Expanding the number of practical engineers and technicians in the market

Data and action recommendations

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Expanding the number of practical engineers and technicians in the market – data and action recommendations

Executive summary

In spite of the relatively high salary offered new practical engineers and the great value they produce for the market, there are claims of an existing shortage of practical engineers in the industry. Data indicates that students enrolled in practical engineering programs come from disadvantaged socio-economic and academic backgrounds. For students from these populations, graduating is a critical stepping stone to embarking on a promising career path, and achieving upward mobility.

Unfortunately, the high degree of difficulty in engineering programs in combination with these students' academic shortfalls, among other factors, lead to high dropout rates with no certification. Currently, there are several barriers that present a challenge for the system to meet the shortage of high level practical engineers in the industry. These barriers are embedded in the form of lacking funds, as well as inadequate budgeting in technological institutes. The existing budgeting formula is designed to incentivize the institutes to increase the number of students who complete their studies and receive a diploma, but in reality, there is a budget cap restriction mechanism [restricting a college from increasing its revenues beyond its actual revenues of the previous year], resulting in a perverse incentive. In other words, institutes do not enjoy surplus revenues if certification rates improve, thus, in order to improve their financial situation, institutes tend to focus on increasing the number of students, not necessarily graduates, thereby increasing tuition revenues. An economic analysis we conducted showed that the added value of a practical engineer to the market is 1.5-1.9 ILS (discounted over their lifetime), while a third of this value is directly added to the individual. Thus, technological education represents a source of high economic potential. As such, it is recommended that appropriate reforms in technological education be implemented, based on the understanding of the barriers that exist today. Consequently, these reforms must include the following critical components: change the budgeting formula (including the elimination of the budget cap for the college), set graduation rates targets, increase competition between the institutes, determine maximum annual quotas for new students, and establish an appropriate tariff for every graduating student. Furthermore, there should be greater emphasis placed on earning technician certificates after the first year of studies, enhancement of internships that provide industry experience, re-branding and investing in innovative programs in order to reduce dropouts, with methods such as the pay-for-success model.

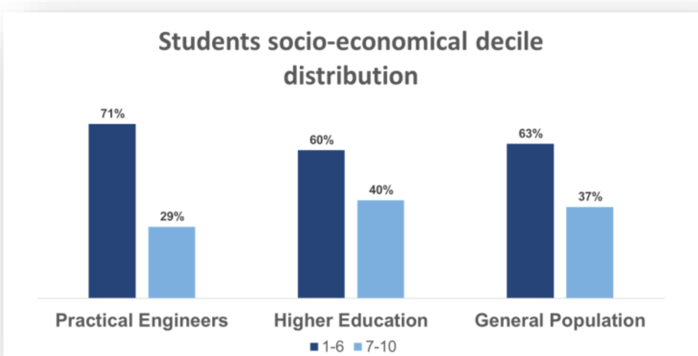
The establishment of effective reform has the potential to bring about significant, positive social change for vulnerable populations, increase productivity in industry, and realize the potential economic value embedded in the technological education system.

Background

In Israel, post-secondary technological and vocational education consists of two primary paths. Students may attend technological institutes to become qualified technicians or practical engineering, or may attend vocational school, and receive training in a variety of professions. The technological education system suffers from deficient budgeting, as the total budget for an academic year is 3 times higher than for practical engineering studies. Furthermore, technological education curriculums are under strict external supervision to the extent that these institutes have almost no professional independence. This is a consequence of required qualification tests, dictated by the National Institute for Training, Technology and Science (MAHAT) – the budgeting regulator of the technological institutes.

