MTM: ANATOMY OF AN ACTIVITY TRANSFORMATION BASED ON ASSESSMENT AND TIME/COST ANALYSIS

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Abstract—*This paper describes the conversion of a traditional residential camp for high school girls into a modular day camp that resulted in a substantially enhanced efficiencies, including use of time, human and financial resources. The conversion created opportunities to concentrate on delivering engineering hands on content, to serve larger numbers of girls and to reach out to students who are not normally attracted to engineering-based camps.*

Index Terms — engineering day camp, cost/time analysis/assessment, high school recruitment, hands on

INTRODUCTION

MTM is a successful engineering day camp for girls on the Penn State University Park Campus that attracts students from as far away as Georgia, Texas and Wisconsin. The participants are diverse: Thirty-five percent of the girls participating in 2003 were African American (14%) and Hispanic American (21%). Only 30 percent of the campers were from the immediate area. And it is growing; 68 students attended MTM 03, up from 23 in MTM 02.

How do we attract girls to an engineering day camp in Central PA? Why did we make the decision to move from a residential week-long camp to a day camp?

CAMP DESCRIPTION

MTM High School Day Camp (Move the Mountain) is an innovative week-long, hands-on day camp for high school girls that last year drew 68 girls from seven states and employed 20 undergraduate and graduate women as mentor/instructors. The strength of this concept is demonstrated by the fact that girls came as far away as Georgia and Colorado to attend at day camp.

MTM is a comprehensive, integrated pipeline program that aims to recruit, retain and develop future women engineers through integrated activities that bring high school girls to a pre-College high school camp. The camp introduces girls to fields and opportunities that will encourage them to enter, continue and excel in engineering. The camp also provides undergraduate and graduate women with leadership opportunities as they role model positive behavior for campers

MTM offers high school girls and undergraduate engineering women the opportunity to gain hands-on competency and confidence through:

- Introduction to key technologies and practices related to engineering
- Development of key problem solving, teamwork and business skills
- Exposure to real world engineering experience through hands-on projects and case study focused activities
- Contact with engineering professionals through networking and related activities

Objectives of the overall camp are to:

1) Introduce girls not identifying engineering as a potential major, to engineering.
   Expected Outcome: High percentage of uncommitted girls who become interested

2) Recruit girls to Penn State.
   Expected Outcome: Girls apply to Penn State

3) Provide leadership experience for upper-level women.
   Expected Outcome: Women retained at higher level; increase commitment to engineering

Each module features an active learning experience, exposure to strong role models and engineering career information related to the module. The modules are all interdisciplinary, introducing girls to engineering through interdisciplinary laboratory experiences. MTM aims to prepare girls to succeed through cross-cultural communications experiences, hands on engineering skills workshops, career preparation, and active networking. MTM uses targeted cross disciplinary activities to introduce engineering to girls as a broad, dynamic and people oriented profession at a time when they are making critical educational decisions.

Each day module features an interdisciplinary look at engineering through topics such as sustainable development, bioengineering, robotics or entrepreneurship. Activities during the day include an overview of the subject area, an introduction to the types of engineering majors involved, a hands-on design project and a tour to a relevant company or University project.

All modules are led and developed by faculty, graduate women or Women in Engineering Program staff. For example, two architectural engineering graduate women, Amy Grommes and Priya Premchandran, designed a day module on Environmental Construction and Design based on their experience in developing hay bale housing designs for Native Americans. Another module, designed by WEP assistant director Cheryl Knobloch, a ceramic engineer, was on Product Innovation and featured designing a "Hot Trot for the Physically Challenged." (Knobloch, also the current camp coordinator, joined WIE in 2002 and has been the major drive behind development of engaging and effective

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hands on modules). Nadine Barrie Smith, assistant professor in bioengineering, has participants construct and test an EKG machine.

An important feature of MTM is the leadership opportunities offered to upper level engineering and graduate women students. This is a successful, combined retention and recruitment strategy. The undergraduate mentor/instructors provide strong and active role models and leadership for younger students at the same time that they solidify their own skills, confidence, and identification with and commitment to engineering. The younger mentor/facilitators themselves will learn and master skills as they to teach them to others. At a time when these young women may be questioning their own abilities, they develop confidence by teaching those younger, acting as positive role models, and increasing their sense of connection with the College, other engineering students, and the engineering profession.

IDENTIFYING AND ATTRACTING THE TARGET AUDIENCE

One of the challenges of offering engineering camps is to attract girls who are not already committed to engineering. It is valuable to reinforce this commitment, but it does not necessarily increase the number of girls who enter engineering. To do that, we must attract girls who are not identifying engineering as a possible path.

