Increasing Manufacturing Engineering Enrolment Through K-12 Outreach

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1. Introduction

Of the top 20 employers in the Grand Rapids area, 19 are manufacturers. This heavy concentration of manufacturing generates a constant demand for highly educated individuals able to support local industries. Moreover, these industries are trying to increase the technological level of their businesses to offset the loss of low skill level manufacturing work to foreign competition. As the manufacturing environment evolves, the level of education of the workforce will increase. To prepare for this change in the Grand Rapids area a new initiative was begun to increase the number of students pursuing manufacturing education.

The Articulation and Integration of Manufacturing Education (AIME) project [2] is focused on increasing the number of students pursuing manufacturing education by streamlining the educational process. The first goal of the project is to expand the number of high school graduates choosing manufacturing careers. This begins in the middle schools when students are starting to form impressions about their career choices, and will soon be able to select their coursework. Multiple efforts are in place to encourage students to pursue manufacturing careers, including technology and engineering. Students are also given access to existing activities, such as FIRST [11] and STEPS [10] to help keep them engaged. Careful advising helps the students select the appropriate math and science courses to ensure that they can pursue technical studies at the college level.

The second goal involves a launchpad course that will be offered for college credit at Grand Rapids Community College to help students in their transition from high school to college. The course is designed to address topics such as math, science, writing and laboratory skills. The course is designed to serve students in high school that do not offer laboratory courses, or to provide a transition between high school graduation and the start of college.

The third goal focuses on streamlining the college experience. In particular the pathways to various degrees, and careers, are outlined. In many cases this involves transfer between institutions and programs. In those cases articulation agreements are in place to ensure that students can easily

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transfer between institutions. The agreements also include scheduling courses so that students may take courses at multiple institutions during the same semester. Advising materials have been prepared that help students make the appropriate choices to achieve their career goals.

The academic partners in the group are GrandValley State University, Davenport College and Grand Rapids Community College. The Grand Rapids Public Schools and many companies are involved, including Steelcase and Siemens. The group has been received financial support from the Society of Manufacturing Engineers (SME) Education Foundation.

This effort builds upon other SME Education Foundation [7] sponsoered events with new commitments from Grand Valley State University (GVSU) 21,000 students [12], Grand Rapids Community College (GRCC) 20,000 students [6], the Grand Rapids Area Pre-College Engineering Program (GRAPCEP) [3], the Right Place Program - Manufacturers Council [8], the Siemens Corporation, and the Steelcase Corporation.

2. The Target Group

In the first stage of the project the focus is on the Grand Rapids Public School (GRPS) school district [5]. The enrolment in 2001 was 25,250, with 68% of the students being ethnic minorities and 67% from low income families (based upon the free lunch program data). According the Grand Rapids Chamber of Commerce [9] in 2000 there were 200,627 people in the focus district, with an average per capita income of $20,363. By contrast there were 379,248 people with a per capita income of $29,191 in the surrounding county.

GRPS students, most of whom are disadvantaged, score poorly on tests of competency in science. At the 5th grade level, over 70 % of GRPS students score below “proficient” in science on the MEAP tests; the score worsens by 8th grade, with over 80% below “proficient” in science on the MEAP tests. Only 2% of GRPS students in the 4 traditional high schools scored at the best level for science competency on the MEAP tests (2000-01 school year). Needless to say, we rarely see GRPS graduates start or finish the engineering program at GVSU. By focusing on this group we could help increase the opportunities for a large group that could satisfy the demand for manufacturing engineers.

Although these numbers are very disheartening, they do indicate an opportunity. Specifically, if prepared appropriately, we can increase the number of low income and underrepresented groups pursuing degrees in engineering or technology. For this effort the target group is students in the Grand Rapids Public School System, which includes a disproportionately large percentage of low income and underrepresented groups.

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Our target employer base is local manufacturers in a number of industries including sectors such as auto parts and furniture. In the Grand Rapids area approximately 28% of the population are directly employed in manufacturing, the highest percentage in the country, according to the Grand Rapids Chamber of Commerce. These industries are already served by graduates from Grand Valley State University, Grand Rapids Community College and other institutions. For example, over 80% of the Grand Valley State University Engineering graduates accept employment with local manufacturers.

