# Enhancing Collaboration between MIT and The Engine: Joint Findings of The Engine Working Groups

## Final Report
## to the MIT Community

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## INTRODUCTION

### Overview: The Engine

In October 2016, MIT announced the creation of The Engine Accelerator, Inc. ("The Engine"), a pioneering new startup accelerator focused on what MIT President Rafael Reif has called "tough technologies." These technologies typically are born of scientific research and advances that take more time and more resources to make the journey from lab to market. To create breakthrough solutions to some of society's most important challenges—renewable energy and energy storage, clean water, noninvasive treatments for Alzheimer's, low-cost early detection of cancer, Zika, and Ebola—a new model is needed that nurtures high-impact ideas and speeds them into the world. The Engine provides such a model.

> *"If we hope for serious solutions to the world's greatest challenges, we need to make sure that the innovators working on those problems see a realistic pathway to the marketplace. The Engine can provide that pathway."*
>
> *—L. Rafael Reif, President of MIT*

An independent entity working with innovators from both within and outside MIT, The Engine advances the Institute's mission by creating an accelerator and a fund to support early-stage, long-lead innovations with patient capital, affordable space, highly specialized equipment, business services, and technical expertise. Initially, The Engine will target specific technological areas such as the Internet of Things (IoT), advanced manufacturing, biopharma, energy, materials, robotics, deep software, and artificial intelligence and virtual reality. The Engine also will "follow entrepreneurs into new areas that, over time, will create or transform an industry," according to The Engine CEO Katie Rae. MIT has invested $25 million in The Engine's initial $150+ million fund. The hope is that The Engine will catalyze innovation on or near the MIT campus, attract millions more in venture capital, and make significant space in Kendall Square and nearby communities available to participating entrepreneurs.

MIT's commitment to developing transformative technologies that will benefit society as a whole creates an unprecedented opportunity. The Institute is poised to deepen, expand, and accelerate the ways in which its faculty, staff, students, and alumni engage in impactful research, development, and entrepreneurship. To ensure maximum impact, however, MIT must bring the full extent of its considerable resources to bear on the success of The Engine.

### The Engine Working Groups

To this end, Provost Martin Schmidt formed a set of faculty-led Engine Working Groups (EWGs) to explore particular areas that could facilitate collaboration between MIT and The Engine. Institute leadership and other key stakeholders identified potential group members representing relevant areas and expertise. The Undergraduate Association, Graduate Student Council, and Postdoctoral Association also contributed to the selection process.

Under the leadership of Professor Anantha Chandrakasan, then Head of the Department of Electrical Engineering and Computer Science and current Dean of Engineering, five internal working groups set to work at the end of 2016. The groups comprised faculty, postdocs, students, and staff—all with specialized expertise—from the MIT campus and MIT Lincoln Laboratory. The EWGs focused on five strategic areas of relevance to The Engine. MIT faculty members chaired each of the groups. (See a full list of members in the "Acknowledgements" section of this report.)

- **New Models for Technology Licensing**—Chair: **Timothy Swager**, *John D. MacArthur Professor, Department of Chemistry*

- **Facilities Access**—Chair: **Martin Culpepper**, *Professor, Department of Mechanical Engineering*

- **Conflict of Interest**—Chair: **Klavs Jensen**, *Warren K. Lewis Professor of Chemical Engineering and Professor of Materials Science and Engineering*

- **Visas for MIT Entrepreneurs**—Chair: **Dick Yue**, *Philip J. Solondz Professor of Engineering, Department of Mechanical Engineering*

- **MIT's Innovation Ecosystem**—Co-chairs: **Vladimir Bulović**, *Associate Dean for Innovation and Fariborz Maseeh (1990) Professor of Emerging Technology, Department of Electrical Engineering and Computer Science;* and **Fiona Murray**, *Associate Dean for Innovation and William Porter (1967) Distinguished Professor of Entrepreneurship, MIT Sloan School of Management*

**Figure 1. Engine Working Groups Structure**

| Provost Martin A. Schmidt<br>Executive Vice President and Treasurer Israel Ruiz<br>Vice President for Research Maria T. Zuber | | | | |
|---|---|---|---|---|
| The Engine Advisory Committee<br>Prof. Anantha P. Chandrakasan (Chair) | | | | |
| The Engine Working Groups | | | | |
| New Models for Technology Licensing<br>Prof. Tim Swager<br>(Chair) | Facilities Access<br>Prof. Martin Culpepper<br>(Chair) | Conflict of Interest<br>Prof. Klavs F. Jensen<br>(Chair) | Visas for Entrepreneurs<br>Prof. Dick Yue<br>(Chair) | MIT's Innovation Ecosystem<br>Prof. Fiona Murray &<br>Prof. Vladimir Bulović<br>(Co-Chairs) |

Each of these topics offers an opportunity for MIT to review its rules, regulations, norms, and activities to understand how best to improve the Institute in relation to the mission of The Engine. The EWGs have raised important questions. How can we facilitate quicker and more seamless patenting and licensing experiences for startups? Can MIT make its highly specialized equipment and facilities more accessible to new enterprises? How do our conflict of interest (COI) rules help entrepreneurs anticipate and avoid COI? Can we provide more entrepreneurial experiences for our international students? How can MIT's vibrant innovation ecosystem be enhanced by The Engine? These are essential questions that the EWGs have explored. Each working group was charged with developing a set of procedures to make it easier for members of the MIT community to become involved with The Engine.



Engine Working Groups Forum, March 22, 2017. Photo: Ian MacLellan.

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The working groups conducted several months of research and engaged in detailed discussions with key stakeholders and topic experts. The EWGs also sought input from the MIT community via a web-based Idea Bank and shared progress reports at community forums attended by hundreds of members of the community. The process was overseen by an Advisory Committee chaired by Professor Chandrakasan and comprised of the chairs of each working group, Vice President and General Counsel Mark DiVincenzo, Executive Director of the MIT Industrial Performance Center Elisabeth B. Reynolds, and Senior Director for Institute Affairs Glen Comiso. This committee evaluated and forwarded recommendations to Provost Martin Schmidt, Executive Vice President and Treasurer Israel Ruiz, and Vice President for Research Maria Zuber for approval and implementation.

## Guiding Principles

The following guiding principles were observed during the development of the working groups' recommendations:

- Develop policies, procedures, and programs that accelerate innovations from the MIT ecosystem into The Engine.

- Leverage the unique relationship between MIT and The Engine to develop special collaborative programs.

- Encourage policies and programs that have a broad positive impact on the regional innovation ecosystem (other accelerators, startups, universities, etc.).

- Develop MIT educational opportunities for the Institute community in collaboration with The Engine.

- Provide a seamless transition from MIT innovation programs to real startups (including support for equipment access, mentors, etc.).

## Beyond The Engine

President Reif has stated that the process has "allowed us to unlock opportunities to enhance the way MIT innovates even beyond the work of The Engine." Many of these policies, procedures, and programs will apply to activities unrelated to The Engine, whether they be startups that do not require the resources of The Engine or endeavors supported by other internal or external accelerators.

After the comment period for these recommendations, the MIT Provost evaluated and prioritized final recommendations, and worked to determine the best entities and pathways for implementation and funding.

> *"Innovation drives the virtuous cycle of freedom and prosperity. Startups out of research universities have proven to be among the most effective ways of innovating—startups built the Internet."*
>
> *—Robert Metcalfe, Founder of 3Com and Co-Inventor of Ethernet*

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## EXECUTIVE SUMMARY

## Overview of Recommendations

In addition to the detailed findings of each working group presented in this report, the EWGs were asked to prioritize the top three recommendations per group. The individual working group report sections offer additional recommendations.

### *New Models for Technology Licensing*

### Develop New Standard Agreements for Technology Licensing and Intellectual Property

To support entrepreneurs and startups, the MIT Technology Licensing Office (TLO) should develop a new standard licensing agreement that can be completed quickly. The new agreement would incorporate an initial limited non-commercial license and an option to license intellectual property (IP).

### Keep Startups Apprised of Anticipated Patent Costs

Startups should be responsible for patent costs, but the TLO should use payment plans as a way for startups to deal with above-average costs. By reminding enterprises of their responsibilities without unduly encumbering them, the TLO can prevent the run-up of large unpaid patent costs.

### Develop New Corporate-Sponsored Research Agreements

In the spirit of promoting enhanced opportunities for collaborative innovation between MIT and industry, the Institute should explore an increased menu of corporate sponsorship agreements that capitalize on the potential gains of a truly open innovation model.

### *Facilities Access*

### Establish a Phased Approach for Facilities Access

MIT will require time to develop the necessary frameworks for widespread voluntary facilities access. In the short term, the Institute should leverage pre-existing facilities access protocols while it develops a new blanket facilities program interface (FPI) agreement. The Engine should look for alternate short-term space to fill the roughly 20% of its needs not accommodated by the Engine Room makerspace.

### Update and Disseminate Access Policies, Agreements, and Logistical Support

MIT should create a new standard access agreement—an FPI—with customizable addenda for use by all departments, labs, and centers (DLCs). The Institute also should provide standard supporting materials to manage, track, and charge The Engine and its portfolio companies for facilities access.

### Develop a Master Database and Complementary Technology Plan

MIT should build a master database that may be used by the separate facilities management platforms of MIT (Mobius) and the Engine Room. MIT and The Engine also must develop a joint strategy for coordinating the software needed to prepare materials for processing on MIT equipment.

### *Conflict of Interest*

### Endorse Existing Financial Conflict of Interest Principles

Senior members of the MIT administration should reinforce the need to adhere to MIT's existing COI guiding principles with visible endorsements of support.

### Increase Community Understanding

The Institute should commit the requisite resources to expand on existing efforts to develop more user-friendly tools and guidance documents to address the administrative burden on our faculty and community in responding to COI.

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### Update Conflict of Interest Approaches

MIT needs to expand its COI processes to include more organizational COI considerations and mechanisms for ongoing review. The Institute also should offer more flexibility for faculty, students, and affiliates to participate in low-risk startup activities.

