Believing is Seeing

The Alchemy of the Mind, Machine and Magic in Cultivating Radical Media Innovations

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A) Sea Creatures **B) Human Experience Modeler** **C) MR MOUT**

Education, Entertainment & Marketing Cognitive Rehabilitation Law Enforcement & Military Training

Figure: 1 *Demonstration of novel models of Mixed Reality developed in parallel for cross-industry transfer with the use of catalytic innovation tools, conventions and infrastructure produced by interdisciplinary collaborations at the Media Convergence Laboratory (www.mcl.ucf.edu).*

"If an American foundation had been commissioned to research the prospects of Gutenberg's process called printing they would probably have said, 'Interesting, but of limited value because most people cannot read'."

--Anonymous, TerraMedia.co.uk Quotations

Making creative leaps in media innovations are plagued with challenges in demonstrating the magnitude of human impact that each new media technology will have. Luckily Gutenberg had the bible to keep him in business, because it took hundreds of years for the convention of the novel and newspaper to evolve. Ironically, even when new technical capabilities are celebrated, they are followed by hype and expectations that cannot be met by scientific or technical solutions alone. All technology is inherently limited. For media to have impact requires that it have an effect on the imagination; that is, it must have an associated magic "behind the eyeballs." This is the domain of the artist – to push new technological capabilities to their limits and to invent new media conventions.

"It is the business of the future to be dangerous."

--Alfred North Whitehead, philosopher

History has shown us that we are inventors and we are innovators, but we are rarely the innovators of our own inventions.

t is the next generation that can examine possibilities, not knowing about limitations. This process of combining artistic and scientific exploration in a process that defies tradition and embraces naiveté can be seen by scholars and respected leaders as a sort of dangerous alchemy of the mind, machine and magic. Like the alchemist, we don't need to see it to believe it; we see it because we believe it. Because every media revolution has been sparked by new science and technological capability, with possibilities proven by artistic imagination, it is inevitable that the subsequent effects will eventually change life as we know it, AND never in the way we expect.

SIDEBAR: Inventors bring new capabilities into our hands in the form of inventions, Innovators bring new possibilities to inventions by adapting them in unintended ways that we find hard to live without. For instance, Douglas Engelbart invented the Mouse, but Apple innovated them some twenty years later. I

Mixed Reality, the blending of the real and synthetic environments and objects, has been able to melt the boundaries between physical and virtual realities and provide the possibility of interweaving simulated characters and worlds into live experiences in the real world. So why do we treat Mixed Reality as we do

more limiting media technology such as virtual reality, television, cinema, radio or print media? A new vision may borrow from tradition, but the key is to make creative leaps to find the magical power within.

Making Creative Leaps (MCL):
Playground of Experiential Media Innovation

"All media as extension of ourselves serve to provide new transforming vision and awareness."
--Marshall McLuhan, Oracle of the Electronic Age

Our research goal is to discover the magic that transforms Mixed Reality from technological invention into media innovation. Since, the Ministry of Magic isn't issuing any funding this millennium, we approached agencies and companies that are most directly affected or whose constituencies are impacted the most by media. This included entertainment, education and training, where we formulated an approach to cross-fertilize insights from each application to formulate ***tools***, ***conventions*** and ***infrastructure*** that stimulate innovation

Mixed Reality is different than traditional linear media. It is real-time, immersive, multi-sensory and intended to engage, but not capture or pacify the audience's imagination. Mixed Reality is intended to embrace real experience as well as the imagination and not shut it out like traditional electronic or virtual media viewing. To measure the impact of this future participatory experiential media requires not so much that we empower the imagination of the creator, but rather that we spark and interact with the imagination of the user.

We quickly learned that media innovation transforms each of the applications we explored as much as each application informs innovation. Our approach was not only designed to melt the boundaries between physical and imagined reality, but also to melt the boundaries between applications, disciplines and markets, providing increased potential economic rewards by applying core technologies across a spectrum of diverse industries. By using the common denominator of human experience we avoided reinventing technology for each of these industries.

We changed the criteria of success from achieving technological function to measuring human impact through performance. We structured the priority of the innovation process towards not what the technology could do, but what it should do, and then invented the technology and artistic convention to match. The concept went beyond form follows function to the more applicable expression
"Form follows function to serve a purpose."