3. The Situation

Currently there are a number of motivational activities available to students in the GRPS and surrounding districts, as shown in Figure 1 and listed in Figure 2. We have broken these activities into Academics, Engagement and Advising. Clearly a majority of the activities attempt to engage students and encourage them to pursue engineering, or a related field. The matrix also indicates a lack of advising and mentoring in the middle and early high school years.

[1] Week long overnight camp at Davenport for grades 7 and 8
[2] Week long day camps at GRCC for grade 8 students and Davenport for grade 9.
[3] Three week overnight camp at Michigan Technological University for women, grades 10-11.
[4] Six week overnight AIM program at Kettering. Week long overnight STEPS camp at GRCC for grades 5 and 6.
[5] GRAPCEP students enrolled in summer math/science classes at GRCC.
[6] FIRST robotics competition for grades 9-12.
[7] Lunch hour competitions for National Engineers Week, grades 9-12.
[8] 9/10 Math Challenge
[9] Original "Math Buster" Competitions, grades 11-12
[10] Rocketry Teams, grades 7-12.
[11] GVSU Advising Guides
[12] Pew Engineering Living Center at GVSU
[13] NSBE Sections in Highschools by GRAPCEP and GVSU
[14] Freshman orientation at GVSU
[15] Advanced/AP Physics at 3 of 4 Grand Rapids high schools
[16] Calculus at 3 of 4 Grand Rapids high schools, 2 are A.P.
[17] Sibley Elementary outreach by GVSU
[18] FIRST robotics support by GVSU Masters students
[19] Science Olympiad at GVSU, grades 7-12
[20] Super Science Saturdays, grades 4-9
[21] Math Counts, grades 7-9
[22] Summer Science Adventure camps at GVSU, grades 4-7
[23] Science is for girls at GVSU, grades 4-7
[24] Co-op education at GVSU
[25] Students societies SME, ASME, IEEE, SAE, NSBE
[26] Company tours by GRAPCEP, grades 7-9
[27] Internships with GRAPCEP, grades 11-12
[28] Teacher development by GRAPCEP and GVSU, grades 7-12
[29] Job shadowing via GRAPCEP, grades 10 & 11

