ATAL TINKERING LAB

Operation Manual

Your Guide to Building Young Innovators

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NITI Aayog

Message from Dr. Arvind Panagariya,
Vice Chairman, NITI Aayog

The Atal Innovation Mission (AIM) was set up in NITI Aayog for transforming the innovation and entrepreneurship ecosystem in the country. A key initiative of AIM is establishing a network of Atal Tinkering Laboratories (ATL) with the objective of creating scientific temper as well as cultivating the spirit of curiosity and creativity among young minds.

ATL provides an enabling environment for students to innovate through a do-it-yourself approach. The Labs will be equipped with sophisticated machines and instruments such as 3D Printers and Microcontrollers for honing the technical and innovation related skills of students. They will help to bring theoretical concepts to life and inculcate a range of skills including those pertaining to design, computational thinking and physical computing. Due to the practical orientation of this approach, students will learn to "make" which, in turn, can lead to the development of real-world applications and new enterprises.

We envisage ATLs to be incubators that can help to shape a generation of citizens who are well versed with the benefits, challenges and consequences of technology use. We are also confident that initiatives such as these will transform conventional teaching methods in India by facilitating the all-round development of young minds and giving them the space to put their ideas into practice.

NITI Aayog

Message from Mr. Amitabh Kant,
CEO, NITI Aayog

It is a pleasure for me to congratulate all selected ATL schools on becoming a part of the Atal Tinkering Lab (ATL) community, and participating in our mission to 'Transform India into an Innovative Nation'.

To develop the next generation of innovators, we want to link our young children with the Atal Innovation Mission. We want to provide them a platform to allow them to nurture their curiosity, creativity and imagination. And that is why the Government of India has taken the initiative to establish 'Atal Tinkering Lab', to attract the young generation towards science and innovation.

The Atal Innovation Mission aims to establish Atal Tinkering Labs (ATLs) across the country for children to work with tools and equipment to understand the concepts of STEM (Science, Technology, Engineering and Math). We look forward to these ATLs being instrumental in shaping the innovative prowess of the students of our nation and to tinker to bring about a positive change in the not too distant future.

We look forward to the success of this initiative and to prove that the hands-on experience and 'Do It Yourself' approach of the ATL will motivate our young generation to carve a brigher future for themselves and for India.

With ATL, we dream to create a new breed of Young Student Innovators in India, with the 'I can do differently' attitude and mindset. On this occasion, I wish all selected schools success in their endeavor to create the next generation of Young Innovators.

NITI Aayog

Message from Dr. C. Muralikrishna Kumar,
Senior Consultant, NITI Aayog

Congratulations on being selected to Create, Connect, and Develop in the Atal Tinkering Labs movement.

Within anyone who has experienced the power to dream... is hidden a creative genius!

To everyone who has the ability to think... is given the power to Make.

Atal Tinkering Lab is envisaged to be a playground to play and learn science beyond school text books, through application based self learning, to foster solutions to community problems. The vision is to create 1 million neoteric innovators in India who will create jobs of tomorrow and lead impact at scale.

We would like to thank the Intel team for their belief in innovation and tinkering as the means to instil a sense of creativity among the youth. The successful conceptualisation of the initiative to set up Atal Tinkering Labs would not have been possible without their enthusiastic support. Intel has also facilitated an accelerated set up of ATLs in 10 schools across the country. These ATLs will act as exemplars for the remaining schools by showcasing best practices for set up and creation of innovations in these labs. Once completed, the ATLs intend to impact a million plus youth with innovation skills and skills for the future.
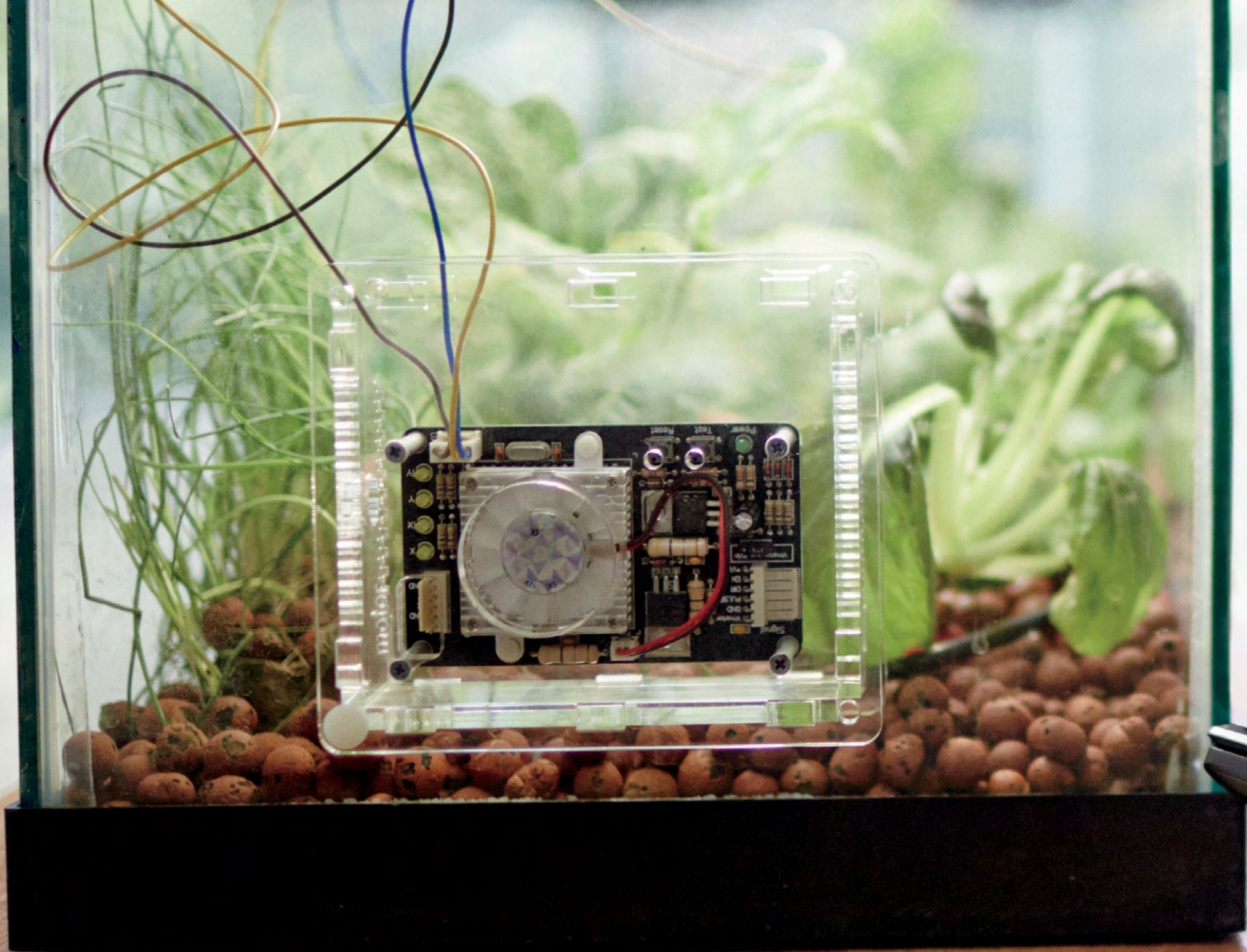
Message from Ms. Rosalind L. Hudnell,

Vice President of Corporate Affairs, Intel Corporation
President, Intel Foundation

Congratulations on being selected to receive an Atal Tinkering Laboratory!

We are excited to partner with you to inspire one million Indian youth to become innovators and use technology-focused maker experiences to solve India's most pressing challenges. Intel has a long history of investing in education and young people. Now we are building on that experience by designing tinkering laboratories to foster curiosity, creativity, and imagination in youth, while developing their design knowledge, computational thinking, problem solving skills, adaptive learning, and physical computing skills.

At Intel, we believe that technology can be a force for positive social impact and has the power to be a great equalizer. We are currently experiencing a period of rapid technological change that is dramatically altering what skills youth will need in order to succeed in the future. We must work together to redefine what it means to be an innovator by expanding who has access to technology skills and experiences. We want the next generation of innovators to be more diverse in terms of geography, economic status, ethnicity, and gender in order to harness the full power of technology to create the best future possible for everyone.

We are honored to be part of the Atal Innovation Mission in partnership with the National Institution for Transforming India (NITI) Aayog to bridge the youth skills divide. We truly believe that the Atal Tinkering Laboratory program will nurture ideas and foster innovation in new and different sectors of the economy. These laboratories will provide youth with opportunities to generate new concepts, work collaboratively, gain entrepreneurship acumen, and positively impact community ownership for sustainability.