Innovating Innovation:
Keeping up with Ideas and Inventions

"Any sufficiently advanced technology is indistinguishable from magic."
--Arthur C. Clarke, Science Fiction Author

How do you go about ***inspiring*** the crazy ideas that produce radical innovations that change not only the product, but also the market, the business and even the users themselves? What is needed to foster the ideas that can make creative leaps into the future and envision the next transformational innovation that changes the way we work, play, learn and live? What does it take to make the technology disappear so the result becomes indistinguishable from magic?

Truly radical media innovations stem from an alchemy of the mind (cognitive and imaginative), the machine (science and technology) and the magic (media and money) over a long and involved process of technological convergence, interdisciplinary creativity, and cross-industry transfer. In the past, this evolution has had as much to do with blind faith, dumb luck and failed investments as it did with anybody's preconceived, well-organized innovation road map.

With all the horror stories of these inventors' dilemmas, is there a better way of "crossing the chasm" to transform ideas into inventions and to neutralize obstacles of adoption to true innovations? Without such a process, we will never keep up with the ideas and inventions being back-logged in academic laboratories and commercial proprietary archives? What can serve as a logistical guide for transfer? What is a measure of success? What can we do to integrate genius and to innovate innovation itself?

Once new capabilities have been invented to overcome limitations in capturing, rendering, replicating, and transmitting sensory stimuli, artists transform the invention into a blockbuster media outlet that we cannot live without. Edison invented motion pictures (projector and camera), but never had a successful film to his name. It took the Charlie Chaplins, Mary Pickfords and D.W. Griffiths to create the movie media experience that transformed the novelty of "moving pictures" to the market phenomenon of "Cinema." The same goes for radio, television, cable and now with simulation and video games. This emphasizes the fact that it is not the ***function*** of the technology but the ***purpose*** of the content that transforms inventions into lucrative media innovations. It is the application that creates demand and drives economics and then the adoption of new media technology.

With the accelerated advancement of science and technology there is a demand for constant media innovation. How do you integrate areas of study into disciplinary collaboration, versus sequential cross-disciplinary development, so that each exploration informs the others? How is the impact on human performance from each development measured to validate results across disciplines? If we could just see the impact of the innovation beforehand, we could gain this insight.

SIDEBAR: From cross-disciplinary to inter-disciplinary to trans-disciplinary, collaboration evolves from sequential development, to integrated creation, to synergistic creativity, respectively. The latter is where the artist thinks like an engineer, the engineer thinks like a scientist and the scientist thinks like an artist. The rapid development of radical innovation requires that we think and act outside of our disciplines, transferring methodologies across areas of study. With Mixed Reality, we needed to transfer artistic conventions into real-time algorithms to create story-based rendering techniques.

Science Meets Fiction:
Human Experience Modeling

We define Mixed Reality as the spectrum of physical reality (participating in the real world), virtual reality (procedural media stimulation) and imaginary reality (sparking cognitive perception and creation by the user). By spanning the sensory modalities and richly layering the realities in all directions and dimensions, we can effectively capture, replicate, render, display and distribute human experience. What was thought of as science fiction only a few decades ago is now possible with MR. Our abilities to melt the boundaries between our real and familiar physical world, with the simulated fantasy of the virtual world, engaging the emotions and psychology of the imaginative world, provides a powerful capability to impact human performance. This is most evident in law enforcement or military.

The Mixed Reality in Military Operations in Urban Terrain (MR MOUT) project used MR and theme park entertainment techniques to simulate future capabilities, even before these capabilities were invented. [1C] This is a process we call validating science fiction. It provides us the ability to evaluate human performance before evolving the function and direction of the technology. No longer is human testing an afterthought to invention; rather it is a prerequisite, helping to define both the function and form of any future innovation.

Innovation Conventions:
Authoring the Mixed Reality Experience

The physical, virtual and imaginary realities are the three nodes of the MR circular continuum (figure 2). The participatory function of the ***machine*** mediates the interaction with physical reality. The procedural convention of the media sparks the ***magic*** of the virtual reality. The ***mind*** is drawn in by the emotional empathy of the story that paints with the user's imaginary reality.