Figure 1 - Current Outreach Activities

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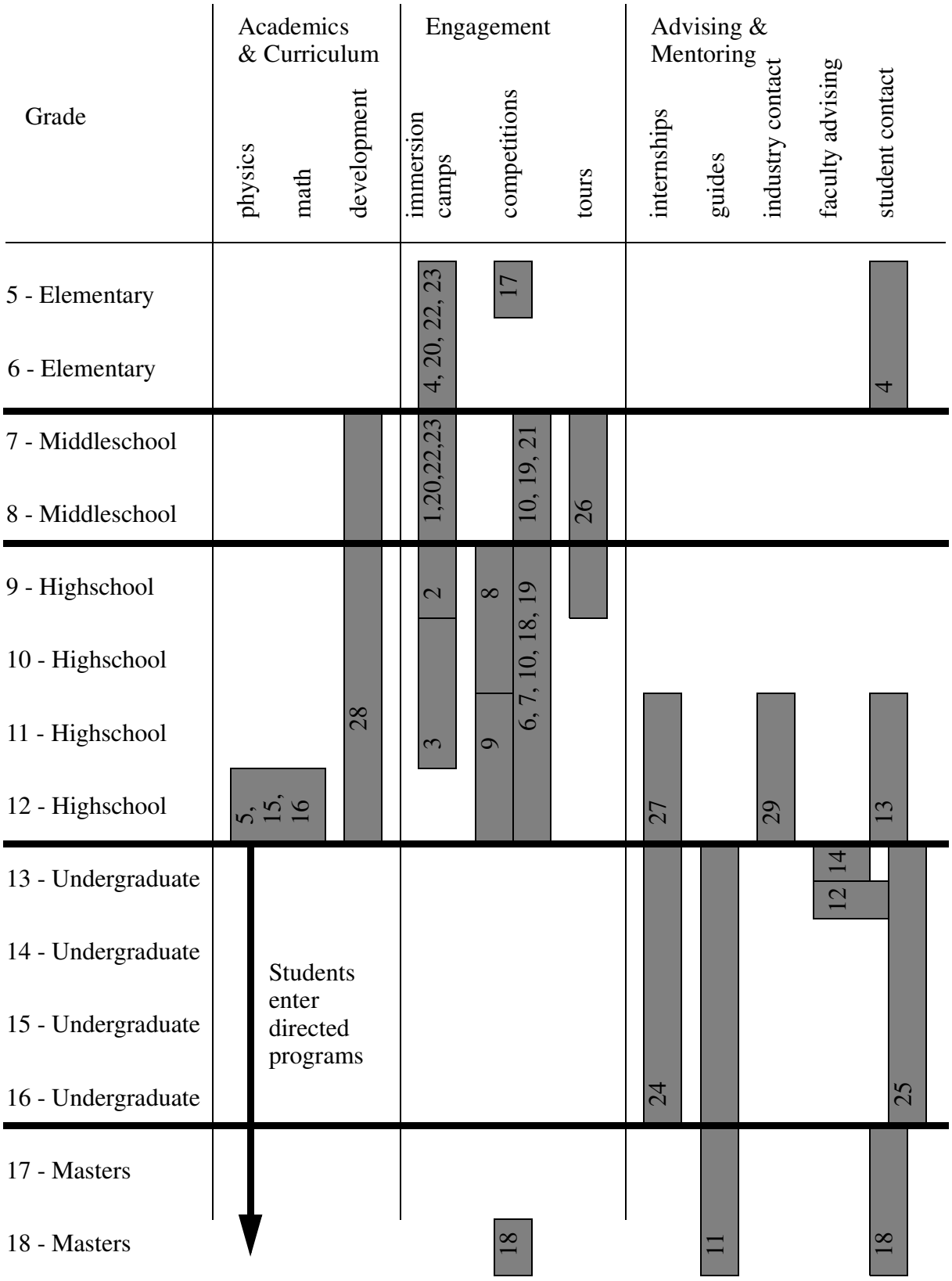

Figure 2 - A Matrix of Current Outreach Activities

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Currently there are a number of educational opportunities, as shown in Figure 3. The most significant issue in this process is that when high school graduates are inadequately prepared for math and/or science their options are limited, or their studies are prolonged. This can be a major setback for students with limited financial resources.

