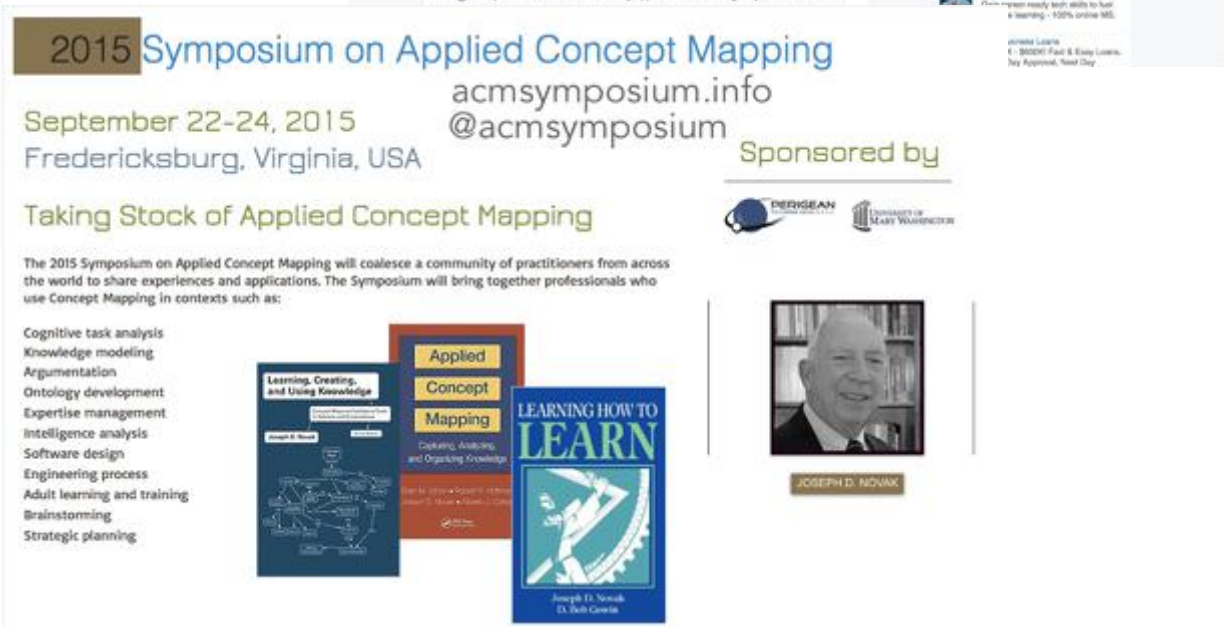
Applied Concept Mapping introduction

My Work

Community Building







PERIGEAN TECHNOLOGIES LLC

My Work

Concept Map-based learning assessment

serolearn.com/cmc2016

Assessment

Successes

Failures

Learning • Creating • Using

Successes

Ongoing concern : Almost 10 years

Satisfied customers

"Can you send me a copy of the big concept map that you prepared for our conference last year. [University President] is going to refer to it in his comments this year and we want to show it on the screen during his comments."

-Former Client

Organic growth

"We are a small company (70 employees), but among other things, we perform training of people in the Power Industry on various aspects of Grid Reliability. It struck me that using Sero might be a good alternative to *Death by Powerpoint*."

-Current Client

Awakenings

"I've come across Perigean Technologies website and I thought I should get in touch. I am writing because during the last six years we have been using mind mapping for our knowledge management. We are an engineering consultancy and knowledge is key for us, but the level of adoption is not as high as we would like it to be. In any case, we thought it's now time to talk with the experts!"

