# Management Analysis of the Technion's Proactive Approach and Contribution to High School STEM Education in Israel

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This paper describes how the Technion's proactive approach towards STEM (Science, Technology, Engineering and Mathematics) education in Israel, though it originated in a very honest desire to contribute to Israeli high school STEM education, has, in fact, several economical merits and can be highlighted by well-known management principles.

Specifically, I will focus on the *Views* program, which the Technion launched three years ago. The name of the *Views* program in Hebrew is Mabatim (Views in English), which stands for מהנדסים/מדענים בחינוך טכנולוגי ומדעי – Engineers/scientists in science and technology education. I will first describe the program and then I will analyze it from a business perspective.

The background story of *Views* is the shortage in high school STEM teachers that many Western countries, including Israel, are currently facing. In order to cope with this shortage, the Technion launched the *Views* program three years ago, in 2011. The objective of *Views* is to help alleviate this shortage in Israel by providing Technion graduates with an additional profession – high school STEM teachers – that they will be able to use if and when they choose to switch to education.

*Views* invites Technion graduates back to the Technion to study toward an additional bachelor's degree in its Department of Education in Science and Technology. The degree they earn includes a high school teaching certificate for STEM subjects in one of 8 tracks: math, physics, biology, chemistry, computer science, environmental sciences, electrical engineering, and mechanical engineering.

Technion graduates enrolled in the *Views* program receive full study scholarships from the Technion for two years. Since the number of credits required to complete this degree is similar to that required for an MBA, the students study one day or two half-days a week for two years, like in MBA programs, and can continue working as scientists and engineers in the industry in parallel to their studies.

Although the Technion graduates who are enrolled in the *Views* program receive full study scholarships from the Technion for two years, they are not required to commit to teaching in the education system. They are not asked to commit to teaching in the education system since the knowledge they gain in the *Views* program – mainly, learning and teaching processes – is also useful in the high tech industry for coping with new knowledge and technological developments. Thus, even if they decide not to switch to education, they will still contribute to Israel's prosperity, but in a different way.

At the moment, 207 Technion graduates are enrolled in the *Views* program: 45 Technion graduates who started the program in its first year, 2012, have completed the two-year program; in addition, we have 70 Technion graduates who started the program in its second year, 2013, and who are now approaching the end of their second year of studies; finally, 92 started their studies in the 2013-2014 academic year.

In what follows, the *Views* program will be analyzed from a business perspective. I will show how it relates to, and is supported by, ten business-oriented ideas and principles (Table 1).

**Table 1: Ten management principles of *Views* initiative**

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|---|
| 1. Knowledge Economy Index (KEI) |
| 2. Proactivity |
| 3. Risk management |
| 4. Diversity |
| 5. Change management |
| 6. Mobility |
| 7. All win |
| 8. The job market |
| 9. The Gini index |
| 10. Connecting academia–education–industry–IDF |

## 1. Knowledge Economy[1]

The World Bank's Knowledge Economy Index (KEI) represents a country's overall level of development towards the Knowledge Economy. It measures a country's ability to generate, adopt and diffuse knowledge and indicates whether the environment encourages knowledge to be used effectively for economic development.

In 2012 (http://info.worldbank.org/etools/kam2/KAM_page5.asp), Israel ranked in twenty fifth place on the KEI. In 2000, Israel ranked 18.

The KEI is calculated based on a country's scores on 4 pillars that relate to the knowledge economy. The first pillar is *economic and institutional regime*; Israel's rank in 2012 was 26. The second pillar is *educated and skilled population*; in 2012, Israel was ranked in 41 place. The third pillar is an *innovation system*; in 2012, Israel's rank on this pillar was 9. The forth pillar is *Information and communication technology*; Israel's rank on ICT is 20.

[1] http://en.wikipedia.org/wiki/Knowledge_Economic_Index

What is important for us to note here is that the pillar that dramatically decreased Israel's position is the *educated and skilled population* pillar. This pillar is about people and it measures a country's ability to create, share, and use knowledge well; as mentioned, in 2012, Israel ranked on this pillar in the 41 place. This means that Israel, as a nation, does not know how to create, share, or use knowledge well.

