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# **AC 2011-448: M-OUTREACH FOR ENGINEERING CONTINUING EDUCATION: A MODEL FOR UNIVERSITY-COMPANY COLLABORATION**

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Gale Tenen Spak is Associate Vice President of Continuing and Distance Education at New Jersey Institute of Technology, Newark, New Jersey. She has extensive experience in the area of professional workforce development and continuing education programs and writes and broadly presents on these subjects. Her experience includes managing, developing, marketing, proposal writing, evaluating and implementing programs for professionals who require new education and training to keep their skill at the cutting edge. The programs she designs involve collaborations among academe, industry, and government; and utilize, as appropriate, online instruction. She earned her Doctor of Philosophy in Political Science and Master of Science from Yale University, and her Bachelor of Arts, magna cum laude, phi beta kappa, in Political Science from Brooklyn College of City University of New York. Before joining NJIT, Dr. Spak was Dean of the School of Professional and Continuing Education at New York Institute of Technology, Old Westbury, New York, and, during America's first energy crisis, served as the Director of the Center for Energy Policy and Research. In the later capacity, she managed federally-funded energy information and technology transfer programs in the United States and abroad; and wrote various reports distributed by the U.S. Department of Energy to every Governor and State energy official to facilitate energy efficiency information outreach activities. She also developed a Masters Degree Program in Energy Management and a combined Bachelors/Masters Degree Program in Architectural Technology and Energy Management which emphasized "green" education. Her recent experiences include providing expert testimony to the NJ State Legislature regarding the capacity of NJ's four-year colleges to rapidly retool professionals for new positions in the 21st century during an economic downturn. Other experiences include serving as a key strategy lead for the U.S. Department of Labor's \$5.1M grant to North Jersey under the Workforce Innovation for Regional Economic Development (WIRED) initiative.

## **Peter Schmitt, Schmitt & Associates, LLC**

Peter Schmitt has extensive experience in both academia and industry.

He started out with a study of physics at the University of Wuerzburg, Germany. He did his Ph.D. at DESY (Deutsches Elektronen Synchrotron) in Hamburg and work at CERN (Geneva) as a postdoctoral research assistant for Harvard University.

Peter Schmitt went into industry starting as project manager for the development of car phones at AEG in Ulm. In 1995 he moved to the United States to work for BASF in various IT positions, among them Director of Infrastructure in the U.S. and Project Leader for SAP implementations.

In 2003, Peter Schmitt founded his own company Schmitt & Associates, which provides Online Training for the industry as well as reporting and analysis tools for business processes.

Peter Schmitt has taught at NJIT as adjunct professor and is a member of the ASTD.

## **Cesar Bandera, Cell Podium LLC**

Cesar Bandera is a founding partner of Cell Podium, an m-learning and m-health company situated on the Newark campus of the New Jersey Institute of Technology. He has deployed enterprise and public mobile multimedia campaigns for NIEHS, CDC, EPA, and several universities and private organizations. Dr. Bandera received his Ph.D. in Electrical and Computer Engineering from the University at Buffalo, NY. His work in the field of multimedia has yielded a Small Business of the Year Nomination from the US Air Force, 2007 NJ Entrepreneur award, a NASA Space Act award, various patents and publications, and six Ph.D. graduates.

## **m-Outreach for Engineering Continuing Education: A Model for University-Company Collaboration**

New Jersey Institute of Technology and Cell Podium, LLC

The most prevalent channel today capable of conveying educational and training content is the cell/smart phone. Cell/smart phones possess a unique combination of ubiquity, portability, connectively and low cost which together could make them a valuable educational tool.<sup>1</sup> As a method for providing training and education, m-learning is commonly defined as “e-learning carried out by means of mobile computational devices” that are “small, autonomous and unobtrusive enough to accompany us in every moment of life”.<sup>2</sup>

Today cell phones can instantly present the user with rich media (text, audio, images and video), opening new opportunities for “just-in-time” learning especially as one part of a blended education program that may combine other components using face-to-face and web instruction. Just-in-time learning is thought to encourage high level learning since the learner can access and apply the information right away rather than first learning the information and then apply it at a later time.<sup>3</sup>

Education and training for busy, working engineers requires convenience, portability, low cost, and, at times, just-in-time knowledge. This population represents one example where training partially using cell phones is germane. Working engineers often have little time to break away from job-related projects to be taught in a classroom. But an opportunity to learn utilizing their own cell phones could enable engineers to study during open time slots on their schedules, free time at home and even at the precise moments when certain information is necessary to successfully complete a work project.

As a new instructional delivery system, most m-learning today is an extension of traditional web-based e-learning. Current m-learning is not yet fully exploiting the medium’s potential. That is, just as television was first treated as an extension of radio, by and large today, the web mostly is being treated as an extension of linear print. For example, m-learning participants typically are part of an enterprise where trainers can pull into web-enabled company-provided smart phones snippets of instructional content which once was taught in a classroom or online. This permits greater functionality than legacy wireless application protocol browsers but the content of learning itself is an extension of the earlier media.

A newer variant of m-learning is emerging. Whereas m-learning is an asynchronous transaction initiated by the recipient or “pulled” by the learner, the newer variant may be called “m-outreach.” As its label suggests, m-outreach has a “push” characteristic to it thus enabling the maximization of skill and knowledge dissemination because it can reach consenting learners automatically (i.e. push out educational materials) as a multicast (one sender, multiple recipients) without learner initiation and intervention.

This paper will describe the collaboration between a continuing education division of a public research university and a start-up company housed within the university's business incubator. The purpose of the collaboration is to pilot the company's m-outreach tool with Professional Engineers (PE) seeking to renew their licenses. Used to describe registered or licensed engineers who are permitted to offer their professional services to the public, PEs, in most American states, must regularly take continuing education units in order to keep the PE designation. The start-up company's particular m-outreach tool is capable of pushing rich media, which is a key consideration for educators because rich media can support the IT methods associated with good m-learning such as high retention graphics, video and animation with voiceovers; and it does this at the same time as it maintains the ubiquity of SMS-based text-only dissemination. That is, continuing education materials can be pushed out to the cell/smart phones of PEs' registered for course(s) without their intervention (e.g., no browsing for information) regardless of the phone model, calling plan, or wireless service provider they own.