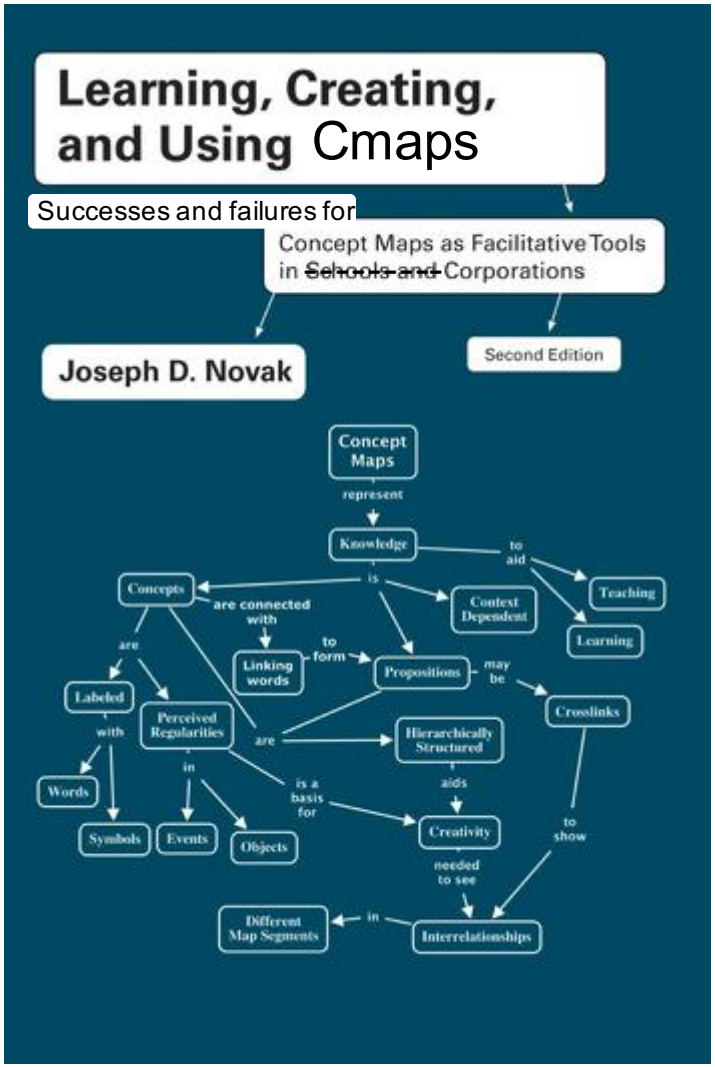
-International Prospect

Failures

- Adoption
  - Scarce beyond champions
- Sustainability
  - Shelf-ware
  - "Examples", "Demonstrations", "Pilots"
- Ubiquity
  - Narrow usage

Why?

L, C, U


Learning, Creating, and Using Cmaps
Successes and failures for
Concept Maps as Facilitative Tools in ~~Schools and~~ Corporations
Joseph D. Novak
Second Edition
Concept Maps
represent
Knowledge
to aid
Teaching
Learning
is
Concepts
are connected with
Context Dependent
are
to form
Linking words
Propositions
may be
Crosslinks
Labeled
with
Perceived Regularities
are
Hierarchically Structured
Words
in
is a basis for
aids
Symbols
Events
Objects
Creativity
to show
needed to see
Different Map Segments
in
Interrelationships

Learning

Training

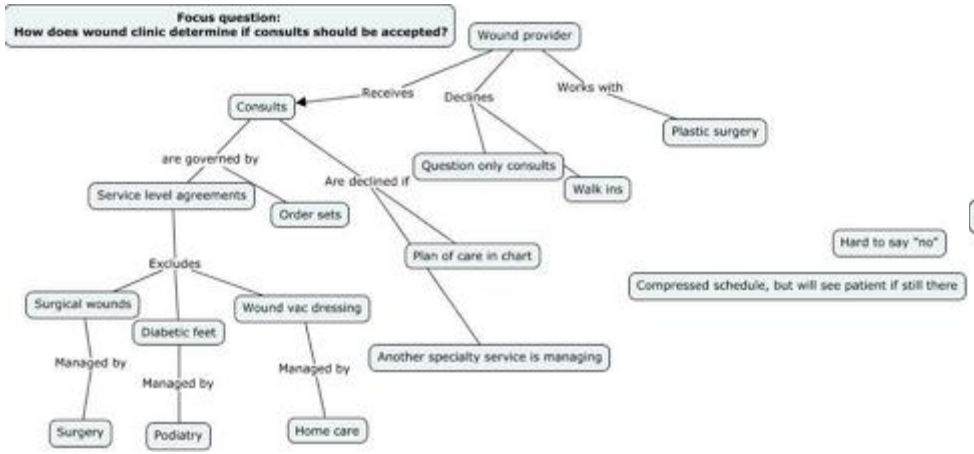
- Cmapology workshop
- Cognitive Task Analysis workshops
- Expertise Management workshops