Lastly, congratulations to the Indian government and NITI Aayog for collaborating with us to ensure that the next generation of innovators is provided with access to technology and innovation experiences.
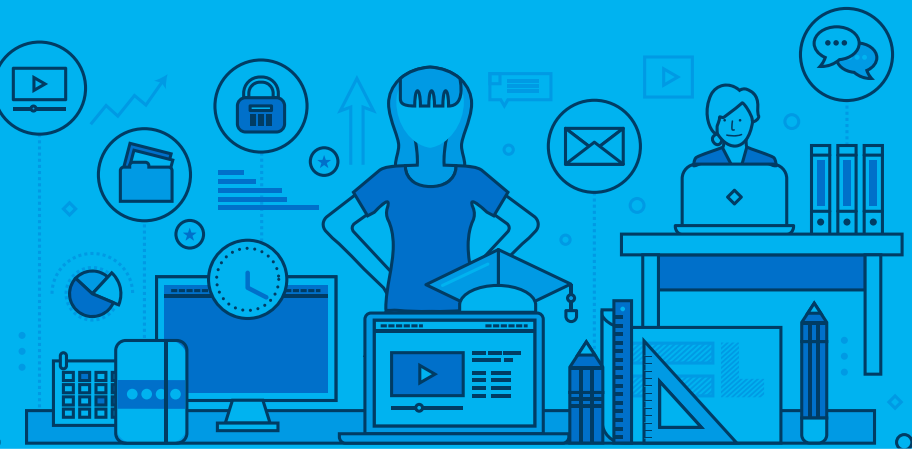
PART 1

INTRODUCTION

Background

With a vision to cultivate one million child innovators in India, Atal Innovation Mission by NITI Aayog and Government of India, envisaged a novel program – establishment of Atal Tinkering Laboratories (ATLs) in schools across the country. The Government of India aims to create an eco-system in the country that promotes the development and use of technology to find feasible solutions to problems. Taking the Prime Minister of India's vision to enable children to innovate and do things on their own in India and to move India forward, more than 13 thousand schools have applied for ATLs.

The objective of this program is to foster curiosity, creativity and imagination in young minds; and to inculcate skills such as design mind set, computational thinking, adaptive learning, physical computing etc. This is in sync with the global scenario where Future Work Skills are increasingly being considered as an important skill set for creating new avenues, providing solutions to global problems and leading the global economy towards the Fourth Industrial Revolution*.

To keep up the momentum of our growing economy, it is imperative to provide opportunities and facilities to our youth and empower them with these core futuristic skills - namely complex problem solving, critical thinking, creativity, people management, teamwork, emotional intelligence, judgment and decision-making, service orientation, negotiation and cognitive flexibility. And for this, training children when they are young is ideal, owing to their high levels of curiosity. Children are natural tinkerers and have a unique approach to problems. Atal Tinkering Laboratories (ATLs) have been conceptualized towards this very direction – to imbibe futuristic skill sets among youngsters by providing them with access to multiple technologies and enabling them to build/make new solutions to solve challenges they see in their communities.
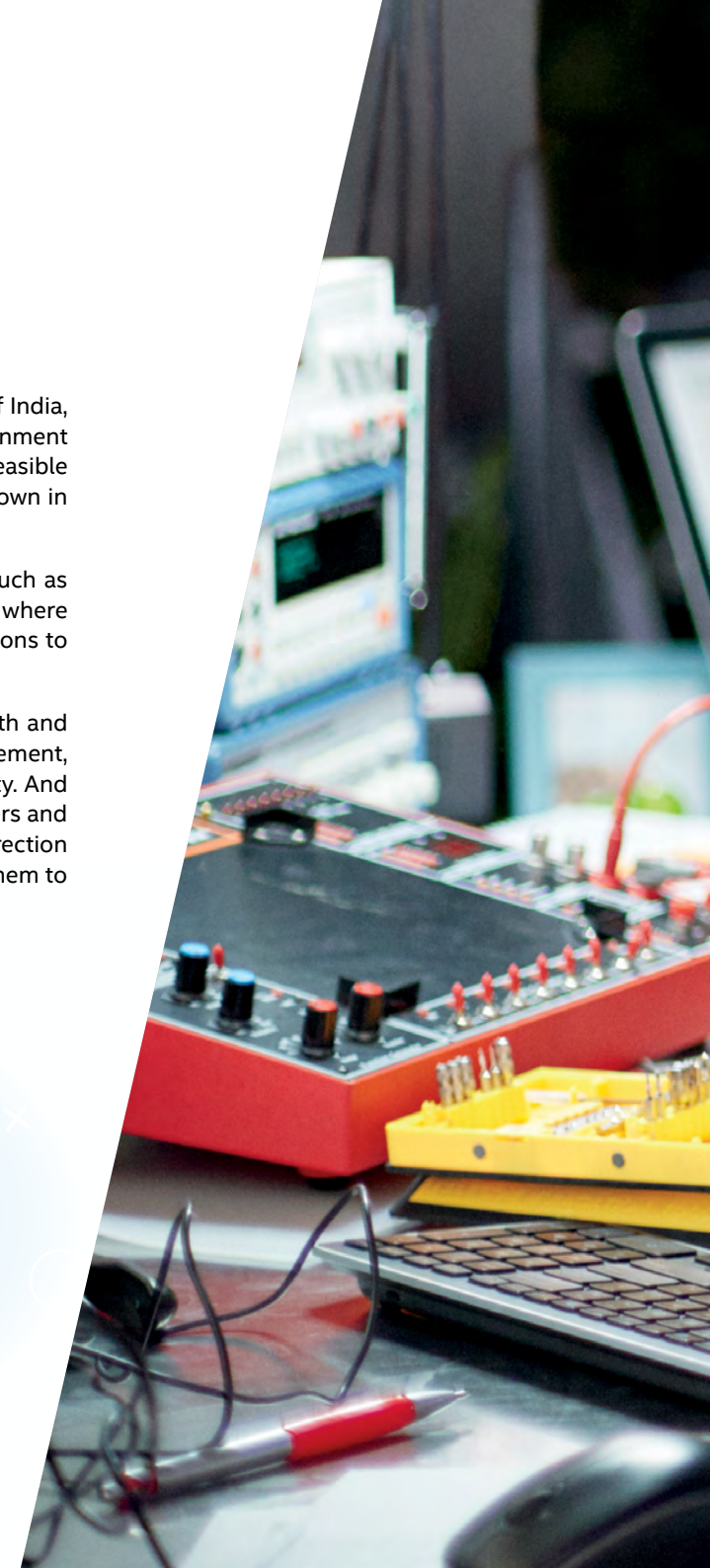
Fourth Industrial Revolution

The Fourth Industrial Revolution, also known as Industry 4.0, aims to combine the physical and digital world across all disciplines and industries. Emerging breakthrough technology such as Artificial Intelligence, Virtual Reality, Internet of Things, Robotics, etc. are the core of the fourth industrial revolution. To know more about the Fourth Industrial Revolution refer to Annexure 11 .

The ability to make sense of an unclear situation and to define the deeper meaning or significance of what is being expressed.

The capability to interact with others in a deeper and direct manner to stimulate reactions and derive desired interactions.

The capacity to critically assess and develop content that uses new media forms and influences the same for persuasive communication.

A problem solving process that involves logically organizing large amounts of data and analyzing them by finding general patterns

The key to managing diverse and inclusive workplaces and the ability to communicate, interact, and effectively lead people across cultures.

Sense Making

Social Intelligence

New Media Literacy

Computational Thinking

Cross Cultural Competency

Novel and Adaptive Thinking

Trans-disciplinarity

Cognitive Load Management

Design Mindset

Virtual Collaboration

The aptitude of thinking and coming up with unique solutions and responses.

The ability to understand and use concepts across multiple disciplines.

The ability to filter and organize information in order to maximize cognitive functioning using a variety of tools and techniques.

The ability to represent and develop work processes for desired outcomes.

The ability to work efficiently, drive engagement, and demonstrate your presence as a member of the virtual team.

Image Source: Future Work Skills 2020

Future Skills 2020

Success of Atal Tinkering Labs

To make Atal Tinkering Laboratories a successful venture, we urge all the students, teachers, principals, and parents to support and help create an innovative ecosystem in our country.

These labs have been envisaged to be the hub for innovation, invention, making, tinkering and giving shape to ideas solving local and global problems using technology. It is expected that these labs will play the role of incubators of ideas and inspire the young students of our country to step out of their comfort zone and work on novel concepts, embrace future skills as well as develop confidence and personality skills.

- To create a work space where young minds can learn innovation skills and sculpt ideas through hands-on/do-it-yourself activities.