Clearly, since the *Views* program is about learning, which is exactly the creation, sharing and using of knowledge, it may improve Israel's score on this pillar. Specifically, *Views* encourages the best STEM professionals in Israel – Technion alumni – to be teachers; these teachers will provide the future citizens of Israel with a very high level STEM education and skills.

Since the four pillars of the KEI are related to one another, it is suggested that raising Israel's ranking on the *educated and skilled population* pillar will influence the Israel's ranking on other three pillars.

## 2. Proactivity

Being Proactive *is one of The Seven Habits of Highly Effective People* - a book written by Stephen R. Covey and first published in 1989.

Being proactive means planning ahead and anticipating problems. Being reactive (which is the opposite of proactive) means waiting for problems to appear before addressing them.

In December 2010, the Technion president, Professor Perets Lavie was interviewed by *Haarets* – a daily Israeli newsletter. The title of the interview was *Science Education in Israel is Collapsing*. The Technion could, like many other universities, be reactive and continue complaining about this situation. It decided, however, to take a *proactive* approach and during the year after the interview, the *Views* program was launched.

In other words, the Technion did not wait for the crisis in STEM education to happen and then start seeking a solution; the Technion also did not wait for government funds to start the program. Rather, the Technion was proactive and launched the *Views* program from its own resources, as one of its efforts to stop that collapse.

**3. Risk Management**

Typical questions we ask when talking about risk management are: What constitutes a risk in the specific case under discussion? How is a risk measured? How are the cost of a risk and probability of happening calculated? How can we reduce the risk probability to materialize and what is the cost of this reduction?

With respect to STEM education, we should ask whether or not the fact that Israel's STEM education is not of a high level constitutes a risk. The answer is definitely positive: A consensus exists in Israel with respect to the importance of STEM education for Israel's future technological leadership and economic strength and that the absence of adequate STEM education in Israel does constitute a risk.

Therefore, other questions still remain: Can we measure what will happen if Israel's STEM education is not of an adequate level? How much will it cost Israel if it does not have enough STEM teachers? What resources are needed to reduce the probability of this risk to materialize?

In the case of STEM education, it seems that both measuring the risk's outcomes and calculating the cost of reducing its probability to happen are a challenge. This is so partially because data on the current number of STEM teachers is not always available and usually, data about the number of teachers is available only after 2-3 years. Furthermore, it is difficult to predict precisely how many teachers we will need, since the future increase in the number of students in STEM subjects is unknown and depends on several factors. Nevertheless, it is evident that the number of high school students in Israel, who choose to study STEM topics on the highest level, has been decreased in the past several years;

this decline is partially explained by the shortage in high school STEM teachers with the appropriate STEM background.

Thus, the Technion, by launching the *Views* program, made the decision to manifest a proactive approach towards this risk management by creating a pool of excelling STEM teachers to alleviate these shortages. Such a pool of excellent STEM teachers can be created by the Technion since its graduates have outstanding backgrounds in STEM subjects.

**4. Diversity**

It is well known that diversity is a social phenomenon that promotes organizations that foster it. Therefore, and not surprisingly, many organizations have a clear mission with respect to diversity.

For example, *Intel* states:

> **"Our People: Intel's Greatest Asset**
>
> Our employees are as diverse as our customers, vendors, and colleagues in the global market. This worldwide perspective helps us anticipate and provide for the growing needs of a changing marketplace.
>
> **Our Focus**
>
> At Intel, we know diversity comes with its own inherent benefits. We continue to invest in our leadership position to maintain and advance diversity."

Another example is *Microsoft*:

> **"A Vision and Strategy for the Future**
> Global Diversity and Inclusion are integral to the vision, strategy, and business success of Microsoft. Microsoft officially formed the Office of Diversity & Inclusion in recognition of the fact that leadership in the global marketplace requires a corporate culture and an inclusive business

environment where the best and brightest diverse minds—employees with varied perspectives, skills, and experiences—work together to meet consumer demands."

Diversity is reflected in *Views* in terms of ages, backgrounds, work experiences, the faculties they graduated from, and more. You can see in one class students who are 20 years old (a regular undergraduate students) and students who are 30 - 40 (60% of *Views* students), 40 – 50 (25% of *Views* students) and 50 + years old (15% of *Views* students).