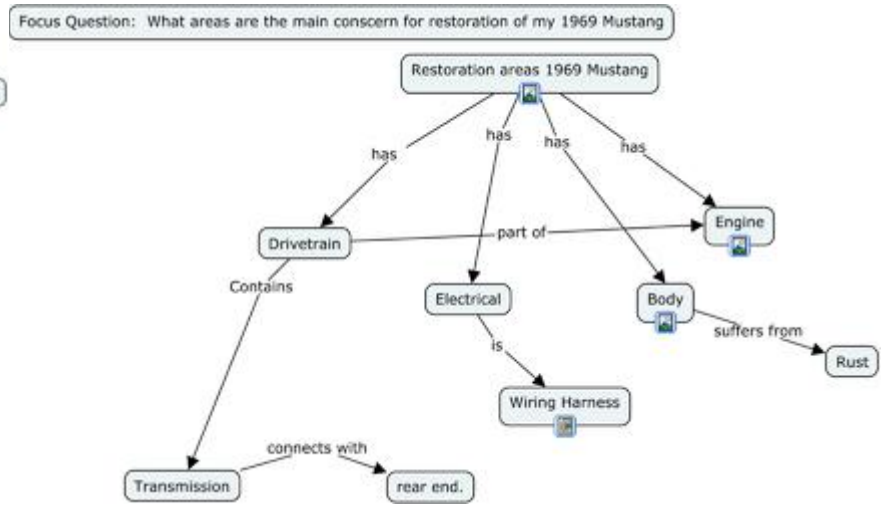
Learning

- IAKM 61095 Expertise Management at Kent State University

Learning

20-year professional





Graduate student

Learning

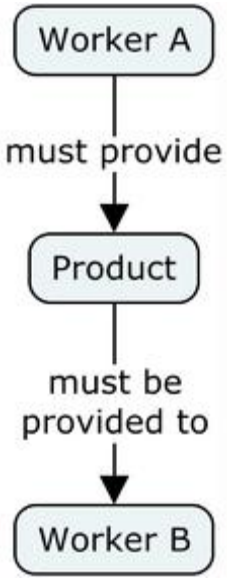
Concept Mapping is difficult.

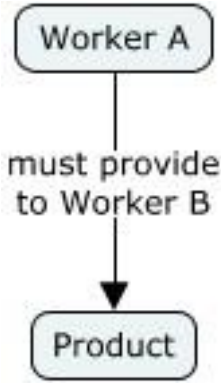
"(*Good, Novakian*) Concept Maps are (*not so*) easy to (*efficiently and effectively*) make and use."

-Moon et al, ACM

Propositional thinking is challenging, and at times, inefficient and awkward.

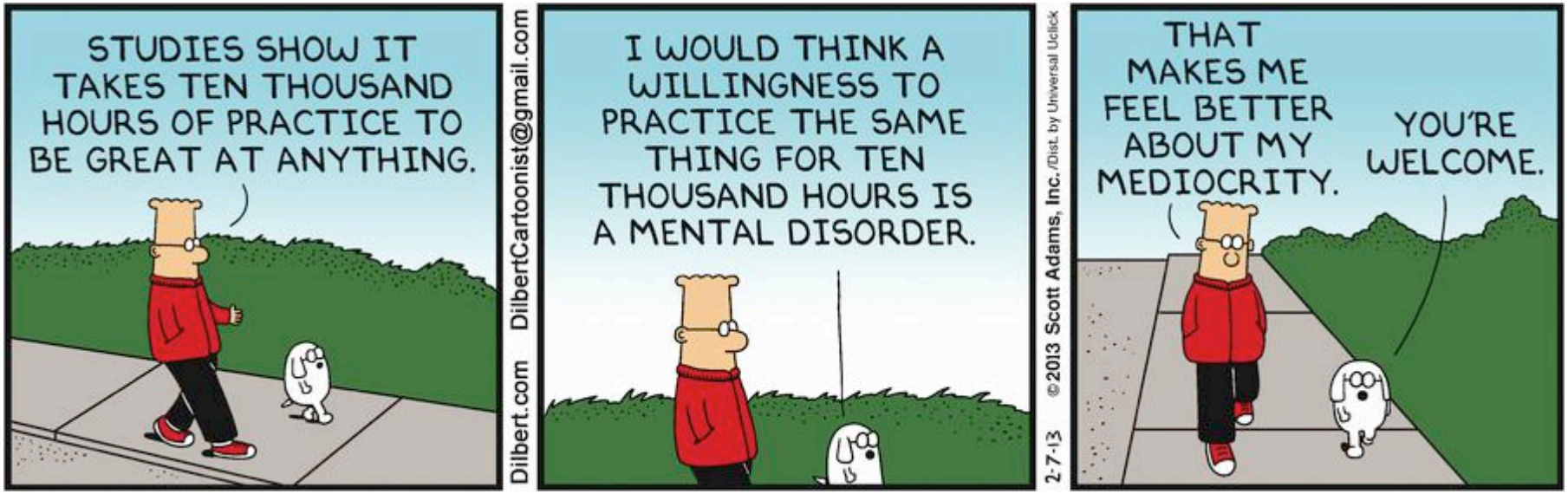
"Worker A must provide Product to Worker B."