In particular, this paper will discuss the following topics:

1. Existing models of university-company collaboration so as to introduce an atypical university-company collaboration in which the partnering company is a start-up which owns a potentially potent m-outreach technology.
2. Definitions of m-learning in order to better understand the unique educational potential for engineers of the m-outreach tool upon which this university-company collaboration rests.
3. Details of the technology behind the new m-outreach tool including the company's track record in its utilization including results in externally-performed trials.
4. Obstacles to achieving university-company collaboration specifically focused on m-learning education and training deployment and why this example could succeed.
5. Pilot program underway by the university and company, which, as a starting point, is using the new m-outreach tool specifically for the benefit of PEs in need of continuing education to retain their licenses.
6. Conclusions and next steps.

#### 1. existing models of university-company collaboration

Workable university-corporate partnerships involve many intricacies which vary according to which of American university's core missions are being facilitated: (1) research; (2) education; (3) community service; and, more recently, (4) economic development. The university-company collaboration described in this paper is essentially about #2 and particularly about education and training of working professionals which is the typical domain of continuing education departments. While many other university academic departments and offices besides continuing education contribute, each in their own way, to regional, national and global economic development, the continuing education unit typically does so through the quality, timeliness and relevance of its short term training programs both for incumbent professionals directly and for the companies employing professional workforces who may or may not be alumni of the partnering university. That is, through training and education programs, continuing education

departments can help companies hire and retain more productive and knowledgeable workers who, in turn are key to their company's success and thus to making contributions to overall economic development and prosperity in the broader community and region. Accomplishing the later is of particular significance to public research universities.

Many existing university-company collaborations for this purpose can be categorized by focusing on two principal intricacies. One intricacy relates to the *content* of training; and the other to the *delivery* of training<sup>4</sup> In particular, the first emphasizes producing curricula with learning outcomes which match what key company leaders say is and will be required in their current workforces or which labor/occupational data and statistics show to be required in available, "in-demand" job functions in the region. In this sort of partnership, the company's role is to identify specialized content, which is well above any baseline education and training skills that all 21st century employees need; whereas the university's role rests with designing courses to assure that the specified content is exactly on-target. Sometimes this content is already available from courses which are part of pre-existing university degrees; but increasingly when these courses are designed to address current workforce needs, they require customization well beyond the subjects covered in university off-the-shelf offerings. This is the case here regarding PE continuing education license renewal courses.

The second intricacy emphasizes the utilization of appropriate delivery techniques to transmit the mutually-agreed upon educational content to the employees. When designed to address current workforce needs, delivery techniques can run the gamut from face-to-face instruction (for example, conducted in the training rooms at universities, at other convenient sites such as hotels and on company premises) to e-learning and m-learning distance instruction, and to approaches which blend or combine a number of these different delivery options together. The university's contribution to the delivery option decision often revolves around the choice of which actual option is selected for the training experience, assuming that the corporate partner is not married to one delivery method already. As educators, it is their core expertise to be the partner best equipped to select the most appropriate delivery method to teach content in ways that can ultimately result in the learner acquiring and retaining new knowledge and skills which they need to better perform their jobs. Assuming there is some flexibility regarding this matter, if a company is partnering with a university to train its employees, management's contribution to the delivery option issue often involves overtly declaring support for the selected option to trainees; making financial investments to ensure the option deploys smoothly; and, if IT-solutions are being deployed, arranging for the training to have a place in the queue of the corporate IT infrastructure. (It might be noted that if an individual is enrolling in university training, then the enrollee's contribution to the delivery option decision takes a different form. Enrollees "vote with their feet" or in other words they sign up to learn a given subject, in some part, based on its being taught in their preferred format.)

However, in a departure from these more typical models of university-company collaboration, this paper describes a collaboration in which the partnering company is not seeking to have its own employees trained or educated by a university. Rather, together the university and the start-up company seek to make use of the company's singular delivery tool as part of the university's training programs which are offered to other companies and individuals particularly from industry sectors which are related to the university's areas of academic excellence. Moreover,

this partnership is designed to provide mutual benefits both to the core profitability mission of a start-up firm and to the core training and economic development mission of a collegiate continuing education department. The parties involved are the New Jersey Institute of Technology's (NJIT) Division of Continuing Professional Education (CPE) and Cell Podium, LLC.

NJIT is a 130-year school which is the State of New Jersey's public science and technology university. It originated to serve the needs of the business owners of Newark, NJ which once was a major American manufacturing city. Today NJIT has six academic schools and a continuing education division that are dedicated to research, education of traditionally-aged students as well as working professionals, community service and economic developments (see: <http://www.njit.edu/>). Alumni from its Newark College of Engineering and its College of Computing Sciences represent 25% of the engineers and computer scientists working in a State known for its high technology industry sectors. Having developed and trademarked the first "Virtual Classroom®" course management system in the 1980's, NJIT provides education to its students—both young and old—often using the latest e-learning, m-learning and soon m-outreach techniques, including the approach which Cell Podium is pioneering.

Cell Podium, LLC is a mobile e-learning service provider and an award-winning developer of mobile multimedia technology. It holds the technology to push multimedia training to cell phones regardless of the carrier or model of the phone and to deliver relevant brief theme-specific videos to users' cell phone without their intervention (e.g., no browsing for information). At present, due to limitations in cell phone telecommunication design, each "pushed" out video is approximately two minutes in length; however, any number of such short bundles of learning can be transmitted. With nothing more than the cell phone, users are able to replay and forward knowledge/information either directly or via any social networking web site. The company was founded in 2008 in response to a critical need for mobile emergency responder training by the U.S. Department of Health and Human Services.