- To provide facilities to work with latest technologies and tools - electronics, sensors, open source micro-controller boards, 3D printers etc., to create technology innovations for applications in multiple sectors including medical, energy, health, conservation of energy & natural resources etc.

- To create opportunities for the young students to work and learn in a flexible environment leading to participation in multiple regional and national level competitions and exhibitions at periodic intervals.

- To help build innovative solutions to India's unique problems and thereby support India to grow consistently as a knowledge economy.

All this requires more than mere setting up of a physical space in schools! It asks for an openness to look at new things and ideas and give them a chance to fail or succeed, free space to think new and different, freedom for people involved to do things differently - take ownership and lead the change etc.

The success of this program depends on how efficiently and effectively all the people involved with this program fulfil these expectations.

About Atal Tinkering Lab Operation Manual

This operation manual is intended to serve as a handbook for the head of the school/ principals/ teachers who will be involved in setting up and managing the Atal Tinkering Lab in the school.

It is directed to provide initial orientation and introduction to the concept and establishment of a Tinkering Lab. It covers various aspects of setting up of a lab - starting from the base, allocating resources etc., all aimed towards achieving the desired impact on the beneficiaries – students, teachers, school etc.

What is Tinkering?

There are many definitions for tinkering - all of them with different connotations, towards different directions and with different end results.

The Free Dictionary says that a tinkerer is "one who enjoys experimenting with and repairing machine parts."

The Oxford Dictionary says that to tinker is to "attempt to repair or improve something in a casual or desultory (unfocused) way."

Tinkering also means trying things out and to develop a "Let's try something New" approach.

These are all helpful starting points, but the concept of tinkering is bigger than the sum of these parts. The kind of tinkering expected at the Atal Tinkering Labs will be more focused in nature and purpose. It promises to be a collective act of various processes - identifying a problem; looking for a solution by thinking out of the box/over and above the conventional/popular streams; conceptualizing the idea; making it on one's own and then using technology to give shape to it and create a new entity which may be local or/and global in nature.

Simply put, we may refer to tinkering as experimenting with various electronic, robotic and technology tools; understanding their potential and creating a solution for local/global problems using ideation as a starting point.

Tinkering involves:

- Identifying a problem and conceptualizing a solution
- Thinking out of the box and above the conventional/popular streams
- Putting the idea down on paper and utilizing technology to give it shape and create a new entity, which may be local or/and global in nature

Differences between Science Lab and Tinkering Lab	
Science Labs	**Tinkering Labs**
Science Labs are designed for guided experimenting.	Tinkering Labs are for open-ended experimenting, with no single solution.
Science Labs may have expensive or fragile equipment.	Tinkering Labs have equipment appropriate to the age of the intended students so that they can tinker without the fear of damaging equipment.
Science Labs have a static design.	Tinkering Labs are intended to evolve with the institution.
Science Labs activities correspond to topics in text books.	Tinkering Labs are intended towards life and creative skills. The skills developed in Tinkering Labs may or may not directly help in academics, but an indirect advantage is most certainly observed.
Science Labs have a fixed curriculum.	Tinkering Labs have a directional curriculum that is not restrictive and provides students with the scope to create and innovate.

source: http://www.tinkeringlab.in/faqs/how-is-tinkering-lab-different-from-a-science-lab/
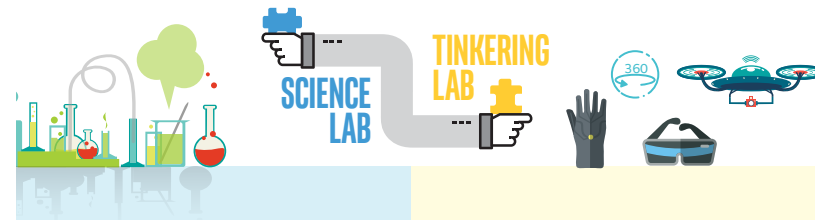
ESTABLISHING THE ATAL TINKERING LAB

Establishing the Atal Tinkering Lab

Developing a comprehensive plan	Creating an organisational structure	Identifying & setting up the physical space	Identifying & allocating human resources for the Lab	Procuring tools & materials for the Lab

Developing a Comprehensive Plan

Failing to plan is planning to fail

Before getting your hands on establishing the Atal Tinkering Lab, it is essential that you plan for the entire process – draw up a plan, create an organisational structure along with a reference document which has all the details.

By developing a plan, you will be making a note of all the steps on a piece of paper which can be executed in the future by you and your team and will be a guiding document throughout. A full-fledged plan in hand will allow you to take the necessary actions to set up the lab, monitor its performance and also administer the workflow of the lab.

A properly detailed plan will increase your work efficiency and help you achieve the desired results.

The key elements of your plan should include

- **Functional Areas –** Physical space and other physical resources – Design should be such that the lab can function both as a workstation and as a classroom

- **Human Resources –** Extremely important to allocate/appoint the right kind of people to manage the lab and conduct activities that will/can encourage students to innovate

- **Content to be used in the lab –** It will be as specified by AIM. In order to ensure that there is constant innovation and optimum use of technology, the delivery of the content has to be in a manner that engages and appeals / attracts the target audience - students/ teachers and community

- **Tools & Materials –** Technical resources – All tools and materials should be in sync with content that will be used and should be procured accordingly – phase-wise on need basis

- **Time Management –** Session in Tinkering Labs should be given equal importance as for any other subject in the school. The goal should be to include tinkering as a part of the syllabus and have sessions where children are free to think, create and play using various instruments in the lab
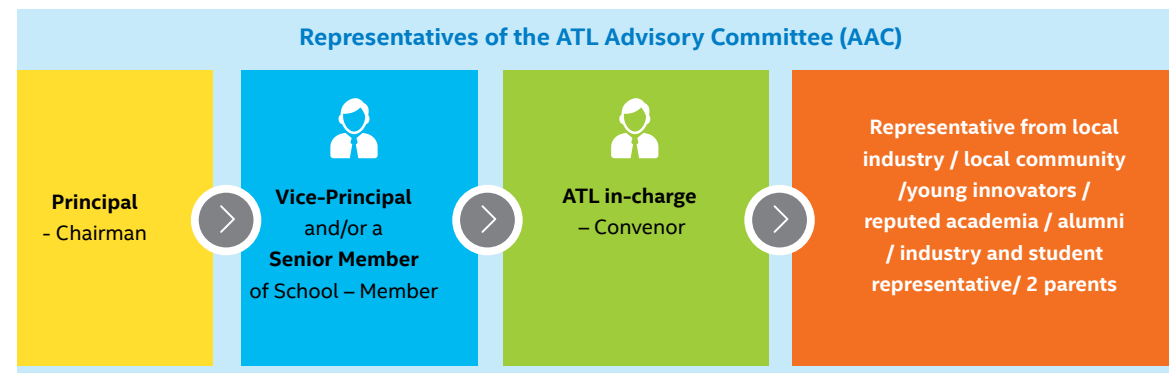
Attached is Annexure 1 - Plan document for Establishing the Atal Tinkering Lab.

Putting in Place an Organisational Structure

Now is the time to connnect with relevant people from your school - those who you think can contribute and help to create a robust plan – e.g. teachers from the Computer Science, Physics, Electronics departments etc. In brief, there is a need for creating an organisational framework for the functioning of your ATL.

Each ATL has to have an advisory body that will monitor the functioning of the ATL as per the AIM - ATL Guidelines. You can constitute a single body/ committee which will help in managing the ATL and also be responsible for sharing the requested reports/ information with AIM. Such a committee – ATL Advisory Committee (AAC) may/ can include:

Representatives of the ATL Advisory Committee (AAC)			
Principal - Chairman	**Vice-Principal** and/or a **Senior Member** of School – Member	**ATL in-charge** – Convenor	**Representative from local industry / local community /young innovators / reputed academia / alumni / industry and student representative/ 2 parents**

We suggest involving teachers who will be able to spend sufficient time irrespective of the subjects they teach; to not have more than 5 members in the AAC, simply to increase the efficiency of making decisions and thereby increase the pace of tasks at hand. Over and above the people mentioned above, we recommend to loop in the Time Table In-Charge for all the discussions revolving around the scheduling of classes and sessions for labs.

Recommended roles & responsibilities for members of the committee

For Principal along with the Vice-Principal and/ or a senior member of school

- Ensure time gets allocated in the lab and/ or classrooms in the school time table for the ATL sessions
- Recruit a new resource person or allocate an existing teacher from the school as the ATL in-charge
- The salary of the ATL-in-charge recruited, will not be included in the grant-in-aid
- Identify, allocate and prepare the space/ lab for ATL in school
- Monitor and evaluate the ATL in-charge on a regular basis

For ATL Advisory Committee (AAC)

- Monitor and evaluate the functioning of the ATL on a regular basis
- Make course corrections in the implementation plan as and when needed
- Identify and develop partnerships with relevant stakeholders - mentors, industry experts, makers etc., thus establishing contacts to obtain in-kind donations/ mentoring sessions etc.
- Ensure that reports reach AIM as desired, as per the requirement

For ATL in-charge

The success of the ATL depends hugely on the ATL in-charge. He/she is the key person who would be engaging, interacting and working with the students and hence has the biggest responsibility in this entire program.

