

# Applying the Key Findings of the EWEP Needs Assessment Final Report to a Single-Gender Outreach Program

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**Abstract** – In 2005 the Extraordinary Women Engineers Project (EWEP), a coalition of engineering associations, the American Association of Engineering Societies (AAES), the American Society of Civil Engineers (ASCE), and WGBH Educational Foundation published the findings of a research study examining the following question: “Why are academically prepared girls not considering or enrolling in engineering degree programs?” In their report, EWEP summarized seven key findings which qualitatively answer questions related to how girls perceive engineering and how their perception relates to their career choices. These seven findings can be effectively applied to the development and evaluation of an outreach program designed to stimulate interest in the engineering professions among high school girls. In 2007, the Herff College of Engineering at the University of Memphis hosted Girls in Manufacturing (GiM), a week-long summer outreach program which was designed to introduce high school girls to engineering in a way that emphasized their motivating influences. This paper applies the seven key findings of the EWEP Needs Assessment Final Report to evaluate the goals and activities of the GiM program.

*Keywords:* K-12 Outreach, EWEP, Gender, Manufacturing, GiM.

## INTRODUCTION

Despite the fact that girls typically enter college adequately prepared for engineering programs, they are dramatically underrepresented in the engineering profession [1]. In an effort to stimulate interest among high school students, the Herff College of Engineering at the University of Memphis, has hosted various all-female outreach programs for several years. In 2007, a new program was developed, with the goal of emphasizing the rewards of engineering. Girls in Manufacturing (GiM) was the result, and in the spring of 2007 corporate funding was received from United Technologies Corporation (through UTC Carrier Corp.) and Cargill Corporation to run two week-long outreach programs for fifteen girls each.

In order to evaluate the goals and activities of this program an objective standard was sought. In 2005, the Extraordinary Women Engineers Project (EWEP) published findings that relate directly to the problem of getting girls interested in engineering as a profession [2]. This study is summarized in seven “key findings” that make an excellent guide for the development and/or evaluation of any program that has the goal of getting girls interested in engineering as a profession. These findings will be used as a standard to define program outcomes and drive the continuous improvement process as it relates to the refinement of the GiM program.

The seven key findings address not only the prevailing attitudes girls have toward engineering, but also the attitudes and perceptions of educators and the engineering community. The findings are stated as answers to seven questions which address the way engineering is presented and the way it is perceived.

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## THE PROGRAM: GIRLS IN MANUFACTURING (GiM)

Girls in Manufacturing (GiM) is a corporately-funded weeklong summer enrichment program for high school girls. Developed by the Herff College of Engineering at the University of Memphis, the program was funded in its first year by United Technologies Corporation and Cargill Corporation. The primary purpose of the program is to expose girls to the field of engineering, and through hands-on, manufacturing-related activities and mentoring by women engineers, explore how women can succeed in engineering. The ultimate goal of the program is to increase the number of women pursuing technical degrees and careers in manufacturing engineering and related fields.

It is tempting to simply call the program an outright success. Response to the program was overwhelming – over 380 girls from six states and seventy-seven schools applied for the program. The program was originally scheduled for a single week, with funding from United Technologies Corporation, but the demand was so great for the program that funding was sought and received from Cargill, Inc. to run a second week of the program.

All of the girls completed exit surveys, and 100% responded that they would recommend the program to their friends. Also, an overwhelming majority indicated they found manufacturing to be more interesting because of the program. As anecdotal evidence, the girls all seemed to really enjoy their experience. In presentations they made on the final day, many of the girls included unsolicited comments highlighting their experience:

My week here at the program went exceptionally well. I had the opportunity to meet some of the most intelligent young women in the city of Memphis, and some of the greatest professors to teach me about engineering. The field trip to Carrier was also fun too. All in all, this program was one of the best educational programs ever!!!!!! (Jasmine Scott, GiM participant)

The program included hands-on activities in the following areas: 1) 2-D and 3-D Design using AutoCAD and Unigraphics NX3, 2) Rapid Prototyping, 3) Robotics, 4) CNC Machining, 5) Welding, 6) Casting, 7) Engineering Economics, and 8) Lean Manufacturing. A typical daily schedule of events is shown in Figure 1.

