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Editors' Preface

Dear readers,

The 2025 issue of Afeka's Multidisciplinary Journal of Science and Engineering is published at a significant moment, as Prof. Ami Moyal concludes his tenure as President of Afeka and transitions to his new role as Chairman of the Planning and Budgeting Committee (PBC) of the Council for Higher Education. This celebratory issue is dedicated in appreciation of his exceptional educational leadership and the vision he has led for over a decade.

Prof. Moyal's contribution to Afeka extends far beyond growth in numbers and impressive achievements. It reflects a profound educational philosophy that views engineering education not merely as the transfer of technical knowledge, but as shaping a generation of technological leaders with broad vision, values, and the ability to drive change in Israeli industry and society. The vision of "a different kind of academic institution" that he championed, combining academic excellence with pedagogical innovation and social commitment, has transformed Afeka into a model for emulation in the higher education system.

Prof. Moyal's transition to lead the PBC fills the entire academic system with hope. The experience, vision, and executive capability he demonstrated at Afeka herald a period of renewal and positive change in Israeli higher education, precisely when the system needs bold and innovative leadership.

This special issue presents a diverse range of articles addressing the challenges of engineering education in an era of rapid change. **Arnon Bentur** offers a comprehensive systemic approach to engineering education, emphasizing the need for lifelong learning and balancing disciplinary depth with interdisciplinary breadth. **Michal Gishri** describes the fascinating transformation process that Afeka underwent under Prof. Moyal's leadership. **Boaz Levy** focuses on academia's role in training engineers while integrating theory, practice, and systems thinking. **Perry Levy** presents the "Personalization Paradox" in the digital age and its accompanying ethical challenges. **Ehud Menipaz** analyzes the central challenges of higher education and offers "push and pull" models for developing knowledge and excellence.

Gabi Pinto and Shoshi Reiter analyze the "junior productivity" challenge and propose a model for bridging the gap between academia and industry. **Dedi Perlmutter** examines the impact of the generative artificial intelligence revolution on education and engineering systems. **Yossi Rosenwaks** presents the conclusions of the CHE committee he chaired, calling for comprehensive reform in engineering studies in Israel. Finally, **Kuti Shoham and Yaron Cohen Tzemach** offer in "The Engineer's Compass" a conceptual framework for four essential meta-skills for training engineers in the Fourth Industrial Revolution.

The issue concludes with a poem by Haim Nahman Bialik, the national poet, reminding us of the deep connection between science and spirit, between technology and culture, between innovation and tradition - a connection at the heart of the educational vision we seek to advance.

In these complex times, we conclude with a prayer for the safety of our soldiers, the swift return of the hostages to their homes, the full recovery of the wounded, and for better days when our nation will return to a routine of building, creating, and flourishing.

We wish you an enjoyable reading,

Dr. Kuti Shoham – Chief Editor

Dr. Yaron Cohen-TTzemach – Scientific Editor

Mr. Ran Cohen – Linguistic Editor

President’s Foreword to the Special Issue of *Afeka – Multidisciplinary Journal of Science and Engineering*

As I step down from my role as President of Afeka, I am honored to introduce this special issue of Afeka’s Multidisciplinary Journal of Science and Engineering, devoted to a topic that has been central to our journey over the past decade: Engineering Education in a World of Accelerated Technological Change. This issue marks not only a professional milestone, but also a deeply personal one of immense pride—it symbolizes a period defined by transformation and development, marked by growth, innovation, and shared purpose that I have had the privilege to lead.

Over the past ten years, Afeka has undergone a significant transformation—evolving in its vision, mission, and impact as we reimagined what engineering education can and should be. As a public academic institution, Afeka has always pursued a clear and purposeful vision: to educate outstanding engineers equipped to thrive in a society and job market undergoing rapid change. In response to this dynamic reality, we developed an educational approach centered on competency development—integrating professional knowledge with practical and personal skills and core values as inseparable components of engineering education. This approach has been embedded throughout every facet of the college’s work: from academic curricula and classroom pedagogy, to extracurricular programs, the design of physical learning spaces, and our close partnerships with both industry and the broader education system.

This journey has not only reshaped the way Afeka operates but has also produced tangible results: our student population has grown by 50%, annual enrollment and graduation rates have doubled, the college’s positioning has improved significantly, and Afeka has transformed from a small college that trains engineers into a leading and influential academic institution in engineering education. Today, we are proud to graduate engineers who are equipped with the full range of competencies needed to excel—professionals with broad vision and strong foundations who are ready to strengthen Israel’s economic, social, and national resilience.

Of course, such profound and far-reaching transformation is never the work of a single individual. It was made possible through the shared effort of Afeka’s academic and administrative teams, the Board of Trustees and Executive Committee, close partnerships with our valued collaborators in industry, the education system, and the military—as well as the collective dedication of our students and alumni. The dedication and contributions of all those involved highlight the transformative power of multidisciplinary collaboration across the national education continuum.

I have always believed that excellence must go hand in hand with enjoyment. That belief has shaped a vibrant and creative environment at Afeka—one in which learning is driven by curiosity, engagement, and a genuine desire to understand, explore, and make an impact. Over the years, Afeka has become a platform for fulfilling dreams: for students who aspire not only to learn, but to grow, create, and find meaning in their work; for faculty who strive to innovate, influence, and dare; and for realizing my own vision—to build a truly different kind of academic institution, one that leads meaningful change in engineering education in Israel and helps shape the national educational continuum.

Looking back, it is clear how this vision gradually took shape—step by step—through clarity of purpose, shared efforts, and unwavering dedication to our mission.

I would like to thank the journal's editors and all the authors who contributed to this special issue, which explores the future of engineering education and promotes a vital multidisciplinary dialogue across the full educational continuum.

I wish Afeka continued growth, leadership, and innovation—and remarkable success in preparing the next generation of engineers who will continue to contribute to Israel's strength—economically, socially, and nationally.

Warm regards,

Prof. Ami Moyal
President
Afeka – Tel Aviv Academic College of Engineering

A Systems Approach to Engineering Education and Maintaining Professional Competence Throughout the Career Lifecycle

Arnon Bentur

The author is Professor Emeritus in the Faculty of Civil and Environmental Engineering at the Technion. He has held senior positions at the Technion, including Vice President for Research, Dean of the Faculty of Civil and Environmental Engineering, Director of the Samuel Neaman Institute for National Policy Research, and President of RILEM. In recent years, he has been advancing research in digital manufacturing within the framework of the Technion Center for Advanced Construction. He has worked to promote academia-industry relations in his role, until recently, as Chair of the Academia-Economy Relations Committee at the National Council for Civil R&D. He founded and managed the Forum for Engineering Education. He serves as Chair of the Steering Committee for the "Academia 360" program at CHE/PBC, dedicated to deepening academic education at the undergraduate level.

The accelerated changes in the modern era in, on the one hand, science and technology, and, on the other hand, in social and environmental fields require a renewed vision of engineering education and the preservation of professional competence throughout the entire career lifecycle. Knowledge becomes obsolete at an unprecedented rate, while new knowledge is available through increasingly sophisticated electronic media, with the latest development being in artificial intelligence. In addition to all these, technological advancement pushes toward a transformation of engineering from disciplinary focus to the need for systemic and multidisciplinary capability, which also interacts with society, environment, and economy. Thus, changes in engineering education are required to provide not only scientific-foundational knowledge but also skills and competencies that will enable engineers to function immediately upon completing their academic training, by providing capabilities for self-learning and renewal throughout their professional careers. This article reviews developments in approaches to engineering education during academic studies while integrating innovative frameworks for lifelong learning.

1. The Challenge in Modern Academic Education

Academic and academic-professional education are undergoing upheaval in the current period against the background of scientific, technological, and social changes. A quantitative expression of this was provided several years ago by Hanushek and Ludger [1], who demonstrated the existence of a relationship between "quantity" and "quality" of education and national growth (Figure 1).

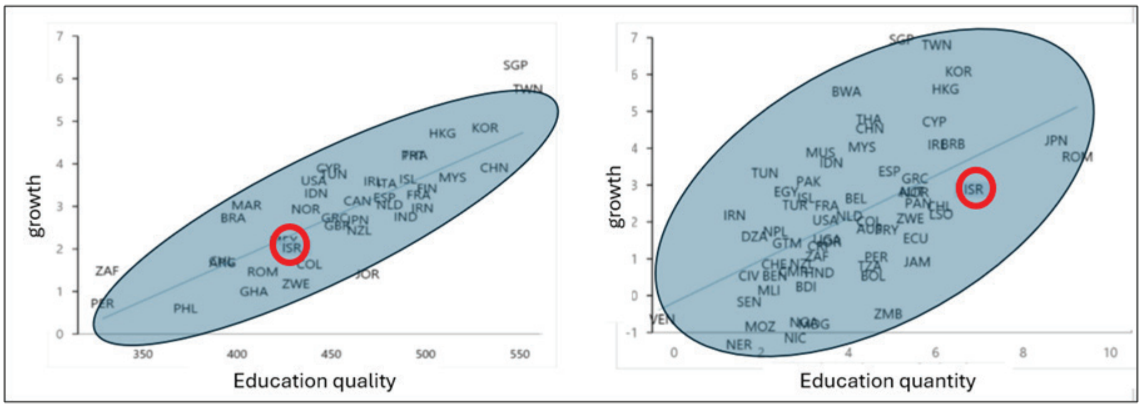

Figure 1: Interrelationships between growth and quantity of education and quality of human capital, adapted from Hanushek and Ludger [1], (Fig 2.1 p. 13, Fig 3.1 p. 44), with Israel's position highlighted (red circle)

From Figure 1, we see there is a trend toward a relationship between human capital quality and growth, but less pronounced is the relationship between growth and quantity of education (dependent on years of study and education level – primary, secondary, and tertiary). This difference in relationships is particularly intensified in the modern period, when knowledge becomes obsolete rapidly: half-life of knowledge is less than ten years, and much less in advanced technological fields (Figure 2); conversely, knowledge becomes available through digital means accessible to the general public and especially to professionals, all amplified recently through AI technologies.

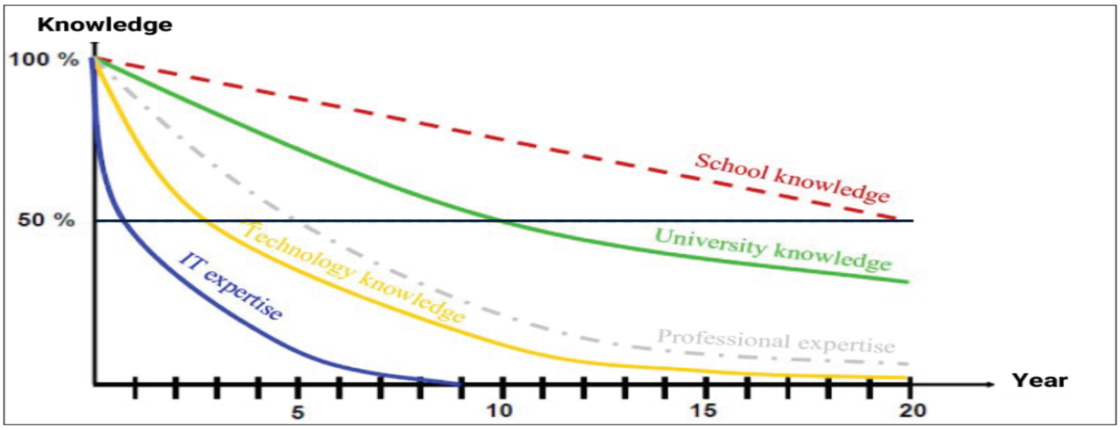

Figure 2: Obsolescence of different types of knowledge and their half-life time, adapted from Charles [2]

Against this backdrop, the quality of education is no longer measured by knowledge alone, but also by embedding skills, for which the previously common term "soft skills" is no longer appropriate. These involve capabilities for self-learning, critical thinking, complex problem solving, teamwork, communication, and more, with currently accepted terms in the category of "hard skills" such as core/essential skills, power skills, etc. The characterization of national human capital is now based on tests such as PIAAC and PISA, which characterize a range of selected skills, and they are also the basis for quantifying human capital quality.

Israel ranks high in quantity of education among OECD countries but unfortunately is below average in education quality. This situation is prominently reflected in the entire education system, but also among tertiary education holders as seen in the example of adaptive problem-solving skills in Figure 3.

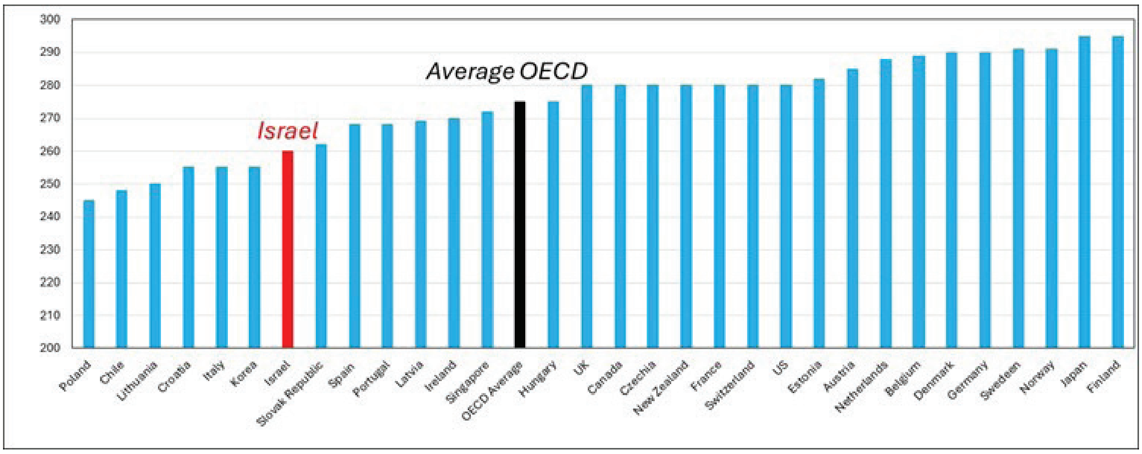

Figure 3: Country ranking by PIAAC test score for adaptive problem-solving skills of tertiary education holders. Adapted from OECD report [3]

Against this background arises the need for renewed examination of academic education in general [4, 5] and especially that of engineering [6], which has an important role in advancing, and particularly in the growth, of society. In Israel, this topic has been promoted in recent years within the Framework of the Forum for Engineering Education established at the Samuel Neaman Institute at the Technion, which includes various stakeholders: universities, engineering colleges, government bodies, industry, and student representatives [7]. Recently, the topic received institutional treatment within a committee established by CHE, which presented recommendations for revisions in engineering education [8].

It should be emphasized that this need to close gaps does not necessarily indicate inherent weakness, but is a natural process learned over long periods, in which education has always lagged behind technological developments (Figure 4). An example that particularly illustrates this is the new challenges in education against the background of recent advances in artificial intelligence.

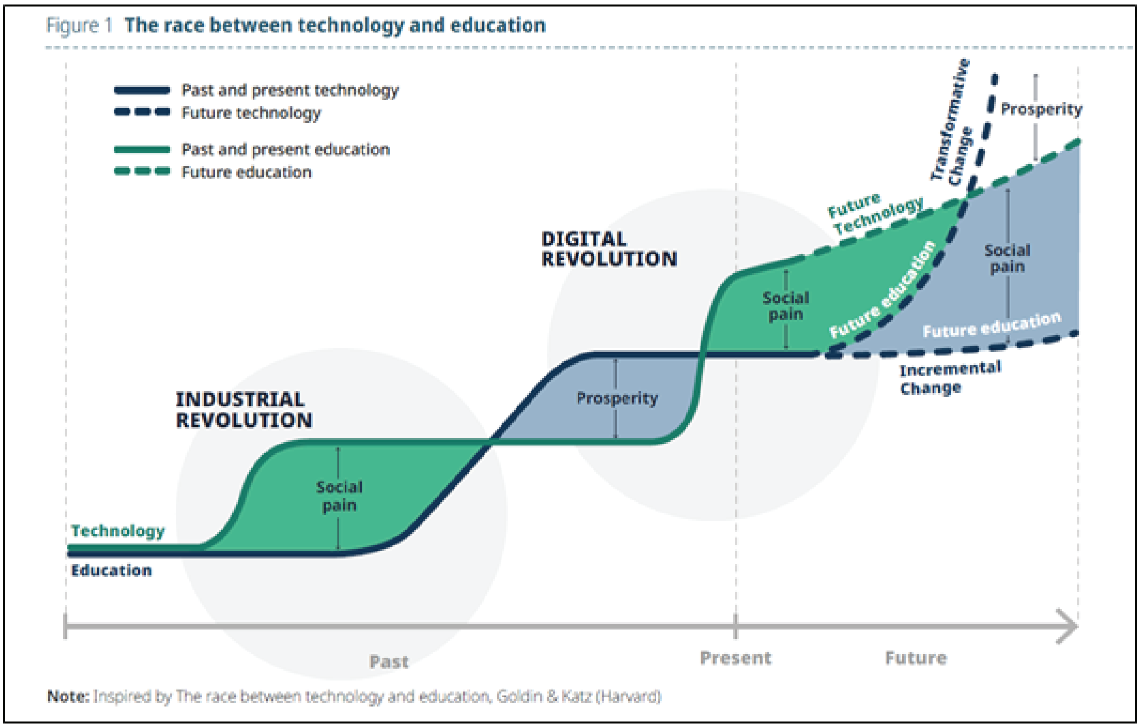

Figure 4: The race between technology and education, from OECD report

The importance of skills and values, such as critical thinking and ethics, not only does not diminish in the AI era, but is expected to intensify. This ensemble of literacy, skills, and values that need to be integrated today in academic education in general (and not only), and in academic-professional education, was defined by the OECD. In the words of the report itself [5]:

Competencies – types of knowledge, skills, attitudes and values students need to transform society and shape the future for better lives.

Knowledge – Knowledge includes theoretical concepts and ideas in addition to practical understanding based on the experience of having performed certain tasks. The OECD report recognizes four different types of knowledge: disciplinary, interdisciplinary, epistemic and procedural.

Skills – Ability and capacity to carry out processes and be able to use one's knowledge in responsible way to achieve a goal. The OECD report distinguishes three different types of skill: cognitive and metacognitive, social and emotional, and practical and physical.

Attitudes and values – The principles and beliefs that influence one's choices, judgements, behaviors and actions on the path towards individual, societal and environmental wellbeing.

In the present article, the emphasis is on the required derivatives in engineering education, but the insights being formed are also relevant to other academic-professional education fields facing similar challenges.

2. Systems Approach and Derived Paradigms

To address these challenges, a new approach to the education and training process of engineers is needed. At the national meta-level, engineering education should be built as a link within the education chain, from schools through formal academic education to lifelong learning [9, 10] (Figure 5).

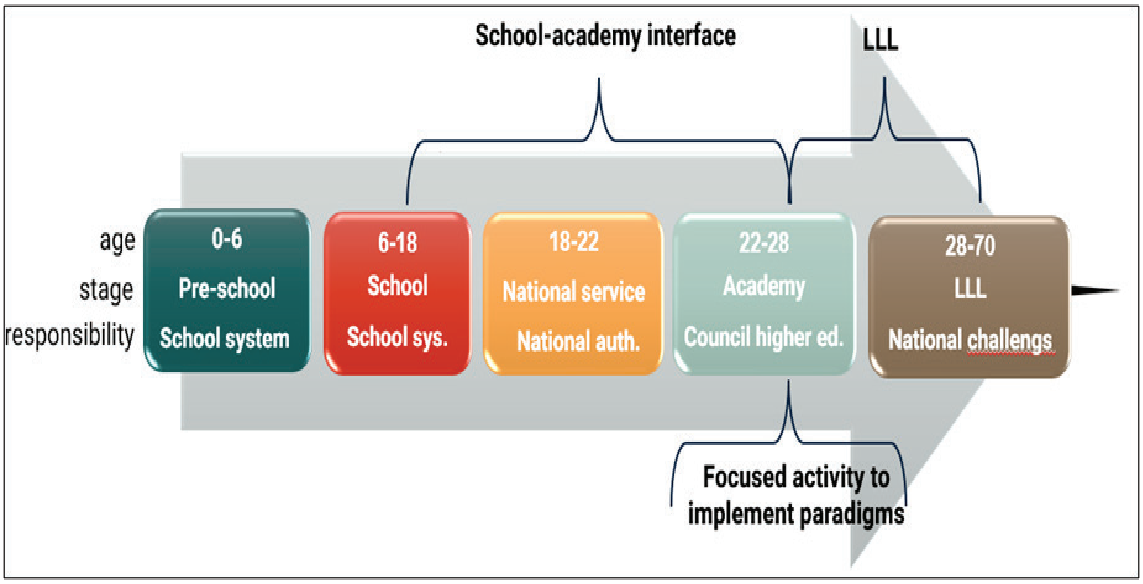

Figure 5: Education chain and unique characteristics of military and national service as part of it in the State of Israel

Practically, academia has limited influence on what happens in the education system, yet it has the ability for indirect impact through admission and selection policies at the interface between school education and academia [11]. This topic requires special attention, which is not only professional but also related to social mobility. This is a weighty topic that stands on its own and is beyond the scope of this article.