### *Visas for Entrepreneurs*

### Create Educational and Degree Programs that Incorporate Entrepreneurial Activities

To increase opportunities for international students who want to engage in on- and off-campus experiential learning, internships, and training opportunities, MIT should create educational and degree programs that incorporate entrepreneurial activities in degree requirements.

### Expand MIT Eligibility for Work Visas

By including entrepreneurial experience and promise as admission criteria, MIT should expand the eligibility of international students for work visas. The Institute also should accept sponsored research that might facilitate concurrent employment opportunities at MIT and at outside companies.

### Support Common Visa and Immigration Needs

MIT should expand the resources and services it offers to international students and scholars to help with common visa and immigration needs. The Institute also should provide shared resources for best practices, templates, consultation, referrals, and expertise that would be available to The Engine and its portfolio companies.

### *MIT Innovation Ecosystem*

### Alleviate Bottlenecks for Startup Teams

MIT needs to provide additional resources for the campus community that will help avoid bottlenecks and help startup teams bridge the gap between the hatching of an idea and an official launch. A "proto-Engine" community space, for example, could be managed across the key entrepreneurship programs and support student teams before they incorporate or graduate.

### Create New Mechanisms to Promote Idea Development

The Institute should create additional mechanisms on campus that will help students develop their ideas while they are still members of the MIT community. A new "innovation master's degree" with a structure similar to that of Course 6A could give students an additional year to pursue an idea, work on internships, and gain additional innovation skills that would prepare them for participation in The Engine.

### Establish Shared Rules of Engagement

By developing rules of engagement that define the interactions between The Engine and MIT student teams, the Institute will ensure that entrepreneurship programs maintain their focus on students' educational pursuits.

As the following summary reports make clear, this exercise has led to a rich set of discussions and thoughtful reflections about MIT and its current innovation-related operations, rules, and practices. These recommendations certainly will enhance MIT's relationship to and collaboration with The Engine. Perhaps more importantly, they will stimulate efforts to improve MIT's innovation capabilities more broadly. This is an exciting prospect for MIT as it embarks on a new chapter in its work to take on the world's greatest challenges.

## NEW MODELS FOR TECHNOLOGY LICENSING

### Overview

In The Engine Working Group on Technology Licensing, we examined how to facilitate the generation and flow of MIT intellectual property to startups and how to coordinate with programs at MIT that will be symbiotic with The Engine. We also looked at how to promote new structures for industry engagement that would enhance technology transition to startups.

Our group expects that The Engine will create new value propositions for MIT's current and future industry partners. Although we are looking at these issues through an MIT lens, our broader goal is to articulate models that can be adopted by other institutions in our region. If the Institute communicates clear expectations, reduces negotiation times, and establishes standard practices that all parties accept as fair and reasonable, we believe that members of the MIT community will reap benefits and efficiencies in working with The Engine and other external entities.

**Figure 2. Summary of MIT Intellectual Property Achievements, 2016**



**800** invention disclosures

**341** patents filed | **279** patents issued | **110** licenses granted

**24** companies formed with MIT intellectual property

*"We must ensure clear processes for talented researchers to develop innovative technologies in the lab and bring them to the marketplace in the form of breakthrough technologies and new companies. That's how we help to solve important global challenges."*

*—Desh Deshpande, Life Member of the MIT Corporation, Co-Founder of Sycamore Networks, and President of Sparta Group*

### Where We Are Today

MIT is renowned for the number and value of the enterprises created by members of the Institute community. Despite this track record, MIT-based "tough-tech" startups still face key challenges with respect to technology licensing and corporate sponsorship.

### Complex Negotiations Are a Burden

In the early stages of a startup, complex IP negotiations can have negative consequences for all parties. This problem is particularly acute when an early-stage company does not yet understand the limits of its technology, the critical claims it needs to make to protect its position, or how to define its market focus.

### Patent Costs Need Reimbursement

Although invention disclosures at MIT are at an all-time high, patent activity is constrained by unpaid patent costs. These expenses cut into the total distributions the TLO makes to departments and the

Office of the Provost. By preventing the accumulation of large unpaid patent costs, MIT and the TLO can create a more sustainable model for startups and potentially increase licensing activity.

### Federal Research Funding Is Unlikely to Rise

In the near term, industry-sponsored research will likely play a greater role in supporting innovation and entrepreneurship at MIT. The Institute must increase its cultivation of industry and private funding. By demonstrating greater efficiency in bringing the outcomes of those investments to market, MIT will increase its value proposition for industry and private funders.

### Corporate Research Often Produces Non-Exclusive Licenses

MIT's existing collective corporate portfolio typically results in non-exclusive licenses for freedom to operate as opposed to ongoing investments that help bring new technologies to market. This outcome can vary significantly by market sector, however. In biotechnology, for example, corporations tend to favor exclusive licenses. The particular goals of individual corporations sponsoring research at MIT also may be a factor, especially when the research is focused on longer-range goals that are not part of their present businesses.

When corporate-sponsored research creates IP with commercial potential outside a company's ongoing businesses, the best option may be to develop the technology via a startup model in partnership with MIT. New models for such corporate engagements may also align well with MIT's mission of translating innovations to serve humankind.

## What We Need

New standard agreements and processes that streamline initial licensing and IP options are crucial to promoting more successful tough-tech startup activity. We recommend that MIT and its TLO focus on reducing costs to startups and balancing risks with potential returns for sponsoring partners.

### Generate Standard License and Option Agreements

Faculty, students, and affiliates could all benefit from approved templates for initial limited non-commercial licenses and options to IP. Ideally, these standard agreements could be completed in short order and at low cost—a procedure that could be completed in days rather than weeks.

This process could set a new standard for the initial granting of rights and be shared with other institutions to promote standardization. Entrepreneurs would be able to secure options at relatively low cost and work to understand the market and their future IP needs during the option period. This would allow for a more informed and focused negotiation of subsequent commercial licenses. The requirements to obtain an option or limited license also could be aligned with the requirements for entry into The Engine, thus minimizing redundant contract negotiations.

### Anticipate Patent Costs and Consider Payment Plans

Projecting and communicating patent costs is crucial to new enterprises. MIT's TLO should play a key role in assisting startups with planning strategies that avert large unpaid patent costs. By creating new mechanisms and practices for anticipating these costs, the TLO can educate startups about their responsibilities. The TLO should also consider offering patent cost payment plans when appropriate.

### Develop New Corporate-Sponsored Research Agreements

In the spirit of promoting enhanced opportunities for collaborative innovation between MIT and industry, the Institute should explore an increased menu of corporate sponsorship agreements that capitalize on the potential gains of a truly open innovation model. Such agreements could leverage the proximity of the Institute to The Engine by encouraging companies to sponsor research at MIT with the intent of creating a startup.

New model agreements could incentivize corporate sponsors to make minority investments in the startups they support. Any such agreements must address the real and perceived risks for sponsors in letting technologies generated through corporate sponsorship transition into startups (e.g., agreements must define what happens if the startup is acquired by a competitor).

## How We Get There from Here

If new standard option agreements offer greater flexibility, they will require increased oversight by MIT's TLO. We also envision a greater role for MIT's Industrial Liaison Program in market testing new corporate agreements with trusted corporate partners.

### Build Flexibility and Oversight into New Standard Agreements

Although simplicity is the goal, new standard limited license and option agreements must accommodate some variability—especially when it comes to appropriate applications of technology, fields of use, and number of patents being sought. We recommend that MIT offer flexibility to startups by allowing an initial option for a broad field of use, for example.

In tandem with this flexibility, the Institute must articulate clear guidelines for licensing that require a narrowing of the field of use through diligence requirements in the commercial license. These guidelines will help the parties manage expectations and ensure that technologies can be developed to their full potentials. In cases where startups need to extend the option periods in their agreements, the TLO should retain the ability to assess reasonable additional fees.

### Provide Periodic Appraisals of Accumulating Patent Costs

The TLO must work closely with MIT-generated startups to provide information on costs due and projections of future costs and fees. This will keep startups engaged with critical patent claims and territories, and aware of the costs of protection. It also will help them complete critical evaluations of markets and technology limitations in advance of key decisions, such as arranging coverage in foreign countries or determining how aggressively to pursue particular patent claims.

### Solicit Feedback from Current and Prospective Corporate Sponsors

MIT should market test any proposed standard corporate-sponsored agreements for open innovation with existing and potential corporate partners. We recommend that the Industrial Liaison Program play a role in this process and use the opportunity to expand corporations' investments in MIT. Ideally, the Institute's existing corporate sponsors will be able to continue their strategies for scoping longer-range technologies while pursuing fresh, nearer-term opportunities using MIT's new pro-startup agreements.

## Open Questions

Corporate venture funds are an untapped resource for the MIT innovation ecosystem. With new agreements and procedures for licensing in place, we see the potential for greater engagement between such funds and Institute-based startups. Although most large corporations have venture funds, few pursue deals with emerging startups (with the exception of the biotechnology sector).

- Should MIT consider using its significant convening power to connect a broader range of corporate venture funds to early-stage startup activity in the Boston area? Given the Institute's proximity to The Engine, MIT could encourage corporations to view sponsorship as a window on emerging regional innovations. This perspective may encourage MIT's partners to increase their engagements with and support of translational research that has the potential to seed new startups. The biopharma sector, for example, has expressed strong interest in participating in this process.

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## FACILITIES ACCESS

### Overview

The MIT campus in Cambridge, Massachusetts, includes 24 classes of equipment that could be described as specialized and highly useful but cost prohibitive or otherwise out of reach for startup companies to purchase, maintain, or operate. For example, access to the MIT Tow Tank, environmental scanning electron microscopes, or bio/wet lab equipment could be game-changing for a new tough-tech venture. As of May 2017, however, MIT's policies and procedures were not conducive to sharing such facilities and equipment.



Edgerton Center Area 51 Shop. Photo: Cattalyya Nuengsigkapian.

In The Engine Working Group on Facilities Access, we examined the opportunities for and barriers to sharing some of MIT's specialized equipment with The Engine. We identified three key areas where MIT must adapt to permit access for qualified individuals and entities: policies and procedures; administrative tools and frameworks; and training, insurance, and safety systems. We believe changes in these areas will foster productive interactions among companies supported by The Engine and MIT's expert makers—facility managers and students who may be able to participate in the activities of The Engine.