In brief, the ATL in-charge is expected to

- Support in setting up the ATL
- Coordinate and collaborate with the school teachers to develop and create a plan/time table for engaging students and integrating ATL in everyday school routine
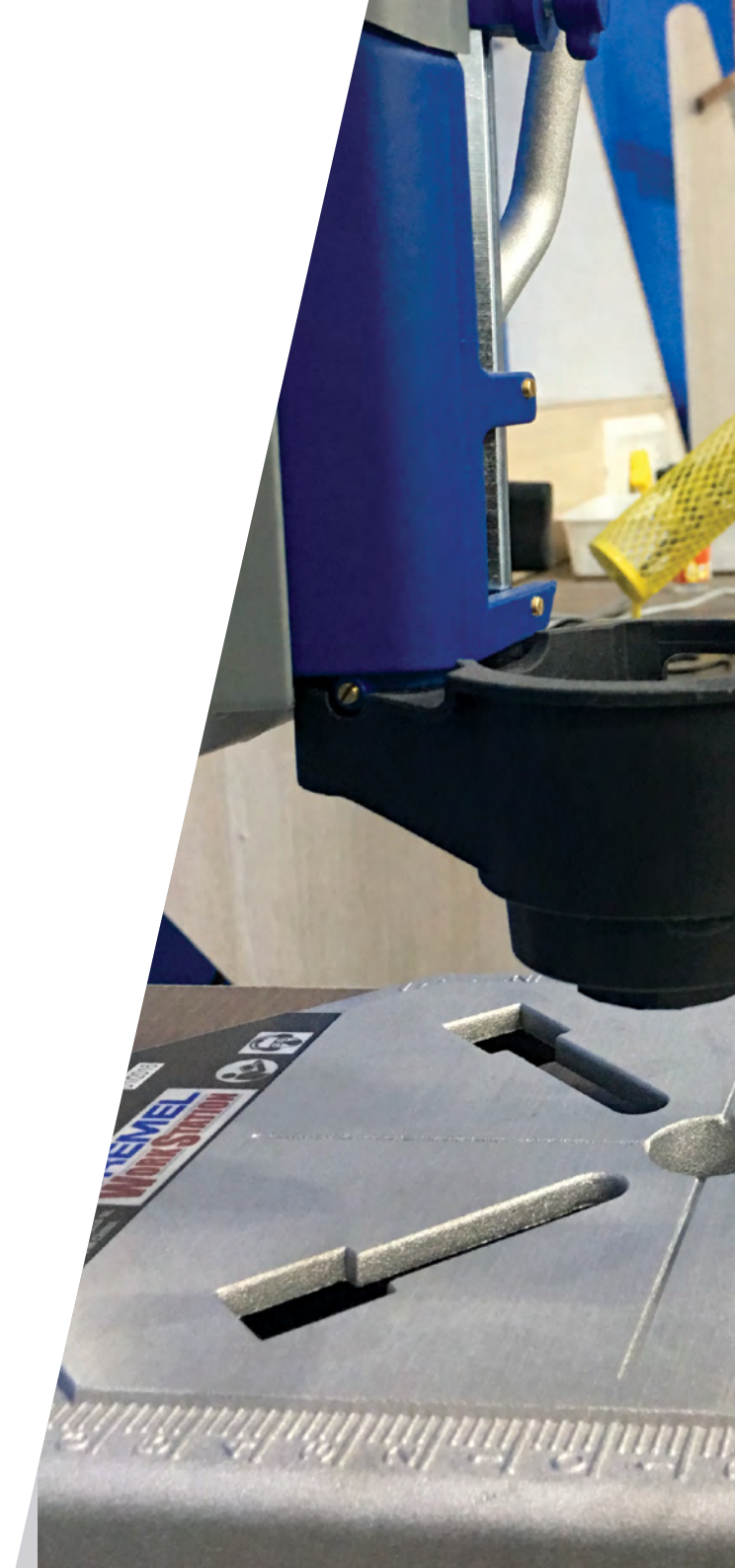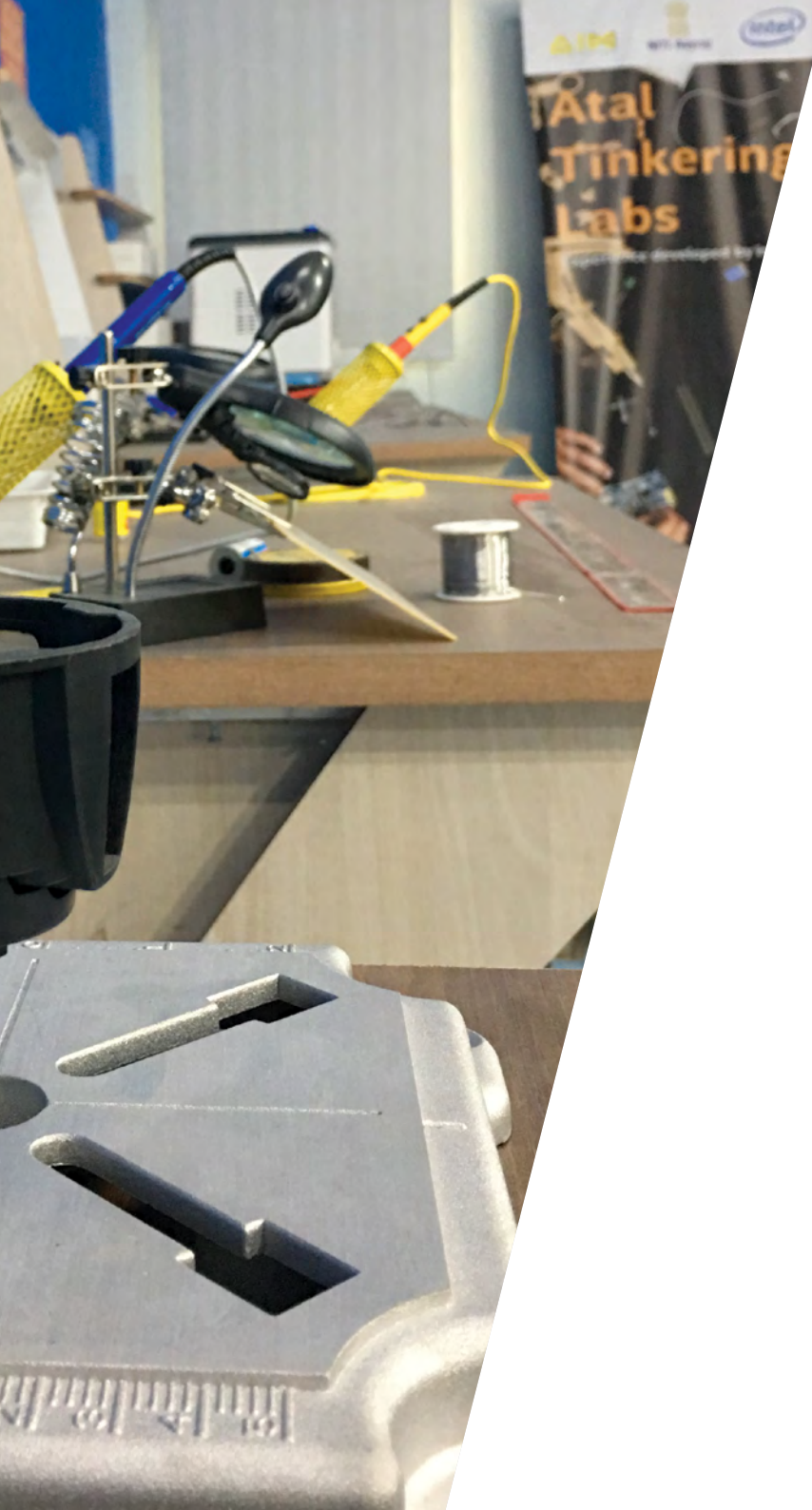
- Steer students towards becoming technology creators and solving local community problems
- Facilitate the learning process as per the pre-decided content and be the go-to person for students
- Maintain databases, document activities, generate reports, create events etc.
- Spread awareness inside and outside school to encourage students to participate in ATL activities
- Bring any serious concerns/issues to the attention of the school Head
- Ensure the safety of students and security of the lab
- Make ATL a conducive place for tinkering, creative thinking and endless innovation

For more details please refer to Annexure 2 - Sample Job Description of ATL in-charge.