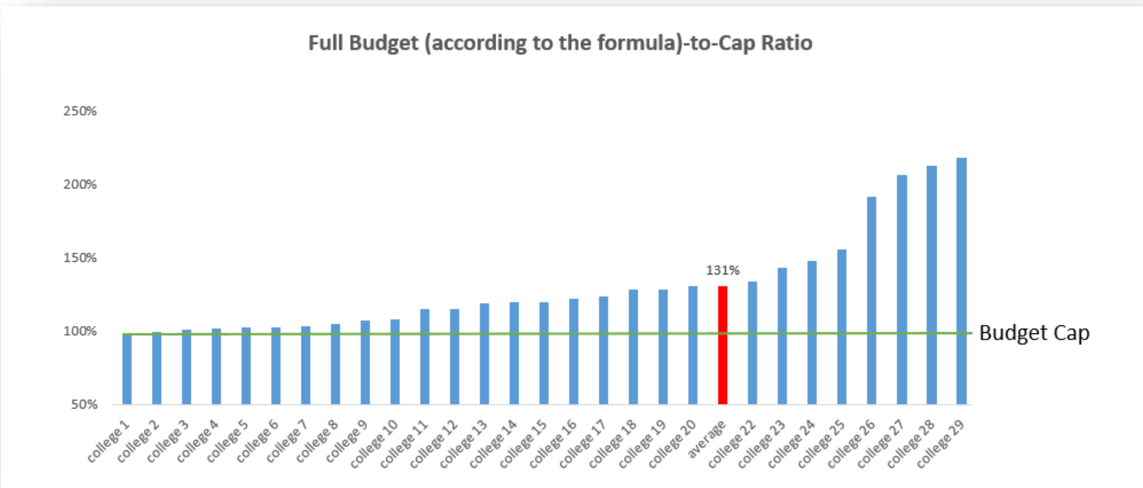
The problem

Despite a high salary offered to practical engineers and a high market demand for their skills, the number of students and qualified practical engineers is limited. As a result, there is a shortage of relevant graduates for the industry. The students who attend practical engineering studies in technological institutes come from socio-economically disadvantaged populations, compared to students attending universities or other institutions of higher education.



The relatively poor socio-economic and educational background of the students, combined with minimum requirements of only 7" units matriculation, cause high dropout rates from practical engineering studies and result in the **lack of practical engineers in the labor market with a diploma.**

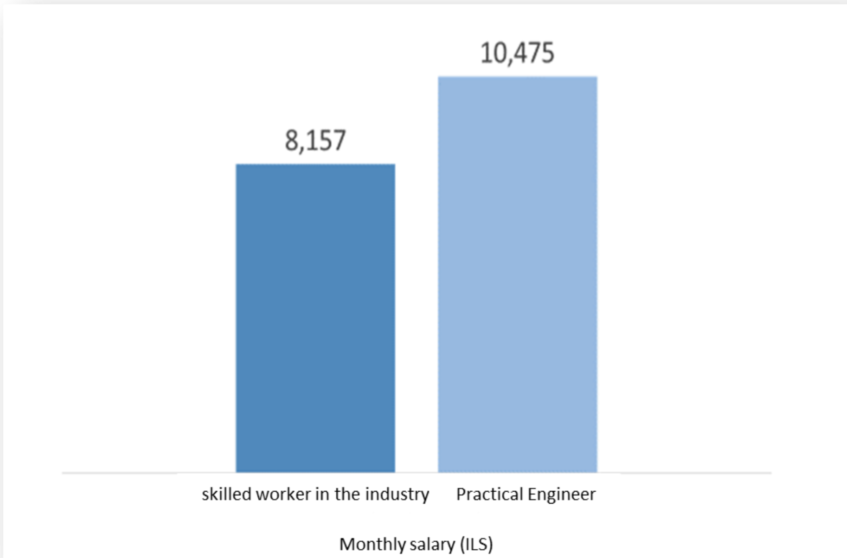
Due to the existing budget cap [de facto: permanent upper limit for the institute's revenues set by the regulator], these institutes are not fully budgeted according to the budgeting formula, which causes some of them to operate in a deficit. The institutes close the deficit in a variety of ways, resulting in the distortion of incentives. In terms of actual budget data, it appears that all the institutes are above the budget cap:



The opportunity

In spite of the relatively poor socio-economic and academic background of this demographic, practical engineering skills constitute for graduates a powerful tool for achieving social mobility and contribute to the Israeli economy. Actions that will reduce dropout rates and increase graduation rates have great social and economic potential for vulnerable populations that lack the academic resources to develop human capital. Furthermore, practical engineering studies appeal to additional audiences that tend to choose academic professions with low demand in the labor market. The increase in human capital resulting from completion of engineering studies at a technological institute will contribute to improve the productivity in the market, reduce salary gaps and mitigate poverty.

