**5. The Incoming Wave of Innovation:** Embedding Modular Interconnected Microsystems to Animate Almost Everything

Those of us working in microsystems have seen bits and pieces of it coming for many years . . . an ever-widening array of innovations in microelectronics, [MEMS](https://www.memsnet.org/about/what-is.html), [nanotechnology](http://science.howstuffworks.com/nanotechnology.htm), micromachining, [micropackaging](http://www.i-micronews.com/advanced-packaging/), [3D printing, and additive manufacturing](http://en.wikipedia.org/wiki/3D_printing).

However, the micro-results have been deeply embedded within final products such as smartphones, autos, aircraft and other macroscale systems . . . and the underlying explosion of microworld innovations has remained out-of-sight, underappreciated by the public and underexploited by entrepreneurs.

That's all about to change as smart phones (as in [Project ARA](http://www.projectara.com/)), watches and [glasses](http://techcrunch.com/2014/01/16/google-shows-off-smart-contact-lens-that-lets-diabetics-measure-their-glucose-levels/), become [LEGO-like](http://en.wikipedia.org/wiki/Lego) [customizable assemblages](https://www.youtube.com/watch?v=oDAw7vW7H0c) that can be reconfigured via modular micro-hardware Apps to meet individual and group requirements.

The wide-social-media-visibility of HW Apps in smart phones, watches and glasses, will lead to the embedding of very-low-cost interconnected microsystems to animate wearable technology, [medical devices](https://www.youtube.com/watch?v=NqDqhzJzQ1U), [personalized technology](https://www.semiwiki.com/forum/content/3109-what-will-drive-mems-drive-i-o-t-i-o-p.html), automobiles and mobility technology, homes, robots, drones, environmental infrastructure and beyond . . . it will also trigger innovations [back within micro-making and manufacturing technology itself](http://wims2.org/publications/newsletter/WIMS2_Horizons_Newsletter_Summer_2013.pdf), closing the loop and providing "intellectual gain" in techno-social exploration of the microworld.

But where will all the innovators come from? Fortunately, [a wave of change](https://www.youtube.com/watch?v=U6FvJ6jMGHU) is also sweeping our universities. Leading engineering and business schools are increasingly exploring [experiential learning](https://www.youtube.com/watch?v=u96I_5fcB6A), [flipped courses](https://www.youtube.com/watch?v=tkd-srAj0E8), MOOCs, SPOCs and [blended learning](http://video.mit.edu/watch/blossoms-using-geometry-to-design-simple-machines-with-professor-daniel-frey-3626/) -- emphasizing entrepreneurial, [multidisciplinary](https://www.youtube.com/watch?v=293KKDBHGc0), user-centered problem-solving in [exploratory team-projects](https://www.youtube.com/watch?v=YqF_mfbF6Kk).

Many incoming students have also gone to [LEGO Camps](https://www.youtube.com/watch?v=gZUhsWeP2Mk), done [3D scanning](https://www.youtube.com/watch?v=0fgqDWyR-oM) and [open-source 3D-printing](https://www.youtube.com/watch?v=C8Wv3LCJcUE), used [Raspberry Pi's](https://www.youtube.com/watch?v=P5KEiuTT_E8) and Arduino, worked in [FAB LABS](http://www.nytimes.com/video/science/100000002402479/whats-a-fab-lab.html) and participated in [robot competitions](https://www.youtube.com/watch?v=MnDgAk3tXUg) and the Maker movement . . . motivating increasing numbers of students towards real-world, user-engaged, team-problem-solving to create products that truly meet deep [human needs](http://www.bloomberg.com/news/2014-01-17/google-unveils-smart-contact-lens-project-to-monitor-glucose.html).

*But what tools will they use?* We’re witnessing a revolution in design tools for user-engaged 3-D [visualization, design, modeling, simulation and prototyping](https://www.youtube.com/watch?v=vSqYx2OuxYo), just in time to support participatory user/designer/fabricator explorations into [how to embed microsystem functionality](http://rogers.matse.illinois.edu/) and "animate" all sorts of [new macroscale products in clothing, homes and offices, automobiles and structures](http://www.usatoday.com/story/money/cars/2014/11/07/3-d-printed-car/18636105/).

As a result, we'll see a refactoring, reshoring, dispersal and market-democratization of manufacturing, leading to the rise of many novel forms of specialized component-integration and subassembly shops -- with user-community involvements, creative quick-turnaround partial customizations, and order-to-delivery times becoming vital market success factors.

*But how will companies connect and thrive* within this massive, rapidly-evolving, collaborative-competitive industrial ecosystem?

The answer: the [hybridization of design automation and social-media technologies](https://www.youtube.com/watch?v=HsOjdbK3E94) will take us way beyond "design tools" into multi-technology "exploration infrastructure” . . . for [user-engagement](https://www.youtube.com/watch?v=YZCX-izCYMk), [interactive market development](http://www.usaid.gov/div/portfolio/solar_sister), user-driven technology evolution, [collaborative learning](http://www.scoop.it/t/leadership-trust-and-e-learning), crowdfunding, crowdsourcing, [meta-level team design support](https://www.youtube.com/watch?v=Zm37gHpnf-I), [IP marketing and validatio](http://www.semiwiki.com/forum/content/section/1642-ipnest.html)n, exploiting [agile project methods](https://www.youtube.com/watch?v=sy0-VhKAr7s) and more . . . enabling participants to dramatically scale-up their connectivity and impact.

As the incoming wave of innovators, investors, social infrastructure, design tools, manufacturers, products and markets crests it will trigger disruptive change . . . moving societies toward more [diverse, egalitarian, inclusive and thriving futures](http://www.youtube.com/watch?v=44o75Mm-1p4), as ever more people migrate from being isolated consumers of mass-produced goods and entertainment towards being [entrepreneurial](https://www.youtube.com/watch?v=TFfWwOCP1TA) and [participatory customizers](http://3dprintingindustry.com/2013/10/18/printers-pearce-interview-3d-printers-peaces-dr-joshua-pearce/) of their habitats and life experiences.

In the process, the Arts will merge into STEM, and [STEM will become STEAM](http://stemtosteam.org/) as they say at the [Rhode Island School of Design](http://www.risd.edu/) . . . as artists and artisans, musicians and performers, writers and filmmakers join with makers, engineers, and scientists in the grand exploration of what it’s possible to do!