For Student Representatives – 2 students

- Share the responses of the students
- Be the voice of the students and contribute in making decisions

For Industry Representative

- To bring in industry expertise, mentor, volunteers etc.

Identifying & Allocating Human Resources for the Lab

In a Tinkering Lab, the expectation is for students to follow their own dreams and passions; designing different kinds of projects, making new things and finding solutions. To facilitate this stream of thinking it is imperative to look at alternate methods of teaching. Thus there may be a need to look for a different kind of skill set while deciding to appoint an existing teacher/or a new person to be the lab in-charge. The objective is to find a person who can connect with the students, inspire them to think out of the box and create a culture of innovation.

Key reference points while deciding to appoint the ATL in-charge

- Most importantly the person should have a passion to innovate and a tendency to drive curiosity.

- Previous experience of tinkering, technology, computers, and physics would be beneficial

A recommended job description / roles & responsibility is listed in Annexure 2 – Sample Job Description

Do's and Don'ts for the teacher/lab in-charge is listed in Annexure 4 - Do's and Don'ts for Teacher/ Lab in-charge

iDEA

Identifying & Setting Up the Physical Space

The following points can help you in making the right decision

As per the initial grant document for ATL –

- Built up space of 1500 square feet for plains and 1000 sq feet for hill areas or island states is required for hosting a tinkering lab.

- Schools located in hill or island states would have to provide at least 1,000 sq. ft. of built-up space.

- The existing facilities for meeting rooms and video conferencing among others can be used to supplement the laboratory space.

'Applicant schools would be required to put in place the requisite physical infrastructure such as laboratory and workshop facilities, a computer lab with working internet within a period of 3-4 months from the date of release of funds. Other desirable facilities, which include a meeting room and video conferencing facility to chat with experts in real time can also be set up by the schools, if possible'. (AS PER THE GRANT DOCUMENT)

*For more information on branding, refer to Annexure 7 - Recommended Branding Guidelines

Key elements while identifying space for the Lab

- **Location of the Lab in the school:** The Lab should be in/near the main building of the school. The expectation is that it will be visited frequently by the students, teachers and participants of the community hence it shouldn't be in isolation.

The Lab should have:

- Proper ventilation
- Storage facilities - drawers, cupboards, storage boxes for tools, etc.
- Power supply - to run instruments, computers, projectors etc.
- Basic infrastructure - like fans, air conditioner if possible, heaters in cold areas, proper lighting and multiple plug points.
- Additional facilities - it is recommended to have a WiFi zone in the Lab or an internet dongle and routers for connectivity, a wash basin , a water cooler etc.
- Furniture - the lab should have basic furniture i.e tables and chairs. It is preferred to have light weight chairs which are easy to move and can be handy for flexible seating arrangements. The lab should be able to accommodate 25-30 students at any point of time.

Once you have identified the appropriate space for the ATL the next step is to set it up. To do so keep the following as your key reference points

Flexible Seating – A modular approach is a major advantage – flexible/movable furniture can be easily and quickly moved to suit the requirements of any lab activity.

Safe keeping of tools – Tools are the assets of the Lab. Please arrange for them to be kept safely. There are multiple ways to store tools - you can arrange them based on the availability of space. Hang them on pegboards, store them in boxes, bags, or chests, or keep them in drawers or in dedicated clearly marked shelves.

Security – Ensure there is a proper locking and security system in the lab to keep your tools and material safe at all the times.

Arrange all the tools and materials in a way that they are visible and easy-to-find – design a system to stock all the resources alphabetically or group wise. Use transparent boxes and drawers.

Organize the Lab in such a way that it is tidy and spacious enough to provide sufficient room to move around freely and without danger. Keep pathways to tools, exits, and safety equipment clear. Lab should be well-lit and ventilated.

Mix seating - Lecture setting for a small group in one part; and a focused collaborative group in the other

Flexible seating to suit the requirement of the lab activity.

Setting for focused collaborative group work
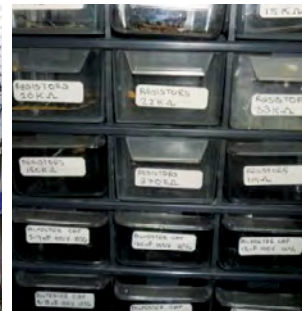

Students working in groups

Atal Tinkering Lab at a glance

Sample layout of ATL

Tinkering tools at a glance

Tools stored in transparent boxes and drawers

Store tools using appropriate labels

Procuring Tools & Materials for the Lab

Tools could be anything from a screwdriver to a computer to a 3D printer. To give students greater opportunities for exploring and tinkering, schools should have a well-equipped ATL.

We recommend you to choose wisely and purchase the tools that are necessary. Focus on generic tools rather than kits, as generic tools will have a broader usage. For example buzzers and relays can be used in various prototypes, LEDs will come handy in most of the projects, open source microcontroller boards will easily fit in to IoT solutions and also power various other projects

Key reference points while deciding to buy tools and materials for your Lab

- It is advisable to buy general equipment before purchasing task-specific tools. For e.g. it is more essential to have enough quantity of LEDs, bread boards etc. in your lab rather than only one big complex equipment.

- Before purchasing expensive and complex tools and equipment, ensure there's at least one person who knows how to operate them.

- Some components can be availed at discounted prices if bought in bulk; for e.g. LED lights, jumper wires, etc. and thus may prove a wise decision in the long run.

- Avoid buying local cheap equipment as this may lead to safety hazards.

- In addition, there is maintenance which needs to be considered. Filters get dirty, alignments need to be recalibrated, blades become dull, 3D printers need filament and sometimes things break. Be sure to allocate a budget for all these contingencies from opex when deciding to buy equipment. It may be worth looking into maintenance contracts for more expensive tools such as 3D printer etc.

Please refer to the NITI list of recommended tools and materials under Annexure 3 - Recommended list of tools and materials.

Please refer to the guidelines shared by NITI Aayog regarding procurement of tools and material for ATL

In the annexures, you can also refer to Annexure 5 - Recommended guidelines for safety to know more about safe practices within the lab premises.

SNEAK-PEAK

The First Atal Tinkering Lab in India

Envisaged to connect, create and develop an interest in tech creation among the young citizens of our country, the first Atal Tinkering Lab is all set to welcome its first set of tinkerers at Salwan Government Girls' School, Delhi.

This lab has been set up with support of Intel as part of a mutually signed collaborative initiative. The objective is to develop 10 of the selected schools as state hubs and empower them to provide support to all the ATLs.

The lab at Salwan Government Girls' School, Delhi has state-of-the-art interiors, a soothing blue wall and the necessary inventory to inspire a whole new generation to tinker! The modular nature of the lab, with generous sunlight and ventilation offers an ideal environment for students to ideate and give form to their ideas.

The lab has been set up keeping the key elements of being open, flexible and safe as the core guiding principles.

There is a specific discussion area designated for learning sessions, watching inspirational videos and deep discussions with guest mentors, speakers, ATL in-charge etc., aptly equipped with a projector, screen and enough seating space.

Individual work stations have been created for soldering, 3D printer etc. keeping the requirement for power supply and safety as the core guideline.

The lab is furnished with movable pieces of furniture - work stations, tables, stools, chairs, storage spaces etc. all giving the freedom to its users to move them as and when required. Equipped with multiple tinkering tools including soldering units, series of sensors, Genuino 101* - the open source development boards, relays, motors etc. the lab has been prepared to provide a platform for various levels of tinkering and creating, based on students' interests and inclinations.

Being safe is of utmost importance and thus the lab has been fitted with fire extinguishers, first aid kit, properly marked Exit options etc.

The lab has a whole range of tools and materials; to ensure all of these are easy to access without causing any confusion; each of them has been properly labeled and stored.