Learning

Concept Mapping requires extensive skill development.



Learning

Ericson's 10,000 hour 'rule' for achieving expertise

Deliberate practice

Constantly pushing oneself beyond one's comfort zone, following training activities designed by an expert to develop specific abilities, and using feedback to identify weaknesses and work on them

Learning

Moon's 10,000 propositions 'rule' for achieving Cmapping expertise

3	X	~33	X	100	+	100
(Proposition)		per map		maps		focus questions
1 succinctly stated concept + 1 meaningful linking phrase + 1 connector to another properly stated concept		Informative map (cmc.ihmc.us = 33)		Range of challenging propositions, crosslinks, elicitations, spacing, designs		Diversity in goals and topics

Assessment:

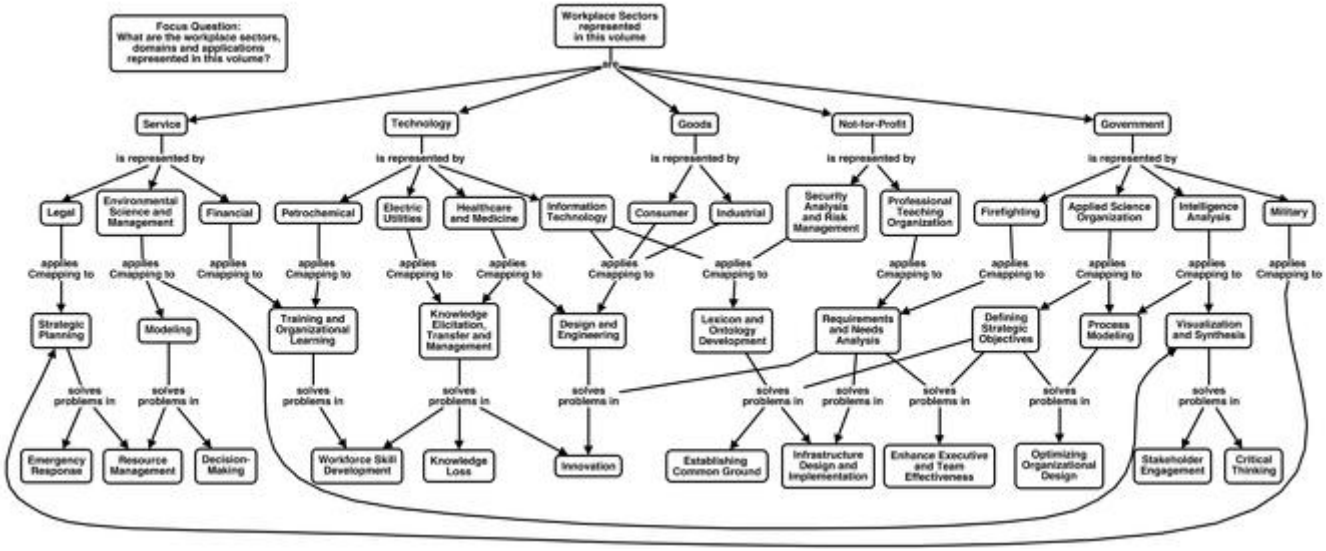
Ubiquity will never happen unless
Concept Mapping expertise is widespread.