<u>**Average salary after two years in the labor market**</u>



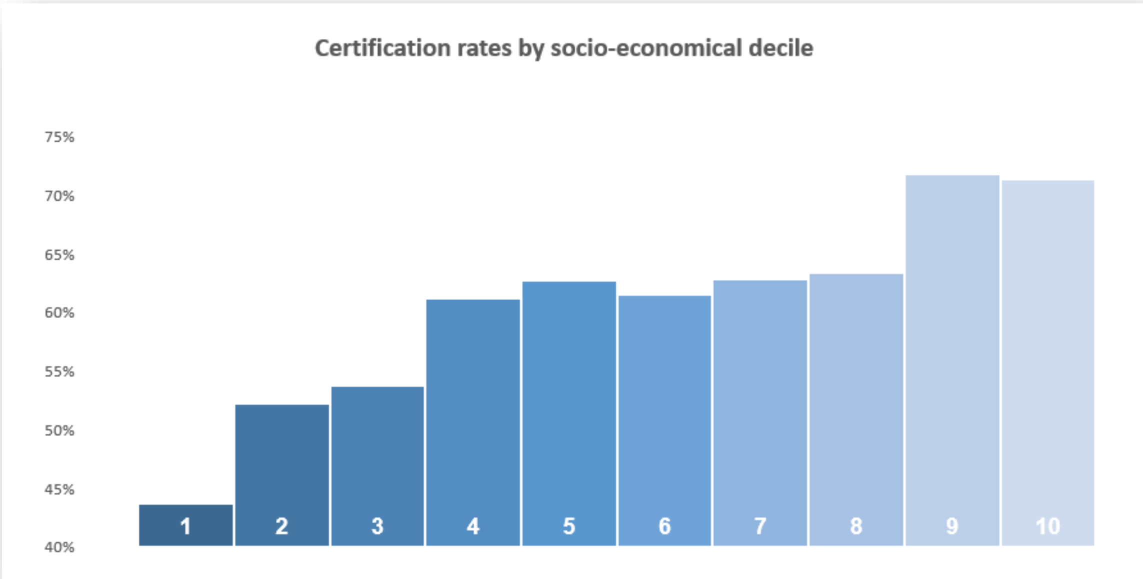
Feasibility study for launching a social impact bond [SIB] to tackle the problem

In light of the information provided above, a collaboration was formed between the **Beyahad Foundation** and **Social Finance Israel** to conduct a feasibility study to launch a SIB [pay-for-success model] to tackle this problem, and work with engineering programs to reduce dropouts. The study included data regarding dropouts from the institutes, economic estimates, graduate salaries and more. Furthermore, the work reviewed the existing budgeting system, the institutes' financial situation, factors predicting dropouts with no certification, motivations of the different interested parties in the field, and economic analysis of the various factors [for data specification and sources, see appendix]. The first product of the study is a recommendation for an intervention program during the curriculum, which could reduce dropout rates. The second product is this white paper. As part of the review, it was decided to share the collected knowledge as well as all conclusions, in order to foster the promotion of technological education in Israel.

Primary findings

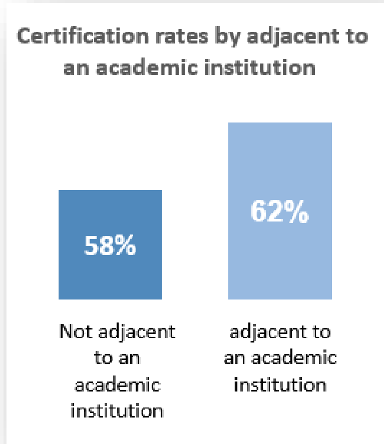
1. **Factors predicting non-completion of studies [dropout and non-certification]**
    - <u>Students:</u>

- Socio-economic background is the strongest predictor for non-completion of studies. Certification rates increase as the socio-economic background is higher.
- **Nationality** – **non-Jewish** students **are less certified**, a phenomenon that becomes sharper as the rate of Jewish students increases.