<b>TUESDAY</b>					
<b>June 26, 2007</b>					
					
GROUP	ACTIVITY	FACILITATOR	LOCATION	DESCRIPTION	
GROUP A	8:30-8:45	ARRIVAL	ET 201	CONFERENCE ROOM	
	8:45-10:00	AutoCAD	MR. HEWITT	ET 216	FOAM DRAWING
	10:00-10:15	BREAK		ET 201	CONFERENCE ROOM
	10:15-11:30	CNC	MR. HEWITT	ET 122	CUT OUT FOAM
	11:30-12:15	LUNCH W/GUEST SPEAKER	MS. HUDSPETH	ET 302	AUTOZONE
	12:15-1:30	MANUFACTURING ECONOMICS	MR. BANNING	ET 226	BEAD GAME
	1:30-1:45	BREAK		ET 201	CONFERENCE ROOM
	1:45-3:00	ROBOTICS	MR. BANNING	ET 227	PROGRAM ROBOTS
GROUP B	8:30-8:45	ARRIVAL	ET 201	CONFERENCE ROOM	
	8:45-10:00	MANUFACTURING ECONOMICS	MR. BANNING	ET 226	BEAD GAME
	10:00-10:15	BREAK		ET 201	CONFERENCE ROOM
	10:15-11:30	ROBOTICS	MR. BANNING	ET 227	PROGRAM ROBOTS
	11:30-12:15	LUNCH W/GUEST SPEAKER	MS. HUDSPETH	ET 302	AUTOZONE
	12:15-1:30	AutoCAD	MR. HEWITT	ET 216	FOAM DRAWING
	1:30-1:45	BREAK		ET 201	CONFERENCE ROOM
	1:45-3:00	CNC	MR. HEWITT	ET 122	CUT OUT FOAM

**Figure 1 – Typical Daily Schedule**

In addition to the hands-on activities, guest speakers interacted with the girls at lunchtime. Each of the guest speakers were female engineers from companies such as Nike, Autozone, Cummins, Cargill, and UTC Carrier. The speakers talked about their jobs, the challenges they have faced, and “survival skills” for women in engineering. The women gave valuable advice about having a professional attitude, developing contacts, and handling challenging situations. The girls also participated in plant tours. The first week they visited UTC Carrier, a manufacturer of air-conditioning equipment, and the second week the group visited a Cargill corn syrup plant. At each facility the girls met women who worked as engineers, and were able to interact and ask questions.

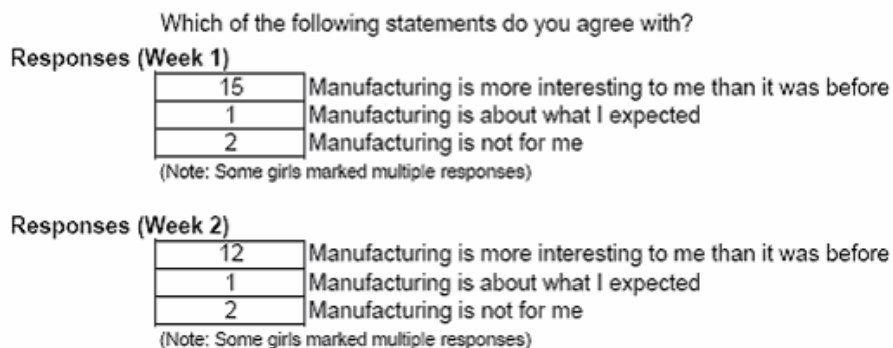
### EVALUATION OF GiM

The evaluation of this project is based on the seven “key findings” of the EWEP *Final Report* [2]. These findings are stated as answers to questions related to the problem of the disproportionate number of women in the engineering fields. A qualitative examination of the program in the light of these findings will provide the GiM team with insight and guidance as we prepare future projects. This evaluation is based on an exit survey (which consisted mainly of free-response type questions), an analysis of the lunchtime question and answer periods and on unsolicited feedback that was provided by the girls in presentations and throughout the program.