Customized, flexible and easy to use workstations
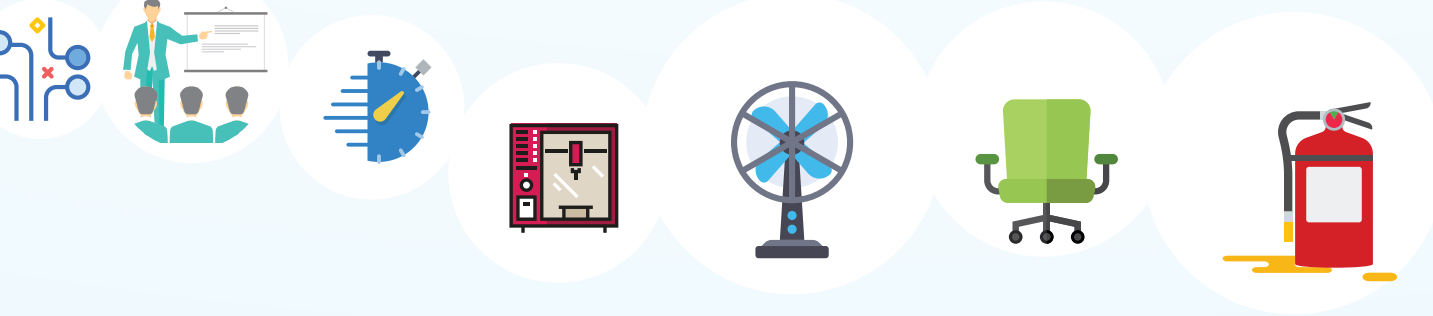
Projector for learning sessions

A fire extinguisher in case of an emergency
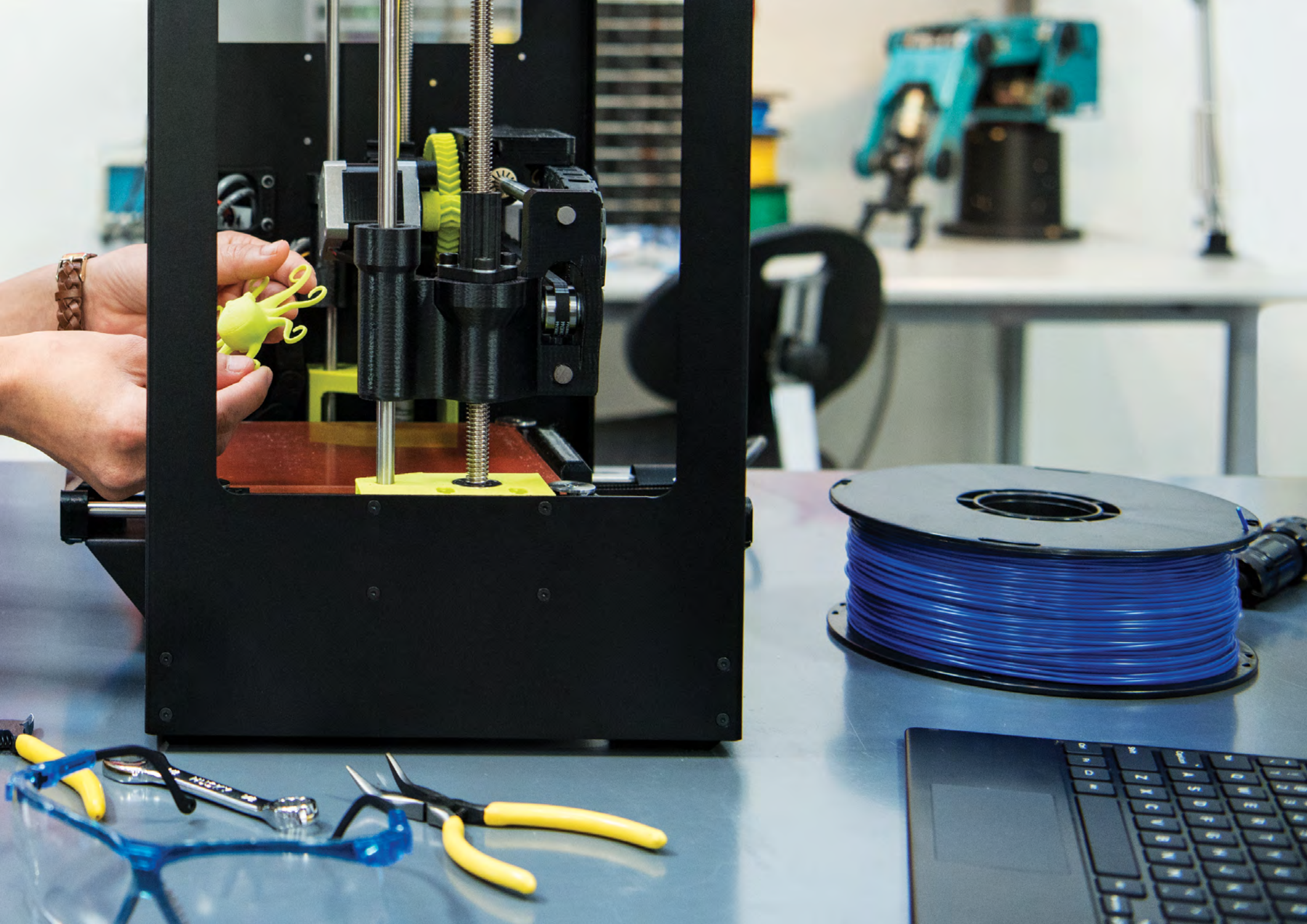

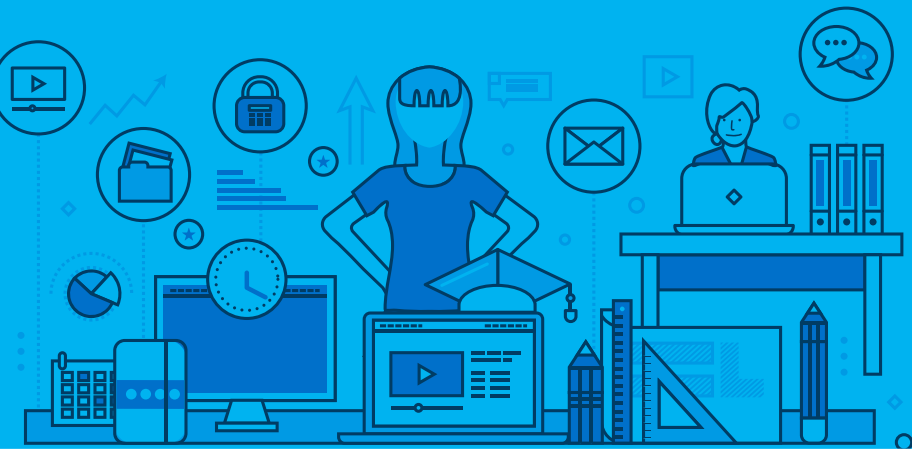Modular furniture to allow flexible sitting

Individual work station

Properly labeled equipment

Information about all tools and materials in one place - The Right To Know compliance centre

MANAGEMENT OF ATAL TINKERING LAB

I. Inventory Management

Inventory management is an important element for successful and smooth functioning of an ATL. This would help to keep a track of all things - tools and materials, content, furniture etc. that have been placed and will be used in the lab.

The ATL in-charge would be responsible for overall inventory management and security of equipment, tools, gadgets, consumable materials etc. He/She will also be accountable for ensuring students handle all equipment with utmost care to minimize chances of damage.

Recommended Process

- **Create and maintain an inventory document** for successful running of your lab. Create a list of all the things that are there in your lab – include everything from tools to furniture to books etc., and maintain this both on paper and in an online mode (using a Spreadsheet or Excel sheet).

- **Maintain records of all outgoing and incoming stock** - Tools, devices, machines, materials, books, content, furniture etc., inventory record of all outgoing material (for maintenance), incoming stock and obsolete stock with complete details

(name/quantity etc.) at the time of being discarded. It should be countersigned by Principal/ Vice-Principal along with ATL in-charge. Have separate forms/templates for safety, replenishment, and excess outdated stock. Please refer to Annexure 9 – Equipment inventory list

- **Determine frequency of ordering stock** by setting a minimum stock level (may happen after the first 6 months of operation).

- **Initiate the process** of procurement before complete exhaustion (discuss, deliberate and submit request to the AAC).

- **Maintain a record of bills/expenses** - There will be some fixed expenses and some recurring expenses; it is important to monitor these expenses and plan the budget accordingly.

- **Community management** - The Lab usage will not be limited to the school students only. Students from outside the school will/can also use the lab, thus there needs to be an effective system to monitor the number of people accessing the lab, utilisation speed of the material in the lab etc.
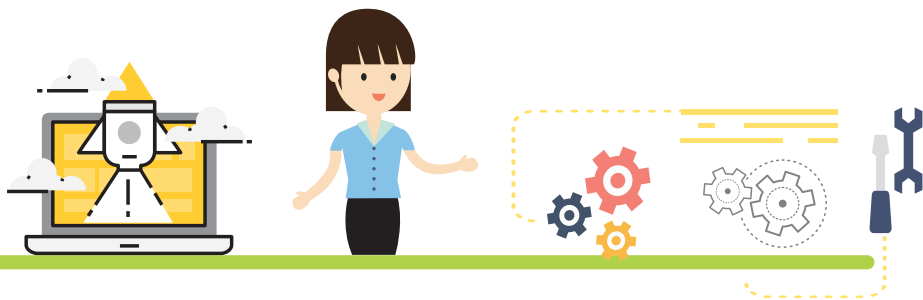
II. Facilities Management – Safety & Security

One of the most important aspects of running a Tinkering Lab in a school is to keep it safe and secure for its users – the students. It is imperative that the space – the Tinkering Lab – is run effectively and efficiently while being safe.