- **Women are more certified**, especially in faculties with a male majority
- **Timing of non-completion of studies** – vulnerable populations **dropout earlier**, thus requiring intensive support following initial assessments

- Institutes:
  - At Institutes that are not adjacent to **an academic institution**, the rate of non-completion is higher.
  - **Small institutes** are not equipped to deal with the decline in certifications due to a lack of resources, and therefore struggle to detect and prevent dropouts.



- <u>Tracks:</u>
    - Completing the last stage in the integrated track (the longer track) involves **a greater effort** from the students, compared to the morning track. The integrated track is challenging because usually the student works, has a family, attends class after the work day, and does so without summer vacation over 3 years.

2. Economic implications for institutes

- Institutes have 2 primary revenue sources:
    - **Tuition** – 16,000-20,000 ILS for the full program (depending on the track). Tuition is dependent on registration in courses and not on graduation or certification.
    - **Government budgeting** – the budgeting formula is designed to incentivize the institutes to improve certification rates but in reality, there are "cap" (sum of budgeting in the previous year) and "safety net" (90% of the actual budgeting at the previous year) mechanisms limiting payments to the institutes. Consequently, **<u>the institutes have no incentive to improve certification rates</u>**.

- The potential revenue loss to the institutes maintaining the budgetary cap ranges between 30,000-93,000 ILS for each additional certified student, depending on the curriculum [relevant for 2017]. These sums are beyond the budgetary cap dictated by the budgeting regulator of technological institutes.
- In order to stay financially sound, the institutes take a variety of steps: increase the number of students in classes, decrease teachers' wages, limit investments in teaching methods and learning infrastructures, raise philanthropic donations and operate in a deficit.

3. Economic implications to the individual, the government and the market

- The average gross salary of a practical engineering graduate, working in his specific field, is 10,500 ILS monthly, regardless of whether he received a diploma or not. By comparison, the average gross salary of a skilled worker in the industry is 8,100 ILS per month. **In short, the yield for technological education is ~15% for every year of study, similar to the yield from high education**.

- This means that **there is a significant advantage to completion of technological studies,** but there is no financial advantage of receiving the diploma itself. There is no significant gap between the salaries of a certified graduate to that of an uncertified graduate.
- The following details the net present value [NPV] of practical engineering studies to the market and the individual, and the corresponding contribution to productivity:

Specification	NPV (Million ILS)	
Contribution to GDP	1.5-1.9	**Value for the market**
Out of this:		
Additional future income	0.5-0.7	**Value for the individual**
Additional revenues from income tax, companies tax and savings in unemployment payments	0.2-0.4	**Direct value to the government**

- Clearly, practical engineering studies provide great value to all parties involved. **A government investment is required in order for this value to be expressed.** An appropriate government investment is expected to expand the number of graduating practical engineers and technicians, improve the quality of their education and do so more effectively, achieving higher certification rates.

4. Barriers in the current situation

- **Deficient budgeting** – the low basic budgeting causes low investment in teachers, advanced teaching methods, classes and equipment, resulting in low academic standards.
- **Budgeting method** – the "cap" and "safety net" mechanisms results in a perversion of the intended incentives, rendering it ineffective.
- **Lack of scholarships** – The length of studies combined with a lack of scholarships constitute a barrier for graduation for those disadvantaged populations enrolled in these programs**.**
- **Preliminary assessment** – there lacks a preliminary assessment of applicants to determine compatibility with the curriculum.

- **Adaptation of admission requirements** – the required academic level for success does not correspond to the learning population.
- **Accreditation sequence** – the lack of an interim technician certificate after one year increases the dropout rate.
- **Incompatibility with industry practice** – curriculums and final projects do not correspond to industry demand or practice.