Creating

Knowledge Models

Reporting

Organizing



Creating

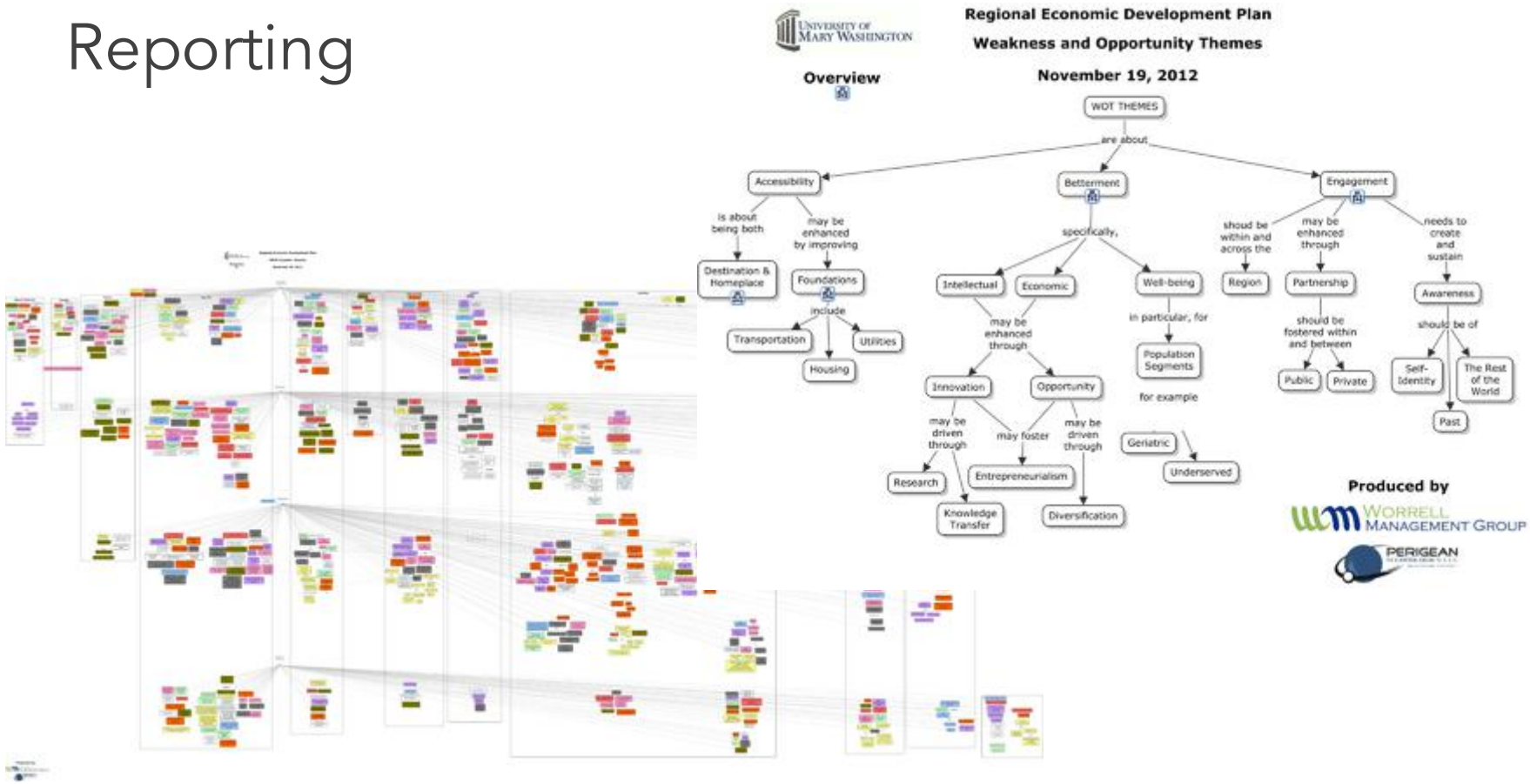
Knowledge Modeling: ~150 – 200 Concept Maps + Resources

Knowledge Model removed for public dissemination.

For example, see NASA Mars Exploration Knowledge Model.

Creating

Reporting



Creating

Organizing

Creating

Concept Maps are difficult to read.

"We'd like to get your help in doing the following: Creating 1-page summaries of all key topics."

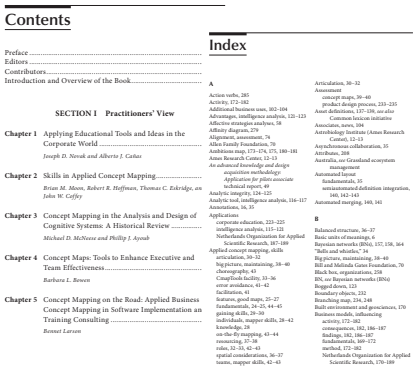
-Current Client

"I understand that this (outline) format omits some of the concept associations that would be part of a Concept Map, but the trade-off is an artifact that end user clinicians can immediately grasp and provide us feedback."