A key principle guiding our assessment has been maintaining the primacy of facilities access for MIT's education and research activities. On the logistics front, our group examined the potential timing of ramp-up activities, safety, training, legal and regulatory issues, information flows, and joint database and software needs.

> *"Access to specialized MIT facilities will boost the ability of entrepreneurs to succeed in The Engine."*
>
> *—Katie Rae, CEO of The Engine*

### Where We Are Today

Contrary to common perception, MIT has at hand most of the components it needs to grant The Engine safe, secure, and mutually beneficial access to Institute facilities. Existing policies and procedures, when properly and uniformly understood, do not raise unnecessary barriers. Administrative tools and safety systems must be adapted, rather than reinvented, to accommodate outside startup users. Important concerns remain, however, related to MIT and to federal policies that MIT must anticipate and monitor proactively.

#### *Existing Policies and Procedures Permit Access*

During our research, our group encountered broad variations in understanding of what is permissible when sharing resources with non-MIT individuals and entities. Much of the confusion stems from a range of conservative policy interpretations that trickle down from offices advising on and governing external access. When assessed objectively, however, existing MIT policies do provide viable paths for external access to on-campus equipment.

Programs at the Koch Institute for Integrative Cancer Research, the MIT Microsystems Technology Laboratory (MTL), and MIT Center for Materials Science and Engineering (CMSE)[1], for example, follow Institute procedures to allow outside use of facilities and ensure compliance with relevant MIT policies, the law, and federal guidelines. The MTL has successfully granted access to many companies for more than 15 years with its Fabrication Facility Agreement (FFA). The CMSE facilities grant outside access to the Shared Experimental Facilities (SFE) and on-campus staff who are funded by the National Science Foundation (NSF). We note, however, that such outside use and charging agreements would require specific modifications for each facility before they could be widely adopted across MIT.

### *Management Tools and Systems Are Not Fully Compatible*

MIT manages the flow of people, money, and materials associated with facilities access using two major platforms, Mobius and Coral. Mobius serves the needs of MIT's shops, makerspaces, and research labs—an inventory of more than 800 pieces of equipment. Coral is the lab management system used by MTL and for some CMSE equipment. Several other units each have their own distinct systems for tracking and qualifying users and equipment. The Engine has developed its own prototype platform, the Engine Room, to perform those functions as well as to make matches among local equipment experts.

Although the Engine Room is powered via the Mobius platform, the Engine Room's database structure was modified during its development. This has created a situation in which compatibility between the Engine Room and Mobius is tenuous and one way. The Engine Room's database can read—with some finagling—from the Mobius database, but the reverse is not true. This incompatibility could worsen when either the Mobius or the Engine Room platforms undergo further upgrades.

### *Foundations of Expertise and Goodwill*

Expertise, trust, and goodwill are the bedrock of any shared facilities program—all of which MIT has in abundance. Cultivating personal relationships with the experts and craftspeople who are running Institute facilities, educating members of the community, and helping people find and use the right equipment are key.

These experts also help build the *mens et manus* skill set within the MIT community, a skill set that is essential for the future success of the startups that The Engine will support. At the same time, clarity about whether and how MIT employees and students participate in this shared use—whether to enable companies' use or as members of companies sponsored by The Engine—is important for continued goodwill and the appropriate use of human resources.

### *Addressing Safety Concerns*

Teams from MIT's Environment, Health, and Safety (EHS) Office oversee safety policies and procedures within Institute facilities. They also have experience working with external entities to ensure proper transfer of hazardous materials and biological materials to campus from outside the Institute. EHS systems work well for the MIT community, but they are not broadly positioned to accommodate external users.

Equipment safety is important to ensuring that machines and facilities are available to MIT students and staff when needed. MIT has excellent training and use policies that help keep people and equipment safe, but equipment does get damaged accidentally. At the moment, minor accidental damage to MIT equipment typically is covered by the host facility, while major accidental damage is covered by MIT insurance. The existing system doesn't provide any means to ensure the rapid repair or replacement of equipment that may be necessary with increased external use.

### *Addressing Export Control Concerns*

At present, MIT is an international community of researchers and educators who conduct fundamental research. MIT policy states that "research conducted on campus, without restrictions on publication or participation, is fundamental research from inception to publication as long as the intent is to publish

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[1] The MIT Center for Materials Science and Engineering (a National Science Foundation–funded center) is now under the umbrella of the recently created MIT Materials Research Laboratory, along with the MIT Materials Processing Center.

the results." Work on campus that does not meet this interpretation is considered an exception that is subject to special review, in part to comply with federal export control policies such as International Traffic and Arms Regulations (ITAR) and Export Administration Regulations (EAR).

It is reasonable to expect that a company sponsored by The Engine would not use MIT equipment for fundamental research and that, as a result, when that company brings materials to the MIT campus, the materials would be considered subject to export control regulations. It is also reasonable to expect that some individuals participating in companies sponsored by The Engine will have at least partial appointments at MIT. For this reason, use of the campus by The Engine and its sponsored companies must adhere to written policies on whether and how ITAR/EAR should be considered separately from existing MIT policy.

### *Allowing Time to Gear Up*

Our working group estimates that The Engine's own newly constructed makerspace will accommodate more than 80% of the typical hardware-type prototyping capabilities needed by tough-tech startups. This includes a modest space for wet-bench work. Given the lead time needed to gear up the MIT facility access program, The Engine may need to consider short-term alternatives to meet the remaining 20% of its facilities needs. Alternative facilities may be useful in the long term when startups from The Engine need access to equipment outside MIT's normal working hours.

Depending upon the activities of the startups, The Engine may need to make similar arrangements for additional wet-bench space. Distinguishing between chemical wet-bench work and biological wet-bench work is critical because infrastructure, equipment, and safety needs differ between the two. This holds true whether the facilities are in The Engine's new makerspace, alternative space accessible to The Engine, or MIT space used by The Engine.

## What We Need

MIT does not need to overhaul its approach to its facilities access. Nor does it require additional equipment. Our group believes that MIT can accommodate the external users who will be coming in through The Engine by clarifying and adapting existing systems for training, oversight, coordination, and safety.



**Figure 3. Identified Areas of Focus for Access to MIT Facilities by The Engine Participants**
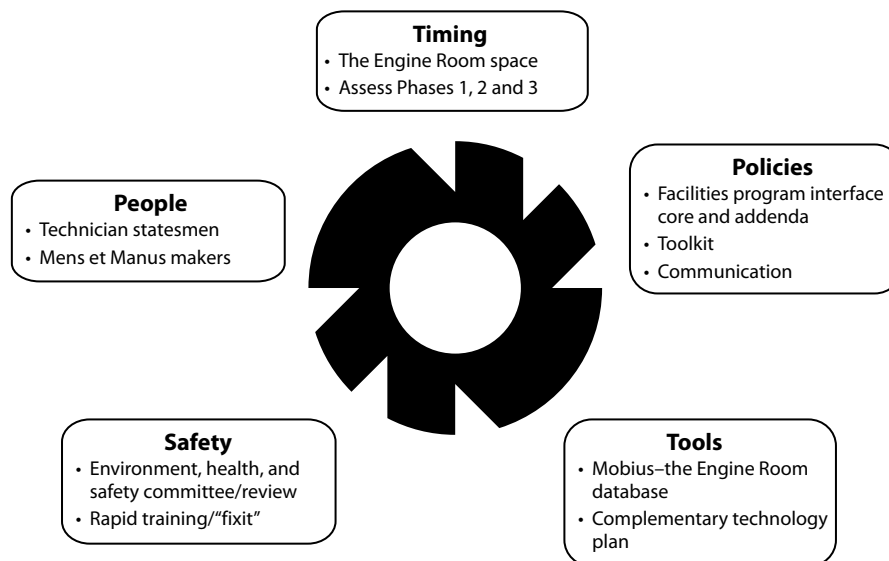
### Standardize and Disseminate Guidelines and Agreements

Given the widespread misinterpretation of guidelines for external access by MIT's DLCs, the Institute urgently needs to review and clarify, or modify, existing policies to ensure consistent interpretation and application of sharing procedures. The Institute should implement a companion communications strategy to educate DLCs about what is permitted under MIT guidelines. In the Facilities Access Working Group, we believe these efforts will encourage more DLCs to opt into a campus-wide shared facilities program.

MIT also needs a standard facilities access agreement that can serve as a template for DLCs wishing to share equipment with startups supported by The Engine. This FPI could be based on the MTL's FFA and other agreements (such as the one CMSE uses), and should be compared with those in use at another federally supported facility. We recommend that the FPI contain a streamlined core document that aligns with MIT's general terms for facilities access. DLCs could supplement the core document with addenda to customize access for their particular facility.

We recommend that MIT also create standard supporting materials that DLCs can use to manage and track sign-in, training, and financial charges associated with granting access to their facilities. The Institute also will need to develop a training program for financial officers and facility staff in the use of FPI templates and related materials.

### Address Database and Software Licensing Issues

MIT must create a master database that may be used by Mobius, the Engine Room, and other MIT entities such as the EHS Office. The master database will enable DLCs to manage equipment, training, payment, and other essential elements of a shared facilities access program. MIT should endeavor to make any new database or querying system compatible with complementary equipment access or query systems already on campus, such as Coral, or make it forward-compatible with new ones.

MIT and The Engine also must develop a joint strategy for coordinating the software needed to prepare materials for processing on MIT equipment. The Institute relies heavily on educational licenses, and The Engine will own commercial licenses. External companies are not permitted to use MIT's educationally licensed software to design, measure, simulate, and optimize parts or to create the programs they need to run computer-controlled equipment within the DLCs. Incompatibilities may arise without proper coordination.

In some cases, educational and commercial versions of software create programs that are incompatible. Work completed using software at The Engine, for example, may be viewable on MIT computers but will not yield code that can operate Institute equipment.