In the field of academic-professional training, where academia has considerable influence, a new approach is needed that should reflect a series of updated paradigms in engineering education. An example is the framework of four groups of paradigms developed within the Forum for Engineering Education at the Samuel Neaman Institute at the Technion [7]:

Knowledge and Skills

1. Breaking the paradigm of knowledge importance as a central and exclusive value.
2. Breaking the paradigm that a professional necessarily specializes in and focuses on a narrow field.
3. In addition to the core of science and engineering, leadership and influence skills (essential/soft) are also required.

The Real World and Industry

4. Providing a toolbox to operate in the "real world," and an insight that there isn't always one solution to a challenge or a problem.

5. Engineering education doesn't occur only within the academy; industry collaboration is needed, and innovative partnership models must be developed.

6. Experience models, leveraging the fact that most engineering students in Israel work in their profession during their studies.

Students

7. Creating a learning experience that generates enthusiasm and passion for engineering as a leading profession.

8. Creating commitment to the profession from the beginning of studies through various mechanisms, such as projects already in the first year and gradual implementation of projects throughout the study track.

9. Selecting candidates based also on characterizing skill potential and not just knowledge and psychometric exams.

Faculty

10. The role of academic faculty must undergo a conceptual change from "lecturer" to "mentor/course content coordinator."

11. Investment in developing and advancing faculty members for assistance and implementation of updated pedagogy – close techno-pedagogical support – including evaluation of contribution to education in academic advancement.

12. Integration of industry appointments through various mechanisms, including Professor of Practice.

To meet these challenges, systemic change is required, as emerged in the Samuel Neaman Institute report [7] and the CHE committee [8]. A systemic model in this spirit was developed and proposed within the activities of the Forum for Engineering Education at the Samuel Neaman Institute (Figure 6).

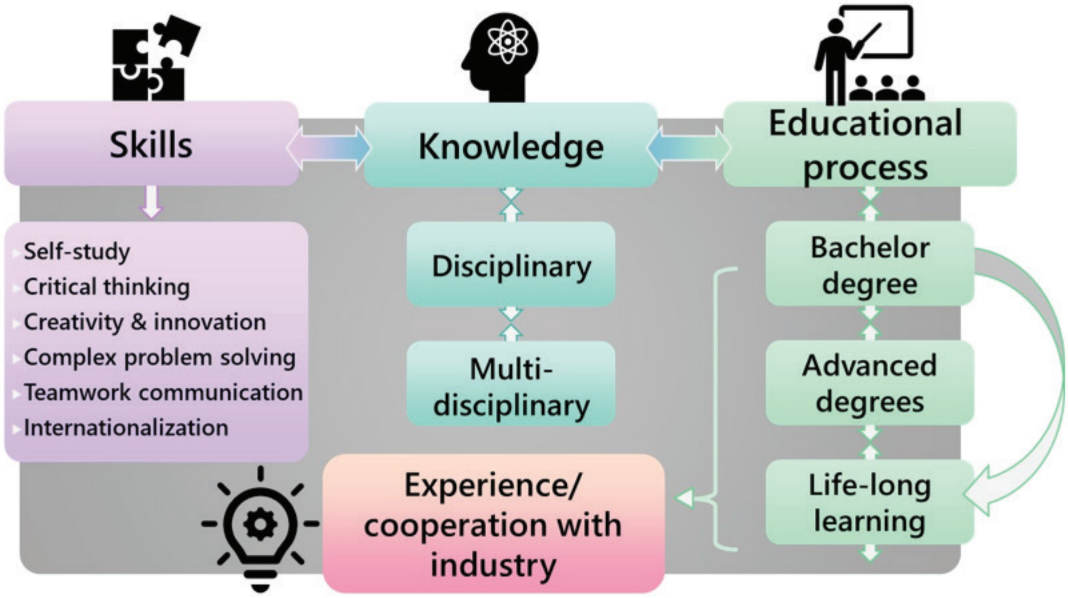

Figure 6: Systems approach to engineering education developed and proposed within the activities of the Forum for Engineering Education at the Samuel Neaman Institute at the Technion

The systems approach presented in Figure 6 addresses the entire educational continuum chain, including lifelong learning as well as complex interfaces within the academic program itself, especially the proper balance of tension between embedding skills and competencies versus imparting knowledge. The derivatives of changes raise the need to involve industry in the learning process as partners, not just as "service providers." These partnerships can be expressed in various mechanisms, including structured industry experience as part of the engineering education process, industry projects, involvement of industry experts as faculty members with Professor of Practice status, who participate in the academic unit's life and curriculum development, not just as guest lecturers.

The tension between embedding skills and competencies versus imparting knowledge is very significant in several aspects: Is one at the expense of the other? What are the important skills and competencies? How are they defined? How do we evaluate and measure their level of embedding at the individual and program level? These challenges are expressed today in a series of research and development of learning and assessment methodologies. One of the leading assessments is that in implementing advanced teaching and learning methods, one doesn't have to come at the expense of the other.

These topics arose in an international round table initiated by the Samuel Neaman Institute at the Technion [12]. One important insight emerging from these activities is that integrating skills embedding within content courses and activities such as projects can benefit the simultaneous advancement of both goals – content and skills. In this integration, knowledge is absorbed more deeply and skills developed within context are embedded more effectively. To focus, it's worth defining the skills and competencies that are more important, that have generic value for all disciplines, and concentrating educational effort on them. Many studies from both academia and industry are conducted to develop insights in this field, and the trends obtained are generally similar, as presented in Table 1.

Table 1: Insights regarding the more important generic skills and competencies based on research initiated by academia (Samuel Neaman Institute at Technion) and industry (Aaron Institute at Reichman University):

Skills for STEM Education Studies and Reviews by Neaman Institute in the fields of education and academia	Skills for High-Tech Employment Aaron Institute Survey of High-Tech Industry Needs
Self-learning/Lifelong learning	Self-learning (74%)
Teamwork, Cooperation and Leadership, Interpersonal Communication	Teamwork (82%) (Communication Skills (88%
Complex Problem Solving/Critical Thinking	Problem Solving (93%) Critical Thinking (83%)
Entrepreneurship/Innovation/Creativity	Creative Thinking (80%)
Cognitive and Emotional Flexibility/Adaptability/ Mental Resilience	Motivation for Tasks (84%) Openness (83%)
Intercultural Awareness/Global Skills and Embracing Diversity	
Taking Responsibility and Making Decisions with Ethical, Moral, and Value-Based Considerations	
	Analytical Skills

3. Curriculum Development and Accreditation

Developing an engineering curriculum in the spirit of the principles presented here largely requires revision. Sometimes, due to constraints and limitations, it needs to be advanced incrementally, based on an existing program. Even if constraints require such an approach, it's appropriate to formulate a framework of the goal to be reached. This framework will serve as a "compass" on which basis every step is analyzed and approved. An example of such a framework, incorporating the principles described above, is presented in Tables 2 and 3. These frameworks were developed by the American Society of Civil Engineers (ASCE), but they contain all the principles of the generic approach based on four categories of clusters [13]: foundation areas (including social sciences, not just exact sciences), engineering sciences, technological/disciplinary field, and professional field. Such a framework includes the balance between breadth and depth as well as integration of skills and competencies embedded in study subjects, classified by cognitive levels (Table 2) and affective levels (Table 3).

Table 2: Curriculum and cognitive learning outcomes; adapted from ASCE [13]

Cognitive Learning Outcomes Table						
Cognitive Level						
	1	2	3	4	5	6
	[1]Know/Recall	[2]Understand	[3]Apply	[4]Analyze	[5]Synthesize	[6]Evaluate
Foundational Fields						
Mathematics	Degree I	Degree I	Degree I			
Natural Sciences	Degree I	Degree I	Degree I			
Social Sciences	Degree I	Degree I	Degree I			
Humanities	Degree I	Degree I	Degree I			
Engineering Foundations						
Material Sciences	Degree I	Degree I	Degree I			
Engineering Mechanics	Degree I	Degree I	Degree I			
Experimental Methods and Data Analysis	Degree I	Degree I	Degree I	Degree II		
Critical and Solution-Based Thinking	Degree I	Degree I	Degree I	Experience	Experience	
Technical						
Depth in Civil Engineering	Degree I	Degree I	Degree II	Degree II	Experience	
Breadth in Civil Engineering	Degree I	Degree I	Degree I	Experience		
Projects Management	Degree I	Degree I	Experience			
Engineering Economics	Degree I	Degree I	Experience			
Risk and Uncertainty Management	Degree I	Degree I	Degree I	Experience	Experience	
Content	Degree I	Degree I	Degree I	Experience		
Sustainability	Degree I	Degree I	Degree I	Experience		
Professional						
Communication	Degree I	Degree I	Degree I			
Teamwork and Leadership	Degree I	Degree I	Degree I			
Lifelong Learning/Self Learning	Degree I	Degree I	Degree I			
Professional Attitude	Degree I	Degree I	Experience			
Professional Responsibility	Degree I	Degree I	Experience	Experience		
Ethical Responsibility	Degree I	Degree I	Experience	Experience		
[1] The capacity to recall previously learned material.						
[2] The capacity to grasp the meaning of the learned material.						
[3] The capacity to use the learned material in new, concrete situations.						
[4] The capacity to deconstruct the learned material into its constituents so its organizational structure is intelligible.						
[5] The capacity to synthesize the learned material into a whole.						
.The capacity to evaluate the learned material's significance for a certain end [6]						

Table 3: Curricula and affective learning outcomes, adapted from ASCE [13]

Affective Learning Outcomes Table					
Emotional Level					
	1	2	3	4	5
	[1]Receive	[2]Respond	[3]Value	[4]Organize	[5]Characterize
Technical					
Sustainability	Degree I	Degree I	Experience	Self Development	
Professional					
Communication	Degree I	Degree I	Experience	Self Development	
Teamwork and Leadership	Degree I	Degree I	Experience	Self Development	
Lifelong Learning/Self Learning	Degree I	Degree I	Experience	Self Development	
Professional Attitude	Degree I	Degree I	Experience	Self Development	
Professional Responsibility	Degree I	Degree I	Experience	Self Development	
Ethical Responsibility	Degree I	Degree I	Experience	Experience	Self Development
[1] The capacity to be aware and ready to accept and be attentive to a certain phenomenon or behavior.					
[2] The capacity to be actively participating in an activity or assignment and respond to motivation.					
[3] The capacity to give value to a certain goal, phenomenon or behavior.					
[4] The capacity to sort values and give precedence by comparing values, characterize conflicts between them and create a system of value hierarchy.					
[5] The capacity to trace a system of value hierarchy that controls a broad, consistent, predictable and characterizing behavior.					

What's special about this approach and similar ones, accepted in several countries, is the reference to curriculum in terms of learning outcomes rather than just as inputs of course syllabi, as well as the distribution by interest across the bachelor's degree, master's degree, and structured experiences (as seen in the color emphasis in Tables 2 and 3). This approach allows flexibility in curriculum construction, as well as emphasis according to the graduate profile, in alignment with each institution's vision and goals.

The definition of learning outcomes requires building appropriate methodologies of pedagogy, assessment and measurement, as well as criteria for accreditation at the national level. Table 4 demonstrates this approach based on learning outcome criteria for recognition in civil engineering according to the principles of ASCE [13] and ABET [14]. These ABET principles are similar across all engineering disciplines. In contrast to this approach, the accreditation criteria according to the Engineers Registry in the State of Israel

(Table 4) are based on prescribed courses with dictated curricula, which doesn't allow the same flexibility and diversity that exists in most advanced countries. It appears, therefore, that revision in engineering training programs requires steps not only at the institutional level but also at the national level, where updated policies need to be formulated within the frameworks of CHE and the Engineers Registry.

Table 4: Accreditation criteria for engineering curricula (example of civil engineering) according to ASCE, ABET, and the Engineers Registry in Israel

Learning Outcome	**ABET**	**ASCE**	**Israel**[1]
Basic Sciences			
Humanities and Social Sciences			
Statistics, Uncertainty			
Problem Solving in 4 Areas			
Experiments in at least 2 Areas			In One Area
Systems Content in Two Relevant Aspects			
Sustainability Aspects in Content			
Management, Public Policy			
Leadership, Teamwork			
Ethics			
Experiencing			
Self-learning			
Breadth			
Depth		In Graduate Studies	In Undergraduate Studies
1. In Israel, accreditation is based on studied subjects; in the U.S., on study products.			

4. Lifelong Learning

The topic of lifelong learning now receives an important place in engineering training. This is against the background of the recognition that engineering training doesn't end with the degree, and there's a need for appropriate frameworks that can enable and encourage continuing education. These frameworks can be flexible in nature: on the one side academic, and on the other side training by non-academic bodies (industry, professional organizations), as well as integration in various models of cooperation between academia and industry.

This gives the impression that the scope of this need is significant, though it's difficult to estimate its exact extent. Lifelong learning occurs simultaneously through many mechanisms, as part of ongoing daily activities, in organized training within the workplace or various professional organizations, and continuing education in academic frameworks, including advanced degrees. An estimate of the potential scope in Israel can be obtained by analyzing the number of engineering graduates in each of the recent decades (Figure 7), considering that about 50% of knowledge becomes obsolete every decade.

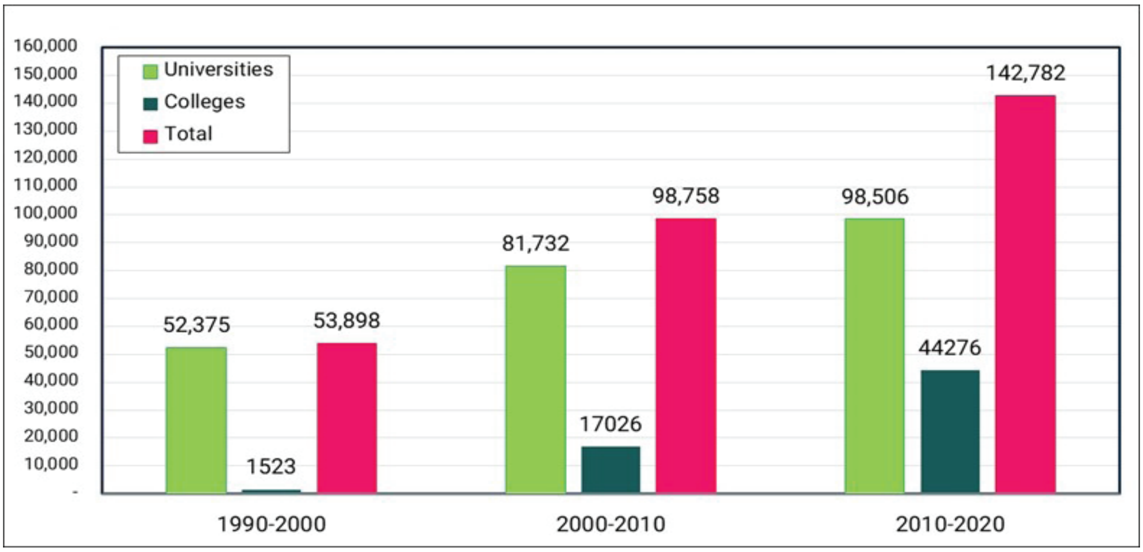

Figure 7: Science and engineering degree graduates from universities and colleges in Israel in the last three decades (Samuel Neaman Institute, from CHE/CBS data)

We don't have estimates of the extent of engineers' participation in lifelong learning, but data recently published by the OECD on adult learning [15] indicates there's a significant lag in Israel relative to other OECD countries, even among tertiary education graduates, with Israel well below average (Figure 8).

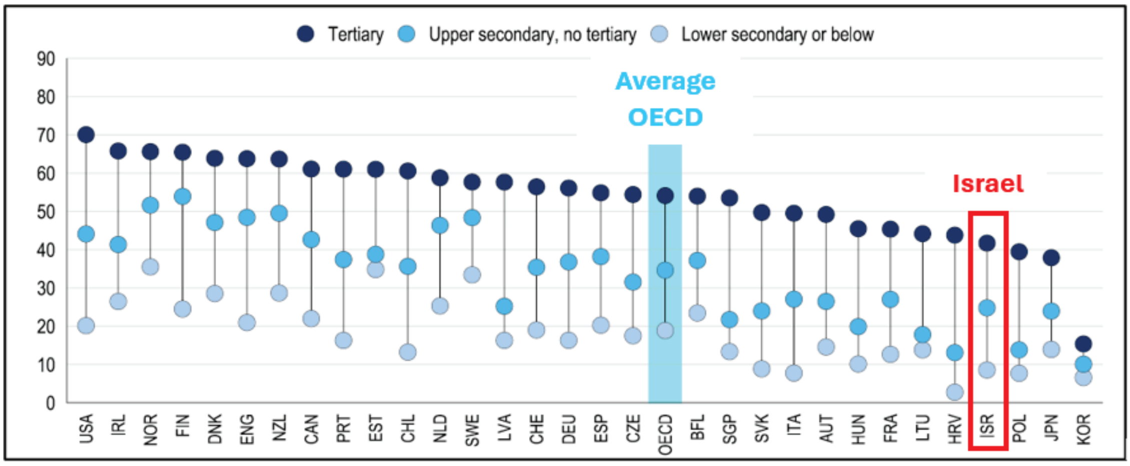

Figure 8: Participation of adults with tertiary education in adult learning, OECD report [15], with emphasis on Israel's position

These significant changes in the half-life of knowledge require a paradigm shift in the entire approach to lifelong learning as a factor that cannot be seen as merely secondary to formal education at a young age. This approach is reflected in renewed thinking about the role of higher education institutions in lifelong learning and their role in accompanying graduates throughout their professional lives. This topic occupies an important place in discussions for formulating policy regarding the role of academia in general and in this field in particular, for example the E&Y report [16]. The insight it expresses is the need for different organizational form within higher education institutions themselves, and also at the national policy level. For example, within institutions, new learning models can be developed, such as learning in short modules, for micro-degrees. At the national level, there's also a need for government involvement in encouraging lifelong learning, an example being Singapore's policy, quoted below [16]:

> "To encourage lifelong learning and skill building, governments could provide citizens with a learning wallet to be spent at the student's discretion on accredited courses, agnostic of the pathway or the provider. The Singapore Government has been doing this for four years through its SkillsFuture program and employers are increasingly offering similar schemes".

In this context, there's a noticeable change in the thinking of leading universities worldwide, updating their strategy to include lifelong learning as one of the goals, not just a side activity driven mainly by economic considerations. Various models have been developed, from traditional models to models such as the open loop at Stanford University and other leading universities, under various names (Figure 9).