Furthermore, Cell Podium is one of some 90 tenants of the NJIT Enterprise Development Center (EDC), which is the largest and oldest business incubator in the United States. Each of the incubator's tenants benefits from university-related services supportive of new business growth. In particular, the EDC is a prime example of the recent trend among many American universities to facilitate the technology transfer of ideas originating not so much from its own faculty as from scientists, engineers and researchers who are unaffiliated with the host university. To maximize the potential for success of all tenants and to overcome growth gaps typical of start-ups, the EDC management team provides tenants with an array of support services. These include: (1) training in state, federal, commercial and private funding sources, (2) referrals to university resources that include academic experts, technology and manufacturing Centers of Excellence, MBA and technical student teams and interns to assist with production and strategy development, (3) access to university library databases, (4) introductions to firms providing legal, strategic planning and accounting services, (5) invitations to Angel and Venture Capital events, to entrepreneurial forums, and to workshops on business acceleration, and (6) access to EDC Incubator Seed funds to subsidize grant writers and to hone business plan optimization, marketing tools, and organizational designs.

Overall, CPE and EDC are but two university offices which in their different ways exemplify NJIT's commitment not only to the fourth mission statement of economic development but also to becoming a more "engaged" university. An "engaged university" is one committed to sharing and true reciprocity with private and public entities outside the university's walls.<sup>5</sup> Moreover—and of special relevance here—as one under girding strategy, for years now, NJIT has been proactively and deliberately using e-learning and m-learning tools to facilitate its engagement and economic development strategies.<sup>6</sup> Because of this long term commitment, CPE views Cell Podium's m-outreach tool as a promising way to disseminate just-in-time knowledge and skills about specific topics which matter to New Jersey's professional workforces and companies, and thus are vital to the economy of NJIT's region especially in areas which are in academic subjects that are hallmarks of NJIT's educational strengths. Engineering is one such academic subject, and an effective training program for PEs would be another specific example of how NJIT is becoming an ever more engaged university.

## 2. what is e-learning and m-learning and how does m-outreach differ?

Based on short-term, small-scale pilots largely in developed countries of Europe, North America and the Pacific Rim, researchers have begun to develop a taxonomy to understand different distinguishing features of m-learning compared to e-learning:<sup>7</sup>

1. Technology-driven mobile learning – Some specific technological innovation is deployed in an academic setting to demonstrate technical feasibility and pedagogic possibility.
2. Miniature but portable e-learning – Mobile, wireless, and handheld technologies are used to re-enact approaches and solutions already used in conventional e-learning, perhaps porting some e-learning technology to these technologies or perhaps merely using mobile technologies as flexible replacements for static desktop technologies.
3. Connected classroom learning – The same technologies are used in classroom settings to support collaborative learning, perhaps connected to other classroom technologies such as interactive whiteboards.
4. Informal, personalized, situated mobile learning – The same technologies are enhanced with additional functionality, for example, location awareness or video-capture, and deployed to deliver educational experiences that would otherwise be difficult or impossible.
5. Mobile training/performance support – The technologies are used to improve the productivity and efficiency of mobile workers by delivering information and support just-in-time and in context for their immediate priorities.<sup>8</sup>
6. Remote/rural/development mobile learning – The technologies are used to address environmental and infrastructural challenges to delivering and supporting education where conventional e-learning technologies would fail.

The m-outreach tool described in this paper could fit under all but #3 of these categories above, suggesting that efforts towards taxonomy development are still evolving. However, as a means of understanding what Cell Podium has invented, the categories may be useful especially when the following distinguishing feature is added. Whereas m-learning is an asynchronous transaction initiated by the recipient or "pulled" by the learner, m-outreach can be understood as

having a “push” characteristic which enables it to maximize skill and knowledge dissemination because it can reach consenting learners automatically (i.e. push out educational materials) as a multicast (one sender, multiple recipients) without learner initiation and intervention. Cell Podium’s tool can accomplish this, thus its “m-outreach” tagging and a feature distinguishing it both from e- and m-learning.

### 3. mobile multimedia technology considerations

#### a. adoption among various demographics

The statistics released in October, 2010, in the CTIA-Wireless Association’s Semi-Annual Wireless Industry Survey show a clear picture of dramatic increases in mobile devices with 93% of Americans now using a wireless device or cell phone and no longer just for cell calls.<sup>9</sup> The Mobile Access 2010 tracking survey of 2,252 adults 18 and older including 1,917 cell phone users from the Pew Research Center’s Internet and American Life Project provides more insights into the demographics of digital outreach.<sup>10</sup> According to the summary of findings:

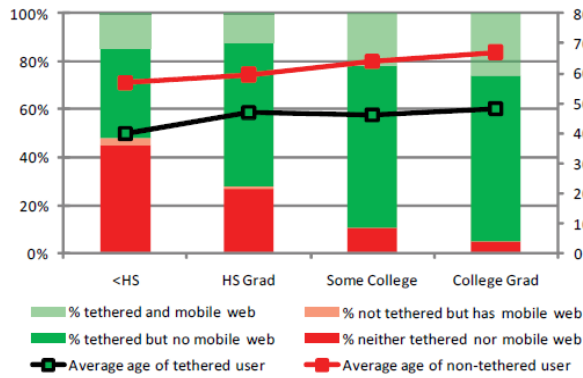
Six in ten American adults are now wireless internet users, and mobile data applications have grown more popular over the last year. As of May 2010, 59% of all adult Americans go online wirelessly.

Regarding cell phone use, roughly half of all adults (47%) go online in this way, up from the 39% who did so at a similar point in 2009. Furthermore, two in five adults (40%) do at least one function using a mobile device, which is an increase from the 32% of adults who did so in 2009. Taken together, according to this survey, 59% of American adults now go online wirelessly using a laptop or cell phone, an increase over the 51% of Americans who did so at a similar point in 2009. That is, even though cell phone ownership has remained stable over the last year, users are taking advantage of a much wider range of their phones’ capabilities compared with a similar point in 2009. Of the eight mobile data applications Pew researchers studied in both 2009 and 2010, all showed statistically significant year-to-year growth. (The eight mobile applications in order of popularity were: taking a picture, sending or receiving text messages, playing games, accessing the internet, playing music, sending or receiving instant messages and recording videos.)