### Connect Two Communities of Experts

MIT needs to help connect its community of experts and craftspeople with staff at The Engine who manage its equipment and advise on engineering and fabrication best practices. These connections depend heavily on facilitating personal exchanges. Interactions between the two groups of equipment experts will strengthen the lines of communication within the facilities sharing program and improve outcomes.

Those connections also will establish a pipeline to The Engine for students who are passionate about the theoretical, prototyping, and experimental aspects of tough-tech enterprises. Finally, MIT and The Engine must understand clearly that access to any MIT facility is a voluntary decision by the known stakeholders of any specific facility or piece of equipment.

### Adapt Environment, Health, and Safety Policies and Procedures

The MIT EHS Office should adapt its systems for tracking policies, procedures, and training to accommodate external users. The office also will need to establish and maintain a formal relationship with The Engine. This will ensure good communication and effective oversight of the flows of people, materials, and waste associated with the use of MIT facilities by external startups.

Our group expects that when ventures supported by The Engine start using MIT equipment, the frequency of accidental damage and the speed of wear and tear on equipment will increase. MIT needs to take steps to minimize repair times and mitigate additional costs that may affect DLCs' education and research activities.

General training in laboratory and shop safety and equipment operation is crucial to the safety of people and machines. MIT and The Engine must determine how to train the entrepreneurs supported by The Engine, and who will supply the resources to do so. In our experience, most MIT facilities lack the bandwidth to train external users. Inadequate training programs may deter many DLCs from participating in a shared resources program.

### Articulate Export Control Policy

Our working group reasonably expects that the use of campus facilities by The Engine and its sponsored companies has the potential to involve materials—including data—that may be subject to export control. MIT and The Engine must provide and enforce written policies on whether and how export control policies differ from current MIT policy. Employees of such companies, some of whom may also have MIT affiliations, should not assume any policy that differs from MIT's current policy with respect to the campus' designation for fundamental research.

### Use a Phased Approach

In the short term, the Institute should leverage pre-existing frameworks to share specialized equipment with The Engine's startups at facilities such as MTL, CMSE, and the Koch Institute for Integrative Cancer Research. For the long term, MIT must develop a blanket FPI agreement that can be customized with addenda according to the needs of each participating facility.

### Protect MIT Community Members in Shared Facilities

Our group recommends that MIT enact protections for students who may use or work within facilities that will be shared with The Engine. Such students should not be exposed to interactions with members of The Engine if non-disclosure agreements (NDAs) are required or if a conflict of interest could arise because students are hired to conduct work within MIT facilities on behalf of The Engine.

## How We Get There from Here

MIT must mobilize key stakeholders and other experts on campus to develop the infrastructure it needs to significantly increase access to MIT facilities by outside users. MIT should collaborate with The Engine to ensure that these frameworks are mutually beneficial.

### Convene a Facilities Program Interface Development Team

To create the core of a new FPI, MIT should seek consensus among the Office of Sponsored Programs (OSP), Office of the General Council (OGC), TLO, and those campus facilities interested in becoming early adopters of the FPI. Our working group recommends that an FPI development team use MTL's FFA as a starting point. Early adopters should play a key role in shaping a suitable core-addendum structure that can be used by participating facilities to adapt the FPI to their circumstances.

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### Invest in a Master Database

We recommend that MIT invest in making the Mobius and the Engine Room databases compatible with a master database that each platform will use as needed. This investment will be particularly beneficial over the next several years as Mobius expands to include equipment at other universities and colleges within our region.

### Connect People and Foster Relationships

The many dozens of people who oversee equipment—rather than the pieces of equipment they oversee—are the most important element of a successful MIT shared facilities program. Understanding and working with these individuals is critical given that this will be an opt-in program.

Our group recommends that MIT and The Engine appoint people on each side who are cognizant of equipment access issues, understand engineering practice and fabrication technology, and have experience building successful teams. These individuals will cultivate relationships among members of The Engine and MIT facility managers. Such individuals also will make it clear internally that access to any MIT facility is a voluntary decision by the stakeholders of any specific facility or piece of equipment.

### Train a Cohort of Mens et Manus Makers

The Engine and the startups it sponsors will need a deep pool of students and postdoctoral researchers skilled in advanced modeling, design, and fabrication to complement the skill sets of other MIT students who focus on the entrepreneurial side of new tough-tech ventures. To fill this need, our group proposes the formation of a Mens et Manus Makers program. The new program would be overseen jointly by Project Manus and The Engine, and would train and vet students for internships at The Engine.

### Establish a Formal Framework for Environment, Health, and Safety

To create subsets of policies and procedures, the EHS Office and The Engine must establish a formal framework for sharing data and vetting the flow of people, materials, and projects to the MIT campus. At minimum, this framework should include regular meetings of representatives from both entities to coordinate proper government permitting of facilities for specific projects and to track and approve the flow of controlled materials (e.g., biological materials, materials, hazardous materials, waste, etc.). This group also should be responsible for generating solutions to EHS issues as they arise.

In addition, our working group recommends that the EHS Office, Project Manus, and The Engine collaborate on an assessment of environment, health, and safety training needs (programmatic, financial, and staffing). As part of training delivery, we recommend the creation of a just-in-time training program that incorporates online training and testing. The online components should be designed to reduce the training load on MIT staff without sacrificing safety or the quality of skill development. MIT's Project Manus programs—MakerLodge and other tiered training programs—can be adapted to address this issue. MIT and The Engine also must create a "Rapid Fixit" program that expedites equipment repair or replacement and thereby minimizes disruption to MIT activities.

### Build Upon Approved Facilities-Sharing Programs

Our working group envisions three phases to the adoption of a campus-wide facilities access program. In phase one, facilities with approved sharing programs and substantial experience (e.g., MTL, CMSE, Koch, and Lincoln Laboratory via CREDA) could opt in and begin sharing resources. Simultaneously, MIT should develop the blanket MIT–The Engine FPI it will deploy for phase two.

Also during phase one, we recommend that The Engine consider a corporate membership at the local, high-end makerspace Artisan's Asylum. This would give The Engine access to a wide range of equipment, including after-hours access, while MIT gears up its facilities access program. In the long term, this type of membership would give The Engine access to equipment its startups could use for work subject to ITAR/EAR without exposing MIT to additional risk.

MIT would launch its formal FPI program in phase two. Using the FPI, plus appropriate addenda, Institute facilities such as the MIT Tow Tank, the Edgerton Center, 3D printing at CopyTech, and BeaverWorks could be opened to The Engine. Access could be expanded to include a select group of local accelerators and startups, such as Greentown Labs and MIT's partner institutions within the National Network for Manufacturing Innovation.

Phase three would incorporate additional MIT facilities that have or can be equipped with administrative structures needed to manage and enforce an FPI. These facilities will have the benefit of lessons learned from early adopters. We envision MIT.nano and the Metropolitan Warehouse Makerspace as part of phase three when their spaces come online.

## Open Questions

We expect that new or follow-on working groups will address many of the issues raised by our recommendations. Beyond that, our group suggests that the MIT administration consider several questions that are fundamental to developing a campus-wide facilities access program.

- What are the best mechanisms for reviewing and approving addenda to the standard FPI agreement when a DLC amends it to meet the specific needs of its facilities?

- MIT and The Engine need to monitor the evolving needs of teams at The Engine and identify gaps in additional resources such as staff and equipment, as applicable. How will MIT provide additional resources if the evolving needs of The Engine make this necessary?

- Federal laws and guidelines may require MIT to include depreciation and other costs related to facilities access that yield a total use fee that is prohibitive to companies sponsored by The Engine. In such cases, will MIT subsidize outside use of its facilities?

- Will The Engine allow work subject to ITAR/EAR? If so, MIT needs to make sure that no work subject to ITAR/EAR from The Engine is allowed on campus without MIT approval. A robust system must be developed to check for and manage any such work.

## CONFLICT OF INTEREST

### Overview

MIT is a world leader in supporting and encouraging spinout companies and a broad array of other entrepreneurial activities. Its first responsibility, however, is to maintain the integrity of the Institute's education, research, and teaching missions. Processes that promote full and timely disclosure of potential conflicts of interest are critical to identifying, managing, and eliminating risks for members of the MIT community who are participating in allowable entrepreneurial activities.

In The Engine Working Group on Conflict of Interest, we examined three types of real or perceived conflicts—conflicts of commitment, individual financial conflicts of interest (fCOIs), and organizational conflicts of interest (OCIs).[2] We surveyed the published COI policies of peer institutions across the country to gain an understanding of where MIT stands with respect to the broader policy landscape. We also drafted some initial scenarios that illustrate common problematic activities for MIT researchers, postdoctoral associates, and faculty members, as well as potential COI challenges for postdocs seeking to engage with The Engine.

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[2] Authors' note: All underlined terminology in this section is defined in MIT's online "Financial Conflicts of Interest in Research: Definitions." http://coi.mit.edu/policy/definitions#fcoi.

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*"At a place like MIT, we need well-thought-out conflict-of-interest guidelines to promote the right environment for launching successful, innovation-based companies."*
*—Robert Langer, David H. Koch Institute Professor*

## Where We Are Today

Current MIT COI policies enable faculty, students, and staff to engage responsibly in entrepreneurial activities on condition that such activities do not compromise their commitment to MIT or the integrity of MIT's mission. These policies are in line with the published COI policies of most peer institutions.

### Existing Processes Strike a Balance

Requirements and procedures for disclosure, review, and management of COI issues (real or perceived) attempt to balance the needs of a thriving entrepreneurial ecosystem with MIT's institutional responsibility to its own community, its sponsors, and its collaborators. MIT has designed its policies to ensure that publishable fundamental research—rather than outside financial interests—drives its activities.