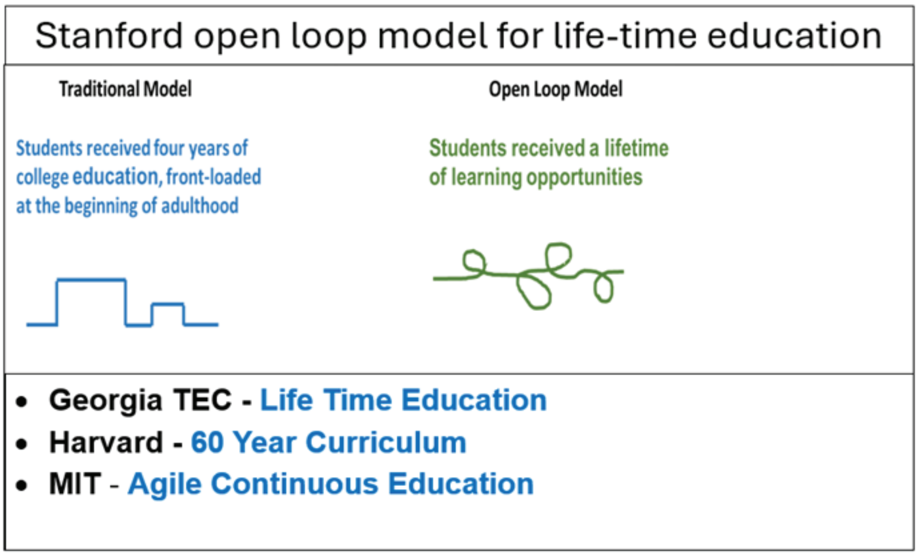

Figure 9: Models for lifelong learning as part of the strategy of leading universities in the USA

In Israel, this topic was regarded as central in the Forum for Engineering Education at the Samuel Neaman Institute at the Technion [10] and was also addressed within the Academia-Economy Relations Committee of the National Council for Civil R&D [17]. This committee recommended establishing a national framework including several layers:

Accreditation and Quality Assurance

- Leveraging the platform of the planned National Credentials Framework as infrastructure for accreditation and quality assurance in general learning fields and lifelong learning in particular.

Mapping and Databases

- Mapping target audiences, consumers, LLL providers, and databases that can connect them (AI-driven interactive databases).
- Mapping professional fields and emerging technologies for directing the development of LLL activities.

Academia's Participation in the National Lifelong Learning Framework

- Models for cooperation between academia and business and public sectors to advance LLL.
- Lifelong learning as a mission in the higher education system.

Advancing Techno-Pedagogical Platforms for Lifelong Learning

- Leveraging the Campus IL platform for lifelong learning.

Implementing these layers at the national level is not easy, but there's definitely room for higher education system leadership in the layer of academia's participation in the national framework, with emphasis on joint models with industry. The experience in the USA [18] indicates that these partnerships also yield important secondary benefits, strengthening ties between academia and industry. Corollaries of renewal are found in curricula and in initiatives for joint research against the background of interaction between faculty members and industry people within the LLL lifelong learning framework.

5. Summary and Conclusions

The accelerated changes in the modern era in science and technology, on the one hand, and in social and environmental fields, on the other hand, have led to the insight that a renewed vision of engineering education and maintaining professional competence throughout the entire professional lifecycle is required. The intensive activity created as a result in various bodies within the academic system and in organizations interfacing with this system, especially the education system on one hand and industry on the other, has led to the understanding that a systemic approach is required, within academia itself and also in its interaction with the education system; education systems are the portal to academia, while the exit gate and continuation are industry and the economy as a whole, the "consumers" of engineering human capital leaving academia's gates.

This systemic perception is essential for academia regarding its continued relevance to professional engineering education (and not only). The educational and structural paradigms derived from this are beginning to be formulated, and directions and models are emerging with general agreement on their principles. The insights are mainly regarding the need for balance between imparting knowledge and cultivating skills and competencies within curricula, as well as the need for new models of cooperation with industry, during degree studies and after them.

The approaches to advancing academic engineering education in these directions are many and varied, but for them to yield the desired results, there's a need to develop, in each institution, a strategic approach fundamentally defining the graduate profile, from which action methods will be derived, with the strategic vision serving as a compass, whether based on drastic revision measures or incremental steps.

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Engineering Education by Design: A Decade of Visionary Leadership at Afeka College of Engineering

Michal Gishri

Michal Gishri worked closely with Prof. Ami Moyal for 16 years, beginning as a linguist and researcher at the Afeka Center for Language Processing, which he founded and led. During his decade as president of Afeka College of Engineering, she established and led the Internal Communications Department, later serving as Chief of Staff and Resource Development Manager. In these roles, she was exposed to strategic decision-making, supported cultural change, crafted internal and external storytelling, and promoted Afeka's STEM education ecosystem across the educational continuum.

Over the past decade, Afeka Academic College of Engineering in Tel Aviv has evolved from a relatively modest engineering institution into a national leader in higher education—recognized for its competency-based curricula, innovative pedagogy, collaborative culture, reimagined campus spaces, and active role in shaping educational policy. This transformation was guided by a structured vision and an ability to anticipate change long before it became visible to others.

The following paper explores how this transformation unfolded under the visionary leadership of Prof. Ami Moyal, whose application of engineering design principles to institutional change created both a roadmap and a culture that embraced it. It examines how a clear and structured vision, strategic storytelling, a strong and adaptive organizational culture, internal engines for change, and platforms for pursuing passions and dreams worked together with exceptional foresight to position Afeka not only as a hub of academic excellence but also as an influential voice in shaping the national STEM education agenda.

Introduction

When Prof. Ami Moyal assumed the presidency of Afeka College of Engineering, he brought with him the mindset of an engineer and the experience of a high-tech leader—over 15 years in industry, from research through VP R&D to CEO. What's remarkable is that his approach to institutional change flowed naturally from his background, without any conscious intent to apply engineering methodologies to academic leadership. His intuitive response to the challenges of transformation mirrored the process of designing a complex product: defining the desired outcome first, creating pathways to achieve it, and continuously refining through real-world feedback. This engineering-inspired approach wasn't a deliberate strategy but rather an instinctive application of his professional experience to a new domain.

The desired outcome of Afeka's "product" was articulated as the Afeka Graduate Profile—a detailed definition of the knowledge, personal skills, and values every Afeka graduate should possess. The Graduate Profile became the compass for the college's transformation, ensuring that every decision—academic, cultural, or infrastructural—could be aligned with it.

The implementation of this vision was not confined to a single reform or initiative; rather, it unfolded across interconnected domains. Curricula were redesigned so that personal skills were not treated as optional byproducts but as defined learning outcomes, integrated into every course and developed with increasing proficiency over the span of a degree. Extracurricular opportunities were expanded, giving students structured avenues to build competencies in innovation, entrepreneurship, social involvement, and collaborative work.

Pedagogical innovation was fostered through annual calls for proposals, initially attracting only a few submissions. Early adopters received significant institutional backing—funding, training, and visibility which encouraged others to follow. Physical spaces were redesigned to mirror the collaborative, flexible environments of high-tech workplaces, with open learning areas scattered across campus to keep it vibrant and active throughout the day. Partnerships with industry informed the Graduate Profile itself, while collaborations across the STEM educational continuum—championed in *The Afeka Framework for STEM Education* (2021)—helped shape national policy.

These interconnected efforts were not just operational moves; they were elements of a deliberate methodology. The paper examines the leadership style that made such a methodology work—how structured vision, storytelling, culture building, and foresight combined to turn a defined outcome into a lived reality.

Applying Engineering Design Principles to Educational Transformation

Prof. Moyal's unique background—combining engineering expertise with high-tech executive experience—enabled him to adapt a methodology typically used for designing complex engineering products into a powerful tool for systemic educational change. This innovative approach applied the six-stage engineering design process to institutional transformation:

Ask: The college began by defining fundamental questions about Afeka's educational mission: What defines our ideal graduate? Does our current educational process effectively lead to this desired outcome? These foundational inquiries set the direction for the transformation.

Imagine: Drawing on extensive industry consultation and educational research, Afeka envisioned a comprehensive graduate profile encompassing technical knowledge, personal skills, and professional values—a blueprint for what its graduates should embody.

Plan: Rather than pursuing isolated initiatives, the institution developed a multi-faceted strategy addressing all aspects of the educational experience—from curriculum and pedagogy to physical spaces and organizational culture—ensuring that all elements worked together toward the defined graduate profile.

Create: Implementation activated change across multiple fronts simultaneously: updating curricula to incorporate skills as formal learning outcomes, establishing dedicated units to drive innovation, transforming campus spaces, and fostering industry partnerships.

Experiment and Improve: Afeka embraced an iterative process in which experimentation and improvement were inseparable. Faculty and staff piloted new approaches, with early initiatives carefully supported and documented. Each trial — whether successful or not — was viewed as a source of insight, and failure was embraced as a valuable learning method. Continuous improvement mechanisms, including formal reviews, faculty discussions, and data collection, ensured that lessons from each experiment were rapidly integrated into practice. This approach treated the transformation as a dynamic system, constantly refined and adapted to emerging needs rather than a fixed set of reforms.

This systematic application of engineering principles to institutional change represents a paradigm shift in academic leadership. Where traditional academic reform often proceeds piecemeal or focuses primarily on knowledge transfer, Prof. Moyal's strategy treated the entire educational process as an integrated system designed to produce specific outcomes. The effectiveness of this methodology is evident in Afeka's dramatic transformation—rising from relative obscurity to national leadership in engineering education within a decade.

Internal Engines for Change

A critical insight from Prof. Moyal's approach was the need to establish dedicated organizational structures that would serve as engines driving the transformation from within. These strategic units were designed to catalyze change across departmental boundaries and provide sustained momentum throughout the multi-year process.

The Internal Communications Department, established early in the transformation, played a pivotal role in fostering a cohesive organizational culture. Rather than simply disseminating information, this unit crafted an institutional narrative that connected day-to-day activities to the larger vision. Successes were celebrated publicly, challenges were addressed transparently, and every communication reinforced how individual efforts contributed to the collective journey. This consistent messaging created a shared language around the transformation and helped overcome initial resistance to change.

The Center for Promoting Teaching emerged as another crucial change engine, providing faculty with both the technical support and pedagogical expertise needed to redesign courses around skill development. By offering workshops, individual consultations, and resources on innovative teaching methods, the Center became an incubator for educational experimentation. It created a safe space where faculty could develop new approaches, receive feedback, and refine their teaching techniques before implementing them in the classroom.

Perhaps most innovative was the establishment of the OFEK Centers for Skills Development, which provided structured opportunities for students to build competencies outside the formal curriculum. These centers — focusing on areas like innovation, entrepreneurship, student clubs, and social involvement — created learning environments where students could apply their knowledge to real-world challenges while developing the personal skills emphasized in the Graduate Profile. Many of the activities were student-led, enabling participants to take ownership of projects, pursue their personal passions, and translate them into tangible outcomes. By treating extracurricular initiatives as intentional learning experiences rather than mere diversions, Afeka extended its educational mission beyond the classroom and empowered students to grow as both engineers and individuals.

These internal engines shared key characteristics that made them effective: they operated across traditional departmental boundaries; they combined practical support with strategic vision; and they created communities where new ideas could be developed, tested, and refined. By establishing these dedicated change structures, Prof. Moyal ensured that transformation wouldn't depend solely on his leadership but would become embedded in the institution's daily operations. Importantly, these structures were deliberately designed to ensure that the processes and innovations introduced during this presidency would continue to evolve and thrive well beyond it.

Storytelling as Strategy

From the earliest days of the transformation, Prof. Moyal understood that for change to take root, it had to be part of a larger story. A list of reforms might inform, but a compelling narrative could inspire—and inspire across boundaries: internally among faculty and staff, externally with policymakers and peers.

When advocating for the creation of a National STEM Council, he did not present the idea as a standalone recommendation. Instead, he told a story of exponential technological change, the new demands on engineers in an AI-driven economy, and the growing gap between the skills graduates possessed and those industry required. Afeka's own transformation was presented as proof-of-concept, showing both the need and the feasibility of change.

Two cornerstone documents became part of this storytelling toolkit. *The Afeka Framework for STEM Education* (originally published in 2021) laid out a national strategy for aligning STEM education with workforce needs, including proposals—like the STEM Council—that have since gained government approval. *Integrating Skills into the Learning Outcomes of an Educational Process* detailed the method Afeka used to embed skills into curricula, offering a roadmap other institutions could adapt.

This narrative strategy extended to public platforms. Prof. Moyal's social media posts often read like opinion pieces—clear, contextualized, and vision-driven. They not only shared Afeka's achievements but framed them as part of a broader educational movement. The college's domestic and international PR strategies also revolved around this consistent messaging, positioning Afeka not merely as an educational institution but as a thought leader in engineering education. Media appearances, conference presentations, and published articles all reinforced key narrative elements: the changing nature of engineering work, the need for a more holistic educational approach, and Afeka's pioneering role in developing it.

By telling Afeka's story consistently and convincingly, he built buy-in not just within the college, but across the national STEM ecosystem, as well as internationally, leading to substantial resource development success for a new campus that will allow Afeka to expand its impact and take the next step in being one of Israel's major engines for growth, educating a large number of excellent engineers annually.

Culture Shift: Embracing Change

The structural changes at Afeka were matched by a profound cultural transformation. Faculty who once worked in isolation began collaborating in pedagogical communities, sharing methods, testing new approaches, and learning from one another. Innovative teaching was no longer a marginal experiment but a celebrated and supported part of academic life, with visible recognition reinforcing its value.

One driver of this cultural change was the reimagining of Afeka's learning and work spaces. Prof. Moyal understood that Afeka graduates would likely work in high-tech environments, so the campus atmosphere was deliberately designed to reflect that world—open spaces, modern design, and vibrant wall art portraying historical scientists as contemporary figures with inspirational quotes. Learning areas were intentionally scattered across campus—not confined to the library—so students could study independently or in groups between classes. These spaces supported project-based and experiential pedagogy, fostered collaboration, and encouraged students to remain on campus, creating a constant, energetic presence that became part of Afeka's identity.

Another visible manifestation of this cultural shift was the call for faculty to propose new, innovative pedagogical approaches. Early adopters were encouraged to experiment, provided with institutional support, and recognized for their contributions. Their success stories inspired peers, creating a ripple effect that embedded innovation into the college's teaching culture.

Internal communications—built from the ground up—played a central role in connecting day-to-day activity with the larger vision. Achievements were framed as steps in the strategic journey, reinforcing a sense of shared ownership. A weekly newsletter became a staple of Afeka's culture, keeping the community informed, aligned, and connected.

Even Afeka's *Afeka Journal of Engineering and Science (AJES)*, for which this piece is written, embodies the Graduate Profile's emphasis on interdisciplinary thinking, publishing research that connected engineering with diverse societal and scientific contexts.

Prof. Moyal treated Afeka as a platform for fulfilling dreams. If a proposal aligned with the vision, had a structured plan, and clear metrics for success, it was given resources and support—even if it involved risk. This approach staged failure as a learning opportunity, encouraging initiative rather than caution.

The result was an organizational culture where excellence was expected but also enabled. Rising standards were not imposed from above without support—they were matched with investment in people, spaces, and tools to meet them.

Seeing Around Seven Corners

Visionary leadership is often described as the ability to see around the corner. In working with Prof. Moyal, it became clear that he could see around seven—anticipating not just the next step, but the sequence of developments, reactions, and consequences that would follow.

This foresight was evident both in long-term strategic planning and in times of crisis. The integration of the Graduate Profile across multiple domains was designed not as a set of isolated projects, but as a resilient, adaptive system. When COVID-19 disrupted higher education, Prof. Moyal insisted Afeka act quickly. While others relied solely on temporary remote teaching tools, Afeka invested in equipping every classroom with advanced hybrid-learning technology by summer 2020—preparing for a gradual, flexible return to campus.

During the Iron Swords War, Prof. Moyal was insistent that the college design solutions aimed at long-term sustainability rather than temporary fixes. With more than 40% of the student body serving in the reserves, the potential for dropout was considerable. Under his leadership, Afeka developed a comprehensive approach to flexibility that allowed reservists to continue their studies without compromising academic standards. One example was the decision to repeat all courses throughout the year, enabling students returning from service to rejoin the learning process. Though administratively complex and financially demanding, this and other measures ensured that reservists received the support they needed while preserving the integrity and rigor of Afeka's academic programs.

Throughout his tenure, professional disagreements often arose because others could not yet see the long-term consequences of decisions under discussion, but his track record of being "seven corners ahead" repeatedly validated his approach.

A Platform for Pursuing Passions

Over the past decade, Afeka has become a place where ideas take shape, where students, faculty, and staff can transform personal passions into concrete achievements. This shift did not happen by chance; it grew from a deliberate strategy led by Prof. Moyal to create an environment that empowers people to take initiative, explore new directions, and see projects through from concept to reality. For students, Afeka offers fertile ground for turning a personal passion into an engineering accomplishment. Through the OFEK Skills Development Centers and student-led clubs, they immerse themselves in projects that combine technical challenge with creativity and teamwork. Whether designing and racing custom vehicles in the Auto Club or leading other innovation-focused clubs, students experience the process of moving from vision to execution in a collaborative, supportive environment.

Faculty members, too, find in Afeka a space to pursue their passions — in developing innovative pedagogy, integrating industry-relevant skills into curricula, and conducting applied research that addresses real-world challenges. They are encouraged to experiment with new approaches, work across disciplines, and align their initiatives with Afeka's mission of producing engineers who are both technically proficient and personally skilled.

For staff, the college has become a place where professional roles extend beyond routine responsibilities. They are invited to initiate projects that strengthen Afeka's culture, build strategic partnerships, and enhance the institution's influence beyond its campus. Many have found deep professional satisfaction in advancing projects that have lasting impact.

For Prof. Ami Moyal himself, Afeka has been the realization of his long-held dream: to lead an institution that is fundamentally different in its approach to education — one that produces excellent engineers while also enabling its community to pursue their passions and dreams. This vision now permeates the institution's culture, shaping how Afeka defines success and measures impact.

Conclusion: The Power of Structured Vision and Foresight

Afeka's transformation over the past decade demonstrates what is possible when an institution applies the logic of engineering design to its own evolution—and when that design process is led by someone with both the discipline to define an outcome and the foresight to adapt along the way and that does not fear or try to avoid conflict along the way, but rather embraces it part of the process.

Under Prof. Moyal's leadership, the Graduate Profile and the transformation achieving it required became more than a document; it became the DNA of the college, shaping curricula, culture, spaces, partnerships, and public engagement. Storytelling turned internal reforms into a national example. A culture of trust, support, and ambition empowered people at all levels to contribute to the vision. Recognizing that real transformation must endure beyond any single leader, Prof. Moyal also laid robust platforms for long-term sustainability that embedded continuous improvement into Afeka's DNA.

Today, Afeka stands as a living example of what can be achieved when an institution becomes a platform for pursuing passions and dreams — for individuals at every level and for the organization as a whole.

For Prof. Ami Moyal himself, Afeka has been the realization of his long-held dream: to lead an academic institution of a different kind — Israel's leading institution for training engineers, built with the DNA of high-tech, capable of influencing the national agenda, and delivering an educational process that is relevant, empowering, and experiential. Over the years, this vision has been woven into the fabric of Afeka's culture, reflected in its Graduate Profile, its partnerships with industry and government, and its role in shaping national STEM education policy. His decade of transformative, forward-looking leadership at Afeka undoubtedly influenced his appointment as Chairman of the Planning & Budgeting Committee of Israel's Council for Higher Education — the highest position in Israel's higher education system — and will continue to guide him in this new role.

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The Essential Changes Needed in Academia for Engineering Training in a Changing Reality

Boaz Levy

Boaz Levy is an internationally renowned Israeli expert in systems engineering and space technologies, currently serving as CEO of Israel Aerospace Industries. Levy has over three decades of experience in designing, developing, and managing complex projects in the fields of missiles, space, and advanced defense systems, and has led professional teams in large-scale national and international projects such as the "Arrow" and "Barak 8" systems. Holding engineering degrees from the Technion and having served in the Air Force, he has combined technological achievements with innovative management and business vision in his work. In his tenure as CEO, he has made substantial contributions to advancing innovation and industrial excellence in Israel and is considered one of the prominent figures in shaping local and international security and science.

This article addresses innovative concepts in engineering education, with emphasis on integrating theoretical studies, practice, and systems thinking. The author emphasizes the importance of innovation, the ability to lead teams, and incorporating advanced technologies (such as artificial intelligence) in the training process. Focus is placed on "Time to Market," skills for working in multidisciplinary environments and applied projects, alongside fostering excellence and conceptualizing the engineer's role as a leader and multidisciplinary professional. The article's goal is to propose an updated educational model for engineers suited to the challenges of industry and science in Israel and globally.

Just as the computer and internet revolutions had their impact in their time, today's artificial intelligence revolution and the accelerated development of technology in general require fundamental changes in the academic training of engineers. The essence of this change is a transition to developing creative thinking, business leadership, and the ability to lead innovation – both in defense and civilian industries.