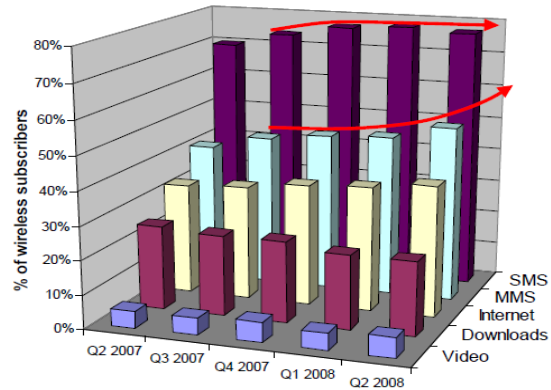
Engineers, who are the focus of this paper, are typically over 22 with PEs being older yet given the years it takes to achieve the PE credential, meaning that a useful age range to examine is between 25 and 49. Other studies of cell/smart phone use provide insights regarding usage preferences by age range. For example, data of a 2009 benchmarking study conducted by a marketing company shows that “adults under 50 are the most likely to be mobile users with 93% owning a mobile phone today.”<sup>11</sup> This work identifies 14 different categories of “consumer information” in order to explore which types are most sought via cell phones by age range. Of these categories, the closest one to this paper’s engineering focus is “technology/sciences.” Results show that some 85% of 25–34 year olds and 78% of 35–49 year olds view their cell phones as the primary place to go for this sort of information.

Engineers, not only are older than 25, but by, definition, are better educated than the general population. Pew Research’s 2009 Mobile Access Spring Tracking Survey of 2,253 adults finds

that use of a computer, whether at home or at work (see, green color coding in Figure 1) correlates with education.<sup>12</sup> Some of those who use a computer also access the web with their cell phones (see light green versus dark green in Figure 1).



**Figure 1. Access to wired (tethered) and mobile web**



**Figure 2. MMS is the fastest growing and 2<sup>nd</sup> largest data service among cell phone users**

The mobile media protocol most used is the Short Message Service (SMS), which conveys only text; the second most used and fastest growing mobile protocol is the Multimedia Messaging Service (MMS), i.e., picture and video messaging including the high resolution graphics, video and animation with voiceover characteristics of good m-learning (Figure 2).<sup>13</sup> The m-outreach technology which is the focus of this university-company partnership employs MMS technology. As such, MMS can permit outreach to engineers for continuing education purposes to occur by multicasting rich media and by enabling the recipient to forward it to others in his/her support ecosystem.

Ubiquity, portability, and connectivity demonstrated by the demographic data may be reason enough to consider cell-smart phones as vehicles to advance learning among engineers, in particular, but there is an additional benefit. Given the ever growing popularity of these devices, if so deployed, it would mean that engineers would not need to acquire yet “another technology to receive learning materials.”<sup>14</sup> One example would be the iPad.

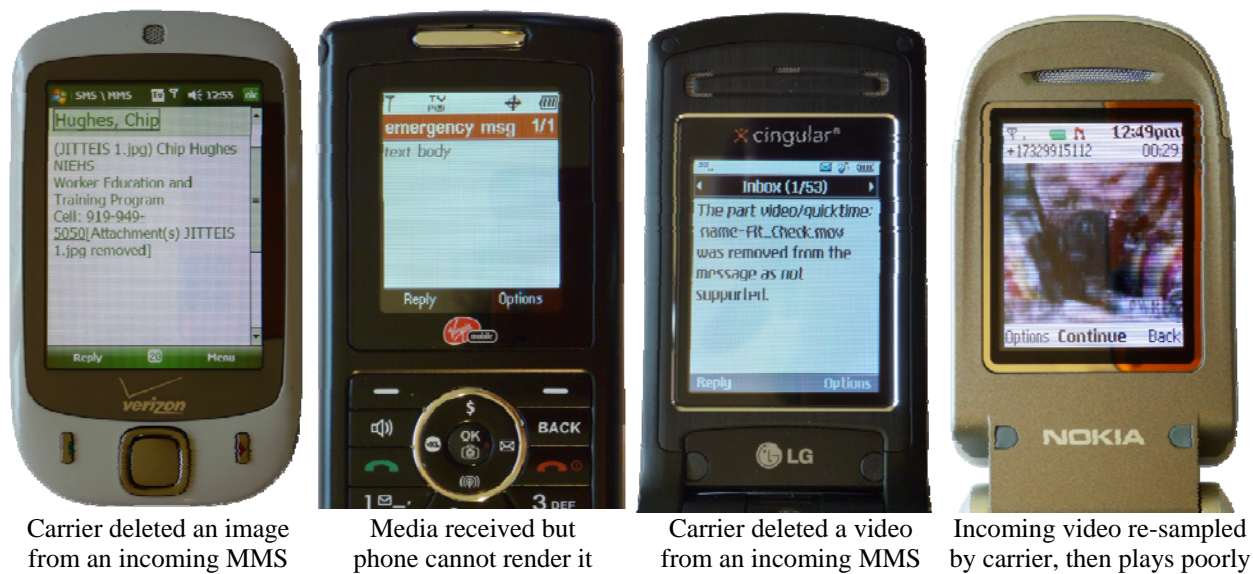
#### b. challenges to mms in m-outreach

In spite of high user adoption of MMS, full implementations of the MMS protocol by device manufacturers and wireless service providers (i.e., carriers) have been stymied by the lack of interoperability of their SMS implementations.<sup>15</sup> Multimedia messages are occasionally received without content, with poorly down-sampled content, or with content replaced by a URL where the carrier posted the multimedia (precluding MMS as an alternative to the web), as illustrated in Figure 3. Impediments to interoperability include the following, which are mostly independent of the sophistication of the mobile device itself:

1. Device manufacturers and carriers employ many media formats and delivery protocols, but any one user will only be able to receive a small subset of these formats and protocols depending on the user’s device, its date of manufacture, subscription plan, and carrier.