Gender diversity is also expressed in the cohort of *Views* students: out of a total of 207 students, 109 (53%) are men and 98 (47%) are women. This data indicates that the *Views* program attracts populations that traditionally do not choose education as their first choice mainly due to social norms, and who at the same time are attracted by its educational vision.

So, if and when the *Views* graduates join the education system, this diversity in the cohort of high school STEM teachers may also change the image and quality of the profession of STEM education and benefit STEM education in Israel high schools as it benefits organizations such as *Intel* and *Microsoft*.

**5. Change Management**

It is clear that schools are going to undergo various changes in the near future, due to technology and other cultural factors. The questions are: In what ways will schools change and how will that change affect STEM education? the answers are: We don't know. Nevertheless, when schools do undergo change, *Views* graduates will be well equipped to lead the process, since:

(a) they can introduce the schools to a different organizational culture, one they have experienced in the hi-tech industry, including that of start-ups and international markets. This culture is innovation-oriented and is inherently different than the traditional organizational culture of schools.

(b) they already have experienced coping and working in an industry that functions in a very dynamic world and is constantly changing; therefore, it is reasonable to assume that they will not obstruct change in the schools as happens, unfortunately, in many educational reforms.

And (c) many of them have already managed and led change processes in their organizations and will be able to lead and implement this experience in the education system as well.

**6. Mobility**

Technion graduates who participate in *Views* gain an additional profession – teaching – that may enhance their mobility either in the industry or in the education system.

For some of these Technion graduates, this potential mobility will be the fulfillment of a dream to contribute to the educational system that they could not have accomplished otherwise; For other Technion graduates, this mobility may include potential jobs in the industry in which they are currently working, in training and professional development departments as well as leadership positions that require teaching skills. Others may teach part-time or join informal educational programs and continue working in their various companies.

In addition, earning a degree in STEM education can solve the problem faced by many engineers either during economic crisis or when they approach the age of 40-50, when some lose their jobs and have difficulties finding new jobs.

**7. All Win**

*Views* reflects a win-win situation on many levels. We just saw that the Technion graduates win by increasing their mobility.

In addition to them, the following parties also win from the establishing of the *Views* program:

First, the **hi-tech and technology industry**, which is the work arena of most of the *Views* participant, gains (at no cost) people with pedagogical knowledge which is essential in this industry. This is why these companies allow their Technion graduate employees to miss work one day a week in order to study in *Views*.

Second, the **Technion** wins since the returning graduates have very extensive and solid scientific and engineering knowledge and so, if and when they switch to education, they will be able to better educate future generations of Technion students. This, of course, is not to say that other teachers do not have strong and updated knowledge.

Third, the Technion's **Department of Education in Science and Technology** benefits in particular since the Technion graduates, who are enrolled in the *Views* program, study together with the department's regular undergraduate students and bring to the classroom relevant, new and up-to-date knowledge. The instructors teaching in the *Views* program have already recognized these added values and have witnessed the change in the class atmosphere since the Technion graduates joined their courses. At the same time, the regular undergraduates are inspired by the fact that successful scientists and engineers are considering joining the education system and working in the profession that they chose to study.

Fourth, the **high school educational system** benefits from the *Views* program since its graduates bring into the education system not only updated content knowledge but also organizational experience, which includes new management methods and teamwork habits that they implemented previously in the high-tech industry.

Fifth, **curriculum development** of STEM subjects in the school may also improve since these scientists and engineers bring into the system updated knowledge and relevant examples that they have worked on in the industry, making the curriculum more vivid, appealing and interesting.

Sixth, the **government** wins, since *Views* may (at least partially) eliminate the need to invest special effort (and funds) in order to attract qualified people to switch to education or to encourage young people to enter into the field of education by offering them financial benefits. Thus, it will be possible to stop advocating an approach that sometimes leads to bad feelings in teacher lounges, when teachers discover that different teachers receive different pay, which is not necessarily based on their educational success and commitment to the system. The government will be able to invest these funds in promoting teacher status, among other ways, by salary incentives.

Seventh and lastly, the **state of Israel** wins since this new pool of scientists and engineers with educational backgrounds is an investment in the state's human capital.