Academia currently places great emphasis on familiarity with "engineering truth" and learning rules, laws, and methodologies. But for integration into today's job market, it is now necessary to develop and refine **engineering thinking** based on systems perspective, problem-solving, and intelligent use of advanced technologies. This is a fundamentally different approach from what led academic training in the past: less specialization in programming languages or specific tools and more integrative understanding of the system.

The two main parameters that define an engineer's success and the relevance of their products in today's market are the time it takes to bring the product to market, from the idea and planning stage to market release (Time to Market), and its cost. Experience shows that those who can shorten development time and reduce costs will inevitably lead the future market – and this in itself is a capability that requires a change in the conception of engineering training.

In the current reality, artificial intelligence provides engineers with far more sophisticated tools than before. Thus, instead of spending years learning how to write code in various languages, it's enough to know how to formulate a clear request to an AI tool and receive the ready solution. This is also true for mechanical and electronic design – while in the past comprehensive expertise was required to design gears, today optimal design can be obtained within minutes.

It's important to remember that this revolution is not the first to cause dramatic changes in engineering professions in particular and the job market in general. Several decades ago, when the first computers entered industry, many feared that engineers would become redundant. In practice, systems became more complex, and the number of engineers actually grew. Similarly, today, in my estimation, industry won't require fewer engineers, but they will engage in more complex and sophisticated tasks.

Accordingly, the required change in academia is significant – instead of focusing on learning specific tools and solving differential equations, the focus should be on developing engineering thinking. Today, engineers don't solve equations themselves because computers do it for them, but intelligent systems cannot substitute for creativity, intelligent problem-solving, or developing innovative solutions to existing needs.

The Gap Between Traditional Thinking and Innovative Approaches

In the current reality, engineers require different thinking patterns from those that predicted success in the past. To illustrate this, let's focus on a challenge that arose at Israel Aerospace Industries when we embedded 3D-printed components in satellites, aiming to reduce their weight and shorten development time.

While veteran engineers designed components according to traditional principles, placing significant emphasis on mechanical strength and stability, young engineers not limited to old methods proposed revolutionary solutions: hollow designs, minimal material use, and abstract geometric shapes that more precisely matched the new needs. The result was a product that was not only lighter but also cheaper to produce, faster to develop, and with improved performance.

This is just one example of the gap academia needs to address – not just training engineers who know how to perform traditional calculations, but those capable of thinking outside the box and utilizing all available technologies for their purposes.

One of the significant challenges before us currently lies in the need to prepare engineers for proper work with new technologies. In electronics, for example, the ability to print 3D circuits with integrated components enables designs that were impossible in the past. This is a true engineering revolution because today the engineer is almost unconstrained regarding manufacturing and design capabilities. In other words: while in the past one had to consider limitations of production lines or certain standards, today the main limitations are price and time – and these are two parameters that can definitely be controlled through creativity and intelligent planning.

Since the main gap between academic training and industry needs is not in mathematics or physics, but rather, as mentioned, in engineering thinking capability, and since the engineer's purpose is to define the desired product and think about the simplest physical ways to achieve it – it follows that academic training must develop future engineers' systems perspective capability, meaning understanding how each component in a product connects with other components and how the product integrates into the larger system.

The Engineer as Entrepreneur and Leader: The Need for Business Skills

Of approximately 15,000 Israel Aerospace Industries employees, about 7,500 are engineers, and each one is, to a large extent, an entrepreneur who needs to "sell" their ideas to various stakeholders – investors, managers, colleagues, and customers. Successful engineers are also those who know how to present their vision in a smart, clear, and convincing business manner.

Academia today still doesn't train engineers for this type of business thinking. The implication is clear: engineers who don't know how to present the product they're designing or their entrepreneurial thinking coherently will need more time to advance their careers, even if their knowledge is extensive and their skills excellent.

Currently, every engineer is a potential project manager, and every project requires management and leadership skills. Therefore, they're expected to know how to lead multidisciplinary teams, coordinate between different parties, and make decisions even in uncertain situations. These are skills that traditional academia, as mentioned, doesn't emphasize sufficiently, but they're critical for success in modern industry.

In recent years there has been a dramatic increase in the proportion of women in engineering professions – and this is obviously a blessed and necessary trend. While in the past the number of women in "heavy" engineering professions was low, today the rate grows consistently and continuously. Moreover, beyond the increase in the number of women in industry, there's also a rise in the number of female engineers reaching senior positions and becoming knowledge centers in organizations, including at Israel Aerospace Industries.

Israel Aerospace Industries is proud to be a partner in this change and contribute to empowering women in senior engineering positions. Reality on the ground shows beyond any doubt that there's no fundamental difference between male and female engineers in their professional capabilities, with existing differences mainly stemming from social and cultural influences that are, as mentioned, decreasing.

Critical Traits for Success in the New Era

Alongside the required changes in engineering training in academia, it's important to emphasize that the personal qualities and character traits of engineers themselves have decisive weight in professional success. Two character traits that stand out in this context are curiosity and broad vision. Curiosity is what drives an engineer to seek new solutions and not settle for existing ones, while broad vision is defined as the ability to be a "T person" – someone with deep knowledge in a specific field, alongside broad understanding of additional fields and the ability to see the big picture.

Engineers with curiosity and broad vision also understand how their field connects with other fields and how to harness knowledge from other fields to solve problems in their field. The ability to hold deep professional knowledge and understand the economic, social, and technological implications of an engineering solution – is what makes an engineer a significant anchor in complex and multidisciplinary industry.

Ultimately, it's important to remember that the artificial intelligence revolution is just one of many technological revolutions that industry has experienced. True, the leap it will enable may be more significant, but the way to navigate it is identical and requires proper preparation and adapting training to changing reality.

Academia must transition from training focused on technical tools to training that places greater emphasis on creative thinking, business capabilities, and leadership. Today's engineers – not just tomorrow's – are technological entrepreneurs who combine deep professional knowledge with business understanding, leadership capabilities, and strategic vision.

This is a necessary condition for shaping a new generation of engineers who can lead Israeli industry into an advanced future and ensure the preservation of its technological and security superiority. In a reality where Israel faces complex security challenges, the need for leading and creative engineers is more critical than ever.

The Personalization Paradox: How the Pursuit of a "Market of One" Builds the "Organized Self"

Perry Levy

The author, with over 20 years of experience in business management, marketing, and digital strategy at leading organizations, specializes in driving customer-centric digital transformation, developing personalization systems, and implementing innovative solutions for user experience management. Throughout her career, she has held senior management positions at Strauss Group and Colmobil, where she led innovative digital initiatives and interdepartmental collaborations, alongside establishing an independent consultancy agency in data and digital services. Her professional background provides her with a broad perspective for understanding the paradoxes and challenges of integrating AI technologies and recommendation systems in organizations, reflected in applied and critical analysis of their impact on organization-customer relationships in the digital age.

This article examines how smart technologies and AI-based recommendation systems are transforming user experience in the digital age: on the one hand, they enable optimal personalization leading to engagement, convenience, and economic value; on the other hand, they increase risks of filter bubbles, loss of diversity, decision fatigue, and algorithmic biases. The article proposes models for balancing personalization with preserving human-social values, and presents ethical challenges (fairness, privacy, value-sensitive design) alongside current regulatory and technological solutions, using field examples.

An Inter-Generational Dialogue (A Fictional Story)

Shahar, a software engineering graduate from Afeka, arrived excitedly at her grandmother's house, a retired psychologist. "Grandma, look", she said, presenting "CURA", the podcast application she had created. "The algorithm learns you and serves you exactly the content you'll love. It's the end of unnecessary searches".

Her grandmother smiled warmly. "Impressive, dear. It reminds me of 'Tuesdays with Schwartz'". Shahar looked confused. "Who's Schwartz?" "Oh", her grandmother laughed, "he had a record stand downtown. Every Tuesday I'd go to him, and he'd say, 'Ruth, I heard something you'll love'. He knew my taste, but sometimes he'd surprise me. 'This isn't exactly you', he'd say, 'but give it a chance'. That's how I discovered Coltrane. That's how the whole neighborhood discovered Nina Simone. Schwartz wasn't an algorithm; he was a community curator. He didn't just give us what we wanted; he shaped our shared taste".

Shahar listened, and her excitement began to shift to deep reflection. She had built a perfect tool for understanding the individual, but what about the shared experience? Was CURA, in all its sophistication, creating millions of personal, isolated content worlds where no one discovers the "Nina Simone" of the next generation together?

At that moment, Shahar understood **the personalization paradox** – the pursuit of perfect personal fit ("The End of Average") could, unintentionally, dismantle the shared culture that makes us a society and trap each of us within our own comfortable bubble, the "Organized Self".

The Great Promise, the Death of Average, and the Pursuit of the Individual

The vision that drove Shahar is one of the deepest business-technological revolutions of our time. For over a century, the world operated under the "design for average" paradigm. As Todd Rose argues in his book "The End of Average", the problem is that the average person isn't someone you can meet on the street – they're the result of a calculation (Rose, 2016). Thus, many systems from education to consumer products built and developed curricula and products for "the average person", a mythological creature that doesn't really exist. The result was systems and products that didn't perfectly fit anyone.

The aspiration for personalization, driven by data and artificial intelligence technologies, offered an escape route. For the first time in history, we could build systems that adapt themselves to the individual. The shift from focusing on who customers are (demographics) to focusing on *what they do, want, and feel* (behavior and context) gave birth to a "market of one".

The promise is enormous. A more efficient, relevant, and personal world. In this world, Nike doesn't just sell shoes; it becomes your personal fitness coach through its running app, Training Club (Nike, Inc., n.d.), which collects behavioral data and in return provides value in the form of training programs. Stitch Fix doesn't run a traditional clothing store but maintains an ongoing dialogue about style with each customer, using AI and human stylists (Stitch Fix, Inc., n.d.) to discover their unique preferences. Amazon creates millions of personalized digital storefronts, and Netflix even customizes poster designs for each viewer (Netflix, Inc., n.d.).

This is a world where technology understands us deeply and saves us time and cognitive effort. The consumer feels "seen" and valued.

The Economic Engine of the Flywheel

What makes the pursuit of personalization so powerful isn't just the technological potential but the economic model it creates, sometimes called "The Personalization Flywheel". This is a self-reinforcing circuit: the more users engage with a product, the more data it collects to improve the personal experience, causing users to become more engaged, and so on. This flywheel creates an "Economic Moat" around companies like Netflix and Spotify. An "economic moat" means a sustainable competitive advantage that protects the company from competitors, just as a moat surrounding a castle protects it from invaders. Their real asset isn't the algorithm itself, but the user data that feeds it (Zuboff, 2019).

The mechanism works as follows:

1. **Initial value:** The company offers a product or service with basic value, for example, the ability to listen to podcasts on CURA.
2. **Data collection:** The more active the user, the more data they generate about their preferences and behavior.
3. **Product improvement:** The data feeds the algorithm, which improves the experience and makes it more personal (more accurate recommendations, customized interface).
4. **Added value:** The improved and personal experience provides more value, and the service feels like it "understands" the user.
5. **Increased engagement:** As a result of the added value, users increase their product usage, leading back to collecting more data.

The Hidden Cost: Building the "Organized Self"

But every promise has a price. Personalization, as a tool, isn't neutral. It's driven by business goals that usually prioritize "Engagement" and "usage time". To achieve this, algorithms predict what we'll want, when their goal isn't necessarily to expand our horizons but to maximize the likelihood we'll stay active on the platform.

Here the "Filter Bubble" is created, a term coined by Eli Pariser in his book *The Filter Bubble: What the Internet Is Hiding from You* (Pariser, 2011). This term is the personal technological mechanism that filters our information, whereby algorithms surround us with different versions of what we already love, know, and believe in, thus our news feed becomes an "echo chamber" where only our opinions are echoed back (Sunstein, 2001). And the consequences? They're far-reaching:

- **Serendipity Loss**. We lose the ability to accidentally encounter something different, challenging, that might change our lives. Algorithmic recommendation eliminates "fortunate randomness", which was an important source of learning and discovery.
- **Atrophy of the choice muscle**. When difficult choices are made for us, we lose confidence in choosing for ourselves. This phenomenon is closely related to the idea of "Decision Fatigue", researched by psychologist Roy Baumeister (Baumeister et al., 1998). Baumeister showed that willpower is a limited resource. Algorithms offer us a magic solution to prevent this fatigue, but in the long term, reliance on these "crutches" could lead to atrophy of the "muscle" of conscious decision-making ability. This theory is disputed in research but continues to serve as a useful model for understanding the cumulative impact of cognitive load.
- **The attention economy**. As Tristan Harris from The Center for Humane Technology warns, the business model of most platforms turns our attention into a product (Harris & The Center for Humane Technology, n.d.). Features like infinite scroll and autoplay are engineered to exploit psychological weaknesses and keep us connected, not necessarily to make us happier (Fogg, 2003).

These concerns are supported by research. A study by Bakshy, Messing, and Adamic (2015) on Facebook found that recommendation algorithms significantly reduce exposure to diverse opinions. Another study by Fleder and Hosanagar (2009) showed that recommendations lead to "homogenization" of taste, as people with different preferences become more similar over time.

The result is a world where technology not only serves our existing desires but also actively shapes our future desires. It paves comfortable, almost invisible paths for us, and the human brain, programmed to save energy, chooses to walk in them. Thus, without noticing, the individuality that personalization promised to serve begins to shrink into a predictable data profile.

Choice Architecture and Economic Impact

Beyond psychological impact, personalization has direct economic consequences for consumers. It enables companies to implement "Dynamic Pricing" techniques, a strategy where the price of an identical product or service isn't fixed but changes in real-time from person to person. The algorithm evaluates each consumer's "willingness to pay" based on purchase history, location, and even the type of device they're browsing from. For example, an Uber ride or flight ticket price can be higher for a user the algorithm identifies as more "desperate" or affluent. Thus, Apple users may sometimes see higher prices.

Personalization, then, offers us not only more relevant products; it could also cause us to pay more for them in a way that serves the seller's interest, sometimes at the expense of transparency and fairness.

Algorithmic Cultural Hegemony and the Creator Economy

The impact of personalization extends beyond consumers and disrupts the world of content creators, musicians, writers, journalists, and video creators. In the "Schwartz" era, to succeed, a creator needed to convince a small number of human gatekeepers. Today, every creator faces one gatekeeper, giant and almost impossible to crack: the algorithm. The "algorithmic king" prefers content that can be easily categorized, that fits existing patterns and generates quick engagement.

Creativity becomes subordinate to optimization. The algorithm identifies trends and amplifies them, leading to cultural "homogenization", where the mainstream becomes even more central. In simple words, everyone starts to sound and look more similar because they're aiming for the same algorithmic goal. Ironically, there's inherent tension among young consumers (Generation Z), who on one hand champion values of authenticity and uniqueness, and on the other are deeply influenced by and tend to adopt the latest algorithmic trends on TikTok and Instagram.

The result is enormous pressure on creators to adapt themselves to the machine:

- **Optimization at the expense of creativity:** YouTube creators engineer their video titles to contain precise keywords. Musicians insert the chorus within the first ten seconds of the song because they know that's when Spotify's algorithm decides whether to skip. Writers write for "Amazon keywords".
- **Remix and trend culture:** An algorithm identifies a trend (TikTok dance, certain musical style) and amplifies it. To "ride the wave", many creators rush to produce variations on the existing trend instead of creating something entirely new. The result is cultural "homogenization", where the mainstream becomes even more central and it's harder for breakthrough and different creations to surface.
- **Economic inequality:** While personalization allows niche creators to find their exact audience, a phenomenon called the "long tail" (Anderson, 2006), it also creates the "all or nothing" economy, promoting what's already popular and creating a positive reinforcement loop for big stars, while other creators struggle for attention scraps.

Moreover, since most algorithms were developed in Silicon Valley and fed with Western data, they tend to prefer content with American or European aesthetics, language, and cultural norms. The result, sometimes, is that personalization could become a tool of cultural globalization where local and cultural narratives and styles are pushed to the margins or receive no exposure at all.

The dilemma for the modern creator is existential: should they create the art they believe in or the art the algorithm will promote? The trend is even intensifying with the entry of generative artificial intelligence (GenAI) that enables creating infinite variations on known and successful formulas, threatening to push out even more original human creativity.

Beyond the Bubble: Social and Neurological Effects

The impact isn't limited to personal experience but spills into broad social and neurological implications. Socially, filter bubbles exacerbate polarization. When different groups in society consume different versions of reality, the cultural and factual common denominator erodes, and public discourse becomes a "dialogue of the deaf" (Sunstein, 2001). This is a real danger to the foundations of democracy based on an open marketplace of ideas, and a shared factual basis becomes a trainer. Remember "Schwartz"? He was the neighborhood's "tribal fire". Today, we have billions of personal fires, and it's increasingly difficult to find the communal one.

Neurologically, personalization harnesses the principle of neuroplasticity, the brain's ability to create and strengthen neural connections based on repeated experiences. Every time we consume a certain type of content, the "neural pathway" in our brain associated with it strengthens. Algorithms, by repeatedly presenting similar content, actually pave and tighten the "neural pathways" in our brain. As a result, deviation from the familiar path requires greater cognitive effort. But it's important to remember, neuroplasticity works both ways; just as the brain can learn limiting patterns, so it can, with conscious effort, create new pathways and break old habits.

The Algorithmic Bias Dilemma

Another critical question is that of biases. Algorithms learn from past data, and if these reflect existing social biases, the algorithm will not only replicate them but amplify them. For example, if a recruitment algorithm "learns" from a company's hiring history where most engineers are men, it might conclude that men are better candidates and begin systematically filtering out women's resumes. Similarly, studies like "Gender Shades" showed that facial recognition algorithms proved less accurate in recognizing faces of dark-skinned women, as a result of training databases that weren't diverse in terms of race and gender (Buolamwini & Gebru, 2018), and not necessarily from technological failures themselves. The result emphasizes how biased data can harm entire populations. The engineer's responsibility isn't just to build an accurate model but also to actively examine the data it's trained on, identify potential biases, and correct them. Otherwise, personalization could become an engine of mechanized discrimination.

The Collision Point: The Responsibility of Digital Experience Designers

The responsibility for dealing with the personalization paradox isn't only on regulation or industry but also, and perhaps primarily, on those who design the technologies themselves – engineers, experience designers, algorithm developers, and data professionals. They are the digital experience designers and therefore hold the power and responsibility to set the rules of the game.

Already today there are signs of change – ventures seeking to introduce ethical metrics to business success metrics, companies redefining the conversion ratio between screen time and profit, or academic institutions introducing courses in AI ethics. Even in corporations like Microsoft, Salesforce, or Google, complementary success metrics like Wellbeing Index or Trust Scores are beginning to be examined to assess not just how well the algorithm sells, but also its long-term impact on users.

The dilemma isn't technological but ethical in essence. It's expressed in concrete questions that development teams must ask themselves:

- **What is our success metric?** Are we measuring only "usage time" and "click rate", or are we trying to measure more complex concepts like "mental wellbeing", "horizon expansion", or "personal growth?"
- **How do we balance personalization with serendipity?** Can we intentionally engineer "surprising recommendations?" Can we allocate 10%-15% of our recommendations to content that challenges the user profile?
- **How much transparency and control do we offer?** Does the user understand why they see what they see and can they "tune" the algorithm?
- **Where is the line between persuasion and manipulation?** Is our use of data intended to help users make better decisions for themselves or to get them to make the decision we want them to make?
- **How do we deal with fake news and harmful content?** How do we ensure the information users receive is accurate and balanced?

Beyond the Dilemma: Ethical Action Frameworks

Dealing with these questions requires education that's not just technical but also humanistic and ethical. The engineer of the future must understand not just how to build the system but also its psychological, social, and cultural impact, and be not just a problem solver but also an ethical gatekeeper. This is a challenge requiring multidisciplinary training including psychology, sociology, philosophy, and ethics, alongside advanced technical skills.

The answer to these challenges cannot remain at the theoretical level. In the technology world, practical frameworks are currently developing for dealing with ethical dilemmas. Advanced companies are beginning to adopt models like "Value Sensitive Design", a methodology requiring defining human values (like privacy and autonomy) at the beginning of the specification process and ensuring technology is designed to advance them, not just meet business goals (Friedman et al., 2008).