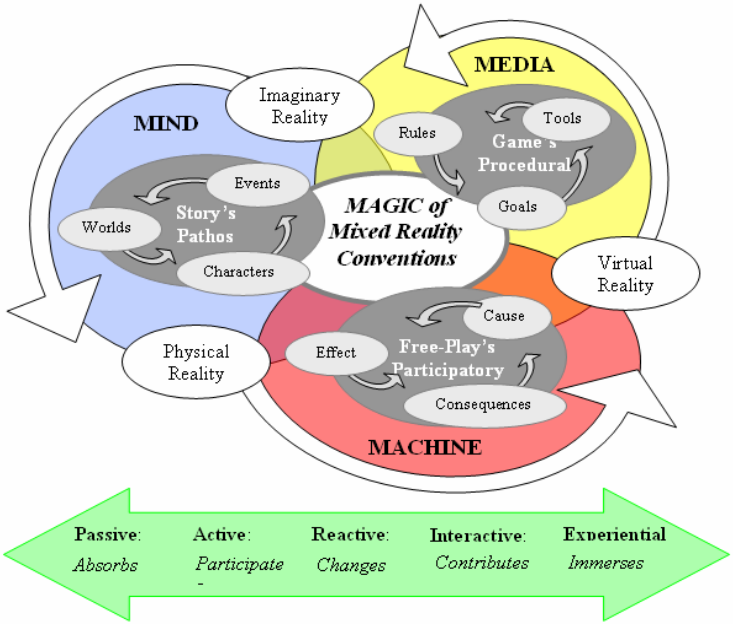

Figure 2: Transdisciplinary Poesies of Mixed Reality

In applying Mixed Reality with the child's imagination of mainstream educational and entertainment venues, we found that authoring these diverse spectrums of reality required the age-old technical and artistic conventions of story, game, and free-play, each working interdependently. This was done within the Sea Creatures exhibit [Figure 1A] by deconstructing traditional structural elements of convention into innovative convention that addresses both artistic purpose and technical function. This model was transferred from an earlier marketing/entertainment scenario modeled in partnership with MR Systems Laboratory, Canon Inc. for MGM marketing, where the expectation was to look like a movie, play like a game and be immersed like a theme park.

The diagram above does not define a solution as much as it defines the challenge of MR convention. ***STORY*** conventions draw on the Empathy of the participant and deal with motivating elements of ***characters***,

environments and ***events***. Unlike traditional linear story, this process borrows from the interactive/non-linear techniques and theories of Role Playing Games (RPG). ***GAME*** conventions, on the other hand, deal with the Procedural (or game mechanics), which utilizes ***rules***, ***tools*** and ***goals*** to engage the computer rendering of media. ***FREE-PLAY*** draws upon the Participatory aspect of the intuitive physical interaction and generates ***cause***, ***effect*** and ***consequences***. These integrated conventions engage the heart, mind and body, respectively. Ideally, these utilize the entire spectrum of interactivity converging conventions, versus inventing new ones.

The pitfall in this approach is that those not intimately versed in all three conventions find it difficult to mediate. Most storytellers are fearful about interactivity and game mechanics. Most gamers know little about interactive story versus linear full-motion video, and thus marginalize the power of story engage. Most Hollywood game and story masters are unaccustomed to inviting the contribution of the user outside of a passive or reactive role. This is where the next generation of transmedia story creators plays a critical role in defining future conventions. Transmedia pioneers such as Brenda Laurel interweave the techniques of story, game and play, or theater, cinema and simulation to be complementary versus competitive disciplines.

"An important scientific (and artistic) innovation rarely makes it way by gradually winning over and converting its opponents. What does happen is that its opponents gradually die out, and that the growing generation is familiarized with the ideas from the beginning."
--Max Planck 1858-1947,
Theoretical Physicist

This transmedia-based approach interweaves the psychology (mind/cognition/imagination), computer science (machine/story engine) and the media (magic/experiential story conventions) in one process that can simulate human experience.

Innovation Tool:
Human Experience Modeler (HEM)
Human Experience Modeling (HEM) in all mixtures of realities, modalities, directions and dimensions is a capability of Mixed Reality that allows us to capture, codify and replicate a wide range of experiences in great detail. Experiencing activities as mundane as making breakfast, as demanding as protecting your comrades in urban combat, and as playful as interacting with prehistoric marine reptiles allows us to model capabilities not yet invented, evaluating concepts that are as much fiction as they are science, to explore their impact on human performance before developing real processes and products.

