

## Fab Labs: Re-envisioning innovation & “entrepreneering”

ASQ – Advancing the STEM Agenda  
Presentation draft  
July 20, 2011  
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### Fab Lab Concept

- Neil Gershefeld – CNN
- Director, - MIT’s Center for Bits and Atoms

▪ <http://www.youtube.com/watch?v=Y9HDMmyDwJE>

### Overview:

- Fab Lab – Concept and Definition
- Today’s Education, Social, and Economic Climate
- Fab Labs for Systemic Change

### What is a Fab Lab?

- Small-scale workshops – connected to one another via the Internet
- Prototyping and development capabilities to underserved communities
- Open source software
- Off-the-shelf, industrial grade equipment
  - CNC Milling Machines
  - Laser cutters
  - Scanners
- Individually driven
  - Define/Identify a problem
  - Prototype solutions
  - Share ideas

Amsterdam Fab Lab at The WAAG Society  
Rory Hyde Projects  
<http://roryhyde.com/blog/?paged=2>

Concept and Definition  
Fab Lab

### Fab Labs Around the World

- July 2010 – 45 Labs in 16 countries  
[http://www.enotes.com/topic/Fab\\_lab#Lab\\_locations](http://www.enotes.com/topic/Fab_lab#Lab_locations)
- Fab Lab Links  
<http://fab.cba.mit.edu/about/labs>
- Wisconsin/Minnesota
  - Appleton – Fox Valley Technical College
  - Menomonie – UW – Stout
  - White Bear Lake – Century College
  - Mahtomedi Public Schools (fall 2011)
- <http://sites.google.com/site/fablabsinks/the-network>

## Fab Lab Projects

- Biogas plant in India
- Track sheep flocks in Norway
- Mobile refrigeration in Ghana
- Jewelry and Toys in Boston
- Mobile Fab Lab
- [http://wiki.fablab.af/index.php/FabLab\\_Summary](http://wiki.fablab.af/index.php/FabLab_Summary)
- [http://www.youtube.com/watch?v=Z\\_WzHimvmlg&NR=1](http://www.youtube.com/watch?v=Z_WzHimvmlg&NR=1)

[http://www.fablab.co.ke/index.php?option=com\\_content&view=article&id=59:tom-okit-es-trip-to-india&catid=1:latest-news&Itemid=115](http://www.fablab.co.ke/index.php?option=com_content&view=article&id=59:tom-okit-es-trip-to-india&catid=1:latest-news&Itemid=115)

## Today's Learners Are Digital Natives

- Think and process information differently
  - Computer games, Internet
  - Multi-task
  - Parallel process
  - Random access
  - Graphics First
- Have used digital technologies since birth
  - College grads – 5,000 hours reading, 10,000 hours Video Games, 10,000 hours TV
- Taught differently
  - Faster paced delivery
  - "Legacy" content (reading, writing, math, logical thinking)
  - "Future" content (technology, ethics, politics, sociology)
- Digital Natives (Prensky, 2001 <http://www.marcprensky.com/writing/prensky%20-%20digital%20natives,%20digital%20immigrants%20-%20part1.pdf>)

## Today's Climate Education, Social, Economic

## College Enrollment

- Immediate College Enrollment (immediately after high school)
  - 16% - 35% of high school graduates don't go to post-secondary school upon HS graduation
  - 55% (low income), 67% middle income, 84% (high income) do go on to post-secondary school
  - [http://nces.ed.gov/programs/coe/indicator\\_trc.asp](http://nces.ed.gov/programs/coe/indicator_trc.asp)
- Graduation rates
  - 4 – year institutions = 57% of first-time students complete within 6 years
  - 2 year institutions = 27% completed within 150% of time (varied by public/private)
  - [http://nces.ed.gov/programs/coe/indicator\\_pgr.asp](http://nces.ed.gov/programs/coe/indicator_pgr.asp) (2009)

