ABSTRACT
One of the greatest challenges facing the world economy is its rather limited capacity to convert scientific breakthroughs and technological advances into industrial and commercial success. As a result, there is a growing awareness of the pro-active approach being taken by many academic institutions around the world that have adopted a direct entrepreneurial role in collaboration with the business sector. This paper discusses a novel approach taken by the largest engineering college in Israel - Shamoon College of Engineering (SCE) - to enhance its students' entrepreneurial intentions and activities. We describe the Engineer-Entrepreneur Program in detail and discuss the contribution of various program modules (the college, students, community, industry and the next generation involvement) to the total entrepreneurial approach of engineering in institutions of higher education. The program has been extremely well received both at the college and beyond, with the government granting it massive support. Yet, despite its uniqueness, it is applicable in any academic engineering institute, especially in areas with features similar to Israel's.

INTRODUCTION
In the nineteenth century, Cardinal John Newman defined the ideal university as being dedicated to the pursuit of knowledge for its own sake. In his view, universities should be the "high protecting power of all knowledge and science, of fact and principle, of inquiry and discovery, of experiment and speculation."(Klofsten & Jones-Evans, 2000) However, as we look into the twenty-first century, the perception of higher education has changed. The universities are no longer seen only as institutions of higher learning; today's universities are important engines of technological development and economic growth. This includes the ability to apply new technologies, access new markets, develop new products, incorporate
optimal management practices in enterprises, and inculcate a high level of skills suited to the entire labor force.

Fostering entrepreneurship is now a matter of the highest priority in public policy. Given the growing concern over technological advances and aggressive global competition, entrepreneurial activities are seen as the driving force of innovation.

Shamoon College of Engineering (SCE), the largest technology college in Israel, is located in the south of the country, an area known as the periphery. Unlike other institutions of higher education in Israel, SCE believes that the standard admission scores do not accurately reflect the true potential of prospective students. SCE regards the scores as socially, culturally and demographically biased, unfairly limiting accessibility to institutions of higher learning. Therefore it opens its gates to all sectors of the population, providing support and equal opportunity.

We describe a unique, new, start-up-oriented program - the Engineer-Entrepreneur Program - that is being successfully applied at the Shamoon College of Engineering in Israel. The program integrates all the key elements in education and entrepreneurship, as well as other elements that we believe lie at the heart of the program's success. Five critical elements are integrated: community, the next generation, industry, the college, and students – in order to create a comprehensive educational system for academic entrepreneurship. The Engineer-Entrepreneur Program is the only such program that prepares engineers for venture-oriented work in the country's leading organizations and promotes independent start-ups. As stated, the Engineer-Entrepreneur Program can be readily adopted in any academic institution in Israel and abroad.

IMPLEMENTATION
The biannual Engineer-Entrepreneur Program includes two academic courses for undergraduates in their third (next to last) year; fourth year students have access to a personal business coach for their final project; and students on the program's individual track can develop independent ventures. The program also affords students the opportunity to gain experience in imparting knowledge to high school pupils and applying their abilities in developing start-ups with them. This project encourages our students to develop ventures aimed at improving the environment and community, operate in close contact with the heads of Israeli industry, and take part in workshops that strengthen the key skills they will need in the global market. This section describes the relevance of each stage in the program.
Recruitment: Participants in the Engineer-Entrepreneur Program are recruited in a number of ways. Freshmen students are informed about the program through summer mailings and visits by the Entrepreneurship and Innovation Center’s faculty to "Introduction to Engineering" classes in each department. Graduates of the program also bring in new members by word of mouth. Participants are selected on the basis of a written application submitted in the summer prior to the opening of the school year. All of the students at SCE have an equal chance of acceptance to the program as long as their academic standing is up to par and they have completed two-thirds of their degree.

Team organization: Participants are divided into permanent teams. Team size may vary, but groups of five to twelve seem to work best. The teams are organized around project themes that the faculty decides; but the students are allowed to express preference for a particular project. In the introductory meeting, students are given a brief description of the companies and themes and can choose whichever team they want to be in. During the second meeting, students begin organizing their team into a business around corporate theme and deciding on the product.