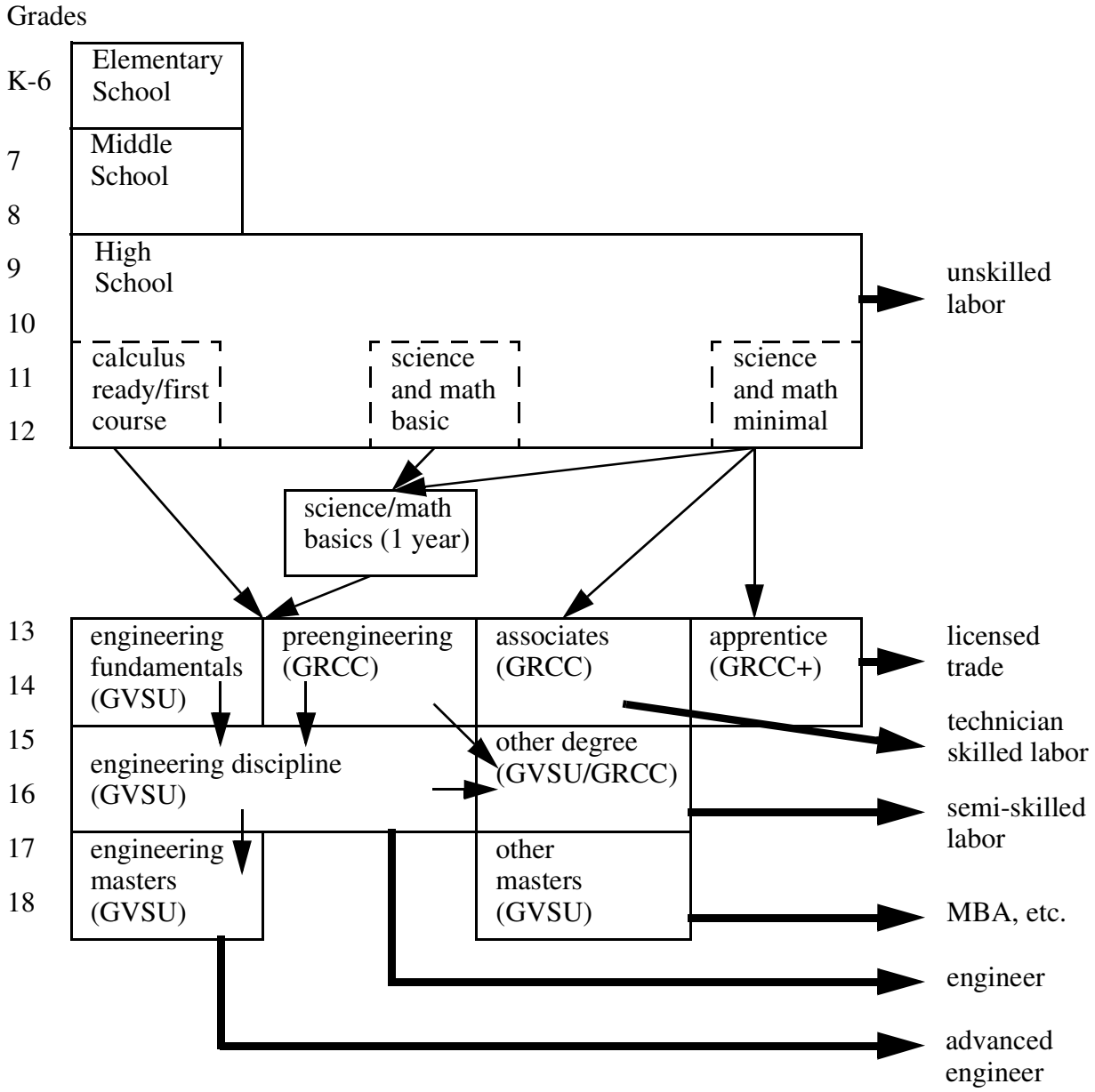

Figure 3 - Educational Pathways

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5. Bridging the Gaps

The project has three main goals, as listed below. All three are complimentary and designed to increase the number of students pursuing manufacturing engineering, technology, or a related area. In other words, to "expand the pipeline".

Goal 1: To develop formal **articulation agreements** between the programs offered by GRAPCEP, GRCC and GVSU to **coordinate** routes of entry into professional careers in manufacturing, including early identification of potential candidates, shared resources to provide career experiences, and opportunities for entrance into appropriate educational programs. Consortium representatives from the Manufacturers Council will contribute the industry perspective and help to expand the pipeline into manufacturing careers.

Goal 2: To develop and implement **new mentoring materials, and strategies**, in order to improve mentoring methods for potential engineering students and to effectively assist them in choosing appropriate routes for entry into careers in manufacturing engineering and technology. These materials and strategies will be distributed broadly at all levels of education and in industry.

Goal 3: To develop and conduct a **college level launch-pad course** to be offered by GRCC to better prepare students academically for entrance into manufacturing engineering and technology programs. This course will be developed by a team representing the Manufacturers Council, GVSU, GRCC, GRAPCEP and the Grand Rapids Public Schools. The content of this course will address defined gaps in the high school curriculum and those seen in the workplace.

6. Conclusions - What Next?

The project was started recently and the partners are starting to work towards the goals. Over the next two years the mechanisms will be put in place to "expand the pipeline" and increase the presence from the GRPS district.

There are a number of issues that the group must overcome. The most significant is the public perception of manufacturing. There is a constant supply of news focusing on the loss of jobs in manufacturing because of the current economic conditions. However, this is a time-proven cycle that will reverse with the next economic upswing. Moreover, engineers and other professionals are more immune to these economic swings. The group will work to convey a clear message to students parents and counselors about the value of manufacturing careers.

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Acknowledgements

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Biography

HUGH JACK earned his bachelors degree in electrical engineering, and masters and Ph.D. degrees in mechanical engineering at the University of Western Ontario. He is currently an associate professor at Grand Valley State University and chairs the graduate and manufacturing programs. His research interests include using open source software for industrial control.

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