The realization of the limitation of pure virtual reality was never more evident than when adapting the Mixed Reality Human Experience Modeling for use in cognitive rehabilitation [Figure 1B]. The test subject was very comfortable with the virtuality; however the critical need for human-to-human interaction and full body and sensory perception by both the instructor and subject was critical. Adjusting the balance between virtuality and reality provided an adaptable system that met the application's objective. The eye-to-eye contact, the gentle guide of the therapist's hand, the arrangement of actual mementos from home, the interaction with real appliances, the smell of the coffee and bagel cooking, the feel of the cream cheese spreading, the coldness of the refrigerator and the heat produced by the toaster oven all assisted in adapting and transferring real day-to-day activities into adjustable experiences that could capture, simulate, replicate and analyze the experience in an exceptionally detailed way. Real and virtual worlds were modeled, animated, tracked and integrated, allowing for the possibility of an out-of-body after-action-review of the session.

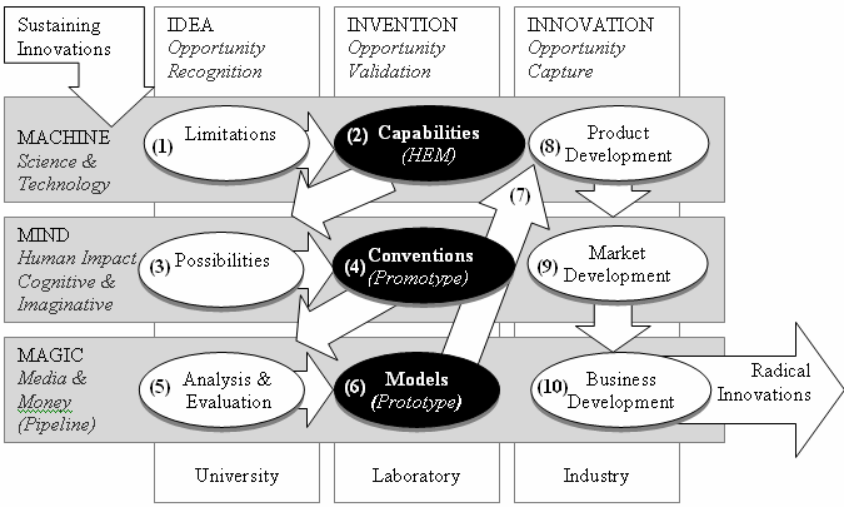

Figure 3: Innovation Model

Normally rehabilitation centers have only one generic kitchen requiring the patient to generalize skills that transfer to the home. The adjustable modularity of the Kitchen HEM allowed for a fuller and more realistic

rendering of the specific home experience, allowing for more pathways of interaction to feed the learning experience. The contextualization of the patient's real kitchen allowed the direct transfer of skills learned because the subject did not have to generalize activities in order to transfer these from a generic facility to a unique home. Results from the pilot test show great but preliminary promise for effective training that could lead to shortening a patient's length of stay within the clinic. Avoiding the need to generalize the knowledge learned within a generic kitchen, the contextual simulation of their real kitchen allowed for the training to be applied directly to the real home environment. Our pilot test subject showed immediate improvement in reducing time in preparing breakfast by more than half after only five training sessions [3].

The capture of the point of view of the subject also allowed friends and family to gain better insight and empathy for the challenges faced by the patient. Graphical read-outs support the recognition of patterns to automate the analysis of behavior into detailed quantitative and qualitative aspects. The continuity of diverse environments in the same facility allows aggregate data to be compared across subjects.

Innovation Infrastructure:
Venture Catalysts Mapping Vision into Reality

"Every innovation occasions more harm and derangement of order by its novelty, than benefit by its abstract utility"

--Legal Maxim, Thinkexist.com Quotations

Managing a culture of disruptive change in order to stimulate and nurture media innovation from idea to utility pushed us to create a repeatable innovation infrastructure, or interdisciplinary roadmap that involves academia, government and business. The goal is to track, nurture and anticipate change before good ideas are discarded due to failed practices that could not adopt radical change. Exploring and developing the technology, media and human modeling in parallel provides critical feedback to inform each discipline and evolve a solution that can overcome typical obstacles to adoption. Models created in the lab with the HEM produced adaptable and demonstrable prototypes that incorporate critical field requirements and expertise to better match purpose and function.

The belief that a killer app is merely going to show up and change the world just by being invented is a fantasy that lost all credibility during the "Dot.Bomb" phase of the Internet. Venture capitalists seized the opportunity to get rich quick, thinking that you could take an idea and throw it into the market place and it will innovate by itself. It was assumed that if you make it, they will buy it and start not only a media revolution, but a whole new business model as well. The other misconception is that media technology could develop without entailing experimentation and validation of new creative or business ideas and conventions. Historically, new technology enters the market places via new content that drives adoption and validates new business models that deliver new products that are cheaper, faster and better than the old.