An outline for a solution within the framework of the reform

- A shift from external certification to **internal certification** by the institutes. Due to the irrelevance of the certificate to the industry, the curriculums should be supervised and enable the institutes to certify their students while promoting competition between them. This can be accomplished with government publication of certification rates, placement and salary of the institutes' graduates, and more. In professions with safety elements, Safety certification tests should be conducted by an external auditor wherever it is required.
- **Changing the budgeting formula**
  - **Eliminate the current budgetary cap for the college**
  - Determine realistic graduation rates for institutes and publish success rates to increase competition.
  - Establish maximum annual quotas for new students in order to maintain a budgetary framework without damaging the system's incentives.
  - Incentivize a lower student-to-teacher ratio, to increase quality of education.
  - Determine an **appropriate** tariff for every graduating student – this tariff should be based on the existing need in the industry for each track and not on the basis of program cost.
  - Altering the 'adjustment factor' in the budgeting formula, so that it does not decline yearly and instead provides long term budgetary certainty.
- **Reducing institutes** – a minimum number of students at a technological institute should be set, in order to justify staff maintenance and government oversight. The current excess of institutes does not enable effective supervision.
- **Enhance industry internship programs** – Institutes, students and employers should be incentivized to conduct internships instead of projects, as a condition for certification and graduation. This way, the student has continuous experience in industry along with the classroom. It should not be compulsory, in order to avoid harming institutes in the periphery where there are fewer internship opportunities.
- **Technician certification** – the curriculums should be built in a modular way, so that it would be possible to obtain a technician certificate at the end of the first year a structured and rewarding sequence should also be implemented for those students matriculating from practical engineering to engineering studies.
- **Active detection of dropouts and support scholarships** – budgeting projects to prevent dropouts will ensure that budgets be disbursed in the best possible way to tackle this

issue. Furthermore, housing scholarships for disadvantaged students who require support to graduate should be included in institute budgets.

- **Branding** – An appeal is needed to attract new populations who are not approaching this field due to inadequate branding. Effective branding will draw strong populations to the field, and constitute a necessary element in promoting the field.
- **Advanced teaching methods** – there should be an allocation of resources for the development of advanced contents and teaching methods, which will conform to industry demand and instructor needs.
- **A flexible public budget supporting innovation in high technological education** – In comparison to the High Education Council direct budgeting of higher academic institutions, this solution supports innovative programs to promote and improve academic education. This sort of flexible budget is vitally important for the field of technological education.
- Update the study programs **and adapt them to meet industry demand**.
- Adjust regulation structure so that authorities may deal with the mission of promoting technological education on a national scale.

Adopting this layout will strengthen the institutes and their ability to train their capable practical engineers and technicians. It will also lead to upward social mobility of populations who are currently not taking part in higher academic education, and are not contributing to the growth of the Israeli economy.

The market will benefit from a rise in human capital and productivity, which will reflect on economic prosperity and bolster the government's economic resources.

Appendix: data retrieval

The study was based on analysis of administrative data regarding certification and dropout rates at the technological institutes, as well as on a financial analysis based on an updated alumni survey regarding salary of practical engineering graduates. This is the data that assisted in the study:

1. **Data regarding dropout and certification at technological institutes** – data from the Government Institute for Training, Technology and Science regarding beginners, graduates and certified in the last decade.
2. **In-depth analysis of 6 leading institutes** – data on beginners and graduates, categorized by socio-economic, geographical, demographical and educational characteristics.
3. **Salary data of practical engineering graduates: Government Institute for Training, Technology and Science and the Ministry of Economics** – salary and employment data from a survey of hundreds of the Government Institute for Training, Technology and Science

graduates of the year 2013-2014 [an updated survey soon to be published to the public]. There was an 85% response rate to the survey and a 75% response to salary questions.

4. **Data regarding the institutes' financial situation** – technological institutes' financial reports.
5. **Data constituting a basis for financial analysis**:
    5.1. Bank of Israel – share of labor in GDP
    5.2. Central Bureau of Statistics – salary and employment data regarding workers who are not practical engineers.
    5.3. OECD – capitalization rates of human capital
6. **Interviews with interested parties from the public, business and social sector** – in-depth interviews and meetings were conducted with leading representatives from the government, technological institutes, employers, and social sector organizations relevant to the field.
7. **Economic modeling** – analysis of the economic modeling was conducted under the gracious guidance of Avihay Lifshitz and by consulting Prof. Zvi Ekstein from the IDC.