This can be achieved only if we have in place some organizing principles - some non-negotiables – some steps that all have to follow without any exceptions. The aim is to make the space a safe and positive place to work and learn for all its users.

Recommended process

- Label all machines, devices, equipment and materials in the lab with:
  - Name
  - Hazard posed
  - Storage Instructions
  - Expiry date (if any)
  - Source and date of procurement

- Make arrangement for collection, storage and safe disposal of waste of all kinds

- Mark the entry and exit prominently in red

- Place a safety notice board near the entrance of the lab with all important information pertaining to safety and security – Annexure 6 - Right to Know Documentation Center

- Prominently display emergency contact numbers, emergency equipment list, well-stocked first-aid kits and their location, emergency response plan in case of fire and evacuation plan.

- Make necessary arrangements as per the need and type of machines, equipment etc., for example soldering stations should have sufficient ventilation or be placed in an area outside the common work bench area; projects and machinery with sensitive electronics need to be protected from moisture etc.

- Enforce a strict cleanup policy throughout the lab to be followed by all.

- Keep a check on anything lying loose on the floor – like wires etc. - these can easily become a tripping hazard.

- Aim to provide access to grounded power outlets all along the perimeter of the room and/or dropped from the ceiling for each workbench/ work table.

- Ensure tools have enough space to be operated safely and not endanger the user or other people in the lab.

- Make sure all tools are well maintained and have all safety features in place. Put in place a system for monthly/ fortnightly monitoring of the lab by AAC and document the same in the form of a lab safety certificate sealed/signed by AAC.

III. Information Management Reporting & Documentation

Yet another extremely important aspect needed for running a successful lab!

It is essential to be able to document and report all activities in the lab.

1. Information sharing for/with internal purposes/ audiences

The internal audiences are the school itself - students, parents and guardians, teachers, board of trustees, and school management officials. It is important to keep them in the loop as they are your first and prime stakeholders. They are the people who will play the most crucial role in making a lab successful. And thus, they need to be informed about relevant topics, issues, events, plans etc. Some of them may even be the decision makers and need to be appraised of the current situations in order to enable them to be able to provide solutions or necessary support to make sure that the lab functions in an optimum manner.

2. Information sharing for/with external purposes/audiences

The external audiences include – AIM Team, ATL Management, the neighborhood schools who will/ can have access to the ATL, other ATLs, the maker community, and the potential partners/stakeholders (people/organizations who can partner and/ or provide some kind of support – mentorship/ donation of equipment etc.) The objective is to share relevant information so as to keep them informed and seek/take support as and when needed. The mode and amount of information sharing with these two different kinds of audiences would be different as per the needs and expectations.

The various formats/ modes for sharing information could be:

3. Reports

- Weekly, monthly, quarterly, annual basis with the aim to inform about activities in the ATL including details of projects, students, events, financials etc.
- Special reports – could be in the form of case studies highlighting a particular event/project/ group of students etc.

For sample/formats for ATL in-charge attendance/ Weekly Reporting/Monthly Report/Visitor Registration/Time table, refer to Annexure 8 on Information Management - Periodic Reporting Format, and Annexure 3 on Recommended List of Tools and Materials.

4. Documentation

To share best practices, specific project details, or any other specific event related detail or anything that could be of use to you or any other similar lab in future as a reference material. This could take any form - written document/video/video blog etc.

5. Publicity Collateral

This would be aimed to spread awareness about the ATL and get the attention of in-school students and out of the school - neighbourhood schools/ students/mentors/experts/alumni etc. This could also serve as a mode of recognition for exemplary students/teachers/other support staff/alumni etc. The various formats/templates could be - leaflets/banners/posters/videos/blogs/written documents etc.

6. Social Media

In today's social media led scenario, it is necessary to have a proper system to document, report and share as much as possible - this helps in collaboratively working towards solutions and can also become a support system for all. This could be any or all of the following - Twitter handles, Facebook page, community radio/local channels etc.

7. Showcase platforms

In order to provide recognition and encouragement, plan and arrange for platforms where students can showcase their projects and "work in progress" plans. These could be intra-school/inter-school/regional/national etc.

In brief, the key objectives of information sharing management system are to:

- Provide recognition and encouragement
- Monitor and evaluate progress
- Document and save for further dissemination and course correction
- Make available references for others – best practices, samples etc. For more information please refer to Annexure 10 - Samples for Project Synopsis
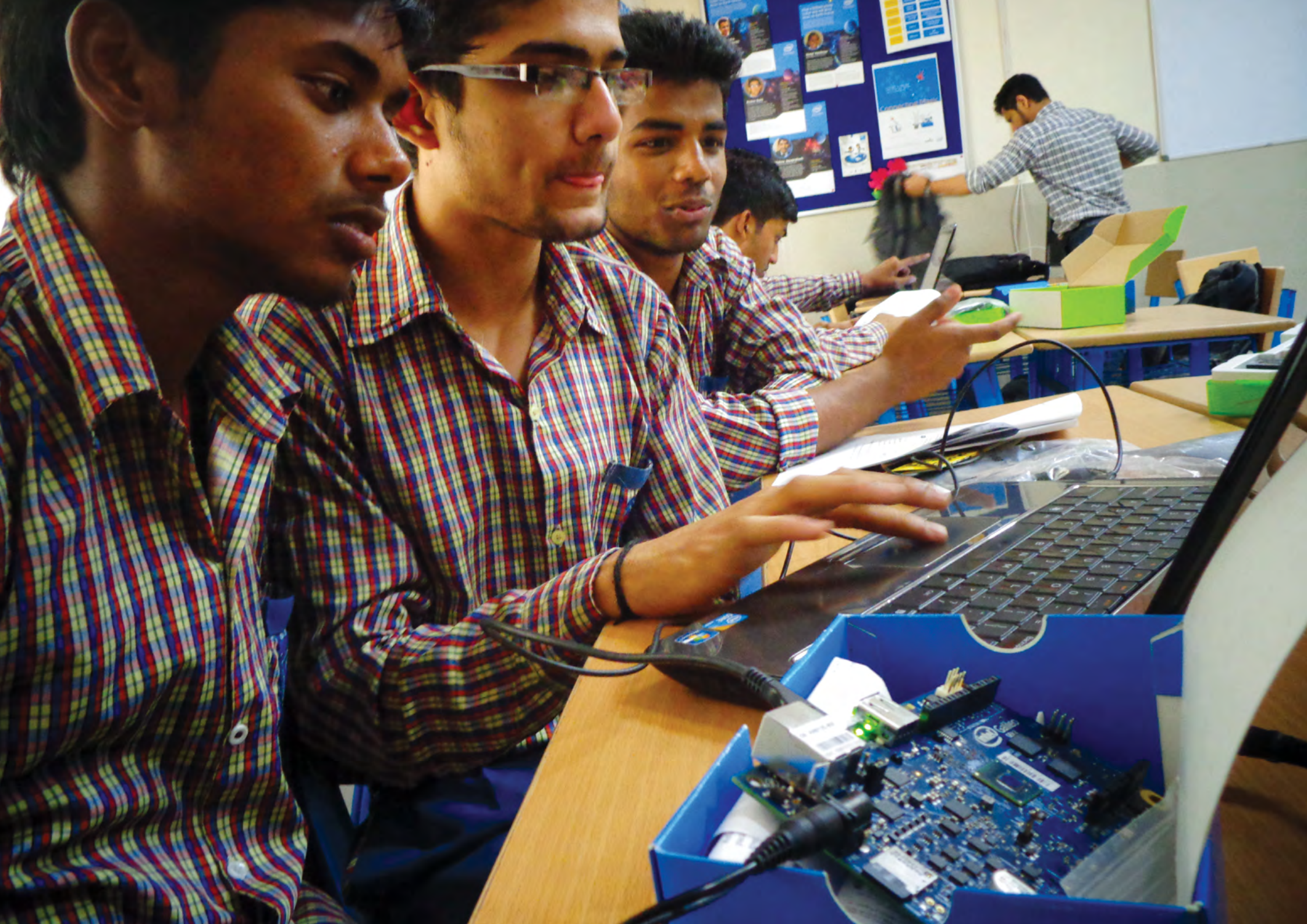
Recommended Process

- Ensure there is proper documentation of all the activities that happen in the lab. Several projects and DIY activities will be done in the Lab - proper documentation will assist students and teachers to review their progress.
- It is advisable to have a brief synopsis stored online of all the projects. Interesting projects can be shared with the Open Source community through portals like Github, with other students, labs etc.
- Weekly/Monthly/Annual Reports will be brief and give a view of what is happening in the lab whereas the documentation would give a full picture. E.g. Weekly Report may say - 100 students visited the lab; worked on 10 different projects whereas documentation would have the details of each of the projects – the progress, the future steps, support required etc.
- A Social Media group/page of the Lab can be created where activities/ events and updates can be shared regularly with the community.
- Visual documentation - During important events, documenting data through photos and videos should also be done. For instance, during a guest lecture by a renowned personality, it would be good to have a video for future reference.