-Current Client

Creating

Reading Concept Maps vs. Text



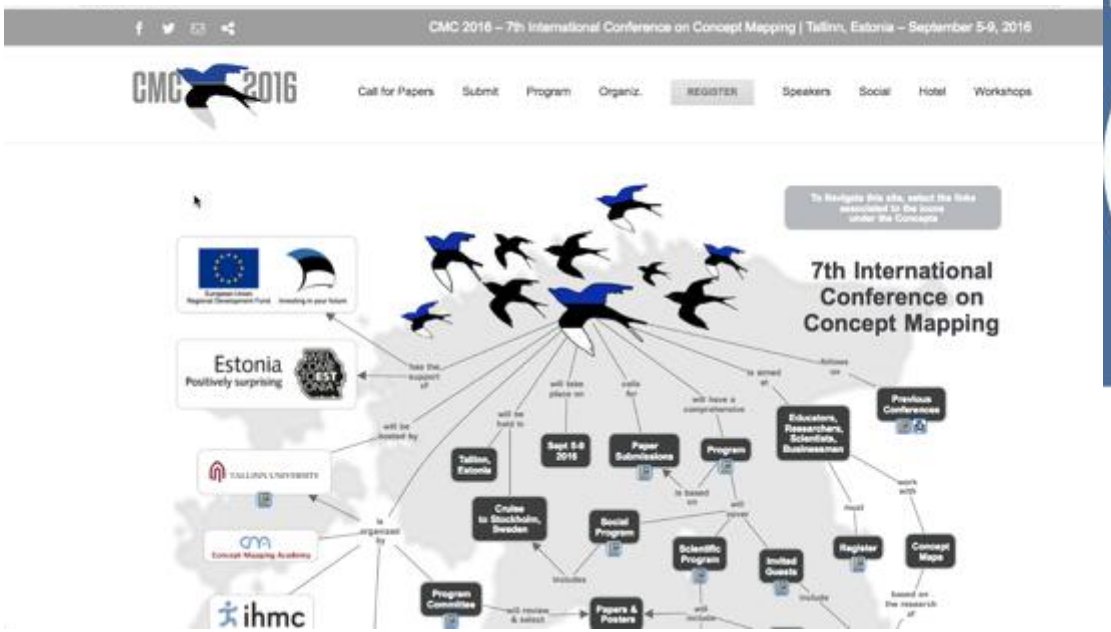
Contents

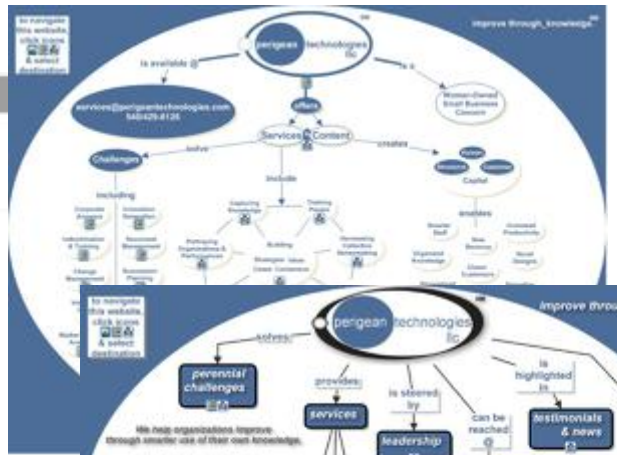
Index

	Traditional text		Hypertext		Cmap		PowerPoint	
	Mean	STD	Mean	STD	Mean	STD	Mean	STD
Preparation time (in mins)	N/A	N/A	N/A	N/A	1080	N/A	3120	N/A
Review time (in mins)	22.13	5.51	21.38	5.89	27.25	8.32	26.36	12.16
Pre-test score (% correct, 10 questions)	16.67	13.84	15.63	14.71	13.46	16.51	25	16.29
Post-test score (% correct, 20 questions)	56.58	21.22	52.81	23.07	47.49	11.94	58.75	12.44
Pre- and Post-test score difference	**39.92**	N/A	**37.19**	N/A	**34.03**	N/A	**33.75**	N/A
Recreation wordcount	168.67	69.00	153.38	68.24	126.46	105.48	184.57	73.02
Recreation proposition count	38	14.66	35.69	9.56	33.77	19.46	43	19.21
Recreation format (net-like only)	0	N/A	1	N/A	3^3	N/A	0	N/A

Creating

Concept Maps are, at best, an ambiguous mechanism for organizing information.





PERIGEAN TECHNOLOGIES LLC

@perigean

Creating

Assessment:

Ubiquity may never happen for many types of Concept Map products.