While pipeline issues are critical and it is clear that we need to attract more underrepresented students into the engineering pipeline at an earlier age, it is also clear that in many ways the pipeline is already primed—it's the pumping that needs work. Today more girls than boys take higher math; what is not happening is that those girls take the next step and decide to study engineering.

MTM specifically targets these girls with the preparation and ability to pursue engineering but who have not yet identified engineering as a possible career or study path. Providing hands-on problem solving and design projects that are interdisciplinary are key factors in the camp design. The presentation of engineering through interdisciplinary, socially relevant projects is a critical component of the camp.

The target group is chosen deliberately: Too often girls with the promise and interest unknowingly narrow their options because they have not received the necessary support, encouragement or basic information. MTM is designed to reach them at a pivotal time to reinforce their interest and participation in math and science and to encourage them to continue to take the coursework necessary to succeed in an engineering discipline.

An effort is made to attract a multicultural group to the MTM modules. Last year one-third of the participants were from underrepresented groups. To achieve this, WEP worked with a predominately Hispanic magnet school in Philadelphia and an African American girls club in Harrisburg to bring girls to campus for camp modules. For these, WEP arranged overnight sessions featuring networking and more engineering activities.

Methods for recruitment include: working closely with identified schools to recruit underrepresented girls; working with Girl Scout and Black Achiever leaders: advertisements in kid sections of area newspapers; an interactive, on line registration process: and a broad distribution of brochures about the camp. A particularly effective recruiting tool has been announcement of the camp in the college alumni magazine.

Developing a format that would make it possible to attract this diverse group of girls was a key factor in undertaking a major re-invention of the original camp described below. The camp is based upon the assumption that the pipeline for engineering is primed but hasn't yet been effectively pumped; more girls than boys are now taking higher level math in high school. Accordingly, MTM is designed specifically to identify girls who have the talent and prerequisites to study engineering, but who are not planning to. By offering day modules in week long sequence, girls can participate in one day, all week or any configuration of day modules they want. For girls who are dubious about engineering, or anything smacking of geekdom, participation in a day activity is a much easier sell than an entire week.

USING COST/TIME ANALYSIS TO ASSESS AND EVALUATE THE RESIDENTIAL CAMP MODEL

MTM started life as a standard week-long residential camp for junior and senior high school girls designed to introduce them to engineering and with the specific goal of recruiting them to Penn State. The objectives and target audience for the week-long camp are described above.

By all typical measures, the initial camp offering was a success: in pre-camp survey, 5% of participants indicated that they wanted to become engineers as compared with 100% in the post-camp survey. The post-camp survey also showed that 13 of 15 senior participants (87%) indicated their intent to study engineering at Penn State. In post-camp survey items that gathered formative and student satisfaction data, participants also reported high approval ratings of the camp's organization, hands-on activities and mentors. All of the leadership indicated that the camp was a positive experience.

As a formative instrument, the survey was a good tool for continuing to develop the customer satisfaction (e.g. whether participants enjoyed the activities, meeting with engineering women, meeting each other, and the camp overall) but it did not provide information on whether the camp objectives were met. The enthusiastic responses of the formative survey, which was administered at the end of the camp, was more a measure of how much fun they had than a reliable predictor of a long-term commitment. (Funding was not available for a longer term post survey for this first

offering; the camp is now using assessment tools developed through the Assessing Women in Engineering Project.)

Fortunately, we were able to access other data to assess whether or not objectives were achieved: tracking for recruitment and a cost/time analysis. When these data were checked against reality, the camp did not look as successful.

When we checked the applications to Penn State to determine how effective the camp was as a recruiting tool, we discovered that of the 15 seniors, 13 of whom reported an intent to study engineering at Penn State on the formative document, only two actually applied to Penn State and only one of those was accepted.

We also looked at the budget. The pilot offering came out to a cost of almost $1500/girl. While that number would have gone down in subsequent offerings and was defrayed by camp registrations, it was still high. Scholarships would have been a simpler and probably more effective recruiting tool.

A time analysis was also revealing (see figure 1). While a major objective of the camp was to introduce a girl to engineering, only 10% of camp time was actually spent *on engineering*. In fact, once sleep is omitted, the next largest chunk of time was give to eating (15%), followed closely by logistics (12%). Overall, we were directly addressing our objectives only 27 percent of the time (tours, teamwork, engineering and computer/math.)