#### “What do high school girls think about engineering?”

According to the EWEP report: “High school girls believe engineering is for people who love both math and science. They do not have an understanding of what engineering is. They do not show an interest in the field nor do they think it is ‘for them.’”

GiM Evaluation: The GiM program allowed girls to have an appreciation for what engineers do by involving them directly in engineering activities. Math and science were included in the program, but they were not the main event. The program focused on allowing the girls to be creative. Participants designed their own products and saw them go through the various manufacturing processes. The girls saw and interacted with women engineers in a relaxed atmosphere. On exit surveys, only a small percentage indicated that manufacturing was not for them (Figure 2).



**Figure 2 - Exit Survey Summary Excerpt**

#### “Is there a gender divide in engineering?”

EWEP: “The common understanding among all audiences is that engineering is perceived to be a man’s profession and there is little to no encouragement for girls to consider engineering.”

GiM Evaluation: The following response from two of the program participants bore this fact out. Girls do have the impression that engineering is a man’s profession, but apparently the program did have an impact:

We chose GiM, because it was different from other programs we have attended in the past. Another reason was because we never really thought about manufacturing as a career. Before

attending the program, we thought a career in manufacturing/engineering included BIG PLANTS packed with HUGE MACHINES and MEN. As we came in we learned that women can have jobs in engineering also. After all, this is what the program is about... bringing girls together to teach them about manufacturing and helping them think about maybe going into a career in manufacturing. (Ebony Worles and Jasmine Strickland).

At least two girls responded that a gender-related issue was their favorite thing about the program (Figure, 3). On one exit survey, a participant described her favorite thing about the program as “Finding out that women seem to rule in manufacturing” (Kiera Ott).

#### **“What are career motivators for high school girls?”**

EWEP: “Professional interests for high school girls hinge upon relevance. Relevance incorporates that a job is rewarding, and it suggests that the profession is for someone ‘like me.’ Girls want their job to be enjoyable, have a good working environment, make a difference, offer a good salary, and be flexible.”

GiM Evaluation: Boise State University has had good success by designing their e-Girls program around the factors that influence the career choices of female students [3]. GiM took a similar approach by trying to accentuate the rewards of being an engineering professional. The lunchtime discussions with female engineers best addressed these motivating factors. The women discussed the rewards of a good salary, the ability to visit sometimes exotic locations through business travel, and the satisfaction of succeeding in a challenging profession. All of the engineers obviously enjoyed the work they did and truly accentuated the positive aspects of being an engineer.

#### **“Who are the career influencers for high school girls?”**

EWEP: “Parents, peers, educators, and the media are reported to be key influencers and resources for information gathering.”

GiM Evaluation: GiM tried to involve as many career influencers as possible. As a way of reaching the parents, GiM included an awards program after lunch on the last day. Parents and other family members were invited to attend the program at which the participants presented slideshows of the various activities they had participated in. Attendance at the program was excellent, and parents were able to meet with faculty from the university to discuss the challenges and opportunities of majoring in engineering.

The program also attempted to involve educators by requiring letters of recommendation for teachers or guidance counselors. This helped generate interest in the program as a teacher who was writing a recommendation often told others about the program, and simultaneously about women being involved in engineering.

The media also was involved. The local newspaper ran a full-page article on the program [4]. Through interviews with faculty and participants, the fact that women are commonly enjoying success as engineers was publicized.

#### **“What do the career influencers say about engineering?”**

EWEP: “Career influencers, including educators, are not familiar with how to guide students toward engineering. The positive stories about engineering are not being told to this audience.”