Additionally, the importance of new organizational roles is rising, like "organizational ethicist", whose role is to serve as the development team's "conscience", challenge basic assumptions, and perform "Ethical Impact Assessments" before launching new features. Questions they ask include, "What are the unintended consequences of this feature? Who might be harmed by it? How can it be misused?"

Implementing such frameworks and roles is the way to translate ethical discussion from abstract questions to concrete work processes and ensure responsibility doesn't "fall between the cracks".

Navigating the Paradox: Building a Responsible Digital Future

The solution to the personalization paradox isn't choosing between "The End of Average" and "The Organized Self" but intelligently combining both. We should strive for technology that understands us enough to be useful but respects us enough to leave us room to choose, err, and discover. The way forward consists of two parallel paths:

1. **Personal "digital mindfulness".** We must develop awareness of how technology affects us. We must move from passive consumption to active and conscious use, including intentional diversification of information sources, taking control of settings, conscious consumption ("why am I seeing this?"), and maintaining "analog" spaces not digitally mediated, like face-to-face conversation, nature walks, reading printed books, thereby allowing the brain rest from algorithmic stimuli.

2. **"Responsible personalization" as an industry standard.** As creators and developers, we must build better. This means adopting principles of:

   - **Active transparency –** explaining to users in clear language how the algorithm works, not just through long policy documents but in the interface itself.
   - **Meaningful control –** giving users real "regulators" to direct their experience. For example, adjustment between comfort and challenge, between innovation and security, and between diversity and relevance.
   - **Genuine mutual value –** ensuring users receive measurable value that improves their lives, not just keeps them "engaged".
   - **Intentional diversity –** embedding mechanisms that intentionally expose users to content and ideas they wouldn't choose themselves but might enrich them.

3. **Smart regulation.** Relying on companies' goodwill and user awareness might not suffice. Governments worldwide, especially in Europe (with GDPR laws and Digital Services Act), are beginning to understand the need for regulation. This regulation shouldn't stifle innovation but set clear red lines. For example, platforms could be required to offer users a chronological, non-algorithmic version of their feed, demand full transparency on how recommendation engines work, or prohibit "dark psychology" methods – Dark Patterns (Gray et al., 2018).

The Alternative of Human Curation

Are there practical alternatives to the pure personalization model? The answer is yes. Take for example the streaming service MUBI. Unlike Netflix with its almost infinite catalog, MUBI offers only 30 films at any given moment. Every day, one film is removed and a new one is added, and the selection is made by a team of human curators, cinema experts. Their model isn't based on "what else would you like to see that's similar to what you've already seen?" but on a clear statement, "This is the film we think you should see today". This model returns trust in human expertise, creates a shared experience (everyone talks about "today's film"), and encourages adventurous viewing. MUBI and tools like Readwise, which allow users to randomly discover passages from their reading library, prove it's possible to build successful business models based on "less but better", and that there's a large audience thirsty for human curation and not just algorithmic matching.

The vision isn't a world without algorithms but a world where we consciously harness them; a future where Shahar, founder of CURA, embeds a "discovery mode" in her product, and a future where Netflix will let us click a "really surprise me" button and present us with a black-and-white film by Japanese director Yasujiro Ozu. This is a future where personalization doesn't just serve as a mirror reflecting our familiar image but as a window, opening possibilities we haven't yet explored. The challenge and great opportunity for the next generation of engineers, developers, and entrepreneurs isn't just to build tools that understand humans as they are today, but to create tools that will help them discover everything they don't yet know they can be.

Three Points for Implementation

1. **Recognize the paradox:** The technology enabling amazing business personalization ("The End of Average") is the same technology that could create "filter bubbles" and reduce personal autonomy and diversity ("The Organized Self"). Understanding this tension and recognizing it as a challenge requiring conscious solution is the first step to building responsible technology.

2. **The responsibility lies with the architects:** Engineers, developers, and entrepreneurs have an ethical responsibility to build systems that respect users as complex, developing humans. Success should be measured not just in engagement and usage time but in real value to people's lives, integrating principles of transparency, control, and intentional diversity.

3. **Adopt a proactive approach (as users and engineers):** As users, we must consume content consciously and actively. As engineers, we should strive to engineer systems that enable not just adaptation but also discovery, surprise, and personal growth.

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Academic Coupon: The Path to Rapid and Effective Rehabilitation of the Engineering and Technology Workforce in Israel

Ehud Menipaz

Ehud Menipaz is a Professor Emeritus, a world-renowned multidisciplinary expert in management, engineering, and innovation. He served as Dean of the Faculty of Industrial Engineering and Management at Holon Institute of Technology (HIT), was head of the Abe and Sol Krok Chair in Entrepreneurship at Ben-Gurion University, and founded leading academic centers for business, technology, and society. Menipaz is a member of international committees, scientific editor, and recipient of awards for academic excellence and global leadership. He has advised international organizations and supported the advancement of entrepreneurship and innovation in dozens of countries. Among his roles: founding director of Junior Achievement Israel, advisor to governments and industries, and fellow of leading economic forums worldwide.

This article addresses the central challenges facing higher education in the current era, particularly in the fields of engineering and management, and describes trends and changes requiring systemic, innovative, and multidisciplinary responses from institutions and researchers. The article discusses the impacts of technology, globalization, and demographic crisis on the education system, and proposes "Push & Pull" models for knowledge development, excellence, and training technological leaders for a changing market. Its conclusions emphasize the importance of entrepreneurial thinking, adapting content and teaching approaches, and the close relationship between academia, industry, and society.

In recent years, it has become increasingly clear that engineering education in Israel is at a crossroads, requiring innovative, sometimes radical thinking suitable for 21st-century challenges. This is not merely about updating curricula or integrating advanced teaching technologies, but about a comprehensive paradigm shift regarding how young women and men acquire engineering education.

The history of engineering education in Israel is replete with impressive Zionist initiatives. Already at the beginning of the 20th century, long before the establishment of the state, the Technion was founded in Haifa through the initiative of visionary figures such as Dr. Paul Nathan, David Wissotzky, and Ahad Ha'am. Subsequently, additional institutions were established, including the Hebrew University in Jerusalem and the Weizmann Institute of Science in Rehovot. These institutions laid the foundation for establishing Israel's higher education system, which over the years has expanded to include dozens of academic institutions – research universities, public and private colleges, and applied technological institutes.

However, in 2022, after more than a hundred years of institutional development and knowledge accumulation, there is a growing need for an educational revolution: a transition from a linear, fixed, and rigid teaching model to a flexible, modular, and personalized system where students can combine learning with realizing business and technological initiatives, relevant employment, or applied research in real-time.

The Need for Flexibility and Employment Reality

Professional forums and numerous academic committee recommendations repeatedly note that the traditional model of a four-year study program, delivered in a unidirectional approach ("Push") from lecturer to student, no longer matches the changing needs of the economy or of the students themselves.

Reality shows that between 30% and 40% of students work during their studies, and a significant portion of them are interested in working in their field of study – creating a need for closer interface between academia and industry from the earliest stages of education.

Hence a creative, pragmatic, and innovative solution emerges – the "Academic Coupon."

The Academic Coupon: Principles and Practical Proposal

The Academic Coupon is a program for making academic education in engineering and technology fields accessible in a modular, gradual, personally adapted manner without immediate linear commitment. In this model, candidates with appropriate qualifications will receive a personal coupon, similar to a voucher, allowing them to study at any institution they choose from a list of participating institutions – over a period of up to ten years.

Key Elements of the Model:

1. Conditional suitability coupon – will be given to candidates with high potential in engineering and technology fields.
2. Extended implementation period – ten years for full or partial redemption of the coupon, including the possibility of intermittent redemption.

3. Option for entrepreneurial or employment leave – students can take planned breaks for relevant work, developing a venture, or implementing a patent – with notification only, without requiring approval.
4. Flexible return to studies – possible to return to studies at any participating institution, even if different from the institution where studies began.
5. Degree eligibility – will be granted according to the institution where students completed most of their studies, or according to predetermined rules.

Pull Approach – Education on Demand

The Academic Coupon supports the "Pull" approach: learning is driven by the needs of students or employers, not by a fixed didactic structure. In this model, students are active – aspiring, choosing, building a personal path. They are not pushed into a fixed track but pull the relevant knowledge at the appropriate time.

This approach meets employers' demands, who often don't require a formal academic degree but rather current practical knowledge, cognitive flexibility, and real experience – all direct products of a flexible, initiative-encouraging, market-adapted system.

Conversations with Israeli hi-tech communities show enthusiasm for the idea. Entrepreneurs across the country – from Rothschild Boulevard to the Matam Park in Haifa – see the Academic Coupon as an engine for accelerating technological development, reducing barriers to academic entry, and strengthening the connection between education, innovation, and employment.

Managers and engineers at companies like Intel, Elbit, and Rafael have also expressed great interest. They argue that this approach enables the development of young talents who cannot integrate into existing frameworks due to personal, economic, or entrepreneurial commitments.

Summary

The Academic Coupon offers a significant, practical reform with the potential to fundamentally change engineering education in Israel. The model doesn't abolish academia but strengthens its relevance – while allowing students to choose the time, place, and manner in which they acquire their education. In doing so, it returns academia to the center of social-technological discourse, not as a closed body but as an open, collaborative space adapted to the new generation of learners and creators.

Learning to Think, Feel, and Adapt: General and Engineering Education in the Age of AI

Dadi Perlmutter

Dadi Perlmutter is one of the leaders of Israeli high-tech and a senior engineer with global influence in computing. During his years at Intel (1982–2014), he served as Senior Vice President, led the development of Pentium processors and the mobile computing and wireless internet revolution, and was the most senior Israeli in the company's management. Perlmutter founded a high-tech investment fund, advised and led social organizations at the core of technology-society interface, and headed government committees for advancing human capital in high-tech. In 2025, he was appointed Chairman of the Board of Governors of the Technion and stands at the center of activities promoting education, innovation, and technological employment, alongside public activity in AI training, education, and broad social impact.

This article addresses the impact of the generative artificial intelligence revolution on education systems, engineering, and training for the changing economy. It analyzes global trends, such as changes caused by Generative AI and their implications for the job market, thinking capabilities, and technological knowledge. The author proposes dynamic approaches to education and engineering training, emphasizing the importance of continuous learning, developing current skills for dealing with changing reality, and renewed integration of digital content and tools in teaching, management, and economic activity processes.

Since my early childhood, I loved reading about people of science and the humanities and their way of thinking. Einstein's most memorable statements to me are that learning is not just acquiring knowledge and facts, but primarily developing ability, thinking, understanding, and asking questions. This was the essence of education in his eyes – not filling one's mind with information, but training thought based on deep knowledge.

This way of thinking also served me throughout my life, from my youth and throughout my career. I was guided particularly by the mantra "questions are more important than answers", which was for me a tool for developing curiosity and searching for new problems and creative solutions, and was a guiding light not only in my professional path but also in educating my children and now my grandchildren.

Academia today faces enormous challenge and risk on the one hand, and unprecedented opportunity on the other hand – how to equip graduates not only with knowledge but also with the abilities and skills needed to deal with today's complex world and future challenges. Academia has always been a unique space where human knowledge develops, and it should be the compass directing society toward the future. However, today it sometimes seems that academia is not connected to the pace of change and struggles to respond to the changing needs of the job market and society in general, requiring renewed thinking.

The Historical Context: Revolutions Changed the World and Education

In addition to geopolitical fluctuations affecting the economy, alongside war and political crisis, we now stand at the threshold of a new revolution – the artificial intelligence revolution. This is a revolution that is fundamentally technological, but in essence changes world orders in all areas of life – it is actually a "thinking revolution" the world is undergoing. Until now, thinking was completely human; in recent decades we were aided by digital media that accelerated processes, but in the current period, those who settle for human tools alone will be left behind. The new thinker is one who combines human and digital.

Like the previous revolutions – from the agricultural revolution, through the industrial revolution and electricity revolution to the information and computing revolution that brought digitization into our lives – this revolution too completely changes human lifestyle. One of the dramatic changes is the way humanity educated, taught, and trained its children and youth. Educational institutions were created – schools and universities, demand began for literacy and reading and writing ability for all, and university education became a necessary condition for entering knowledge-intensive professions.

The Development of Academia Throughout History

The roots of modern academia lie in the Middle Ages, with the establishment of the first universities like the Universities of Bologna, Oxford, and Paris, which focused on fields such as theology, philosophy, law, and medicine. During this period, with the Industrial Revolution in the 18th and 19th centuries, academia underwent significant change, as traditional fields of knowledge such as engineering, chemistry, and physics underwent a revolution that adapted them to the modern and industrial world. They were joined in the second half of the 20th century by new professions like computer science. During this period, universities began focusing on training skilled workforce and applied research supporting industry.

The expansion of the knowledge base and communication possibilities enabled the change from a period when knowledge and control were in the hands of few, mainly clergy, to its dissemination to an increasing number of people. This was not just scientific and economic momentum but a transition to democracy and more freedom for the individual. Ultimately, education became a reality-changing economic, social, and employment engine. Citizens transformed from being "stupid citizens" who followed orders to "smart citizens" who were informed, involved, and influential.

During the period between the two world wars and after, academia became a significant center of advanced scientific research, as countries increased investments in academic research and technological development. For example, in the United States, organizations like DARPA, NSF, and NASA were founded, bringing enormous breakthroughs in science and technology. In the era of the digital revolution at the end of the 20th century and beginning of the 21st century, academia again developed significantly and became a center of innovation, development of computing technologies, and digital communication.

Throughout history and until today, academia has been the central source of human knowledge through research in all fields and particularly in science, technology, and engineering. It was, almost exclusively, the body training both professionals for the employment world and future researchers. Its activity led over the years to unprecedented economic growth and opened opportunities for acquiring education for many populations worldwide.

Today, in the age of artificial intelligence, academia's future stands under a big question mark: How will the thinking revolution affect academia and how will academia create its future so it maintains the crucial influence it has been creating and leading for hundreds of years? Academia must again adapt itself to changes and adopt a new role, where emphasis is on developing creative, multidisciplinary skills and critical thinking, while finding new ways to conduct breakthrough research.

The Perfect Storm: The Engineering Job Market in the Age of Artificial Intelligence

The world – including Israel – is experiencing a "perfect storm" of social, political, economic, and technological crises amplified by tools that emerged in the digital revolution era, like the internet and social networks, alongside the ability to create "fake news" by anyone and distribute them worldwide in fractions of a second. Various technological capabilities enable production of advanced weapons even for bodies with limited means. While past wars were over water, territory, religion, trade routes, and oil, today global tensions have added struggles over control of advanced technology. Within all these, we face unprecedented change.

The agricultural revolution enabled use of animal power stronger than humans, and the industrial revolution made use of machines stronger and faster than humans and animals, and recently, machines that compute calculations and find data faster than humans – in all these, the common trait of them all was that humans were the thinker and controller of the process. But now, for the first time, comes a capability developed by humans, but with impressive self-learning ability that may develop intelligence higher than human – meaning threatening to exceed the boundaries of human control. Paraphrasing Ecclesiastes, one can ask: "What advantage has man over machine? None."

On the one hand, artificial intelligence technologies create new groundbreaking opportunities; on the other, they bring deep uncertainty in the job market and fear of massive job loss. Generative AI, like GPT and GEMINI, already affects many engineering professions, replacing routine tasks and emphasizing the need for new skills. Therefore, fields like software engineering and computer science, mechanical engineering, civil engineering, and electrical and computer engineering are already beginning to feel the direct impact of AI through advanced automation, smart simulations, and optimization of processes that were until recently under engineers' exclusive responsibility.

Here the question is asked, and debates are many: Will most jobs become redundant and we'll all be unemployed? Or will jobs indeed disappear, but new ones will be created, and those that remain will change fundamentally? The World Economic Forum report predicts few jobs will disappear, and new jobs will be created – but most importantly, a significant portion of jobs will change, a certain percentage of them fundamentally, due to the appearance of artificial intelligence (World Economic Forum Report on the Future of Jobs, 2025).

The risk and major change in the short term is actually in white-collar professions, mainly in routine tasks: basic-level programming, accounting, report writing, and the like.

Required Skills and Thinking in the Age of Artificial Intelligence

In the world being created before our eyes, where artificial intelligence changes the rules of the game, acquiring narrow technical knowledge is no longer sufficient. In the past, many workers, including in engineering fields, worked mainly in application. They received a problem, more or less defined, and were asked to precisely design the solution for it: whether through writing software, designing a bridge, developing a computer chip, and more.

In my first roles as a computer chip development engineer, I was asked to solve tasks given to me by my managers – they asked and I answered. Over time, I learned to successfully answer more difficult and complex questions. But when I became a manager and architect, my responsibility changed: then I was asked to define what the next problem to solve was. I discovered that for this I needed to ask more complex questions and find answers with additional people working with me. Then I discovered that the people I work with are better than me at finding answers, and I need to specialize in asking the right questions, since this requires more skill and entrepreneurial ability, creativity, and critical thinking.

During my work, but also as a parent, I discovered an interesting phenomenon: in coloring book tasks, there are people who know how to fill in the right color and not exceed the lines; others, fewer, don't want to color at all but create the shapes themselves; an even smaller minority knows and loves to do both things.

In the age of artificial intelligence, the need for those who know how to color is decreasing, and those who remain are those who know how to ask, gather the right data and focus on describing the problem, and are helped not only in getting answers but also and mainly helped by artificial intelligence to ask questions. That is, the ability for multidisciplinary and multi-system thinking about the system as a whole prevails over deep and narrow knowledge in specific application fields.

For this purpose, the following skills and competencies will be dozens of times more important than before:

- **Literacy –** the ability to clearly express questions and ideas (in Hebrew and especially in English).
- **Critical, scientific, computational, mathematical, and multidisciplinary thinking –** acquired through studying mathematics and sciences (mainly physics) and emphasizes that nothing should be taken for granted, even if it comes from a smart and knowledgeable tool like artificial intelligence.
- **Deep analysis abilities of complex processes (engineering, scientific, historical, economic) and ability to connect between several fields –** for example, in my conversations with people involved in drug development, I was told that in a world of artificial intelligence they're looking for graduates with deep understanding of biological systems with computational thinking, data science, and use of artificial intelligence.
- **Creativity and innovation –** the ability to define new problems and develop original solutions. **Curiosity is a human trait –** we just need to encourage it and teach tools to use it, ask new questions and find new answers.
- **Teamwork, self-learning ability, learning from failures, and developing resilience –** in an era of enormous changes at increasing pace, we'll never learn everything we need to learn. Continuous learning will be part of all our lives.
- **Using artificial intelligence as a tool for empowering imagination, creativity, and problem-solving ability.**
- **Developing an ethical backbone –** this is a critical component, especially as technological tools intensify and capabilities seem infinite, so it's important to take it into account. For example, among other things, deep ethical and moral awareness is required for responsible use of technology in general and artificial intelligence in particular. Additionally, ethics should be integrated as an integral part of the curriculum, as part of the discussion on technological innovation.

The Role of Academia in the New Era: Risks and Opportunities

In the 80 years since World War II, academic studies, whether intended for advancement in a research track or for entering the knowledge-rich employment world, especially in the scientific, engineering, and technological world, became public and were established in Western countries as a necessary stage in citizens' personal development and countries' economic development. However, in recent years this perception began to waver, even before the development of artificial intelligence. For years, young people from Generation Z tend to be impatient toward long-term investment and give up academic studies of four years or more.

This process already raises the question: Is academic study even relevant in the current period, and won't the study material become outdated during the years of study even before entering work? Students feel they don't receive appropriate preparation for actual application of knowledge in the professions they studied for the work world, and especially that they don't receive tools for thinking and using artificial intelligence tools – which also change daily. So why study so much if I'm not sure I'll find work anyway?

Moreover, in Israel there's also the service track in technological units, often perceived as a bypass track to academic studies that launches outstanding graduates directly to high-tech work at high salaries without any degree. Thus, academia finds itself trailing behind industry – which precedes it in research and learning and work methods and knows how to develop training programs itself, casting further doubt on academia's relevance.

One thing is clear: the linear perception of the education and training path that starts in kindergarten and school, continues to the army, and ends with a degree at university or college, stops being relevant.