2. Software compliance with communications protocol and multimedia format standards varies among device manufacturers and carriers.
3. Carriers employ an approach commonly known as a “walled garden” which refers to the practice of carriers or service who maintain control over applications, content, and media on cell-smart phone platforms and who restrict convenient access to non-approved applications or content. The approach promotes subscriber retention with the vendor’s multimedia services, but it occurs at the expense to subscribers of interoperability with subscribers on different carriers.
4. Some carriers block subscribers from installing 3rd party applications on non-smart phones. These subscribers can only install software purchased from their carrier.
5. Repurposing traditional e-learning content to mobile devices involves extensive adaptation due to the instructional design issues unique to their small screens, keypads, and bandwidth.



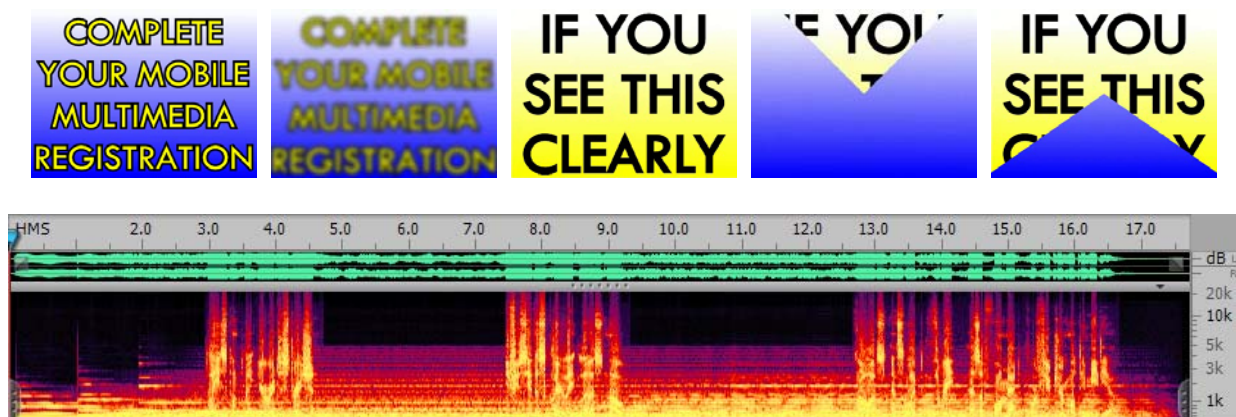
**Figure 3. Problems commonly encountered when receiving mobile media.**

The successful delivery of m-outreach content requires tailoring it to each recipient. One approach is to call User Agent Profiles, online descriptions of cell phone models (e.g., screen size, codecs) developed to assist automated content adaptation, but 20% of these are incorrect.<sup>16</sup> Moreover, a user’s preferred media format is not determined exclusively by the device capabilities; two users with the same cell phone may prefer different formats (among those supported by their devices) because viewing the higher resolution format requires pushing more keypad buttons.

To prevent tailoring content to an incompatible or suboptimal format, Cell Podium implemented an “opt-in” protocol for its m-outreach that asks each user to select a favorite format from among a set of device-specific options. The user enrolls in m-outreach by calling a VoiceXML server that captures the cell phone’s caller-ID, pushes to the cell phone a set of numbered sample multimedia clips, and asks the user to speak the number of his/her favorite clip. All subsequent m-outreach to that user is then tailored to the format of preferred clip. The user can also call to

opt-out or change preferences. The user cannot select a format that is incompatible with his/her phone, carrier, or account because the associated sample clip will not have been rendered.

Most modern cell phones will display at least two (and up to four) of the sample clips sent, and the opt-in protocol is “encouraging” the user to select the clip whose format yields future m-outreach content with the best audiovisual quality. Consequently, the multimedia sample clips are authored to exercise the internal components of the cell phone, including its audiovisual codec, processing speed, speaker fidelity, and screen resolution. All sample clips include smooth color gradients that are best rendered with large color palettes (many bits per pixel), motion that is best rendered with high frame rates and artifact-free temporal video decompression, and an audio power spectrum that extends beyond voice band (Figure 4).



**Figure 4. High-contrast gradients, wipes, and wide audio power spectrum in sample multimedia clips**

Moreover, the current opt-in protocol which Cell Podium is using does not assume of the user any prior experience with SMS/MMS, nor of any technical knowledge of mobile multimedia formats (the different sample clips are identified only by a large ID number rendered in the video, audio, and message header). Interestingly, while users with no prior experience with SMS or MMS sometimes have a difficult time sending a message for the first time, they rarely have difficulty viewing a message that was sent to them.

c. examples of current cell podium mobile multimedia outreach trial(s)

Cell Podium was recently awarded a Small Business Innovation Research contract from the Centers for Disease Control (CDC) Office of Public Health Preparedness and Response to develop and evaluate m-outreach tools for preparedness and response that supplement text messaging with multimedia. In just a few months, CDC deployed Cell Podium’s m-outreach technology in two campaigns. In the first campaign, the CDC Emergency Operations Center is pushing videos to the cell phones of health care workers in Haiti that describe the guidelines for the rapid rehydration of critically-ill cholera patients. In the second campaign, CDC is pushing preparedness videos for severe winter weather to the open public.