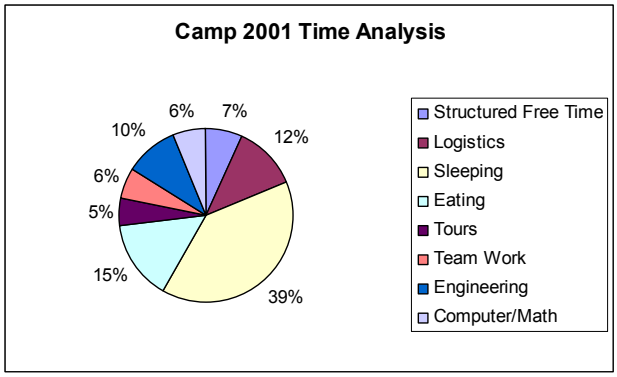

FIGURE. 1
TIME ANALYSIS OF RESIDENTIAL CAMP, 2001.

We also looked at the initial projections of how many students we had the potential to serve with the residential camp design: 50 girls.

A fairly clear picture appeared: the residential camp model was expensive, both in resources and in staff time and failed to target resources towards the camp objectives. Furthermore, with a projected cap of 50 girls, its usefulness as a recruiting tool was structurally limited.

DECISION TO MOVE TO DAY MODULE MODEL

Using the metrics described above, the first question we asked was how to better meet the objectives, increase cost effectiveness, and use our limited staff to best advantage. The idea of converting to a day camp surfaced fairly early, with the biggest disadvantage being our location in a small town equally distant from everywhere. The advantages, however, outweighed this concern.

A day camp would:

- Avoid many of the complications and expenses of a residential camp, not to mention lessening wear and tear on the staff and administrators.

- Allow us to better attract our targeted audience. In the first offering, we were able to identify and attract this group but they were not, in the beginning, happy campers. Considerable effort was required during the first two days to convince them that their parents' decision that they should attend was a good one. With the day module, girls reported no reluctance to experiment and "try out" engineering.

- Offer the camp much more cheaply. MTM '03 came in at a cost of $428/girl overall and $142/girl by daily participant. (Sixty-eight girls participated overall but some of those attended multiple modules. The participation count was 190.)

- Potentially serve and potentially recruit more girls. The day module camp has the potential of serving 350 girls, as compared to 50 girls in the residential model. (The 350 total reflects our ability to add concurrent sessions to a day with increased demand and as our staffing and coordination allow. In theory, the size of the camp is limited only by our ability to provide the staffing to keep each module experience small and effective.)

- Be more flexible. The camp is now designed so that we can begin to offer one-day activities based on the modules. We can also add modules for days that have a high number of registrants.

- Direct our human and financial resources towards achieving the stated objectives. As seen in figure 2 (next page), the pieces of the pie dedicated to the objectives rose dramatically with 76 percent of the time now going to engineering related activities.

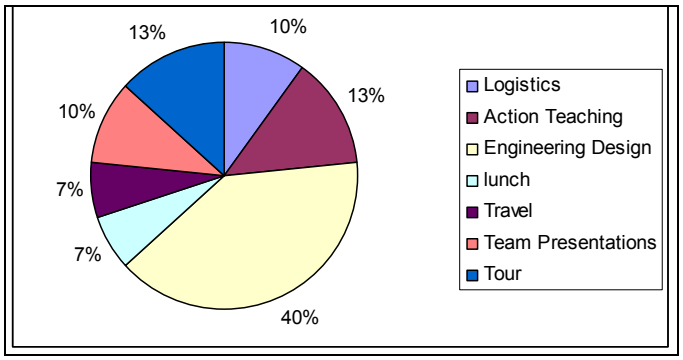

FIGURE. 2
TIME ANALYSIS OF MODULAR DAY CAMP, 2003.

We are also implementing the AWE (Assessing Women in Engineering) pre-and post-instrument, another cost savings in terms of development and data analysis.

CONCLUSION AND LESSONS LEARNED

Lessons learned include:

- Poor data or incomplete data can lead to wrong overall evaluation and negatively impact subsequent planning and decision making
- Good data from multiple sources can lead to more accurate assessment and enhancement of activities
- Effective assessment may be painful but can lead to better programming that achieves projected outcomes.

Based on assessment, Penn State's Women in Engineering Program converted a traditional residential week-long camp for high school girls to a modular day camp. The camp now better serves the stated objectives, has the potential to serve far more girls, and is much cheaper to run, both in terms of human and financial resources. Pre- and Post-assessment instruments are now in use, which will help to determine how effective the new model is. Other measures, such as numbers of girls attracted, the distance they are willing to travel to participate, and the cost and time effectiveness are all positive.

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