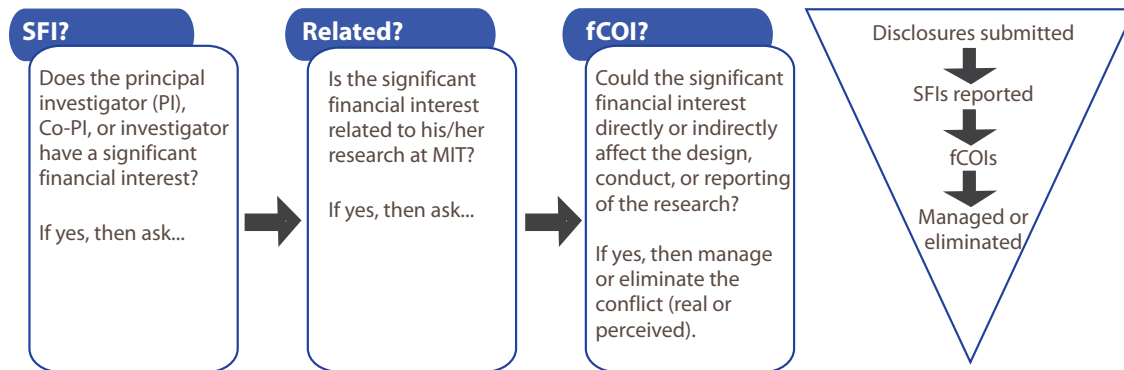**Figure 4. Who's Part of the Conflict of Interest Conversation?**
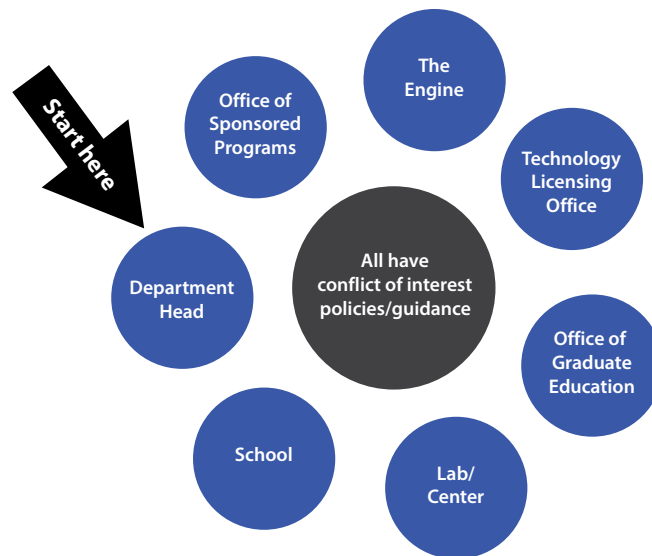


Under the current MIT financial conflict of interest policy and using existing guidelines, MIT faculty members can participate with confidence in a wide range of outside activities that align with their institutional responsibilities. Such activities may include, but are not limited to, consulting, starting companies, and serving on scientific advisory boards. Present policies and practices also promote appropriate use of and access to Institute resources and facilities.

### Transparency Is Expected and Encouraged

Full and timely disclosure of significant financial interests (SFI) is critical to identifying, managing, and eliminating financial conflicts of interest. This ensures that the design, conduct, and reporting of research funded via grants or cooperative agreements are free from bias that may result from an investigator's financial conflicts of interest.

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**Figure 5. Process for Identifying and Managing Conflicts of Interest**



Investigators, for example, must describe the business focus of a related entity, their work or role with that entity, and any relationship that business activity may have to their institutional responsibilities. A related entity is an organization in which the investigator, alone or in combination with family, holds a significant financial interest. This level of transparency is particularly important in relations with research sponsors and other collaborators.

### Two Processes Protect Individuals

MIT uses two distinct processes to collect and review the information it needs to assess activities that may lead to real or perceived conflicts with the institutional responsibilities of a faculty or staff member, student, or MIT affiliate. The Office of the Provost monitors conflicts of commitment (measured in time) and conflicts of interest via the annual Outside Professional Activities (OPA) report. The Office of the Vice President for Research tracks individual fCOIs—measured in money—that could affect MIT research. The data collected by these two offices indicates that fCOIs often are interconnected with conflict of commitment.

*30 to 90 days to disclose a new financial interest in a startup*

These two processes for disclosure, review, and management combine to protect both the integrity of MIT's mission and the reputations of MIT and individuals within the MIT community. Identifying and eliminating potential COI issues also remove risks to sponsored research funding (from industry and other sources), compliance with federal fCOI regulations, and MIT IP policies. These processes also preserve the ability of staff members and subordinates to carry out Institute responsibilities free of possible COI. Tracking and reporting protects students and postdoctoral associates and fellows—and their educational and training goals—from being unduly influenced by their own outside financial interests and those of their faculty advisors.

### The Engine Structure Mitigates Potential Organizational Conflict of Interest

Because The Engine is organized as a separate corporate entity, its structure mitigates potential OCI for MIT. Only three people who are faculty or employees of MIT are involved in the governing body or operations of The Engine. MIT Executive Vice President Israel Ruiz and School of Engineering Dean Anantha Chandrakasan serve on The Engine's Board of Directors and Media Lab Director Joi Ito is a member of the Investment Advisory Committee. Neither the Board of Directors nor the Investment Advisory Committee will make decisions about which companies participate in The Engine. Those decisions, including which companies receive support from The Engine's investment fund, will be made by The Engine's officers and other investment professionals who are employed directly by The Engine— not by MIT.

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## What We Need

The Engine is not restricting its support solely to companies that originate from MIT, license IP from MIT, or are otherwise connected to MIT, and selection criteria will not include a preference for ventures with Institute connections. Nonetheless, MIT enterprises are expected to be among the companies participating in The Engine. Thus, every member of the Institute community must understand MIT's COI guiding principles and be able to recognize potential conflicts of interest vis-à-vis The Engine.

### *Endorse Existing Financial Conflict of Interest Principles*

By following the Institute's existing fCOI guiding principles, faculty, students, and staff can participate in The Engine activities without real or perceived conflicts of interest or conflicts with their obligations to MIT's research and educational missions. Senior members of the MIT administration should reinforce the need to adhere to these principles with visible endorsements of support.

### *Increase Community Understanding*

Every member of the community must understand the guiding principles behind MIT's COI processes and be equipped to recognize potential conflict situations. Our working group recommends that the Institute commit the requisite resources to expand on existing efforts to develop more user-friendly tools and produce guidance documents that address the administrative burden on our faculty and community. Such resources are necessary to our ongoing efforts to demonstrate an exemplary model for how fCOI is understood and managed by a leading university in a uniquely complex and creative environment.

### *Expand Organizational Conflict of Interest Processes*

From time to time, MIT takes equity in companies to which it licenses IP. Because MIT is an investor in The Engine's accelerator fund, it will have an indirect economic interest in more startup companies. The potential for OCI, or perception of OCI, is likely to increase. Our working group expects that OCI concerns will arise primarily from MIT's equity interest in startups licensing MIT IP, and we are reviewing how and when the Institute collects the information it needs to make informed decisions about mitigating OCI.

### *Be More Flexible in Allowing Low-Risk Activities*

MIT should consider evaluating risk in a way that offers more flexibility for faculty, staff, and students to participate in startups. Customized arrangements could potentially allow startups to use MIT facilities and to seek funding for research they undertake. To implement such new arrangements, the Institute may need additional mechanisms that enforce COI management plans, minimize disruption to timely completion of academic degrees, and prevent the division of lab personnel and staff into "haves" and "have nots."

### *Develop Mechanisms for Ongoing Review*

Given the novel attributes of The Engine's mission and structure, our group recommends that MIT develop new mechanisms for ongoing review of COI and OCI policies. These assessments should include risk/benefit analyses of policy changes developed in response to experiences with The Engine, other startup activities, and best practices at peer institutions.

## How We Get There from Here

With respect to The Engine and potential COI, MIT should pursue twin goals: increase opportunities for its faculty, staff, and students to participate, and minimize or eliminate the risk factors. Our working group believes that increased education, standardization, and new licensing approaches are key to achieving these goals.

### *Expand and Refine Community Outreach*

We recommend that MIT create a common web portal to educate the Institute community about new and existing COI policies and procedures, including a section focused on the broad range of issues related to startups. MIT also should develop constituent-specific materials tailored to the particular circumstances of faculty, staff, and students.

### *Investigate New Strategies in MIT's Technology Licensing Office*

The TLO could prioritize potential COI and OCI issues early in its licensing activities. Forethought and planning by the TLO could significantly minimize or even eliminate COI and OCI issues for MIT and its community members.

### *Create a Committee for Review of COI Policies*

MIT should establish a new committee comprising faculty members, postdocs, students, and administrators to review inconsistencies in COI policy interpretation. This committee also could recommend changes to existing policies to make sure that they continue to support MIT's innovation and entrepreneurial initiatives.

## Open Questions

In the course of our review, our working group identified a number of issues and questions that require further study.

- What best practices from peer institutions should MIT consider adopting?

- How can the Institute best prioritize long-term impact ahead of short-term gain when considering new policies?

- What mechanisms should MIT use to review and reevaluate its role in encouraging participation by its faculty, staff, and students in The Engine while maintaining policy compliance?

- To what extent can MIT establish standardized interpretations of what can and cannot be done under existing policies and procedures? In particular, can the Institute develop standard interpretations for the following sections of MIT Policies and Procedures?

  - Section 2.3 (Academic Instructional Staff Appointments)

  - Sections 4.4 and 4.5 (Faculty Rights and Responsibilities on COI and OPA)

  - Sections 5.2 and 5.3 (Sponsored and Academic Research Staff Appointments)

  - Section 8.0 (Graduate Student Appointments)

  - Section 12.5 (Use of Facilities)

  - Section 13.1.5 (Information Policies/Consulting Agreements)

As we considered various scenarios, our working group identified a number of policy issues that require clarification in the areas of relationships, facilities, and startups.

### *Relationships*

- How does MIT define "student?" For example, are students distinguished by their rank (e.g., undergraduate, graduate), or are all students treated equally under Institute policies?

- Should MIT consider postdocs to be staff rather than trainees? Should they be afforded acceptable allowances to participate in outside professional activities as part of their training?

- What is MIT's perspective on the relationships that faculty, staff, and students may have with startups? For example, does MIT allow all or only some of these categories of individuals to provide consulting services? Are any individuals required to take leaves of absence or a reduced appointment at the Institute to work at a company?