Using

Knowledge Models

Analysis

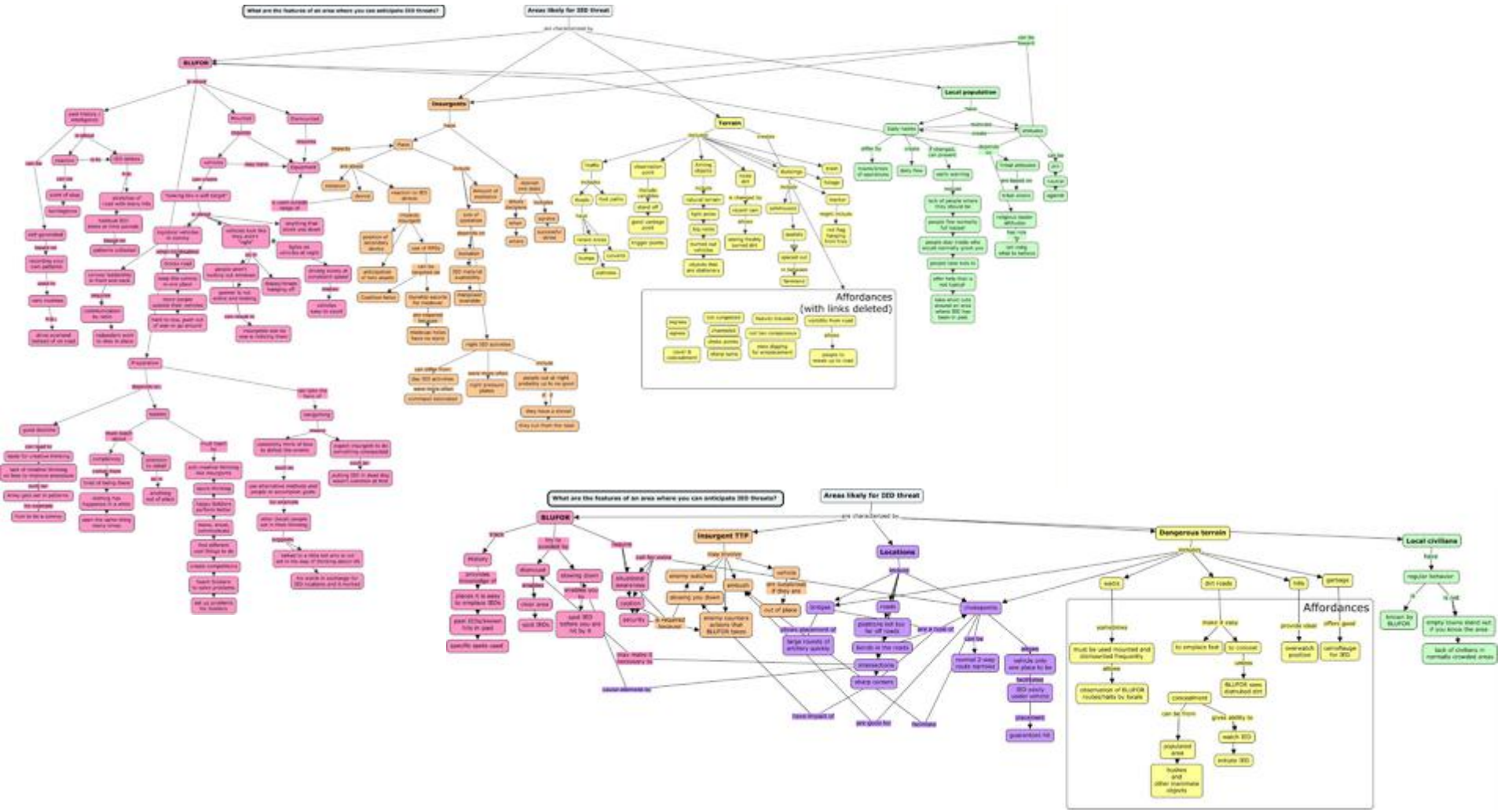
Learning Assessment

Using

Knowledge Models are, at best, underused.

Customer story : 2010 to 2015

Using



PERIGEAN TECHNOLOGIES LLC

Using

Analysis Dichotomy:

Concept Maps must be small to be readable;

Small Concept Maps offer limited insight.

Using

Concept Maps are difficult to assess.
(not in red!)

(But more importantly,)
Assessing Concept Maps is laborious.

Using

CmapTools can be challenging for corporate IT.

May 17: "…we plan to stand up the server…"

August 9: "We are in the process of getting a server stood up for Cmap, but that is not yet complete. I will keep you updated."

Using

Assessment:

Ubiquitous use will not happen unless Concept Mapping/Maps are useful and efficient means to other ends.

Reflections

Learning

Concept Mapping is difficult.