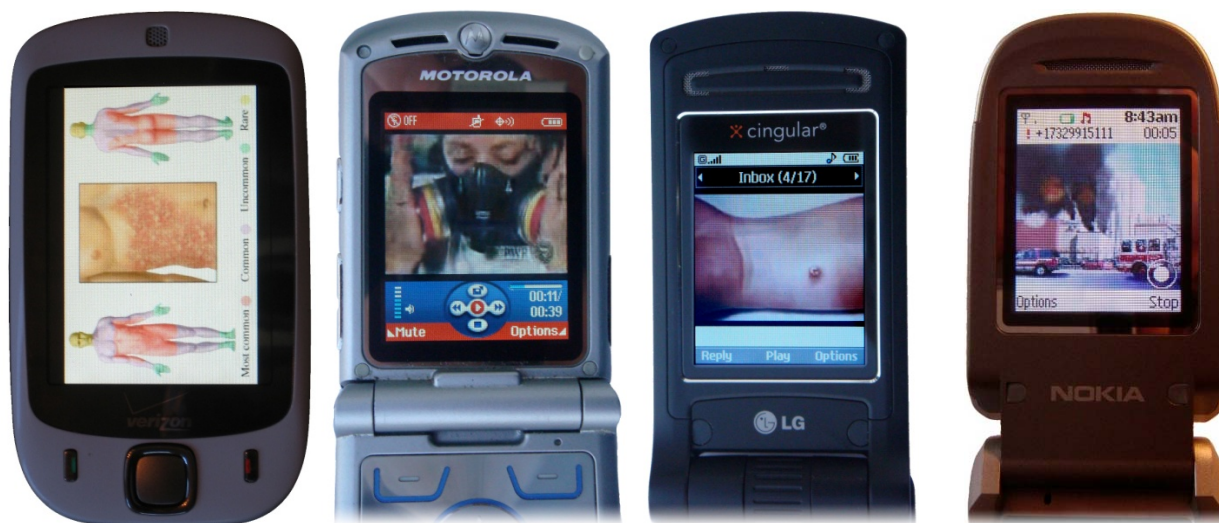
The health and safety of workers including those cleaning up the 2010 British Petroleum oil spill in the Gulf of Mexico is of top priority to Cell Podium and their clients, including the Worker

Education and Training Program (WETP) of the National Institute of Environmental Health Sciences and CDC's Office of Public Health Preparedness and Response. Among the efforts to protect these workers and the public who risk exposure to oil contamination is the offering of mobile-accessible oil spill response training. Cell Podium has developed several just-in-time training videos from the WETP Oil Spill Response Training Tool that give crucial and imperative safety training within one minute for such topics as: Heat Stress and Protect Yourself. These videos are available in English and Spanish and are currently posted for free through the YouTube page <http://www.youtube.com/user/cellpodium>, thus offering an opportunity for additional training for workers in the field, especially those with limited experience with chemicals.

As another example of current usage of the m-outreach tool, Cell Podium has deployed and tested an application specifically developed for the Office of Public Health Practice and the New Jersey Center for Public Health Preparedness of the School of Public Health of the University of Medicine and Dentistry of New Jersey. To wit, the Just-In-Time Training for Emergency Incidents System (JITTEIS) serves "Skilled Support Personnel" (SSP).<sup>17,18</sup> SSP are deployed to aid first responders in emergency incidents, and include laborers, operating engineers, carpenters, ironworkers, sanitation and utility workers. Often exposed to the same hazards as responders, SSP lack incident preparedness because their employment reinforces skill development and the range of potential scenarios is too broad. These factors increase personal risk to the SSP and mission risk at the incident site. Providing education and training is essential to the protection of workers. The Occupational Safety and Health Administration requires that training be provided for hazardous waste clean up workers and emergency responders, as well as for SSP.<sup>19</sup> The most ubiquitous mobile device among SSP is the cell phone. Through trials, JITTEIS met requirements to avoid being a distraction in an already stressful setting:

1. Lessons are audiovisual, maximizing imagery, animation, video and audio, while minimizing text.
2. The system does not require the learner to change any settings, on his/her phone, install any new software, or change cell phone, wireless service provider, or service plan.
3. Enrollment, authentication, lesson selection, and viewing minimize key strokes, password memorization, and maintenance of phone number lists.
4. The rendering of multimedia is tolerant of temporary wireless bandwidth decrease and signal interruptions.

JITTEIS maintains a collection of brief theme-specific multimedia safety courses specific to the hazards that SSP encounter at the emergency to which they are responding. The health and safety information maintained by JITTEIS is targeted to the role and anticipated hazards of the responder. Upon an emergency, the Incident Commander, Safety Officer, or dispatcher selects relevant safety courses (see Figure 5). SSP deployed to the incident are enrolled in JITTEIS which sends to their cell phones all lessons and messages associated with that incident, including updates. At any time, SSP can view the content on their cell phones, and forward it to colleagues. SSP can also send photos and videos captured on their cell phones to JITTEIS via MMS or email; JITTEIS stores all media submitted from the field and assigns it to the selection of incident-relevant safety courses.



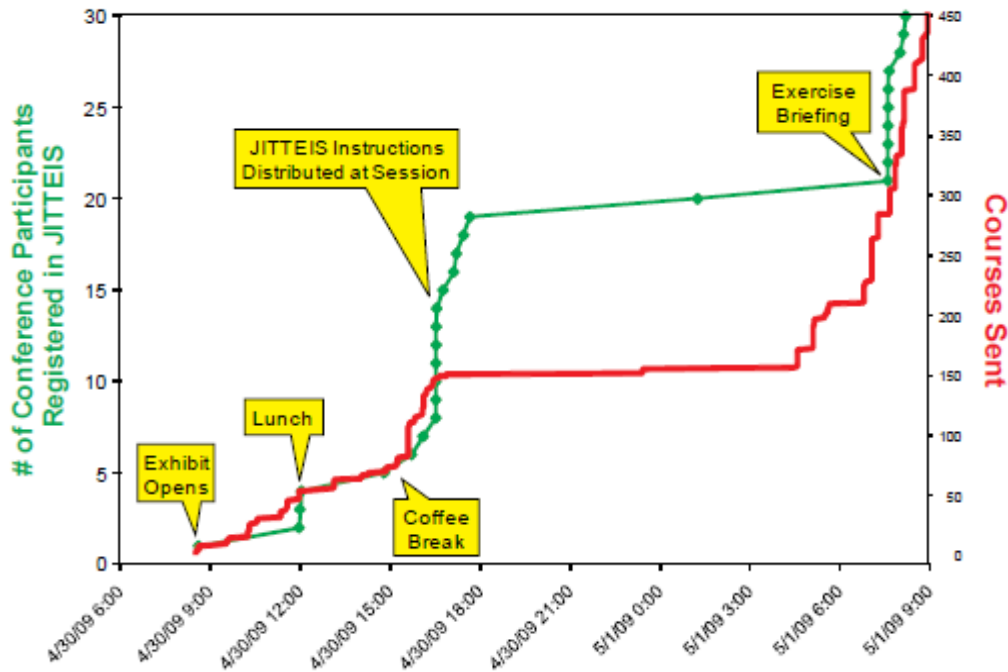
a. Likely sites of influenza rash (HTC on Verizon)    b. Testing PPE for proper fit (Motorola on Verizon)    c. Skin lesion caused by anthrax (LG on Cingular)    d. Suspicious white plume at fire (Nokia on T-Mobile)