Ways to Impart New Skills in Academia

At the beginning of the digital revolution, already in the 1970s, it was clear there was a new "tool": computer use and programming. Initially, these were perceived as more technological tools – we learned programming languages and tools and methods to develop software. But already in the early 1980s, when I worked as an engineer in chip development, a real revolution occurred – not just what we develop, but how we develop: we moved from drawing on paper, solving equations and using methods we learned to perform development and optimization, to performing work with computer help, and eventually we defined for the computer what was needed so it would do part of the work for us.

This was a fundamental change in the entire way an engineer works: those who couldn't adapt themselves were left behind, and those who advanced were those who could think about the problem in a more systemic and abstract way. Without this change, all the progress in circuit miniaturization (the famous "Moore's Law"), which enabled packing hundreds of billions of devices into one chip, wouldn't have been possible. In a lecture I gave to engineering students, I asked: Are you learning to be able to design and build a bridge over an abyss – that would be 10 times longer or more than the longest bridge in the world today? To answer this question, students need a different thinking task, different building materials, and development and construction methods unknown today.

In academia, much is learned in depth, but there's a failure in the ability to integrate knowledge and systems thinking. The student in their first years doesn't understand what the various subjects will serve them for and why they're learning them at all. Exceptionally, my daughter who studied architecture was asked to perform a community center construction project on her first day of studies, before she learned mathematics, physics, and statistics. When she learned these, she already understood why these subjects are important.

The high-tech industry claims it takes about 18 months to train outstanding academic graduates, and this was before the days of artificial intelligence. Today they already wonder if it's worth employing a university graduate without experience, or rather giving artificial intelligence the tasks previously given to junior employees, since senior engineers have already acquired the required skills.

Here's another example from a school visit I made, where I was exposed to completely different teaching and training methods more suitable for the new world. When the principal asked a 17-year-old student participating in a robotics club why it was important for him to study this particular field, he said he wasn't learning robotics but English, mathematics, and physics alongside learning how to clearly present a problem and solution and how to think independently and in a team. Their project is building a robot – an excellent didactic tool representing the essence of knowledge integration. This is a learning approach I also recommend academia adopt, in collaboration with industry.

So, our task is not to learn to use artificial intelligence as a tool, but as a developing skill that will enable us to perform more complex engineering tasks and in completely different methods.

The meaning is clear: we need to turn the curriculum on its head and not treat the change as "another programming language". Students should be given all the tools they need – from the mathematical foundation, data science, machine learning and more, as part of developing their thinking abilities.

Academia needs to adopt new models of teaching and learning and develop a new "toolbox" for imparting this knowledge and skills. Curricula should integrate advanced AI tools, project-based education, and practical experience through industry collaborations. Accordingly, teaching staff training must also change fundamentally: instead of "knowledge transmitters," teachers and lecturers need to become mentors and learning process guides – meaning leading students to acquire critical, independent, and creative thinking.

Academia's Impact on Educational Systems that Feed It and on Lifelong Learning

Academia cannot settle for just its roles as a research body and as institutions for training researchers and engineers. The new toolbox in collaboration with industry should contain a combination of artificial intelligence skills, ethics, multidisciplinarity, advanced literacy, and self-learning as part of every study program. It should, of course, impart this toolbox to students, but also help impart it among school students.

In the first stage, at the very least, admission requirements to academia should not be based only on matriculation exam scores in mathematics, physics, and English, but should also include the skills I mentioned. Selection based on skills is already common in military technological units and the high-tech industry, and new tools are being developed to teach and test the acquisition of these skills.

Due to the teacher shortage problem, especially those skilled in all required abilities, academia should develop teacher training tracks, strengthen informal programs where students can be auxiliary force, and develop models similar to Schwartz-Reisman physics centers in collaboration with the Weizmann Institute. Developing capabilities will also enable training engineers already in the job market who completed their studies years ago and face the danger of losing relevance and losing their workplace to young people who studied and were educated for the new world.

Academia should adopt modular programs, online courses, and micro-degrees that will enable lifelong learning and provide tools for upskilling and reskilling according to frequent changes in the job market.

Conclusion: The Future of Academia in the Age of AI

Academia now faces an enormous challenge, but also an unprecedented opportunity. It must adopt a new educational approach that will equip graduates not only with knowledge but with the abilities and skills needed to deal with the complex world changing at the rapid pace of the 21st century. Focus on critical, creative, multidisciplinary, and ethical thinking, alongside intelligent use of artificial intelligence as a tool for upgrading these abilities, will enable academia to continue filling a central role in creating innovation, and leading and developing knowledge and skilled workforce that will serve society in the knowledge and science-based economy.

The required change is not just technological but pedagogical and philosophical. Academia must change from an institution that transmits existing knowledge to an institution that develops thinking abilities, creativity, and adaptation. This is a significant challenge, but also an opportunity to lead positive social and economic change.

Therefore, the following three processes are needed:

- **Defining the "new toolbox" –** combining AI skills, ethics, multidisciplinarity, advanced literacy, and self-learning as part of every study program.
- **Strengthening the connection and partnerships between academia, industry, and public systems (government, military, industry) –** with emphasis on research activity, developing innovative learning methods, and training for degrees and throughout life.
- **Clear commitment to change –** from academia management to curricula, to prepare the next generations for dealing with a complex, dynamic, and technology-rich world.

Academia has a rare opportunity to position itself as an engine of innovation, leadership, and knowledge creation, adapting itself to our dynamic contemporary world and continuing to be a central and necessary tool in maintaining Israel's technological and economic advantage in the global arena.

This change is not just possible but essential. The challenge now is to expand this vision to the entire higher education system, and ensure that the next generation of engineers and researchers will be equipped with the tools required not just to survive but to thrive in the age of artificial intelligence. Only thus can we ensure that academia continues to fulfill its critical role in shaping the future of society and the economy.

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Junior Productivity: A Case Study of Shortening the Maturation Time of Young Engineers through Practical-Engineering Education

Gabriel David Pinto and Shoshi Reiter

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Every year, approximately 8,000 junior engineers enter the Israeli job market, but many arrive at organizations professionally immature, causing wasted valuable mentoring time and economic losses estimated at 6.4 billion shekels annually. This article examines how to shorten the maturation period of young engineers through an integrative educational model implemented during academic studies. Through a case study of the Department of Industrial Engineering and Management at Azrieli College of Engineering Jerusalem, a model is described that contributed to high placement rates and narrowing the gap between studies and work. Students participated in dozens of practical projects, guided by academic staff with industry experience. The curriculum was continuously updated according to market needs, emphasizing developing skills such as presentation ability, problem-solving, effective communication, and time management. The results in key performance indicators related to teaching were increased industry placement of juniors and early integration of students in the job market, decreased dropout rates from studies, and an increase of over 80% in the number of students in the department.

Introduction

One of the central issues in the transition from academic training to employment integration in engineering is the long "maturation period" required for young engineers (juniors) to become significantly valuable to an organization. Moreover, in recent years, many companies are no longer willing to invest in training new employees and prefer to hire only those with prior experience.

Israel has approximately 350,000 active students, a third of whom are in STEM fields (Science, Technology, Engineering, and Mathematics) and about 35,000 of them in engineering studies (Central Bureau of Statistics, 2023/4). Although about 8,000 engineers complete their studies annually in Israel, in practice, many require months or even years of professional mentoring before they can function independently. If we assume an engineer works about 2,000 hours per year, half of which are dedicated to learning and mentoring in their first two years (each year has two cycles of juniors, i.e., 16,000 engineers), this amounts to 16 million learning and mentoring hours per year. With a conservative assumption of economy productivity of 400 shekels per engineer hour in Israel, this represents a potential lost output of about 6.4 billion shekels annually, or more than 60 billion shekels within a decade. This phenomenon reflects not only the gap between theory and practice but also the ongoing structural failure in the job market and higher education system regarding training engineers for immediate functioning in the employment world. The potential inherent in shortening the professional maturation period is enormous. The central question is: Will academic institutions be able to make the required adjustments, "reinvent themselves" (Shalgi, 2018), and take an active part in addressing this challenge?

A similar trend is evident outside Israel. According to SignalFire's "State of Tech Talent: 2025" report, there has been a decrease of more than 50% in the number of positions for engineers at the beginning of their careers in the American job market since 2019 (SignalFire, 2025). The decline is particularly notable among large technology companies in Silicon Valley, such as Meta, Google, and Amazon, which once characterized themselves with extensive recruitment of university graduates for entry positions. The report is based on comprehensive analysis of LinkedIn data from millions of professionals and companies in the United States, providing reliable indication of hiring trends in the American high-tech industry. Large companies are forced to adapt to a new work world where employees stay at the same workplace for fewer years than previous generations.

Additionally, companies are forced to downsize due to macro-economic trends such as investment slowdown, rising interest rates, and budgetary efficiency, and for this reason prefer not to employ inexperienced workers, including juniors. However, this is not just a temporary decline but a deep structural change. As artificial intelligence use expands, tasks that previously served as the basis for training new employees are now performed by automated systems (Tschang & Almirall, 2021). This significantly reduces opportunities for entry positions. This process amplifies what is called the "experience paradox": a market seeking candidates with experience but not providing them the opportunity to acquire it (Perrone & Vickers, 2003). In this situation, the responsibility to provide graduates, specifically junior engineers, with meaningful experience gradually shifts from industry to higher education institutions, which need to develop more practical tracks that bridge the gap between academia and the job market.

This situation requires renewed thinking about the professional maturation process, not as a stage that begins only after completing studies, but as a process that should be shaped already in academia. No longer theoretical training disconnected from the field, but integrative, continuous, and directed integration of practical components within the curriculum. Sun and Partt (2024) emphasize that given artificial intelligence's impact on the work world, there is growing importance to implementing work-integrated learning already in initial training stages. Such integration allows students to acquire relevant tools for entry positions that are rapidly being replaced by automation. Similarly, Boun and others (2021) point to the need to integrate professional world challenges directly and actively within the academic teaching process and not postpone dealing with them until after completing studies.

The report "The Forum for 21st Century Engineering Education: Insights, Methods of Action and Paradigm Shifts" (Bentur & Zonnenshain, 2019) reinforces a perception recommending a comprehensive transition to an approach viewing learning as an integrative, systemic, and action-based process, combining theoretical knowledge, problem-solving, life skills, and collaboration with industry throughout the study period. The report presents four groups of topics, each with three paradigms that need to be redesigned in academia.

The paradigms in the knowledge and skills group emphasize the need to: (1) expand training focus also to applied, systemic, and current skills; (2) encourage critical, multidisciplinary thinking and problem-solving; (3) add leadership and interpersonal communication skills components (essential/soft skills) alongside the core of science and engineering, as an integral part of engineering training.

In the real world and industry group, the report emphasizes the need to strengthen the connection between academia and the field by: (4) providing a toolbox that will enable students to operate in complex environments where there is not necessarily a single correct solution; (5) recognizing that engineering education doesn't occur only within academic walls, therefore industry should be integrated into learning processes through projects, mentoring, and practical experience; (6) developing self-learning skills already during the study period as a basis for the ability to integrate and develop throughout one's career.

In the student group, the report proposes: (7) designing a learning experience that generates enthusiasm and identification with engineering as a leading and meaningful profession; (8) transitioning from assessment based solely on exams to assessment based on product quality; (9) changing admission methods for degrees to be based also on characterizing potential and skills, not just grades and standard tests such as the psychometric exam.

Finally, in the academic staff group, it was proposed to: (10) make a conceptual change in the lecturer's role from knowledge transmitter to mentor guiding an active learning process; (11) invest in continuous development and training of staff members, including evaluation of their contribution to education and not just research; (12) integrate professionals from industry in the academic system.

Cumulatively, the report presents a clear call for comprehensive paradigmatic change in engineering education, a change required not only to address existing training gaps but also to ensure the relevance of system graduates to the changing work world and their practical and value readiness to face 21st-century engineering challenges.

In recent years, there has been a growing recognition of the need for fundamental reform in STEM education that will integrate the work world into the training process from the first years. Research by d'Escoffier and others (2024) emphasizes that integrating problem and project-based learning (PBL) and creating communities of practice narrow the gap between theory and practice and promote development of independent learning. Examples of academic institutions that have implemented the required change are from Olin College of Engineering in the USA (Guizzo, 2006). Olin is a small college of about 400 students presenting an innovative and radical approach to engineering education, different from the traditional approach. At the center of the approach is project-based learning integrating from day one engineering knowledge with design skills, entrepreneurship, and systems thinking. Students don't learn theory as a preliminary stage to action but acquire knowledge through experience in real situations, in close collaboration with multidisciplinary teams and external bodies. The organizational culture at Olin is flat and open, where lecturers serve as mentors and students are involved and active partners in shaping learning (Engagement). This builds an educational system promoting independence, innovation, and deep connections to the real world. Olin's approach suits few students and is not scalable.

Another example is Aalborg University in Denmark. The Aalborg method in engineering education is based on PBL and closely integrates theory with practice. Each semester, students work in groups on a real engineering project where they define a problem, research it in depth, and develop a solution while applying research methodologies and systems thinking. The emphasis is not just on acquiring knowledge but on developing capabilities for self-learning, teamwork, interpersonal communication, and time management. Lecturers at Aalborg function as guides rather than traditional lecturers, and the entire process is directed at improving practical training and dealing with real-world challenges. This approach is considered world-leading and has been implemented at the university since the 1970s, now serving as an inspiration model for other academies, especially due to its suitability to 21st-century requirements (Habbal, 2023). When engineering education focuses on acquiring skills by working on projects, this can come at the expense of knowledge level. Graduates will indeed be able to manage engineering projects, but this may prevent them from being excellent development engineers.

In Israel too, attempts have been made to advance this perception. Afeka's "Graduate Profile" framework (2024) defines ten super-skills required for the future engineer, including responsibility, collaboration, creativity, communication, problem-solving ability, and self-management. However, in practice, most higher education institutions worldwide and in Israel have not fundamentally changed actual learning, and deep institutional leadership is required to implement the principles in the field.

Case Study at Azrieli Academic College

This article presents the activities of the Department of Industrial Engineering and Management at Azrieli College of Engineering Jerusalem between 2019 and 2024. The model, initiated by the department's faculty members,[1] was a natural experiment and received support from the college management: then-

1. Ms. Rachel Asulin, Ms. Louise Twito, Mr. Hillel Stoller, Mr. Garo Kabushian, Dr. Kobi Inbar, Dr. Roni Weitzman, Dr. Pini Davidov, Prof. Alon Dominis, Dr. Inessa Einbinder, Dr. David Avishai, Dr. Roni Horowitz, Dr. Benjamin Bersky, Dr. Guy Kashi, and Dr. Gabriel David Pinto.

President Prof. Rosa Azhari, then-Rector and current President Prof. Tamar Raz-Nahum, and then-CEO Dr. Rafi Aviram. Department faculty members mobilized for the mission in a spirit of partnership and commitment, acting as academic and professional change leaders. The model represents a deep change in profession-oriented academic training. The department operated from a strategic understanding that to train engineers relevant to the job market, a systemic and scalable approach to teaching must be developed, including integration between academia, industry, and students. To address the 12 paradigms (Bentur & Zonnenshain, 2019), reinforces a perception recommending a comprehensive transition to an approach viewing learning as an integrative, systemic, and action-based process, combining theoretical knowledge, problem-solving, life skills, and collaboration with industry throughout the study period. The report presents four groups of topics, each with three paradigms that need to be redesigned in academia.

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Zonnenshain, 2019), the department formulated ten operating principles (Table 1), defined as "The Ten Principles of Engineering Leadership":

1. Structural flexibility: Special tracks were launched including a postgraduate track in computer science and the option to complete a bachelor's degree in engineering and master's degree in five years. Additionally, the operations specialization was replaced with an updated data science specialization.
2. Updated curriculum according to industry requirements: The department held regular round tables with industry engineers and implemented content relevant to job market needs: 34% new courses in data science specialization, 18% new courses in information systems specialization; content was updated in 24% additional courses.
3. Academic staff with rich academic and business experience: More than 70% of faculty members held doctoral degrees and more than 60% had rich business experience. The college built a compensation mechanism focusing not only on research but also on teaching.
4. Industry connections: Strengthening industry connections included joint courses, tours and seminars by industry professionals each semester, and many guest lectures by industry professionals in courses.
5. Practical experience during studies: Integrating problem and project-based learning throughout the degree (PBL). Executing more than 30 practical projects throughout the degree (in about 60% of courses). Some projects were cross-curricular and performed over several semesters. PBL courses were integrated, the central one being "Industry Experience," where students work at a company three days a week during summer semester under industrial-academic mentor guidance and receive credit points. Another course is research-PBL, where students experience research during an academic year with a faculty member and receive the opportunity to present at scientific conferences and publish articles in leading journals. Additionally, in the fourth-year final project, students are required to prove that their project was implemented in an organization.
6. Logistical flexibility: Studies in the final year of the regular track were reduced to just one day per week, allowing students to work in student positions in industry.
7. Systems thinking and experience with advanced technologies: Courses were developed in systems engineering, process engineering, Industry 4.0. These courses were integrated into two specializations: data science and information systems. Additionally, an innovative laboratory was developed including the nine pillars of Industry 4.0, including Internet of Things (IoT), advanced robotics, augmented reality (AR), 3D printing, cloud computing, and horizontal integration.
8. Essential/soft skills: Personal connection with lecturers (students study about 3-5 courses with the same senior faculty member) and project-based learning enabled de facto academic and administrative department staff to serve as mentors and impart essential/soft skills to students.
9. Making studies accessible to different populations: Morning (regular) track; evening track for working people; track for the ultra-Orthodox population.
10. Integration of online studies: Distance learning was integrated into the curriculum according to Council for Higher Education guidelines (up to 30% of classes). Online studies were integrated mainly in advanced years to allow students to work in the field.

Table 1: Implementation of paradigms through engineering leadership principles

Engineering Leadership Principle	Paradigm											
	A. Knowledge and Skills			B. Real World			C. Students			D. Faculty		
	1	2	3	4	5	6	7	8	9	10	11	12
1. Structural Flexibility	√					√	√	√				
2. Curriculum	√	√			√	√	√	√		√	√	√
3. Academic Faculty	√	√	√	√	√	√	√	√	√		√	√
4. Industry Relations	√	√	√	√	√	√	√	√				
5. Practical Experience	√	√	√	√	√	√	√	√				√
6. Logistical Flexibility					√		√					
7. Systems Thinking	√	√	√	√		√	√	√				
8. Essential Capabilities	√	√	√	√		√	√	√	√			
9. Population Accessibility									√	√		
10. Online Studies					√							

In addition to the model's contribution to improving graduate readiness, it's worth noting that research outputs of department faculty members not only weren't harmed but actually increased during this period (as in all college departments), partly thanks to college policy that encouraged faculty members to remain research-active and synergistically combine research and application worlds (Table 2).

Table 2: Total research outputs of faculty members in the Industrial Engineering and Management Department

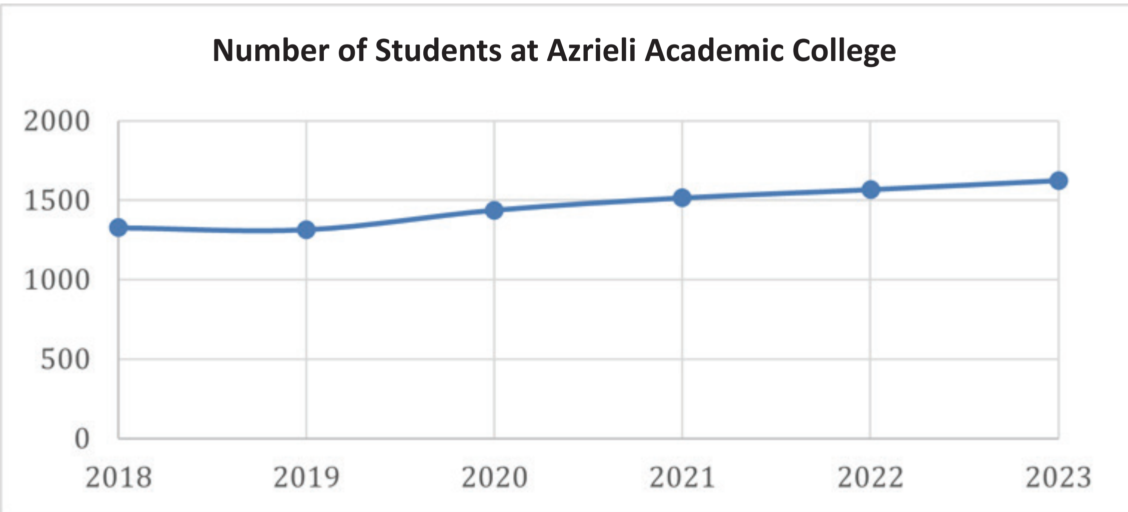
Year	Papers per Faculty Member	Conferences per Faculty Member	Undergraduate Students Listed as Paper Authors
2018	1	4	0
2019	3	4	0
2020	2	8	0
2021	4	15	0
2022	6	28	1
2023	6	38	6

Results: Impact on Graduates, Students, and Candidates for Department Studies

Academic departments examine their teaching quality on multiple levels, three of which are critical: (1) successful integration of graduates in industry; (2) most students successfully complete their studies; (3) demand from candidates for academic studies to study in the department increases. The results of implementing the ten principles of engineering leadership were impressive in the three key performance indicators (KPIs) related to academic teaching:

1. Early, quality, and continuous integration of graduates and students in the job market. This integration was expressed in placement of over 90% of juniors and students in their final year of studies.
2. Decrease in dropout rates from academic studies.
3. Approximately 80% increase in the number of students in the department. The percentage of Industrial Engineering and Management students out of total college students rose from 19% in 2018 to 28% in 2023 (Graph 1).