Propositional thinking is challenging, and at times, inefficient and awkward.

Creating

Concept Maps are difficult to read.

Concept Maps are, at best, an ambiguous mechanism for organizing information.

Using

Knowledge Models are, at best, underused.

Analysis Dichotomy: Concept Maps must be small to be readable; Small Concept Maps offer limit insight.

Concept Maps are difficult to assess.

Assessing Concept Maps is laborious.

Vision

Learning

10,000 propositions (very difficult to achieve)

Deliberate practice

> I'm looking at your example cmap …and I noticed that under the "grains" category, you have some larger linking phrases for grains->myotoxin and for grains->affitoxin. If it were me, I would made "wet, humid conditions" and "drought conditions" separate concepts on their own instead. Is that wrong?
>
> -Perigean employee

Exercises

- Hoffman's are very useful
- New Exercise: Unpacking
  - "People → drive → cars"
  - How deep do we unpack? When is "driv(ing)" a concept?

Vision

Creating

Need help with:

- Navigation through Knowledge Models
- Complex representations / hybrids
- Sharing and presenting
- Converting to other formats

Extend utility as products

Vision

Using

- Help with analyzing big maps
  - Big ‘qualitative’ Data: 1,000s/1Ms propositions
  - Merging multiple maps
  - Semantic integration and qualitative analysis tools
  - Save audit trail
  - Show all propositions connected to this one
- Help with the tedium
  - Arranging
  - Global changes

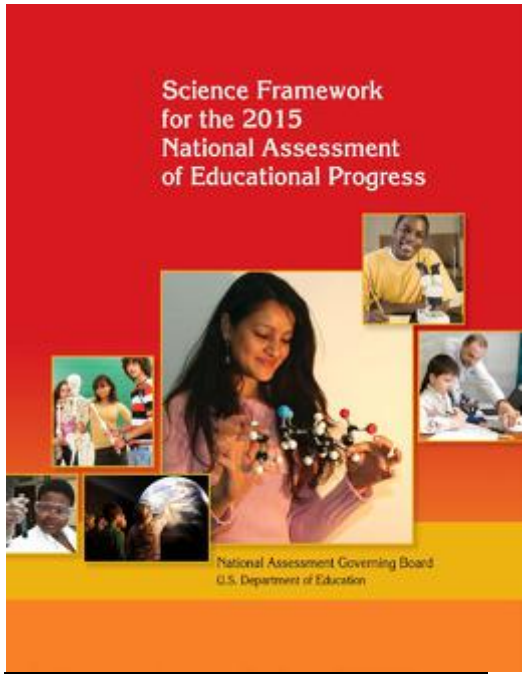
Vision

Future

- Mental model assessment: process support
- Embedding: Virtual reality presents opportunities, QR codes - Tobias Ley's example
- Interface: Cmaps that do something
- Hybrids: Integrate with other representations
- Games: Make Cmapping fun
- Empirical study: Primarily of usability and utility
  - NOTE: Corporations do not care about features of the maps – they care about content, efficiency, and utility

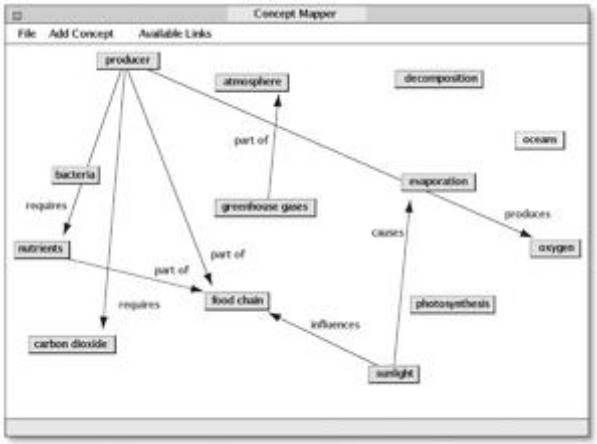
Vision

Ubiquity in education will not happen until the market requires it.



Illustrative Item

In this task, middle and high school students used a customized software program to create concept maps. Students received 18 environmental science terms and 7 link labels.* Students could drag and drop these concepts onto the grid space of the mapping program and add, erase, and link the items in their newly constructed maps. (See appendix C for more information about this task.)



L12.5, Identifying Science Principles
Source: Adapted from Herl et al. 1999.

* Link labels should not be provided to students on the NAEP Science Assessment. See the Specifications

Thanks!

Thank you,
Priit and Alberto!