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- Do a person's efforts in starting a company count as consulting for the purposes of our policies? In other words, is "consulting" as used in MIT Policies and Procedures intended as a proxy for "outside professional activities?"

### *Startups*

- Can a startup company with which a faculty member is involved fund research in that same faculty member's lab?

- Can faculty members and their startups co-apply for federal money (with a sub-award arrangement, for example)? If yes, what mechanisms (if any) do faculty members need in place to make such an arrangement allowable (e.g., limiting the arrangement to less than a year, requiring a co-investigator on the project who is not affiliated with the startup, etc.)?

Additional background information for the Conflict of Interest section may be requested at theenginewg@mit.edu.

## VISAS FOR ENTREPRENEURS

### Overview

In 2016, the National Foundation for American Policy reported that nearly 25% of the billion-dollar startups in the US "had a founder who first came to America as an international student."[3] Similarly, a 2015 entrepreneurship and innovation study at MIT revealed that foreign-born students were making a disproportionately large contribution to the number of companies founded by MIT alumni—despite the fact that existing US immigration laws limit pre- and post-degree entrepreneurship options for MIT international students and scholars.[4] During the 2016–2017 academic year, 3,003 international students were enrolled in degree-granting programs at MIT, accounting for 26% of all students. International undergraduates numbered 430 (10% of all undergrads) and international graduate students numbered 2,876 (43% of all grad students).

**Figure 6. International Students at MIT, by Region, Academic Year 2016–2017**



22%
Europe

52%
Asia

8%
Latin America

7%
North America

3%
Africa

7%
Middle East
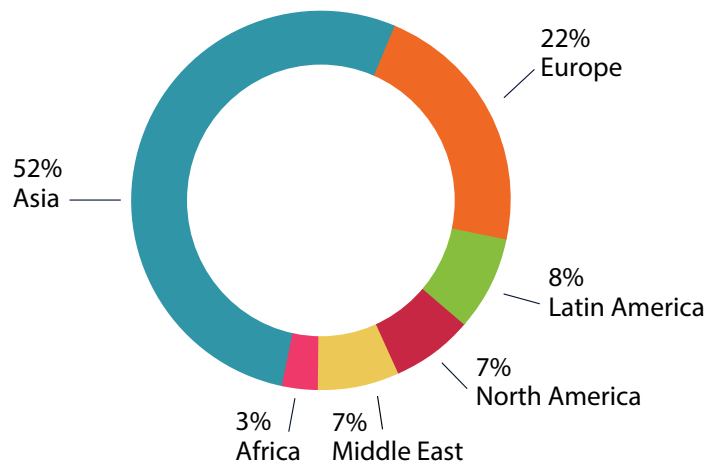
[3] "Research: Immigrants Started More Than Half of America's Billion Dollar Startup Companies," National Foundation for American Policy, March 17, 2016. http://nfap.com/wp-content/uploads/2016/03/Immigrants-and-Billion-Dollar-Startups.DAY-OF-RELEASE.March-17-2016.pdf

[4] Roberts, Edward B., Murray, Fiona, and Kim, Daniel J., "Entrepreneurship and Innovation at MIT: Continuing Global Growth and Impact," MIT Sloan School of Management, Massachusetts Institute of Technology, 2015. http://web.mit.edu/innovate/entrepreneurship2015.pdf

In The Engine Working Group on Visas, we surveyed the current immigration and work permit landscapes for international entrepreneurs and considered the different scenarios and needs that exist within MIT's international community. We also examined the academic benefits that would flow from increased student participation in entrepreneurship experiences, and explored broad categories of new opportunities and pathways that may require the Institute to rethink or modify its policies and procedures with respect to visas.

> *"When students come to the Commonwealth, they often stay and start their own businesses, creating wealth for their investors and employees and new products and services for the marketplace. More than one-third of American founders of startups and spin-offs were born outside of the United States, and many of these founders were educated in Massachusetts schools."*
>
> *—Charlie Baker, Governor of Massachusetts*

## Where We Are Today

Compliance and enforcement actions dominate the current US immigration landscape. The new presidential administration is focused on protecting US workers and reexamining visa programs that grant work permission to foreign nationals. Many commentators anticipate increases in enforcement actions and restrictions on employers, including ongoing site visits, audits, and limits on the ability to issue visas for alien entrepreneurs. Recent directives released by the US Department of Homeland Security and US Department of Labor confirm these new enforcement policies.

For reference, more than 3,800 international students currently are enrolled at MIT. In addition, approximately 1,400 postdoctoral associates and fellows are on appointments in more than 60 Institute DLCs. These individuals are responsible for much of the research being conducted at MIT, and some have entrepreneurial ambitions.

### *Visa Programs Are Outdated*

Current US visa types do not meet contemporary business needs. Employment-based visas are not designed for or suited to self-employment or work at a startup. MIT, other large research institutions, and industry must advocate with the new White House Office of American Innovation and with Congress for new job-creating, economy-expanding visa options. Appropriate options will ensure that the most creative entrepreneurs and most highly educated graduates of US institutions will have the opportunity to form companies that improve manufacturing, spur medical advances, revolutionize transportation, maximize natural resources, create new technologies, and improve the world.

In this environment, the greatest impediment to employment for MIT international entrepreneurs is the lack of a straightforward pathway to creating a company in the US. The lack of a startup visa is an important aspect of this problem. In addition, while H-1B Specialty Worker visas can sometimes be used for entrepreneurs, the cases in which H-1B visas apply are limited. Such cases also are restricted by an annual cap on the number of H-1B Specialty Worker visas that can be granted to foreign nationals at non-academic, for-profit employers. Each year, US Citizenship and Immigration Services (USCIS) receives approximately 200,000 applications for 85,000 available visas. Academia is exempt from this cap, but other employers are not. This greatly limits post-graduation career options for MIT international students and post-MIT-employment options for MIT international postdocs, especially those pursuing careers in startups or entrepreneurship.

Entrepreneurs are exploring creative solutions that enable them to work on their startups while simultaneously engaging in other activities that make them eligible for visas—student, business, or university employment, for example, or graduate degrees with a period of practical training. Unfortunately, these options are merely stop-gap measures rather than long-term solutions.

### *New Rule Faces Implementation Hurdles*

In January 2017, the USCIS published a new parole rule that would allow entrepreneurs to enter the US without non-immigrant visas to engage in startup enterprises. The rule, which was scheduled to go into effect in July 2017, is for business activity of "significant public benefit" and "substantial potential for rapid growth and job creation." If implemented, qualifying international entrepreneurs would have reasonable opportunities to launch and develop their businesses.

To fully implement this entrepreneur exemption, however, the US Department of Homeland Security (DHS) and US Customs and Border Protection (CBP) would have to train their officers to adjudicate lengthy petitions by foreign nationals waiting in lines at airports or land borders. However, the long-term fate of the program is uncertain.

### *Federal Regulations Hamper Participation in Startups*

DHS immigration regulations specify that enrolled students must maintain their full-time course enrollment throughout their program of study. They cannot fall below a full course of study to pursue concurrent employment while under student visa status. Regulations limit the eligibility and number of hours per week that international students can work on campus while school is in session. Even when DHS regulations permit enrolled international students to participate in off-campus internships or experiences, the authorizations are limited. Curricular Practical Training (CPT) and Optional Practical Training (OPT) under F-1 visa regulations, for example, limit such experiences to those directly related to students' fields of study. CPT requires that these experiences be part of the established academic program curriculum and count toward the fulfillment of graduation requirements.

J-1 Exchange Visitor (student category) visas also offer limited authorizations for students who maintain full-time course enrollment to pursue off-campus employment in their declared major field of study under the J-1 Academic Training authorization. Such authorizations include internships and other experiential learning opportunities. Because the period of authorized off-campus employment is limited for both the F-1 and J-1 student visas, students must be strategic to make the best use of the limited employment authorization periods available under their visa status.

Any immigration infractions by an enrolled student may jeopardize more than their eligibility for a post-degree work authorization in their field. Such infractions also may affect the student's ability to complete their program of study. Pursuing a work or employment activity without proper authorization is considered to be the most egregious infraction.

Postdoctoral associates and fellows on J-1 visas can participate in outside activities only under very limited circumstances. The J-1 visa is for academic exchange and training. Postdoctoral associates on MIT-sponsored H-1B visas are authorized for employment solely at MIT. They can work for another entity only if that entity is able to secure a concurrent H-1B visa.

### *MIT Policies Limit Outside Activity*

At present, MIT sponsors employment-based visas only for foreign nationals with certain academic qualifications and levels of degree in full-time academic teaching and research positions. Institute policies bar MIT postdocs from consulting activities. MIT postdocs also are prohibited from working for a faculty member's company while simultaneously working in that faculty member's MIT lab.

The Institute uses the F-1 student visa primarily for degree students. The F-1 allows both CPT and OPT authorizations for off-campus academic experiential learning opportunities. The MIT International Students Office website provides details about international student employment authorization requirements.

### *Application Fees Can Be Prohibitive*

In addition to policies and regulations that limit the availability of work visas, the cost to entrepreneurs for application and legal fees is significant—and potentially prohibitive. The short-term competitiveness of MIT startups suffers if they do not have the financial resources to secure employment-based visas for their employees and founders. In the longer term, such ventures are similarly challenged by the cost of permanent and immigrant visas for employees.

### *More Curricular Practical Training Authorizations Are Needed*

OPT authorizations, which are elective for students and can be used to pursue internships or direct experiences, generally are limited to a maximum of 12 months per degree program. Because the 12-month allowance can be used either during or after degree completion, MIT students who wish to participate in startups must save as much OPT time as possible for use after they complete their degrees. Given this limitation, students find CPT authorizations much more useful for engaging in entrepreneurial activity prior to degree completion.

The challenge with CPT authorizations is that they require students to be enrolled in an internship or experiential learning course in their major program. Such internships and experiential learning courses must be for credit or mandatory for all students in their specific academic programs and must count fulfilling the requirements for degrees in those programs. From an educational perspective, these opportunities must enhance learning. Very few academic degree programs at MIT, however, require all students to complete an off-campus internship or experience in order to graduate.