Graph 1: Number of undergraduate and graduate students at Azrieli Academic College (according to CHE data)



Employers identified the department as a quality source for work-ready and productive engineers, and long-term partnerships were created with leading industries. Employers repeatedly noted that graduates employed by them from the department showed rapid integration and began producing outputs within a very short period relative to graduates from other institutions. Graduates demonstrated good abilities in presentation and communication skills, problem-solving, teamwork, cognitive flexibility, and adaptability. Employers approached on their own initiative to receive additional graduates. Strengthening the departmental brand: The department branded itself as a leading body in practical and innovative training – which brought new collaborations with industry.

Discussion: Model Expansion and Systemic Implications

The model presented in the article demonstrates a practical and feasible possibility for significantly shortening the professional maturation time of young engineers. However, its expansion to additional institutions depends on several prerequisites:

1. **Involvement of institutional management and relevant government ministries –** The existence of institutional, budgetary, and organizational support is essential for successful implementation.
2. **Dynamic curriculum –** Constant adaptation of courses to technological developments and economic needs.
3. **Combined academia-industry teaching staff –** Holders of advanced academic degrees and industrial-business experience.
4. **Close cooperation with industry –** Not just in project guidance, but also in updating study content.
5. **Project-based learning (PBL) –** Integration of dozens of projects throughout the degree as an integral part of training.
6. **Logistical and employment flexibility –** Study structure allowing students to integrate into work during the degree.
7.

Beyond technical implementation, there's a need to address a fundamental tension between imparting deep theoretical knowledge and developing practical skills. "Academic institutions aspire to train graduates at a high scientific level, suitable for advanced research and development positions, but simultaneously need to equip students with skills that will allow them to integrate quickly and efficiently in the job market. In this sense, it's not a dichotomy – skills like problem-solving, systems thinking, and teamwork ability are essential both for industry and research" (Prof. Ami Moyal, President of Afeka Academic College).

"The Ten Principles of Engineering Leadership" presented in this article constitute a systemic approach capable of combining both worlds – providing graduates with solid scientific infrastructure alongside practical tools for professional success. The model's advantage is being scalable and adaptable for thousands of students and different institutions, without need for radical changes in academia's structure.

It should be emphasized that the model presented is not the only way to improve graduate readiness. Institutions adopting similar operating principles can develop alternative models adapted to their unique needs. What's required is institutional willingness for renewed thinking and reformulating effective education policy for STEM professions, focusing learning on readiness for professional functioning – not just on traditional academic excellence.

This article offers a practical response to a tangible problem: an overly long maturation period for young engineers. Through case study and presenting an applicable model, an effective path is demonstrated for shortening professional maturation time and increasing the readiness of engineering program graduates for rapid and efficient integration in the job market. Based on the findings, we recommend the following steps:

1. Adopt models of problem and project-based learning with personal guidance from faculty and industry personnel.
2. Make practical experience a mandatory component in STEM training programs.
3. Redefine industry's role as a substantial partner in academic training, not just as a framework for experience.

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Adapting Engineering Education to the 21st Century: A Committee Report of CHE

Yossi Rosenwaks

Prof. Yossi Rosenwaks serves as President of Afeka – Tel Aviv Academic College of Engineering and as a member of the Council for Higher Education (CHE). He previously served as Dean of the Faculty of Engineering at Tel Aviv University. Currently, he chairs the CHE's Technology and Engineering Subcommittee, and in this capacity led the committee examining undergraduate engineering studies in Israel. Prof. Rosenwaks is an expert in electrical and electronics engineering and contributes significantly to advancing engineering education in Israel while combining academic excellence with industry relevance.

The CHE committee under my leadership examined engineering education in Israel and found it has become less relevant. International comparison revealed that Israeli programs are too long (180 semester hours versus 130-150 globally), with excessive emphasis on introductory courses (52 credits) and almost no general studies (only 4 hours). Key recommendations: maintaining a 160-credit degree, enabling double majors combining engineering with exact sciences, adding 20-30 credits of non-engineering courses, and integrating soft skills. Without comprehensive reform, Israel risks losing its technological advantage. The committee emphasized urgency in adapting engineering education to 21st-century industry needs and global standards.

Introduction: The Relevance Crisis in Engineering Education

As a member of the Council for Higher Education (CHE) and former Dean of the Faculty of Engineering at Tel Aviv University, I had the privilege of leading a unique committee tasked with reexamining undergraduate engineering studies in Israel. The committee, established by the CHE, was designed to address the challenges of rapid technological changes and a dynamic job market. As Chair of the Technology and Engineering Subcommittee, I recognized the urgent and important need to adapt engineering education to the 21st century (CHE, 2023). This report presents the background, process, and recommendations of the committee's work, based on accurate data, comprehensive international comparisons, and field testimonies. The central conclusion that emerged throughout all committee discussions is sharp and clear: **engineering studies have become less relevant in recent years**, and comprehensive and immediate reform is required to maintain Israel's position as a technological powerhouse.

The committee's work was based on in-depth analysis of quantitative and qualitative data, including detailed comparisons between curricula in Israel and leading institutions worldwide. The analysis revealed significant gaps in the scope of studies, program structure, and adaptation to changing market needs. As part of our work, we heard testimonies from senior industry representatives, heads of academic institutions, faculty members, and students, all of whom pointed to the urgent need for change. The report before you presents a comprehensive and accurate picture of the existing situation, while proposing practical and implementable solutions to the identified challenges. It is important to emphasize that all data and conclusions presented here are based on reliable and current sources, and have been carefully reviewed by committee members and the CHE professional staff.

Background to the Committee's Establishment: Changing Reality and Complex Challenges

For several years now, we have been in an era that includes dramatic changes in higher education in general and engineering studies in particular. The main driving forces of these changes are the changing needs of industry, the Fourth Industrial Revolution, the revolution in knowledge and information availability and accessibility, and the profile of the 21st-century student. The modern engineer is required to be multidisciplinary, meaning possessing knowledge and skills in more than one engineering field and/or in the exact sciences. In addition to acquiring knowledge, the 21st-century engineer requires many skills beyond engineering, often called "soft skills", and recently considered "essential skills." These include abilities such as critical thinking, complex problem solving, multicultural teamwork, effective communication, and the ability to quickly adapt to new technologies and methodologies.

Scientific and technological changes in recent years have been particularly rapid, such that engineering training upon completion of the bachelor's degree becomes less relevant after just a few years. A striking example is that students who completed their bachelor's degree 4 or 5 years ago did not study machine learning courses, and today this is one of the most sought-after skills in the market (WEF, 2025). There are many other examples - artificial intelligence, natural language processing, computer vision, and other fields that have become central to industry but were barely taught a few years ago. In light of this, we must create a framework for continued education provision (lifelong learning), including through small modules - thematic clusters in key areas. Self-learning ability and career-long learning have become critical - it is important to provide a strong educational foundation that will give students self-learning abilities, so they can complete new topics and update themselves in additional areas throughout their professional careers.

One of the disturbing findings that emerged from the committee's work is the growing gap between what is taught in academia and the real needs of industry. Due to rapid technological changes, elective courses studied as part of the bachelor's degree become less important after a few years. A situation has been created where graduates must learn new topics and fields independently. The better a graduate's self-learning abilities, the better they can meet this challenge. Additionally, we discovered that in many leading universities worldwide, engineering degrees are shorter, about 130-150 semester hours, while in Israel programs typically include over 180 hours. This gap raises difficult questions about the efficiency and relevance of the existing structure.

Another worrying phenomenon is the high demand for degrees combining engineering and sciences or engineering studies in different fields. However, such degrees currently require "double degree" studies lasting at least nine semesters, too long a period for the average student. This creates a paradoxical situation - on one hand, industry demands graduates with multidisciplinary knowledge, and on the other hand, the academic system makes it very difficult to acquire such knowledge within a reasonable timeframe. Therefore, there is a need to streamline combined study programs that will also better contribute to preparing graduates for the dynamic needs of the high-tech world. Moreover, many companies recruit employees who have not studied engineering at all or who have undergone short professional training that is more relevant to the job market (Innovation Authority, 2022). This fact should motivate higher education institutions to make engineering studies more attractive and more relevant to the elite industry (high-tech). If programs and the nature of studies do not change, there may be a significant decrease in the number of students who will study engineering subjects in the future.

Detailed Comparison to Engineering Studies at Leading Global Institutions

As a central part of the committee's work, we conducted a comprehensive comparison between electrical engineering studies at several leading institutions worldwide and what is customary in Israel. It is important to note that since the scope and composition of engineering curricula in Israel are very similar across all institutions and fields, the electrical engineering studies shown in our analysis are a good example for all fields and institutions. The analysis was based on detailed data collected from institutions such as MIT, Stanford, ETH Zurich, and other leading institutions, and compared them to the structure of programs in Israel. The results were unequivocal and disturbing.

Several striking conclusions emerged from the analysis: First, it can be clearly seen that the number of semester hours at most institutions worldwide is much lower than what is customary in Israel. While in Israel programs typically include over 180 semester hours, at leading institutions worldwide the scope ranges from 130 to 150 hours. This gap raises questions about the efficiency of Israeli programs and students' ability to focus on essential studies. Second, the number of hours in introductory courses (mainly mathematics and physics) is much higher in Israel compared to quality institutions worldwide. In Israel, about 52 credit points are dedicated to introductory courses, while at leading institutions worldwide the number is significantly lower. Third, and perhaps most disturbing - the scope of general studies is significantly low in Israel compared to leading institutions worldwide. In Israel, only about four semester hours of general studies are required, while at institutions like MIT or Stanford the requirement is for dozens of hours of studies in humanities, social sciences, and arts (ABET, 2023).

The detailed analysis also revealed differences in program composition. In Israel, the number of hours in engineering elective courses is much higher compared to leading institutions worldwide - about 64 credit points compared to 30-40 at leading institutions. On one hand, this gives students great flexibility in choosing specialization, but on the other hand, it comes at the expense of multidisciplinary studies and soft skills. In core engineering courses (about 44 credit points), Israeli institutions are well positioned in the middle of the international comparison. However, in non-engineering courses, the gap is enormous - only about 4 hours in Israel compared to dozens of hours at institutions worldwide. This gap reflects a narrow perception of engineering education, focusing on technical knowledge at the expense of broad understanding of the social, cultural, and ethical context of engineering work.

The international comparison teaches about deep approach differences in the perception of engineering education. While in Israel the emphasis is on imparting deep and comprehensive technical knowledge, at leading institutions worldwide there is growing recognition of the importance of broad and multidisciplinary education. The global approach recognizes that 21st-century engineers need to be not only technical experts but also leaders, innovators, and engaged citizens. They need to understand the social implications of their work, communicate effectively with diverse audiences, and work in multidisciplinary and multicultural teams. Israeli programs, with their heavy emphasis on technical subjects and neglect of general studies, prepare graduates who may be technically excellent but lack the skills and broad perspective required in the modern world.

Committee Work: A Comprehensive Process of Learning and Listening

The established committee included senior representatives from academia and industry: Prof. Yossi Rosenwaks (Electrical and Electronics Engineering), CHE member - Chair; Prof. Noam Eliaz (Materials Science and Engineering), Dean of the Faculty of Engineering at Tel Aviv University; Dr. Ditza Beimel (Industrial Engineering and Management, Computer Science), Ruppin Academic Center; Prof. Zehava Blachman (Biomedical Engineering), Afeka - Tel Aviv Academic College of Engineering; Ms. Merav Ben Hamo Krief (Industry representative, Chemical Engineering), Intel; Prof. Zeev Zalevsky (Electrical Engineering), Dean of the Faculty of Engineering at Bar-Ilan University; Prof. Rami Eid (Civil Engineering), Braude Academic College of Engineering in Karmiel; and Prof. Doron Shilo (Mechanical Engineering), Faculty of Mechanical Engineering at Technion, Israel Institute of Technology. The diverse composition of the committee ensured representation of various perspectives - research institutions and colleges, different engineering fields, and industry representation.

During its work, the committee heard several representatives from both academia and industry. One of the most significant testimonies came from Mr. Dudi Perlmutter, Senior Vice President at Intel Corporation and former Chair of the National Committee for Increasing Human Capital in High-Tech. Perlmutter presented his doctrine on high-tech-adapted academia, emphasizing the need to strengthen digital skills and literacy in all curricula, adding basic courses in statistics and data science, and using artificial intelligence both as a development tool and as a learning tool (Perlmutter, 2021). Additionally, he recommended developing and upgrading curricula and adapting them to the evolving technological era, alongside creating new high-tech-adapted disciplines and growth professions (product management, technical writing, etc.). Perlmutter emphasized that today students require higher ability and integration of several fields of study, and conversely, there is a need to adapt the form and content of studies to Generation Z, and to examine whether there is room to shorten formal engineering studies to 3 years and use the remaining year for collaboration with industry on integration with knowledge and practical implications.

The committee also heard extensively from Ms. Merav Ben Hamo Krief, the industry representative on the committee from Intel. According to her, engineering is a field that is constantly changing, expectations from engineers today are not at all similar to expectations from two decades ago, or even a decade ago. Industry finds itself teaching and training engineers for many months in knowledge they do not receive in academia, and in fact, it takes a long time before a new engineer contributes to the company where they work. If we consider, for example, the world of big data, this means that every engineer today must know how to deal with enormous amounts of data, analyze them, and draw quick conclusions. This requires learning advanced analysis methods, machine learning, high-tech-oriented statistics, and especially drawing conclusions, as well as the need to deepen and expand programming studies. Ben Hamo emphasized that dozens of engineers who completed their studies with honors, who know the material theoretically, do not know how to connect the theoretical knowledge they have accumulated with the real world when they approach solving an engineering problem. In her opinion, engineering studies must be more relevant to the modern employment world.

Another important testimony came from Ami Moyal, President of "Afeka" - Tel Aviv Academic College of Engineering, who described the changes they are making to curricula at the college following extensive fieldwork by the institution's management and engineering program heads, which also included several tours of leading higher education institutions worldwide. In his view, studying engineering is part of a long-term educational process, not just training for the job market, therefore a broader view of engineering studies is required. In his opinion, the committee's most important task is to find a way **to maintain the relevance of the engineering degree**. According to his approach, attention must also be paid to significant changes in engineering education at the global level: traditional institutions are losing their leadership and many institutions have adopted innovative approaches such as imparting soft skills, connection with industry, multidisciplinarity, and some are becoming more attractive as a result.

Prof. Moyal emphasized that the entry of AI-based tools only amplifies the need for relevant studies. For example, if an engineer is asked today to summarize three articles and recommend approaches to solving a problem, they already have AI tools that do this within minutes. Hence it is important to emphasize that what the modern engineer needs is to learn critical thinking, to learn to distinguish between primary and secondary. The entry of various AI tools into learning and teaching only amplifies the need for skills and clear ethical rules. Prof. Moyal reviewed the structured process carried out at "Afeka" to integrate engineering and personal skills (such as oral and written communication, critical thinking, self-learning, and teamwork) in the various courses of the degree. He recommended defining the engineering degree based on foundation clusters and considering a double major, major in engineering and minor in another, a framework of 20-30 credits for several clusters on topics such as systemic leadership, digital literacy, advanced technologies, and humanities and social sciences, and offering first-year studies or shared modules for students in different engineering programs. Regarding recognition of credit points based on industry internship, Prof. Moyal emphasized that the internship must be supervised to ensure an adequate level.

After studying and examining various curricula in Israel and worldwide and after long and in-depth discussion, the committee decided to focus on the following topics: scope of degree studies; flexibility in engineering degree structure, double major, major-minor; whether general studies are required and to what extent - disciplinary depth versus multidisciplinarity; additional fields and skills required in industry (topics in data science, artificial intelligence, etc.); integration of internship in industry; lifelong learning (LLL); and skills in accompanying skills (creative thinking, teamwork, self-learning, skills in writing, reading, and presenting professional topics in Hebrew and English).

Committee Recommendations: A Comprehensive Framework for Reform in Engineering Education

After an in-depth process of learning, analysis, and discussions, the committee formulated a series of detailed and practical recommendations:

1. **Scope of Degree Studies:** The committee concluded that the number of years and credit scope should remain and span four years, and the scope of studies should not be less than 160 credits. One of the main rationales underlying this decision is that the modern engineer must be multidisciplinary, with knowledge and skills in more than one engineering field. Additionally, they also require many skills beyond engineering, what is often called “soft skills” (CHE, 2014). This decision balances the need to impart a solid theoretical foundation with the demand for flexibility and relevance.

2. **Flexibility in Engineering Degree Structure:**

   a. Double Major: The committee discussed extensively and in depth over several meetings the possibility of a double major in engineering. As noted, the modern engineer must have knowledge and skills in more than one engineering field. For example, in many cases an electronics engineer must study mechanical engineering topics in depth (heat transfer, mechanical design, etc.) and vice versa, a mechanical engineer must learn advanced signal processing for fluid analysis. In the committee’s opinion and the opinion of experts invited to meetings, a mechanical engineer (for example) will be a better engineer if they acquire in-depth knowledge in physics, computer science, and data science. In light of this, the committee recommended allowing engineering studies in a double major format combined with a major from the exact sciences or another engineering field only, whose mandatory courses include at least 35 credits from the following fields: mathematics, physics, chemistry, computer science, and data science (CHE, 2023).

   It is important to note that the recommendation not to shorten the engineering degree below 160 credits does not contradict the proposed double major. A typical single-major engineering degree in Israel includes about 52 credits in introductory courses, 44 credits in mandatory engineering courses, and 64 credits in engineering elective courses. A typical double major as proposed above would include most mandatory courses in each major (duplicate courses would be studied once), and elective courses. Hence, the fundamental difference between a single major and double major is in the scope of engineering elective courses. The committee recommends that a double major can only exist at an institution authorized to grant a single major degree in the field.

   b. Major-Minor: The committee heard from the CHE professional staff that such a degree existed in the past. Following appeals from the Civil Service Commission regarding the inability to determine the meaning of the minor degree and the implications for allowing those graduates to apply for government tenders or be accepted to industry with the certificate they received, the CHE decided that there is no place for programs in a major-minor structure. After the committee learned about students' difficulties in job placement, the committee believes that the CHE's decision is justified and that there is no place to approve programs in a major-minor degree structure (CHE, 2023).

c. Non-Engineering Course Cluster: Additionally, the committee believes there is room to allow within the bachelor's degree curriculum in engineering (in single major format) also course clusters in subjects not from the engineering field, in scopes of no less than 20 credit points and no more than 30 credit points. For the removal of doubt, general courses are also included in this scope.

Within the aforementioned general courses, the committee recommends that the CHE ask institutions to consider including the following topics: digital skills; humanities and social sciences; advanced technologies; management and entrepreneurship; fields and skills required in industry (for example, product design). The committee recommends adding some of the proposed courses as mandatory courses to give students a foundation in understanding social sciences and humanities. Additionally, the committee also recommends integrating the imparting of various skills as described above within the various existing courses in the degree. These skills are essential in every employment field today, and they contribute to success in high-tech both in technological professions and growth professions (WEF, 2023).