GiM Evaluation: GiM did not directly address this issue. In the future this could be easily accomplished by making a “fact sheet” about women in engineering available to teachers, guidance counselors and other career influencers. We have access to the positive stories, what is necessary it to package those and make them available to the people who help shape girls’ career goals. The application process for the program would have been an excellent way to accomplish this. The program had a website through which these types of materials could be readily distributed. The guidance counselors and teachers had to fill out forms from the website, and could have easily been directed to other material.

**“What messages is the engineering community sending to high school students?”**

EWEP: “Current engineering messages portray engineering as challenging and stress the importance of superior math and science abilities. These messages are not relevant to this audience. Messages do not include the benefits and rewards of being an engineer.”

GiM Evaluation: The GiM organizers intentionally tried to avoid sending the message: “If you like math, you should study engineering.” Instead, the approach was this: “Engineering is fun, and math and science are what makes it happen.” In reality, most high school students’ experience with math and science is probably less exciting than welding or programming a robot. The GiM program made a conscious effort to put the interesting part of the job up front, and then demonstrate why math and science are a necessary part of being an engineer. It is evident from the exit surveys that girls enjoyed technology-related activities. The following question on the survey was a free response question, and the responses have been categorized and tallied:

What would you describe as your favorite thing about this program?

<b>Plant Tours</b>	1
<b>Gender Issues</b>	2
<b>Technology</b>	
Welding	4
Robots	9
Software	12
Machining	6
Casting	8
Lean Mfg.	5
<b>Program Specific</b>	
Size	1
Presentations	1
Creativity	1

**Figure 3 – Exit Survey Summary Excerpt**

**“What messages about engineering will resonate with high school students?”**

EWEP: “High school girls react positively to personal and informational stories that tell more about the engineering lifestyle. They are interested in learning how engineering aligns with their career motivators—enjoyable, good working environment, making a difference, good income, and flexibility. The most effective messages use examples that contain multiple career motivators.”

GiM Evaluation: Perhaps the best part of the program was time the girls spent with the guest speakers. Each of the speakers had overcome obstacles and achieved success, and each of them obviously enjoyed being an engineer. In addition, the girls were able to be creative, and to accomplish their own “engineering feats.”

If the girls’ survey responses are any indication of their overall impression of engineering, it seems that at least some consider it worthwhile.

Responses	Would you recommend this program to your friends?	
	Yes	No
Week 1	15	0
Week 2	15	0

**Figure 4 - Survey Response Excerpt**

## CONCLUSION

Overall the program goals and activities of the GiM program appear to be in accord with findings of the EWEP report. The girls' indicated through surveys and conversations that their interest in engineering had been piqued, and many indicated they were considering engineering as a career choice. One area where the program could be improved would be to provide material to help career influencers guide girls toward careers in engineering. The program is unique in that it addresses this problem in a very specific way, and it would be the perfect tool to distribute information of that nature. Evaluation of the program could also be improved. The use of more quantitatively structured survey instrument would facilitate analysis of the program, and allow for a more objective evaluation of the program. A more quantitative approach would also serve to identify trends and serve document any improvement as the program evolves.

A continuation of this study would be to use the findings of the EWEP to evaluate our current undergraduate and graduate recruiting material and activities.

## REFERENCES

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Tom Banning earned an AAS Degree with a concentration in Computer Engineering Technology from State Technical Institute at Memphis, a BS Degree with a concentration in Industrial Technology from Southern Illinois University, and an MS Degree with a concentration in Computer Engineering Technology from The University of Memphis. His experience includes 8 years of U.S. Navy service, as an instructor in U.S. Navy AV'B' school, 10 years of design and maintenance as an Electrical engineer for FedEx, 13 years in maintenance and engineering Management, 20 years as an adjunct professor for The University of Memphis and Southern Illinois University. He joined the faculty of The University of Memphis full-time in the summer of 2006 and is now an Assistant Professor for the Manufacturing Engineering Technology program.