In fact, many Institute academic programs lack any required or for-credit elective internship or experiential learning courses in their curriculum that count toward fulfilling degree requirements. Without such offerings, CPT authorizations are not an option for students in those programs. OPT authorizations are available to those students, but the processing time for approval by DHS averages 90 days. By contrast, CPT authorizations can be obtained within two weeks. The timing for receipt of an internship offer, or the advance planning needed to pursue an off-campus activity, can affect a student's ability to pursue the experience—especially given the processing times for employment authorizations by the US government.

## What We Need

To facilitate entrepreneurial activity and academic enrichment for visa-holding international students and scholars, MIT needs to act on two fronts: incorporate entrepreneurial requirements more broadly into academic programs and revise visa sponsorship policies to allow international students and scholars to participate in entrepreneurship activities.

### *Multiply Entrepreneurial Requirements*

MIT should increase the number of established degrees and programs that incorporate entrepreneurial activities into graduation requirements. Such requirements—applied equally to US and international students—would enable international students to take advantage of F-1 CPT regulations to form or otherwise participate in startups while still MIT students. Mandatory requirements in PhD programs, for example, could support CPT authorizations where testing or application of thesis topics would benefit thesis completion. Any internal MIT policies restricting student involvement in entrepreneurial activities should be reexamined in light of facilitating student participation and learning.

### *Create New Degrees, Fellowships, and Programs*

In tandem with adding entrepreneurial requirements to existing programs, MIT should explore opportunities to create new degrees with built-in experiential training or venture-related components. A bioengineering and innovation degree, for example, would support CPT authorizations provided the training experience is related directly to the field of study. New innovation-focused fellowship programs

could provide funding for PhD students, allow them to focus on thesis completion, and not require teaching or research responsibilities during the fellowship term. The Institute also could create more programs like the Translational Fellows Program (TFP) and its standard guidelines for selection, appointment, supervision, and mentoring. TFP generates professional development opportunities for postdoctoral associates while accelerating the transfer of MIT-research-derived technologies into commercial products. Such programs should be open to international postdocs, students, and MIT alumni.

### Establish New Partnerships

MIT should engage with potential industry partners to establish ongoing internship and training placements that align with students' academic endeavors and support industry's need for qualified student research initiatives. This effort should include outreach to MIT alumni or Institute partners for funds and other resources that support entrepreneurial thesis projects or the startup activities of current students and recent alumni.

### Expand Visa Criteria

MIT may want to consider expanding its eligibility criteria for visa sponsorship of international scholars, including recent graduates, to include an assessment of the entrepreneurial experience and potential of applicants. Simultaneously, the Institute should consider sponsoring international employees below the level of postdoc.

To facilitate concurrent employment at a startup while at MIT, the Institute could modify existing student and scholar policies regarding consulting privileges for nonresident graduate students and postdocs on part-time academic appointments. In addition, postdoc development plans could allow more flexibility for postdocs to engage in entrepreneurial pursuits.

### Share Best Practices

Given the lack of straightforward pathways to obtaining work authorizations—along with the uncertain future of US immigration policy—MIT should help potential entrepreneurs explore any and all viable options for obtaining such authorizations. To bring startups up to speed on visa issues and processes, our group recommends that MIT share successful practices—digital services center, templates, procedures—as well as lessons learned with The Engine and its participating companies.

## How We Get There from Here

MIT should assemble stakeholders from its senior administration, academic units, Office of the General Counsel, Human Resources, students, research staff, the International Scholars Office, the International Students Office, and admissions/recruitment teams to examine the feasibility of our recommendations. Above all, the Institute must consider the practicality, risks, and academic benefits of these suggestions with a mind to preserving the integrity of MIT's current visa programs and maintaining MIT's reputation as a compliant and exemplary employer and visa sponsor.

### Promote Innovation/Entrepreneurship-Oriented Degree Requirements

MIT could increase opportunities for international students to engage in innovation/entrepreneurial activities under existing visa guidelines if it establishes a campus-wide goal for internship and experiential learning requirements. The Institute should encourage undergraduate and graduate academic programs to offer elective courses that will count off-campus training experience toward the fulfillment of degree requirements.

When creating new degree programs, departments should make every effort to incorporate entrepreneurship requirements that expose students to the business components of that field of study. A new mechanical engineering and entrepreneurship degree, for example, would include business and management classes alongside engineering classes plus a required off-campus experience. To

comply with current visa regulations, the experience must be directly related to the mechanical engineering degree. Even an off-campus position such as a financial analyst must require the application of mechanical engineering capabilities and coursework principles. Such experiences will heighten students' preparation—both during and after degree completion—for the breadth of components involved in innovation or in launching a startup.

In tandem with the creation of these opportunities, MIT must amend its Graduate Student Non-Resident Status policy to allow enrollment in an internship or experiential learning course during the specific Non-Resident Status term.

### Sponsor H-1B Visas for Part-Time Positions

MIT could sponsor part-time teaching and research positions for H-1B visa holders when doing so would align with a DLC's needs. Part-time employees would be permitted to pursue outside opportunities, including those with startups and other employers that file concurrent H-1B applications for them. Such part-time positions could be funded by research agreements with outside companies. Similarly, summer collaborations with industry to fund research appointments within academic programs (including Undergraduate Research Opportunities Programs [UROPs]) could provide either on- or off-campus opportunities for international students.

### Coordinate Support Services

MIT should create a suite of support services tailored to international students working on startups, both during and after degree completion. Services could include mentorship and guidance on business structures, taxes, and human resource development. The Institute could provide referrals to qualified immigration counsel who can represent new enterprises and their employees to USCIS. A knowledge database of resources—including immigration lawyers—could be established to facilitate the referral of internationals to experts.

Over time, this resource could be expanded by implementing a digital services center that facilitates referrals to these experts based on the unique



From left, Zawadi Lemayian and Irene Berita Murimi, from Kenya; Smeet Deshmukh, from India; and Tendai Chizana, from Zimbabwe, all students participating in the MIT Hosts to International Students program, identify their home countries on a globe as MIT staff member and host Janet Fischer, right, looks on. Photo: Donna Coveney.

background of each international entrepreneur participating in The Engine. To help with legal fees and business expenses related to work visas and green cards, MIT could facilitate favorable arrangements for low-interest loans with financial entities such as the MIT Federal Credit Union.

### Coordinate Advocacy to Congress and Government Agencies

At present, MIT's administration, faculty, and staff advocate to elected officials and government agencies when legislation and regulatory rulemaking affect our academic mission and immigration and visas concerns. To be feasible, many of our group's recommendations would require changes in federal government policies. Coordinating advocacy efforts for a startup/entrepreneurship visa with other universities and research institutions must be an integral part of MIT's support for its student and scholar entrepreneurs.

## Open Questions

In the current immigration climate, our group expects changes in the interpretation of laws and regulations as well as modifications to existing government visa programs and agency procedures. Any of these could affect the availability of visas and the way MIT and The Engine facilitate visa sponsorship. To maintain MIT's integrity and reputation, and the viability of our current visa programs, the Institute must continue to ask the questions we asked within our working group when we began our research:

- How best can MIT include key stakeholders—senior administration; academic units; undergraduate and graduate students; research, admissions, and recruitment staff; DLCs; Human Resources; the Office of the General Counsel; the International Scholars Office; the International Students Office; and The Engine—in investigating the feasibility, practicality, risks, and benefits of our group's recommendations?

- Who are MIT's international entrepreneurs and what immigration options are open to them?

- How can MIT help its international community participate in The Engine and other startup ventures? What Institute regulations and policies restrict their participation in entrepreneurial and other outside activities?

## MIT'S INNOVATION ECOSYSTEM

## Overview

MIT is home to more than 85 centers, programs, competitions, prizes, hackathons, and student groups focused on innovation and entrepreneurship. This vibrant landscape has grown and evolved over time. It often coalesces into novel collaborations that create supportive pathways for students to advance ideas and technologies that benefit the world.

The Engine Working Group on MIT's Innovation Ecosystem convened leaders from many of these entities to develop recommendations on how to prepare the Institute's diverse population of students, postdoctoral researchers, faculty, and staff for entrepreneurial ventures beyond their time on campus—whether through The Engine or other external programs. As a group, we discussed ways to strengthen available resources, enhance community, and ensure an inclusive approach to innovation and entrepreneurship. Our goals included proposing strategies to coordinate and connect existing programs and generating ideas for new opportunities.

**Figure 7. Connecting the MIT Innovation Ecosystem with The Engine**
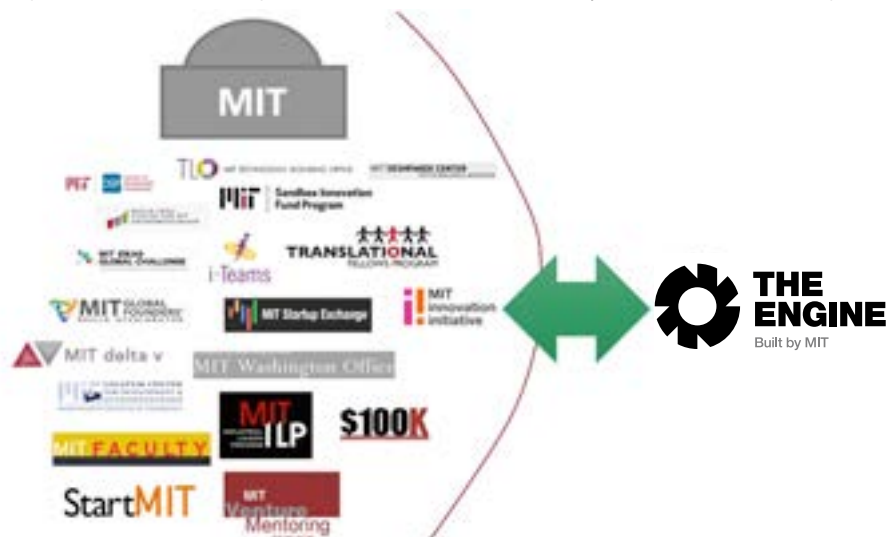
## Where We Are Today

Over the past several years, staff from many MIT innovation and entrepreneurship centers have interviewed students and alumni to learn how those groups were locating and leveraging campus resources. Our Innovation Ecosystem Working Group built on that research by conducting additional in-depth interviews with special emphasis on policies and procedures. We have begun to integrate evidence from multiple sources and to clarify what is presently available on campus, how resources are being used, where gaps exist, and how MIT policies create challenges for startups.