3. **Personal Skills:** The committee recommends that higher education institutions maintaining engineering curricula integrate the imparting of personal and professional skills within existing courses and/or activities outside the formal curriculum. These skills are required for students to enhance their learning process, both as students in the academic institution and in continued lifelong learning, for work in industry and for research and development, both in industry and academia.

The committee recommends imparting the following main skills:

- **Personal skills:** Critical thinking, self-learning, effective presentation ability in writing and orally, and multidisciplinary teamwork.
- **Professional skills:** Design and execution of experiments (Design of Experiments), planning and implementing a system or part of it according to needs and systemic vision.
- **Solving engineering problems** at various complexity levels up to high complexity requiring multidisciplinary teamwork while considering various considerations: ethical, environmental, safety, economic, managerial, social, and gender-related (Innovation Authority, 2022).

The committee also recommends that higher education institutions maintaining engineering curricula update their curricula and add courses from the following knowledge areas:

- **Digital skills -** Advanced programming language, computer organization and assembly language, CAD, fundamentals of algorithms, computational learning, solving complex problems.

- **Data collection and analysis (big data) and AI applications** - Simulation-driven design, experiential-integrative course/laboratory, robotics, data science.
- **Humanities and social sciences -** Ethics in engineering, rhetoric and argumentation, reading and writing, economic and circular engineering, renewable energies and public policy, economics, project and system management, philosophy of technology.
- **Advanced technologies -** Introduction to robotics, robotics laboratory, 3D printing, introduction to computer vision, computer architecture, introduction to monitoring and control, virtual reality.

4. **Practical Experience in Industry:** The committee believes that integrating students into industry as part of undergraduate studies can contribute greatly to students, expose them to practical practice, projects relevant to the elite industry, and many topics they need to learn independently. However, the committee believes that student integration in industry cannot replace the final project, and will be possible only if the institution supervises this experience and ensures that students chose a research topic, experience problem identification, analysis, data collection, building a solution model and the characterization stage, writing code and building a system (as relevant) (IVC, 2024).

The Registrar of Engineers' Position and Addressing Practical Implications

The Registrar of Engineers, Mr. Stefan Abu Khadra, welcomed the committee's work and noted that the changes are necessary for engineering curricula, and added that appropriate combinations should be considered for the proposed double major format and ensure that students have the necessary knowledge in core subjects. He also noted that there are currently many courses in curricula that are not relevant. In contrast, there are many topics that have been renewed and therefore there is a need to update curricula and content in various courses.

The Registrar of Engineers expressed concern that non-engineering subjects (at the maximum scope of 30 credits we propose) would harm the basic training of engineers. After the proposed changes, a typical engineering degree would include 40-50 credits of foundation subjects, 40-50 credits of mandatory engineering subjects, and then 60 to 80 credits remain in engineering elective subjects. The committee believes that if out of 60-80 credits of engineering elective subjects a student studies a maximum of 30 non-engineering credits, this will not harm their training as an engineer but will only improve it as explained in detail in this report (CHE, 2023).

Summary and Future Implications

The committee's work revealed the urgent and important need to adapt engineering education to the 21st century. The central point that emerged throughout all committee discussions is that engineering studies have become less relevant in recent years, and without significant change, the engineering education system in Israel may lose its relative advantage. The formulated recommendations offer a delicate balance between maintaining high academic standards and the need for flexibility, relevance, and adaptation to a changing world.

Successful implementation of the recommendations requires cooperation between all parties - the CHE, academic institutions, industry, and students. The change will not be easy, and it requires resources, commitment, and long-term vision. However, without this change, we will find ourselves training engineers who are not prepared for tomorrow's challenges, losing our status as leaders in technological innovation.

As President of Afeka - Tel Aviv Academic College of Engineering, I am committed to implementing the recommendations and leading change. Our institution has already begun processes of change and adaptation, and we see positive results. I call on all those involved in engineering education in Israel to embrace the spirit of change and work together for a better future for our graduates and the State of Israel.

The way forward is clear - we must maintain academic excellence while being open to change and innovation. Only thus can we ensure that tomorrow's Israeli engineers will be prepared for the challenges and opportunities of the 21st century, and maintain Israel's position as a global technological powerhouse.

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The Engineer's Compass: What the Industrial Revolution Can Teach Us About the Age of Artificial Intelligence

Kuti Shoham and Yaron Cohen Tzemach

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This article examines the challenges of the Fourth Industrial Revolution, driven by artificial intelligence, and proposes how to train engineers for this era. Through analysis of three previous industrial revolutions – steam, electricity, and computing – the article illustrates how disruptive technologies rendered traditional skills obsolete while elevating the value of new capabilities. It presents four essential super-skills: continuous learning for adapting to rapid changes, systems and interdisciplinary thinking for understanding complex connections, critical and ethical thinking for evaluating technological implications, and social and communication intelligence for collaboration and leadership. The article emphasizes that traditional engineering education, focused on narrow technical knowledge, is insufficient, and calls for holistic curricula integrating ethics, collaboration, and systems thinking. This model, implemented at Afeka College under Prof. Ami Moyal's leadership, prepares engineers to lead the revolution while maintaining social responsibility.

Introduction: A Historical Déjà Vu

Public and academic discourse is saturated with the term "artificial intelligence", sometimes to the point of both intellectual and practical vertigo. The emergence of language models capable of writing poetry, code, or academic articles, and algorithms that identify diseases better than doctors, teach us that we stand on the threshold of a new era.

This is a period of change so rapid and profound that it's difficult to grasp its implications. Klaus Schwab, founder of the World Economic Forum, called it the "Fourth Industrial Revolution" – an era where the lines between the physical, digital, and biological worlds blur, and where technologies like artificial intelligence, robotics, and the Internet of Things change everything we know about production, work, and even our very humanity (Schwab, 2016). Public discourse oscillates between promises of a utopian future with creative solutions to humanity's problems and existential anxieties about massive job loss, increased inequality, and erosion of human conception.

For Israel, the "Start-up Nation", these questions aren't theoretical. They touch the very heart of our economic and social engine. At the center of this storm stands a basic question: How do we prepare the next generation for such a world? More specifically, how do we train tomorrow's engineers? What should we include in their toolbox, so they not only survive the change but lead it with wisdom, responsibility, and creativity, adding to Israeli society's resilience?

The answer, paradoxically, doesn't lie in trying to predict the future, but in understanding the past. We argue that the solution to the vertigo we're experiencing is to find an anchor in lessons learned from similar revolutions that have already occurred. Examining previous technological revolutions reveals recurring patterns from which we can distill guiding principles to help us train engineering students for a world of thinking machines and clarify which human skills are critical for the future. We'll see how holistic educational approaches, like the one developed at Afeka College under Prof. Ami Moyal's leadership, aren't luxuries but necessities based on historical lessons.

Chapter 1: The Story of Three Revolutions (and One More in the Works)

Technological disruption isn't an invention of our times but has been the engine of human progress for centuries. Since time immemorial, every wave of innovation that swept the world destroyed old economic models, changed society's face, and posed enormous challenges. To understand this pattern, let's examine three crucial historical turning points.

1. First Revolution: When Steam Replaced the Working Hand

Imagine an expert weaver in late 18th-century England. He spent years perfecting his craft and knew how to weave complex fabrics that were his source of pride and livelihood. His value was measured by his hands' skill and intimate understanding of raw materials. Then, almost overnight, noisy, steam-belching steel monsters appeared – the mechanical looms. The new machines, concentrated in urban factories, made his specific manual skill obsolete, to the point where economic value no longer came from a person's ability to weave complex fabric but from their ability to operate several mechanical looms simultaneously.

The response to this first phase of the Industrial Revolution took on violent and organized character, known in history as a movement of "progress opponents". However, the Luddite movement – those workers who broke into factories and destroyed machines – wasn't blind opposition to technology as portrayed in historical imagination, but rather an attempt by skilled workers who saw their professional and social world collapsing to preserve something of their traditional dignity. They weren't fighting technology but the loss of status and economic security it brought about.

From this we can derive a lesson: technology can make skills considered essential for centuries irrelevant. In their place, new skills were required: factory work discipline, basic literacy for reading instructions, and the ability to become part of a large production system. The new profession created, "factory worker", required less personal creativity and more obedience and flexibility.

2. Second Revolution: When Electricity Gave Rise to the Expert

The main characteristic of the Second Industrial Revolution was the invention of electricity and the ability to transmit it to distant locations, alongside continued development of efficient production methods using internal combustion engines and new communication means. The complexity of new systems – national electrical grids, global communication systems, and enormous factories – required a new type of professional. If the first revolution was based on factory workers, the second gave birth to the engineer and professional manager. For this purpose, institutions were born that made engineering education formal and scientific, based on a scientific conception of production processes and means. At this stage, the engineer's figure began to be perceived as an expert "problem solver", and accordingly, entirely new research, study, and training disciplines were born: electrical engineering, chemical engineering, mechanical engineering.

The second lesson from the second revolution was the rise in importance of specialization: the ability to focus on one area in the production process became a competitive advantage in the job market. This phenomenon is an early expression of what economists now call "Skill-Biased Technological Change" (SBTC), the tendency of new technologies to increase demand and compensation for workers with high and specific skills. Economists Claudia Goldin and Lawrence Katz describe in their book The Race Between Education and Technology how the American education system responded by creating high schools and colleges that trained masses in the new required skills (Goldin & Katz, 2008). However, specialization had a price: it created knowledge fragmentation. The electrical engineer didn't always understand the mechanical engineer's work, and the manager didn't always understand the technical challenges faced by workers or engineers. Hence arose the counter-need for interdisciplinary cooperation ability and for actors with broad systemic vision to balance the tendency toward specialization and point efficiency.

3. Third Revolution: When the Computer Learned to Calculate

This is the revolution we know intimately, commonly called "The Second Machine Age" (Brynjolfsson & McAfee, 2014). Unlike previous revolutions where machines replaced muscles, the new machine – the computer – began replacing routine cognitive tasks, to the point where automation not only replaced entire professions but mainly the repetitive, rule-based tasks that could be translated into a sequence of simple cognitive operations (Autor, 2015).

A classic example is the spreadsheet software "Excel". It didn't eliminate the need for financial personnel, but it made the task of manual calculation obsolete. Clerks and accountants whose entire skill was accurate calculation lost their jobs, but in their place a new role was created: the financial analyst. This role required spending less time calculating and more time analyzing, interpreting, building models, and presenting insights.

The crucial lesson from this revolution is that human value moves "up the cognitive food chain". When computers perform calculations, humans' added value lies in abilities the computer struggled to imitate: complex problem solving, creativity, critical thinking, and communication.

Chapter 2: Four Super-Skills for the Age of Artificial Intelligence

What can we learn from all this? The three industrial revolutions we reviewed illustrate one prominent principle: every time a machine succeeds in automating a certain human skill, economic and social value shifts to other skills – deeper, broader, and not easily replaceable. Once it was physical fitness, then technical expertise, and today it's the ability to understand contexts, exercise judgment, think creatively, and work with people. The educational task now is to identify these skills – and train the next generation of engineers in them.

From a philosophical perspective, this can be framed through the classical Greek distinction between "Techne" and "Episteme". "Techne" is practical knowledge, the "how" to do (for example, the ability to operate a mechanical loom or code in Python). "Episteme" is theoretical knowledge, principled understanding, the "why" (for example, understanding principles of mechanics or computer science). Each technological revolution made a specific "Techne" obsolete, thereby raising the importance of "Episteme" – the principled knowledge that enables developing new and relevant "Techne".

But here a significant counterargument arises: perhaps this time it really is different? Unlike the steam engine or computer, artificial intelligence doesn't just replace routine tasks but begins penetrating areas considered the exclusive domain of human creativity – writing, design, and even complex problem solving.

Precisely because of this, we argue, super-skills aren't being eliminated but their importance is intensifying and becoming more critical than ever. Applying this lesson to the AI era allows us to identify the four pillars of future engineering education and understand how to teach them in practice.

But before we turn to describing the four skills, it's important to dwell on a disturbing blind spot: many engineering faculties still emphasize narrow technical knowledge and measure success mainly by grades. Brilliant students complete their degrees without collaborating in interdisciplinary teams, being required to think ethically, or learning how to communicate a complex idea to a non-technical audience. This very gap between training content and changing reality requirements emphasizes the importance of a new discussion: Which skills will be critical for the age of artificial intelligence? What should be emphasized in curricula if we want to train engineers capable not only of integrating into systems – but also of understanding, critiquing, and designing them?

1. Continuous Learnability:

The most consistent lesson is that today's technical knowledge is tomorrow's archaeological legacy. The "half-life" of technical skills is shortening at a dizzying pace. Historian Yuval Noah Harari argues that to survive in the 21st century, we'll need emotional stability and the ability to "reinvent ourselves" repeatedly, sometimes every decade (Harari, 2018). Therefore, the supreme educational goal isn't imparting a specific toolset (programming language X or design software Y), but rather developing the learning "muscle."

What does this mean in practice? It's the ability to identify knowledge gaps, find reliable information sources, synthesize them, and apply them to new problems – quickly and efficiently. Example: A software engineer who developed mobile applications for a decade understands that Spatial Computing is the future. Instead of waiting for a formal course, she initiates a personal project, independently learns Apple's new development platform, connects with developer communities online, and within months builds a first prototype. She didn't just learn a new tool but proved adaptability.

How do we teach this? Through transitioning from passive to active learning: challenge-based projects with no single solution, hackathons, and encouraging students to teach each other. The lecturer transforms from knowledge source to mentor guiding the discovery process.

2. Systems and Interdisciplinary Thinking:

The AI engineer cannot confine themselves to the algorithm's code files, as technology now requires broader education than ever to manage its complexity (Goldin & Katz, 2008). This requires breaking the knowledge specialization trend bequeathed by the second revolution. In practice, this means thinking like a systems architect – not just their operator, understanding how different components (technological, business, human) affect each other, not settling for the strength of the bolt in the machine, and anticipating unexpected consequences.

Example: An engineering team develops a medical device monitoring health metrics using AI. An engineer with systems thinking won't focus only on sensor accuracy. They'll ask: What are the Health Ministry's regulatory requirements? How do we ensure medical data privacy? What's the psychology of the elderly user who will use the device? What business model will enable the healthcare system to adopt it? They understand the product's success depends on the entire ecosystem, not just the code.

How do we teach this? Through heterogeneous project teams (engineering, design, business administration, and law students), courses integrating humanities and social sciences, and case study analysis emphasizing broader contexts of engineering projects.

3. Critical and Ethical Thinking:

If the computing revolution commodified calculation ability, the AI revolution commodifies content and information production ability. In a world flooded with machine-generated answers, the most important human ability is judgment. What does this mean in practice? The meaning is clear – an engineer in an AI world has a significant human advantage: the ability not to take information at face value but to evaluate its reliability, identify hidden biases, understand model limitations, and ask penetrating ethical questions about technology's goals and impacts.

Example: An engineer at a bank receives an AI model developed by an external company to recommend loan approvals. Instead of just checking if the model works technically, they apply critical thinking: On what historical data was the model trained? Do these data reflect existing social biases (for example, against certain neighborhoods or population groups)? What happens if the model errs? Whose responsibility in case of error or bias? When artificial intelligence can provide any answer, the most valuable skill is knowing which question to ask.

How do we teach this? Through debate workshops on ethical dilemmas in technology, mandatory courses in philosophy and ethics in general and AI ethics in particular, and requiring every final project to present a chapter addressing the development's ethical and social implications.

4. Social and Communication Intelligence:

Paradoxically, as machines become more sophisticated, the value of human interaction increases. The ability to lead a team, collaborate, convey complex ideas simply and convincingly, show customer empathy, and manage conflicts becomes the main competitive differentiator. What does this mean in practice? It's the ability to motivate people, persuade, build trust, actively listen, and mediate between different viewpoints. These are skills that are very difficult to automate.

Example: An engineer leads a development team distributed between Tel Aviv, Kyiv, and San Francisco. Her challenge isn't just technical. It includes managing cultural and communication differences, building team cohesion through video calls, giving constructive feedback that will be well-received, and presenting project progress to senior management in a way that enlists their support. Her success depends on her interpersonal abilities no less than her coding abilities.

How do we teach this? Through team-based learning, effective presentation workshops, receiving tools for managing disputes and public speaking, negotiation practice, and structured peer feedback as part of course evaluation.

Conclusion: Building the Internal Compass

The journey we've taken, from Manchester textile mills to today's cloud computing, teaches an important and reassuring lesson: technology changes, but the human challenge remains similar. At every technological disruption junction, the path to prosperity isn't entrenchment in existing knowledge but embracing flexibility, learning, and broad vision.

Training engineers for the 21st century can no longer suffice with imparting quickly expiring technical knowledge. The answer to the artificial intelligence challenge isn't "more coding" but education that connects code to morality, algorithm to responsibility, and cultivates those abilities history has proven sustainable.

Our call is directed at policymakers, academic leaders, and industry leaders: we must redesign curricula to reflect these four super-skills. We should strive to shape an "evolving graduate profile" – an engineer who isn't just a technical expert but a critical thinker with systemic understanding, capable of lifelong learning, and possessing an ethical compass enabling them to use their technological power wisely.

The engineering education model led by Prof. Ami Moyal over the past decade at Afeka is a living and pioneering embodiment of these historical lessons. His vision, which insisted on combining engineering excellence, holistic skills, and broad education, wasn't a pedagogical addition but a deep understanding of future needs. This is the recognition that to build the future, we must lean on past wisdom. Thus, we not only prepare our graduates for the changing job market but train a generation of technological leaders who can shape the Fourth Industrial Revolution – and not be shaped by it.

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"Song of Labor and Craft"

By Hayim Nahman Bialik

By the sweat of your brow you shall eat bread
This is a blessing, not a curse!
Labor is a song,
Craft is a prayer.
Whoever works with devotion
Is a leader and a guide,
With his hands he builds a world,
And with his wisdom he teaches.

Explanation and Background

"Song of Labor and Craft," written by Hayim Nahman Bialik in 1930 and in the public domain since his death in 1934, is a short yet moving poem expressing the spiritual and practical value of labor and creation. Bialik, Israel's national poet, crafted the poem under the inspiration of Zionist ideals — the building of the country and its society. He posits labor as a blessing rather than a curse, comparing it to song and to prayer, and emphasizes that devotion, leadership, and wisdom in work are the keys to education and social leadership. In an accessible, direct language, Bialik weaves traditional Jewish values — such as "by the sweat of your brow you shall eat bread" —with a modern vision of collective creativity. To this day, the poem serves as a source of inspiration, conveying respect for labor and creative endeavor.

The central message of Bialik's body of work — and of "Song of Labor and Craft" in particular — is the recognition of the simple, daily, and fundamental value of effort, partnership, and responsibility in forging a free, moral, and spiritual society. This message remains a foundational component of Israeli social cohesion and cultural inspiration to this day.

Hayim Nahman Bialik (1873–1934) was born in the village of Radi in Ukraine to a poor family. Orphaned at a young age, he was raised by his grandfather, who provided him with a traditional Jewish education and broad intellectual development. In his youth, he studied at the Volozhin Yeshiva, developed an affinity for the Enlightenment, was drawn to modern literature, and joined the Zionist movement.

In his early years, Bialik produced poetry, stories, and essays in Odessa and became a central figure in Jewish and Hebrew culture in the Diaspora. In 1924, he immigrated to the Land of Israel, settled in Tel Aviv, and became a national symbol: his work was exemplary; he initiated the “Oneg Shabbat” gatherings, edited "The Book of Legends" with Yehoshua Hana Rawnitzki, supported artists, and coined hundreds of new Hebrew words. His house on Bialik Street became a focal point of spiritual life in the city and a source of inspiration for circles of writers, artists, and the public at large. His persona combined Jewish depth, halachic motivation, and the striving for secular social values.

Beyond his poetry, Bialik was known as a poetic innovator of the Hebrew language, a leader and model of creativity, and as a principal architect of modern Hebrew-Zionist culture in Israel. He encompassed the worlds of both children and adults with poems, stories, songs, and essays, forging a path to a modern concept of nationhood, language, education, and culture in the broadest sense.

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