**8. The Job Market**

Students in *Views* join the Department's regular undergraduate students in their studies, and it now has about 400 undergraduate students – half of whom are *Views* students. The *Views* program, in fact, doubled the number of students in the Department.

One quarter of students in the *Views* program, as well as one quarter of all students in the department undergraduate program, are enrolled in the technological tracks – electrical engineering and mechanical engineering education. In fact, these two technological education tracks have grown almost threefold from 31 students (before *Views* was launched) to about 100. At the same time, the physics, chemistry and biology education tracks have doubled to about 40-50 in each one; and the math education, computer science education and environmental sciences education tracks remain more or less at the same size with some increases (with 60, 50 and 30 students, respectively).

This distribution is important due to the increasing attention that technology education has been receiving lately in Israel, after it had almost vanished during the past twenty years, while the Israeli industry and IDF were "starving" for

thousands of practical engineers with technological background (not necessarily engineers). Consequently, in the last several years, an effort has been made in Israel to revive the technological education, and the frequently asked question was: who will teach the pupils who wish to study these subjects in school?

The technological education tracks of the Department of Education in Science and Technology, which have tripled in size since the *Views* program was launched, may significantly contribute to the effort to revive technological education in Israel and partially answer the above question.

**9. Gini Index**

The Gini index measures family-income inequality within a country and gives each of the world's countries a score that ranges between zero (perfect equality) and 1 (total inequality). A correlation was found between the Gini index and the level of vocational education, which is not really surprising since vocational education is a bridge between young people's competencies and employers' needs. Providing vocational education in the framework of secondary schooling is therefore especially important.

According to the OECD's most recent report, Israel ranks among the five countries with the highest level of inequity, together with the United States, Turkey, Mexico and Chile (Israel scored 0.37 on the Gini index, while the average of the OECD countries was 0.3).

Although the technological education tracks offered by the Department of Education in Science and Technology are not identical to vocational education, there are some similarities between the two, and it is reasonable to assume that some *Views* graduates will end up teaching in the vocational education system (several have already joint it). So, it is proposed that due to the relatively large number of *Views* students who study in the technological education tracks, the Technion will also contribute to reducing the family-income inequity in Israel.

## 10. Connecting Academia–Education–Industry–IDF in Israel

The Technion's success is explained, among other things, by its relationships with industry (see *Technion Nation*). These relationships manifest also in the case of *Views*, where academia, the education system, industry, and the IDF, all aim to improve STEM education in Israel.

First, as mentioned earlier, since the *Views* students gain skills that are very useful in the industry as well, the companies that employ the Technion graduates let them study at the program one day or two half days a week, without deducting from their salaries. Clearly, the fact that they gain additional skills required for the industry tighten the relation between the Technion and the industry.

Second, the flourishing of the technological education tracks, which was just mentioned, will foster human resources with technological backgrounds, which are in demand both by the IDF and by the industry.

Third, when the *Views* students become teachers, they will introduce innovations from the industry into the school system.

Finally, since the students in the *Views* program tend to be older and unlike regular students in many cases have children in the Israeli educational system, they often volunteer, either on a regular basis or on special occasions, at their children's schools. When they do so, they too enhance the connection between the industry and the schools.

As we have seen, *Views* clearly strengthens the connections between industry, academia, the education system and the IDF.

### Vision

The Technion's vision is that in about 5-10 years, 1000 Technion alumni will have teaching certificates to teach STEM in Israeli high schools. Since there are

now in Israel about twelve thousand high school STEM teachers, this implies that about 10% of STEM teachers in Israel will be Technion graduates.

If each of these *Views* graduates teaches only one class of 25 pupils a year, each year 25,000 pupils in Israel will be taught by a STEM teacher who is a Technion graduate. These pupils will be inspired by the Technion graduates, and the Technion's future students will be students who were educated in high school by its own graduates. Thus, the cycle will close and a new one will begin when these future students will also enroll in the *Views* program, teach the next generation of the Technion students and so on and so forth. We will have created a cycle that continues to cultivate future Technion students, and as a side effect, fosters Israel's economy as described in *Technion Nation* and supports the fulfillment of the Technion vision to be "a science and technology research university, among the world's top ten, dedicated to the creation of knowledge and the development of human capital and leadership, for the advancement of the State of Israel and all humanity."