## Education Climate

- Students learn differently
- Less than half the population completes 2/4 year degree programs
- Federal Education Initiatives call for
  - Increased student performance
  - Increased teacher accountability
  - Tracking student performance data
  - Revised teacher preparation programs
  - Emphasis on STEM

## Education Initiatives

- Skills for America's Future – June 2011 <http://www.whitehouse.gov/the-press-office/2011/06/08/president-obama-and-skills-americas-future-partners-announce-initiatives>
- Change the Equations – September 2010 <http://www.cnn.com/2010/POLITICS/09/15/obama.education.initiative/index.html>
- Educate to Innovate – January 2010 <http://www.washingtontimes.com/news/2010/jan/06/obama-announce-250m-education-initiatives/>
- American Recovery and Reinvestment Act – 2009 <http://www2.ed.gov/policy/gen/leg/recovery/programs.html>

## Social Climate

- World is becoming "Spiky"
- Resources - are clustering into Mega Regions
- Digital Divide exists impacts education and entrepreneurship

## Digital Divide – Broadband Use

- 30% of all persons don't use the Internet
- 48.4% of persons in rural areas had no broadband access
- 37.8% don't perceive value of broadband
- 26.3% indicate expense a factor
- Less education, less income, less urban = less likely to use

▪ National Telecommunications and Information Administration.  
A Digital Nation [http://www.ntia.doc.gov/reports/2010/NTIA\\_internet\\_use\\_report\\_Feb2010.pdf](http://www.ntia.doc.gov/reports/2010/NTIA_internet_use_report_Feb2010.pdf)

## World is Spiky - Richard Florida

- Economic Activity
- Technological/Scientific Innovation
- Scientists
- Capital

Innovation in a Spiky World

[http://www.creativeclass.com/whos\\_your\\_city/maps/#Innovation\\_in\\_a\\_Spiky\\_World](http://www.creativeclass.com/whos_your_city/maps/#Innovation_in_a_Spiky_World)

Economic Activity in a Spiky World

[http://www.creativeclass.com/whos\\_your\\_city/maps/#Economic\\_Activity\\_in\\_a\\_Spiky\\_World](http://www.creativeclass.com/whos_your_city/maps/#Economic_Activity_in_a_Spiky_World)

## Lack of Skilled Workers

- SECTORS Act – April 2011
  - <http://shopfloor.org/2011/04/addressing-shortage-of-skilled-workers-through-the-sectors-act/19692>
- Manufacturers are looking for skilled workers
  - [http://money.cnn.com/2011/04/14/news/economy/manufacturing\\_rebound\\_jobs.fortune/index.htm](http://money.cnn.com/2011/04/14/news/economy/manufacturing_rebound_jobs.fortune/index.htm)
- Skilled Labor Shortage Frustrates Employers
  - <http://www.cbsnews.com/stories/2010/08/11/eveningnews/main6764731.shtml>
  - 22% of American businesses ready to hire - the right people (those with skills)
  - 2012 – 3 Million skilled workers short

## Clustering of Resources in Mega Regions

- 40 largest Mega Regions
- 17.7% of world population
- 66% of economic activity
- 85.6% of patented innovations
- 83.3% of most-cited scientists

[http://www.creativeclass.com/whos\\_your\\_city/maps/#Mega-Regions\\_of\\_Asia](http://www.creativeclass.com/whos_your_city/maps/#Mega-Regions_of_Asia)

[http://www.creativeclass.com/whos\\_your\\_city/maps/#Mega-Regions\\_of\\_North\\_America](http://www.creativeclass.com/whos_your_city/maps/#Mega-Regions_of_North_America)

▪ <http://www.rotman.utoronto.ca/userfiles/prosperity/File/Rise.of.%20the.Mega.Regions.w.cover.pdf>

[http://www.creativeclass.com/whos\\_your\\_city/maps/#Mega-Regions\\_of\\_Europe](http://www.creativeclass.com/whos_your_city/maps/#Mega-Regions_of_Europe)