**Figure 5. Multimedia learning modules on different devices and carriers.**

On April 2009, JITTEIS was evaluated by WETP at an emergency response training exercise involving a hazardous chemical leak in downtown Cincinnati, Ohio. JITTEIS was used to disseminate videos to the cell phones and mobile devices of the exercise participants, including the event alert; safety, chemical threat, and preparedness instructions; site coordination; and live pictures and videos submitted from the incident site by the participants themselves.

Exercise participants enrolled in JITTEIS by calling the phone number of an automated attendant that recorded the participant's cell phone number and multimedia preference. During the actual emergency response exercise, thirteen courses were sent to each enrolled participant: seven previously authored and stored in the content management system and six provided by participants for immediate dissemination. JITTEIS sent a total of 450 multimedia clips during the exercise. All registered users were able to view the clips on their mobile devices, even when their signal coverage did not permit them to make or receive phone calls. The average time between JITTEIS sending content and users receiving it was 30 seconds.

The social nature of m-outreach is visible in the logs of JITTEIS activity during the WETP exercise (Figure 6). WETP announced enrollment instructions at 4:30 pm on 4/30/09, but enrollment activity began at 9 am as early adopters showed the JITTEIS sample multimedia clips they had received on their cell phones to others, particularly during breaks. Enrollment activity was also high during the transmission of exercise courses at 8 am on 5/1/09, as more conference attendees witnessed the receipt of multimedia by users registered in JITTEIS and opted to register as well.



**Figure 6. JITTEIS activity at 2009 WETP exercise**

To accommodate all possible mobile devices, carriers, and wireless subscriptions, JITTEIS uses a variety of messaging formats and transmission protocols. MM1 is the transmission protocol used to convey MMS (analogous to how TCP/IP is used to convey HTML), and supplemental transmission protocols are made available to users of more advanced mobile devices, such as smart phones and netbooks. When populating the JITTEIS message library, Cell Podium staff use commercially available software titles such as Adobe “After Effects” for authoring mobile multimedia in all these formats from media assets (existing pictures, video clips, etc.), and anyone that can make “home movies” or animated PowerPoint presentations on a computer can likewise use these titles without much difficulty. However, when relaying media residing on separate media libraries, JITTEIS is designed so as not to burden the sender with format conversion; instead conversions happen automatically into these formats.

Cell Podium’s success to date in using their m-outreach tool for this kind of population is the subject of research done already in akin populations, such as nursing, in which different m-learning tools are deployed. That research concludes, “Use of mobile technology in the health care field is growing at a fast rate because of the nature of the work health care workers perform. They are on the move most of the time and need to access information for just-in-time application. Hence, the use of mobile technology to work from anywhere and access information at any time is important for this group.”<sup>20</sup>

However, what about other kinds of populations such as engineers?

#### 4. obstacles to m-outreach in higher education

While m-outreach may work for health care and counter-terrorism professionals, its applicability in different disciplines and professions typically taught in universities poses many hurdles.

According to Traxler:

...mobile education, however innovative, technically feasible, and pedagogically sound, may have no chance of sustained, wide-scale institutional deployment in higher education in the foreseeable future, at a distance or on-site. This is because of the strategic factors at work within educational institutions and providers. These strategic factors are different from those of technology and pedagogy. They are the context and the environment for the technical and the pedagogic aspects. They include resources (that is, finance and money but also human resources, physical estates, institutional reputation, intellectual property, and expertise) and culture (that is, institutions as social organizations, their practices, values and procedures), but also the expectations and standards of their staff, students, and their wider communities, including employers and professional bodies). Implementing wireless and mobile education within higher education must address these social, cultural, and organizational factors... Within institutions, different disciplines have their own specific cultures and concerns, often strongly influenced by professional practice in the “outside world” – especially in the case of part-time provision and distance learning. Because most work in mobile learning is still in the pilot or trial phase, any explorations of wider institutional issues are still tentative but it points to considerable hurdles with infrastructure and support.<sup>21</sup>

Nevertheless and with these precautions acknowledged, collaboration between a university’s continuing education department and a start-up company, housed within the university’s incubator and which owns a particular m-outreach technology may represent a best case scenario for success. In general, this may be true because collaborators in these categories have mutually reinforcing goals which can be maximized through partnering. That is, start-ups seek to become economically viable as rapidly as possible so that they can emerge from incubators to become profit-generating new businesses. Thus, they relish opportunities to partner with universities as a way to beta test, demonstrate, refine, and prove the utility of their patents and ideas in order to attract ever more generous new clients and customers. On the other hand, continuing education departments seek not only to achieve their university’s missions of education/training and economic development but also, and consistent with the “cash cow” nature of most such departments, to produce cold cash from new sources to contribute to their college’s bottom line. In recent years this imperative has become even more important especially at public research universities across the country which are faced with diminished funding from state legislatures. Transient adult professionals registering for non-credit professional development training courses and/or the companies who employ them are such a source of external funds for continuing education departments and their home universities.