Faculty: Two faculty members and two senior executives from local industry supervised each team for the entire year. The seriousness of the senior executive's commitment is viewed as affirmation of industry's interest in the program.

Industry's involvement: Industry's involvement has been a major factor in the program's success. This subject will be discussed in detail below.

Team operation: Class time was often used by the teams to present progress reports of their business planning. In this way, the teams gained from the experience of their colleagues.

Elements of the program: The Engineer-Entrepreneur Program is divided into two parts on a semestrial basis. The first part is based on the course "Introduction to Management in a High Tech Environment" which introduces students to the complex world of business administration. Students learn how a business organization functions. In the second semester students take the course "Business Entrepreneurship" where, in their original teams, they continue to work at putting a technical idea into motion. The course introduces them to the fundamentals of original thinking, intellectual property, business planning, fund raising, developing new products, risk management, and other topics.

Grading: The ‘Engineer-Entrepreneur’ program employs a success-oriented approach to evaluation and grading. Attendance at seminars, student presentations, class meetings and weekly team meetings are compulsory. There are no tests – which is extremely rare in engineering courses. Grading is based on an assessment of how well each participant fulfilled
the role he or she accepted at the start of the semester. The assessment is based on three parameters.

The first part of the grade is a collective evaluation of the group's final presentation and level of teamwork. The second part of the grade is also given collectively and is based on the rating that the general manager of each team gives to the other teams. The third part of the grade is individual and is given anonymously to each team member by members of the same team. At the end of the program all the team members complete a questionnaire that asks them to evaluate their fellow team members according to capability, originality, accessibility, willingness to contribute to the goal, and other parameters.

The personal track: The Engineer-Entrepreneur Program is a bona fide academic program. Each course is worth three academic credits, that is, six credits (out of 160) toward a bachelor degree in engineering in Israel. Students work in teams and develop an idea, service or product for commercial implementation. The program also has a personal track in which SCE students and graduates can receive concrete assistance in a variety of fields for their own start-ups. Students with an original idea come to the program instructors who review the idea and, if it seems feasible, offer assistance for its development.

The Engineer-Entrepreneur Program is a multi-disciplinary, integrated program that trains engineers for professional employment in a dynamic, global workplace and promotes the independent ventures of students and graduates.

PROGRAM ASSESSMENT

Kingon and colleagues (Kingon, Stephen I, Thomas, & Debo, 2002) found “relatively little published information regarding the efficacy of entrepreneurial programs or courses, especially in the newer programs within engineering.” Indeed, while much has been written recently about engineering entrepreneurship programs, comparatively few investigations provide hard evidence of their success.

Students in the Engineer-Entrepreneur Program also fill out a questionnaire in the beginning and at the end of the program from which we try to assess their entrepreneurial potential by applying the Ajzen Planned Behavior Theory (Ajzen, 1991). The results from the first year (fifty-five students) indicated that on the average their entrepreneurial potential and motivation increased significantly (34% of the male students, 55% of the females).
CONCLUSIONS

The Engineer-Entrepreneur Program at SCE reflects a marked change from the regular educational paradigm. We believe that the program can be implemented in any academic engineering institute. It readily lends itself to multi-disciplinary teams and encourages students to develop and market their original ideas.

The Engineer-Entrepreneur Program has succeeded in conveying the managerial and entrepreneurial side of the engineering profession, areas that are not systematically taught in engineering colleges. The program enhances the students' proficiency in leadership, teamwork, and original thinking, and provides them with a wide range of skills indispensable for survival in the rapidly-changing, global workplace of the twenty-first century. Students gain first-hand experience in establishing and managing a start-up - from the birth of an idea, through its growth, to its realization and ongoing development.

The program is especially suited for fringe populations and regions with socioeconomic and cultural gaps because the development of a student's abilities, skills, and business acumen tends to narrow and remove these gaps. A new horizon appears before the graduates as they discover that social mobility is open to them. Engineering, as taught in most institutions, does not prepare the student for organizational life and contemporary organizational development. This lacuna is an often insurmountable obstacle especially in the weaker sectors of society that lack the knowledge and self-confidence to set up a business network and obtain initial funding for a start-up.

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