Idea, Invention & Innovation:
Strategic Media Innovation Infrastructure
Each of our research projects adapted a repeatable pattern of media innovation abstracted from hundreds of years of media revolutions.

Our model (figure 3) follows a pattern found in most media innovation that in hindsight is obvious, yet continually ignored. Almost every disruptive media innovation 1) was sparked by the recognition of a new **science and technology** idea; 2) transformed old ***limitations*** into new capabilities; 3) Within the HEM, we pushed these new ***capabilities*** to the limit with content creators who formulated ideas to transform technological capabilities into creative possibilities; and 4) realized those ***possibilities*** by the invention of new media ***conventions*** that tapped the imagination of the market place in the form of Promotypes (Proof-of-concept for the market place) and created the demand for product as well as the ***human impact***. Even with these steps completed, the life cycle of any new product is defined by how you can effectively get your product to market cheaper, faster and better than ever before. Thus, the process continues with 5) the development of new production and business methods that emanate from an ***analysis and evaluation*** of current standards and practices as well as problems and challenges; 6) the invention and refinement of new prototypes that serve as ***models*** (cost, operation, production pipelines, etc.) within the laboratory environment to discover failure points and invent refinements prior to marketplace pressures; and 7) the creation of a process to transfer ownership after successful models are demonstrated. Even though the transfer occurs as the last step, the transfer process must start from stage one with industry contributing to the recognition of limitations that inform the entire process.

Industry then transforms laboratory models into products, markets and businesses incorporating the same integration of the mind, machine and magic. To do so 8) engineers apply the science and technology for ***product development***; 9) ***market development*** strategically prepares new markets to create demand

and 10) operations and production changes the ***business development*** itself to accommodate the new products and processes.

We map out each phase of research collaboration from the ***basic research*** of university campuses, to the ***applied research*** of commercial and academic laboratories to ***the technology transfer*** for industry adoption. This is guided and monitored by key principal investigators and sponsors representing each contributing discipline of the mind, machine and magic. Each cell presents a unique potential failure point, trade-off and opportunity.

Conclusion

In theory, there is only one class of institution in the world that has the broad vested interests that includes the long-term vision of the military, the short-term interest of the workforce, the cross-industry application of intellectual capital, the broad economic growth interests of commerce agencies, the improvement of public benefit of government agencies, as well as the timely and timeless advancement of science, humanities and economics of innovations. This class of institution is the world's universities whose existence is not directly tied to market whims, limited-term elections, or the narrow focus of current world security objectives; and yet serve all these interests and segments. With their unique and vast intellectual capital and facilities, universities need to lead this venture, not follow, but not with the bureaucratic inertia commonly associated with academia. They need to invest, nurture, and be accountable for wild ideas and new successful models that can decipher hype from measurable outcomes. As a knowledge network and honest broker, academia will need to reinvent itself, taking some of the professors and administrators out of the ivory towers and some of the industrial and political professionals out of the trenches, bringing these diverse people together to play venture catalysts and discover the alchemy of the mind, machine and magic. Doing so, Academia can change the future of society for the better.

Biography and Acknowledgements

Christopher Stapleton and Charles Hughes are co-founders of the Media Convergence Laboratory and bring over 25 years of experience in art and entertainment with over 40 years experience in computer science to innovate the media innovation process within the academic research institution. Our efforts to date were made possible by the many generous collaboration of industry, government and other academic institutions. We owe a great deal to our other founding partners Michael Moshell and Eileen Smith.

References

1. C. E. Hughes, C. B. Stapleton, D. E. Hughes and E. Smith, "Mixed Reality in Education, Entertainment and Training: An Interdisciplinary Approach," *IEEE Computer Graphics and Applications*, in press.
2. S. Malo, C. B. Stapleton and C. E. Hughes, "Going beyond Reality: Creating Extreme Multi-Modal Mixed Reality for Training Simulation," *Proceedings of I/ITSEC 2004*, Orlando, December 6-9, 2004.
3. C.M. Fidopiastis, C.B. Stapleton, J.D. Whiteside, C.E. Hughes, S.M. Fiore, G.A. Martin, J.P. Rolland & E.M. Smith, "Human Experience Modeler: Context Driven Cognitive Retraining to Facilitate Transfer of Learning," *Proceedings of IWVR 2005*, Catalina Island, CA, September 19-21, 2005.