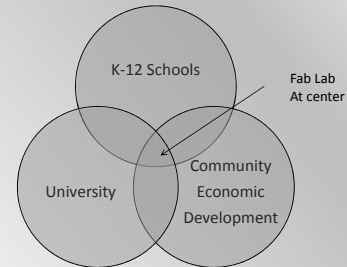
## Economic Climate

- Lack of skilled workers
- Agile production paradigm for manufacturing
- Small businesses contribution to the economy

## Agile Production – New Paradigms

- SCRUM - Game Design
  - Self-organized, cross functioning teams
  - Team leader guiding sprints (2-4 weeks)
  - Frequent feedback and review
  - Mountain Goat Software <http://www.mountaingoatsoftware.com/topics/scrum>
- Manufacturing
  - Rapid response to changes in the market
  - People together in dynamic teams
  - Information technologies
  - Paul T. Kidd <http://www.cheshirehenbury.com/agility/agilitypapers/paper0794.html>

## Three-Prong Approach



## Small Business – Important to the Economy

- Employ over half of all private sector employees
- Pay 44% of the total U. S private payroll
- Generate 64% of new jobs over past 15 years
- Produce 13 times more patents per employee than large patenting firms
- Create more than half of the non-farm private gross domestic product
- <http://www.sba.gov/advocacy/7495/8420>

## Three areas for development

- K-12
  - K-12 students access lab for pre-engineering curriculum
  - K-12 students access lab as part of outreach programs
- University
  - University students access the lab as needed for coursework/personal interests
  - University students and faculty access the lab as part of research efforts
  - University students gain relevant experience as lab personnel]
- Local Community
  - Community members access lab to innovate and invent
  - Community members access lab for personal interests

Education and Economic Development – One Model  
**Fab Labs – For Systemic Change**

## Overarching goals for systematic change

- Build STEM-related skills
- Invent and innovate new ideas for economic development
- Build a community of technologically connected/literate citizens
- Develop a worldwide network of problem solvers
- Address the economic, social, and education issues facing American society

## K-12 (and beyond) Audience

- Access to resources otherwise unavailable
- Digital learning environment conducive to “digital natives”
- STEM content tied to students’ personal interests increasing motivation
- “Best practices” for education and social change can be explored/implemented
- “Design Your Future” courses encourage entrepreneurial and innovation activities
- Partnerships with colleges, universities, and business/industry provide career pathways for students

## Paradigm Shifts - Necessary

- Collaboration – business/industry, communities, educational institutions
- Products and processes driven bottom up not top down
  - Individual/community driven
  - Individual as innovator/inventor instead of Consumer
- Agile production and management methods
- Systemic change modeled
- Constructivist philosophy
- STEM as needed not as subject = Relevance
- “Grow your own future” replaces “Educate them to leave”

## University Audience

- Labs facilitates outreach activities
- Infrastructure for research into “best practices”
- Innovation and entrepreneurship for recruiting, retaining, fund raising
- Innovation in STEM teacher preparation
- All students access to fabrication labs regardless of major
- Foster cross-curricular partnerships
- Partnerships with K-12, colleges, and business/industry provide career pathways & research opportunities,

## Conclusion

## Economic Development – Local Communities

- Access to resources otherwise unavailable
- Economic development using local resources and talent
- Engage community in problem solving
- “Design Your Future” courses for individuals interested in invention, innovation and entrepreneurship
- Partnerships with K-12, colleges and universities provide skilled workforce

## Fab Labs – A viable approach for:

- Increasing STEM skills among K-12 students/community members?
- Motivating K-12 students in STEM-related careers?
- Fostering research in “best practices” for teaching/learning in STEM?
- Providing impetus for new products/processes leading to more local employment?
- Providing alternative paths for employment for non-college bound students?
- Overcoming a digital divide and access to technology?
- Other?