### Highlighting Ecosystem Strengths and Weaknesses

With the help of recommendations from groups on campus, we have identified more than 80 MIT ventures that fit the general description of the "tough-tech" startups that The Engine is targeting. During our initial round of interviews, we asked some of these startups about their journeys—from pre-founding technology development through growth phase—within and beyond the MIT ecosystem.

Those interviews highlighted the strengths of the current portfolio of MIT resources and revealed critical gaps—both in support and in understanding the complexities and nuances of the startup process. We interviewed current students and postdocs launching companies today, entrepreneurs involved with companies that launched more than a decade ago, and those connected to enterprises that have successfully exited.

Interviewees shared positive comments about the vast array of available resources and the effectiveness of certain mentors. They also noted a variety of obstacles and challenges related to conflicts of interest, gaining access to facilities, and maintaining MIT affiliations or work eligibility in the United States.

*More than 80 "tough tech" startups at MIT*

### Seeking Transparency and Guidance

Regardless of whether interviewees described positive or negative experiences with MIT resources, all our conversations touched on a common need—better communication about the organizational decision-tree that potential startups must follow when founding a company while on campus.

This universal need is independent of mentoring on strategy and entrepreneurial skills. Instead, it reflects the need to gain an early understanding of the legal ground rules and boundaries for starting a company at MIT. Interviewees felt underprepared for challenging decision points and underestimated the potential for conflict and complexity.

### Understanding Future Consequences of Early Decisions

Interviewees often cited concerns about their own lack of experience when making critical decisions during the startup process. They said they felt ill equipped to assess the broader implications of their early decisions. They also emphasized the need for greater support during some of their more difficult conversations with the MIT faculty or administration. Even former students and researchers who had positive experiences navigating the system, including those who attributed their success to a single advocate on campus, expressed a desire for more guidance.

## What We Need

No one we interviewed in connection with this report expected that founding a venture, especially one licensing MIT technology, would be a simple process. Everyone agreed, however, that MIT presently does not have an optimized or equitable startup support process. Participants identified a number of common concerns about and gaps in the Institute's existing innovation ecosystem.

### Address Confusion About Who Can License What

Who is allowed to start a company utilizing MIT technology? What happens if more than one party wishes to license the same technology? Multiple interviewees discussed situations in which both a student and a faculty member were interested in starting a company based on their common lab research. Although collaborative relationships were negotiated and launched in many cases, outcomes were not always satisfactory or equitable.

For purposes of strengthening the MIT ecosystem, and without casting judgment on either side of this dispute, we note as an example one case in which a student in that situation identified a lack of institutional support. The student found the process of determining licensing rights to be unclear and expected to receive more assistance from MIT in navigating the conflict, despite having participated in a variety of committee meetings and hearings related to the matter. The student did report receiving strong support from a team of mentors assembled by the MIT Venture Mentoring Service, which helped navigate the often-difficult conversations.

### Understand the Implications of Incorporation

Many founders of MIT startups did not come to campus intending to study business or launch a venture (this is especially true of those in technical programs). When later-stage students or postdocs recognized the potential impact of translating a project to the world through an entrepreneurial vehicle, they often lacked basic startup skills. As a result, they began hacking their way through venture construction without understanding the implications of officially incorporating a company. This was also true of many first-time faculty founders.

While serial entrepreneurs took parts of the process for granted, the first-time founders we interviewed described a complicated and uncertain journey. They struggled to assess what was best for themselves and their prospective ventures. Questions of timing were often complicated by the fact that they intended to license MIT technology and were using campus facilities for their work.

As noted earlier, many individuals succeeded with the help of mentoring provided by the Martin Trust Center for MIT Entrepreneurship, MIT Venture Mentoring Service, and Deshpande Center. A significant number, however, still encountered challenges or had to navigate the process alone. These individuals suggested that MIT find better ways to inform entrepreneurially minded students about the startup process, decision trees, and the



MIT Venture Mentoring Service (VMS) mentor Larry Krakauer speaks with entrepreneur Ian Butterworth, a team member on the VMS-mentored company Leuko, at VMS's annual networking event, the Entrepreneurial Edge. Photo: Jess Durant.

implications of early decisions. All believed that greater transparency about available programs would help innovators find trusted advocates across all domains.

## How We Get There from Here

Our working group recommends that MIT strengthen community-wide understanding of the various Institute guidelines governing entrepreneurial processes on campus. Specifically, MIT needs to clearly articulate policies for all aspects of the startup process. MIT should communicate its policies in a connected and comprehensive fashion using stories and similarly accessible genres that reflect the lived experience of entrepreneurs.

### *Coordinate Across Working Groups*

Our working group recommends continued coordination among the five working groups that contributed to this report. Our initial findings reveal how extensively these five topic areas interconnect and highlight the need to address issues holistically. Ongoing coordination will magnify the benefits of these efforts for MIT's entrepreneurial community.

### *Develop and Disseminate New Policy Guides*

Although MIT maintains various rules and guidelines related to startup activities, it needs to communicate them more vigorously. Our group recommends that the Institute collaborate with its innovation and entrepreneurship centers to develop user-friendly policy guides that address the key issues raised in this report.

These guides should incorporate real, anonymous case studies from within the MIT ecosystem. Relating the application of abstract policies to real-life situations will help demonstrate how the guidelines apply to concrete situations. Guides can be promoted and disseminated jointly by the many innovation and entrepreneurship (I&E) groups on campus through various channels—online, print, and live presentations.

### *Recruit and Train Innovation Advocates*

MIT could magnify the impact of existing I&E centers on campus by recruiting and training a team of innovation advocates from among our faculty and staff. These advocates would be certified as experts on the ins and outs of MIT policies governing technology licensing, facilities access, relevant visa issues, and conflicts of interest.

### *Refine and Document Rules of Engagement*

Informed by years of experience, entities such as the Martin Trust Center for MIT Entrepreneurship and Venture Mentorship Service have developed a set of principles for student support. These honest-broker principles are meant to ensure that programs remain focused on educational value. The principles enable students to trust that the advice they receive from MIT staff and external mentors is unbiased and rooted in students' best interests. More recently founded centers, such as MIT Sandbox, adopted these principles during formation to promote a standard operating system for the internal MIT ecosystem.

Our working group recommends the development of an aligned set of principles of engagement for the interface between the Institute community and The Engine. Mutual understanding among students, MIT staff, and The Engine staff about similarities and differences in the structure and objectives of campus programs and The Engine is essential. These principles of engagement should be codified, clearly stated, and well publicized.

### *Establish Shared "Proto-Engine" Community Space for Startup Teams*

In between the hatching of an initial idea and an official launch, MIT entrepreneurial team members often struggle with the interim phase—exploring viability, markets, and technical feasibility—while still students or affiliates of MIT. Many described the potential value of a new shared space for teams, space that teams could use before they incorporate or graduate from their programs.

Although the Martin Trust Center for MIT Entrepreneurship recently expanded, its new space is already overtaxed and unable to provide even semi-permanent homes to the most dedicated MIT teams. An on-campus "proto-Engine" space that convenes such teams from across a wide variety of campus centers would provide much needed support and lead to greater cross-pollination among centers and departments.

### *Develop an Innovation Master's Program*

In addition to space constraints, many students cited the challenge of fully exploring an idea and developing innovation skills while simultaneously meeting the rigorous requirements of a degree in engineering, science, architecture, humanities, or management. At graduation, they lose their MIT affiliations just as they are ready to leap fully into entrepreneurship. Our group proposes the creation of an innovation master's program that builds upon domain-specific skills, offers hands-on internship experience in a startup, and furthers students' innovation skills as they pursue their ideas. This recommendation builds on the similar idea proposed in the Visas for Entrepreneurs section.

### *Continue Data Collection and Analysis*

Our working group recommends ongoing high-level, programmatic data collection across the various competitions, programs, and centers at MIT to track who participates in such programs and how they benefit from participation. Such data collection could include a collaboration with Institutional Research (IR) that explores the incoming and outgoing entrepreneurial aspirations and actions of MIT students at different stages in their education. This could be achieved by adding a simple set of questions to an existing IR questionnaire.

This macro-level information, combined with program- and center-level data, would help MIT understand which students are best served by the existing network of resources throughout campus. The Institute could use this data to target areas where additional outreach and new offerings would deliver the greatest impact.

## Open Questions

Although we gained many useful insights from our initial set of interviewees, our working group is aware of dozens more MIT companies that are eager to discuss their journeys through the Institute's entrepreneurial landscape. Our goal is to engage with these organizations and update the Institute on how it can better support its aspiring entrepreneurs. We hope to explore three questions that overlap with key issues raised by the other working groups associated with this report.

- What conflicts might arise with my lab advisor or other colleagues if I attempt to launch a company?
- What constitutes significant use of MIT facilities, and why does that use matter?
- What are the rules governing what international students may and may not do in founding startups?

> *"As we continue to expand the Institute's innovation ecosystem, more MIT students and faculty will become entrepreneurs. That will be good for our country—and for society."*
> *—Ray Stata, Co-Founder of Analog Devices*

## CONCLUSION

The EWGs' preliminary recommendations were shared with the MIT community for comment from June to October 2017, and the final recommendations were presented at the October faculty meeting. The MIT Provost has received these final recommendations and is evaluating and prioritizing them to determine the best pathways for implementation. Considerations include the potential impact of these suggestions on current campus activities and the availability of funding for new mandates.

The EWGs expect that many of these recommendations will have broader implications beyond The Engine. Some EWG recommendations have already been implemented, including a June 2017 faculty startup boot camp jointly run with The Engine and the development of new standard agreements for technology licensing and IP.

## ACKNOWLEDGEMENTS

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**JOINT FINDINGS OF THE ENGINE WORKING GROUPS**
Final Report to the MIT Community

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