#### 5. the njit cpe and cell podium collaboration: a pilot program for engineers

In January 2010, an external event occurred which specifically makes for an opportune piloting of this new collaboration model at NJIT. The external event was the enactment into state law of a requirement that, effective in January 2011, all NJ PEs must complete 24 hours of continuing

education over two years in order to renew their professional licenses. Among the various engineering disciplines, the PE credential is most often sought by Civil, Electrical, Mechanical, Chemical and Environmental Engineers. NJ is one of the last states in the country to enact such a requirement for this profession. As the State's public technology and science research university with some 25% of its alumni hired within the state's borders as engineers and as an institution known for its leadership role in distance learning, a new niche for NJIT CPE was born. Especially relevant, too, is NJIT's organizational structure where responsibility for expanding distance delivery options for the benefit of traditional and adult learners is housed within CPE.

As discussed above, most university-company collaborations which are created for the purpose of achieving a university's education mission can be categorized by focusing on two principal intricacies. One intricacy relates to the *content* of training; and the other is about the *delivery* of training. While this collaboration has new aspects to it due to its being a partnership with a start up company, even here too, these two intricacies in part follow established patterns. That is, content is being developed, guided by State regulations, by CPE which is working with NJIT engineering faculty, engineering alumni and with executives from NJ's many engineering consulting firms. On the other hand, assuming that a company which is partnering with NJIT to ensure that their PEs retain their licenses is not already married to a particular way to conduct training, the intricacy of delivery option also is following typical patterns. That is, this intricacy is being shaped by CPE professionals who are in the best position to recommend the most suitable delivery method to convey the specific engineering concepts which the company needs its employees to learn. In this way, the mutual goal to teach professionals new knowledge is advanced.

However, in this collaboration and what makes it distinct, the particular technology, which originates entirely from the start-up company, has become one part of the NJIT PE training program design. That is, if Cell Podium had not invented this m-outreach approach, the partnership described here would not have come into existence.

The first CPE PE training courses are short, no more than 4 hours each, and are being delivered in a blended delivery model in which Cell Podium's tool was incorporated by design both in the near term and far term. The most immediate plan involves utilizing the tool's capability to market or promote the availability of this new area of continuing education from NJIT. That is, at the time of this paper's writing, NJIT media specialists have produced a short video clip about this program in which a respected NJIT civil engineering professor is featured. This has become the raw material for Cell Podium to use to produce a promotional m-outreach MMS message about the training program. With access by CPE, at no cost, to the email addresses of NJIT's engineering alumni, this informational m-outreach message was and will continue to be sent to NJIT alumni who "opt-in" to receive it. Non-alumni also have been given the means to consent to receive on their cell and smart phones similar short MMS messages about the training program.

While no 4-hour PE training course will be conducted in its entirety through Cell Podium's m-outreach tool alone (at least until such time as cell/smart phones are capable of showing lengthier multi-media feeds), there is every intention to use Cell Podium's tool as one element in a blended learning experience. That is, PE training courses are being designed to utilize, as appropriate to the content, a variety of delivery formats. These include face-to-face instruction at convenient locations (e.g., on company premises, at hotels, and in NJIT training rooms);

webinars using synchronous delivery platforms (e.g. WIMBA) and online courses using asynchronous delivery platforms (e.g. Moodle). Contingent on the availability of sufficient budget to CPE to produce short video clips, Cell Podium's tool is planned to play a part in each of these scenarios, especially about key topics most often associated with engineering "just-in-time" knowledge needs. Selection of which points to accentuate through MMS messaging is being made in concert with engineering firm supervisors and managers who are the best resource to know what their professionals require to perform their jobs better.

Other uses of Cell Podium's m-outreach tool are part of the long term programmatic planning for this training. These include various strategies to reinforce and facilitate retention of the content taught during each short course. For example, the MMS message(s) developed for use in any specific training class could be re-deployed for this purpose. Subsequently and spaced several weeks apart, these video(s) will become the MMS messages which are sent to learner's cell-smart phones. Learners then could play and replay the material just-in-time and at need. This way the retention of knowledge is visually and audibly enhanced. So utilized, the m-outreach tool can help overcome the known phenomena of diminished retention over time by learners of the new knowledge and skills which they had been taught.

As Cell Podium and CPE pursue their collaboration what is already known is that there is a willingness and need between both parties to be agreeable and nimble in discovering amenable content to deploy through m-outreach techniques and in modifying the new delivery system to ensure that the learning outcomes of clients are met.

## 6. conclusions and next steps

M-learning via SMS has become commonplace. However, a lack of interoperability has precluded m-outreach through multimedia (MMS), and advances in mobile devices will not guarantee interoperability while carriers and device manufacturers emphasize product and service differentiation.

The opportunity to provide engineers with training they need by building on the high adoption of mobile multimedia among their descriptive demographic (e.g.; educated and older) makes addressing the interoperability issues of multimedia m-outreach an important research agenda. Moreover, pushed m-outreach could address other engineering informational gaps better than pulled web-based content; since the former does not require the user to initiate the media transfer, it is shared more easily, and MMS is cheaper than mobile web access.

The middleware presented in this paper achieves reliable profiling of the user's mobile multimedia capabilities, which are a function of device, subscription, and user preference. To simplify enrollment, this one-time operation is combined with an opt-in process, the latter being mandated by anti-spam regulations of the FCC.

Ongoing research by Cell Podium is progressing along three directions. First, Cell Podium is developing algorithms that automatically detect the capabilities of the cell phone when the user opts into the m-outreach service (i.e., eliminating the need to view and assess test clips). Second, location awareness is being added to m-outreach to enable the delivery of spatially targeted content. Open Geospatial Consortium protocols are used to obtain the locations of enrolled cell



phones. Lastly, scalability techniques are being applied to m-outreach like those used to lower the per-client cost of web-based outreach.

Over time, the NJIT CPE- Cell Podium collaboration holds promise for the parties involved to see mutually beneficial accelerations of research, profitability, and workforce education. But concurrently, as Cell Podium grows and as NJIT expands use of its tool, as appropriate, in its continuing education and academic programs, significant macro impact can emerge. To wit, the expected impact is enhanced economic development and prosperity for a region because of the increased knowledge possessed by its engineering and scientific workforce.

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