Please refer to the guidelines shared by NITI Aayog regarding the reporting and documentation.

IV. Financial Management

For any program to be successful, it is essential to have a robust financial management system in place. To ensure the ATL remains functional and that schools and students benefit from the program, please follow the guidelines and process shared at different points of time. For complete understanding please refer to the NITI Aayog website – http://niti.gov.in/
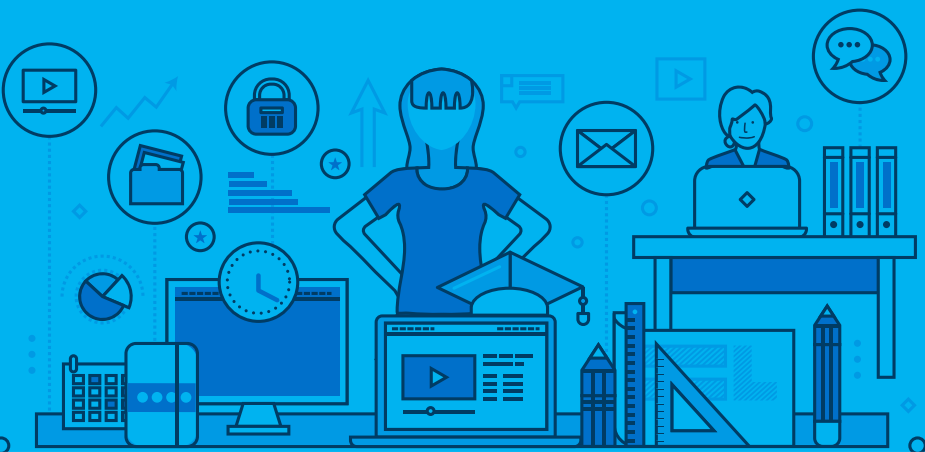
RESOURCES & ANNEXURES

SUGGESTED AND EXTRA READING

Tools & Materials
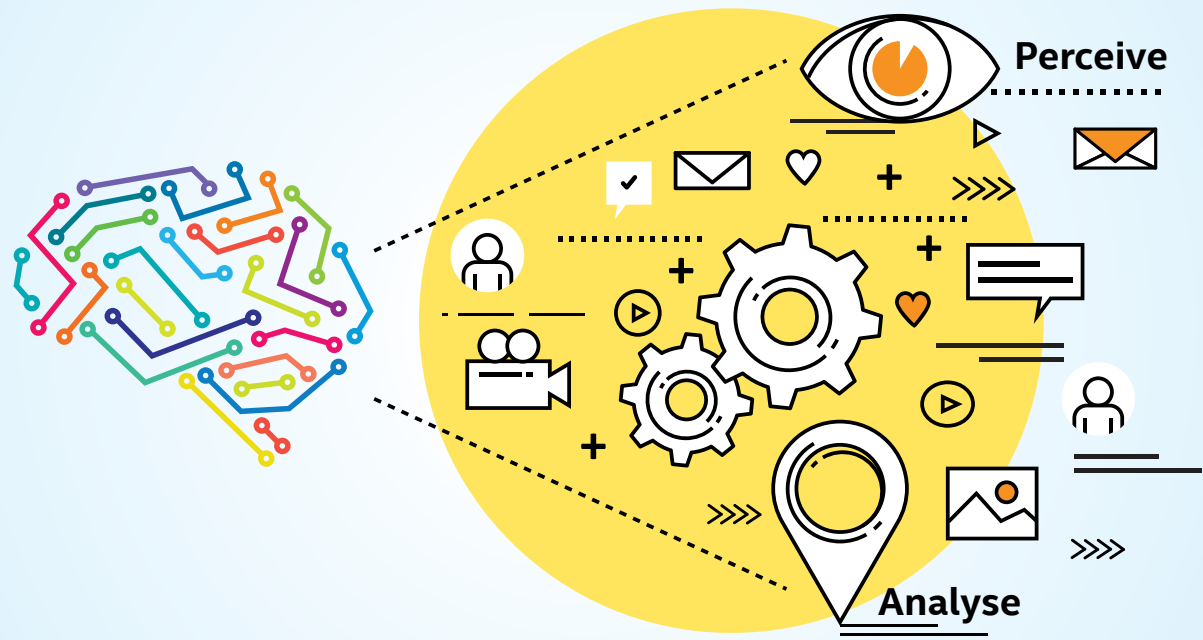
http://spaces.makerspace.com/wp-content/uploads/2012/04/hsmakerspacetoolsmaterials-201204.pdf

http://fab.cba.mit.edu/content/tools/ http://maker-works.com/tools/

Designing Spaces

6 Active Learning Spaces that a Tinkering Lab could have for optimum results:
http://knowledgequest.aasl.org/6-active-learning-spaces-library
http://knowledgequest.aasl.org/transform-library-space-budget

Recommended resources:

Get Active:

Reimagining Learning Spaces for Student Success by Dale Basye, Peggy Grant, Stefanie Hausman

The Makerspace Workbench:

Tools, Technologies and Techniques for Making by Adam Kemp

Kemp Zero to Maker:

Learn (Just Enough) to Make (Just About) Anything by David Lang

A video by a teacher explaining the importance of makerspaces in schools: https://www.youtube.com/watch?v=Ruo904vtQ8w

A video by MAKE magazine and Maker Faire founder Dale Dougherty on being makers: https://www.ted.com/talks/dale_dougherty_we_are_makers

*Contents in the manual have been inspired by various online sources.

Glossary of Terms

AIM – Atal Innovation Mission

ATL – Atal Tinkering Labs

STEM - Science, Technology, Engineering, and Math

AAC - ATL Advisory Committee

R&R – Roles and Responsibilities

Grant Document – To access the Grant Document, please visit http://niti.gov.in/

List of Annexures

1. Plan Document for Establishing the Atal Tinkering Lab

2. Sample Job Description – Atal Tinkering Lab In-Charge

3. Recommended List of Tools and Materials – Atal Tinkering Lab

4. Do's and Don'ts for Teacher/ Lab In-Charge – Atal Tinkering Lab

5. Guidelines for Safety

6. Right to Know Documentation Centre

7. Recommended Branding Guidelines

8. Information Management - Periodic Reporting Format

9. Equipment Inventory List – Atal Tinkering Lab

10. Samples for Project Synopsis

11. About Fourth Industrial Revolution

12. Making India Proud

Print ready soft copies of all Annexures will be provided separately to the Lab in-charge.

ANNEXURE - 1

Plan Document for Establishing the Atal Tinkering Lab

School Name   _____

City   _____

State   _____

Vision of the AIM – ATL
Fostering innovation ecosystem in India – Cultivating one million child innovators in India

Functional Areas:

1. Physical Space Allocation/Identification

_____

_____

_____

_____

2. Human Resource Allocation for ATL

_____

_____

_____

_____

3. Decide/Identify Technical Resources – Tools & Materials

_____

_____

_____

_____

4. Design a Focused & Feasible Time Table

_____

_____

_____

_____

Sample Job Description – Atal Tinkering Lab In-Charge

Will be responsible for management and operation of Atal Tinkering Labs (ATLs)

Roles & responsibilities

1. Setting up the ATL - Support the school head and/ or the concerned person for hard and soft infrastructure, logistics related to setting up the lab

2. Managing the ATL
   - Organize campaigns in schools to spread awareness and get larger number of students to join in the ATL
   - Facilitate the learning process as per pre-decided curriculum
   - Steer students towards becoming technology creators and solving local community problems
   - Identify and develop partnerships with relevant stakeholders - mentors, industry experts, makers etc.: Establish contacts to obtain in-kind donations for ATL
   - Maintain databases, document activities, generate reports, create events etc.

3. Providing support to the students
   - Provide general support and offer encouragement
   - Work one-on-one or in groups
   - Offer specific guidance or workshops in areas of expertise
   - Organize logistics for projects
   - Bring any serious concerns/issues to the attention of School Head

Qualifications for potential candidate

- The ideal candidate would be young and dynamic with a bachelor's degree in science or engineering
- He/She would have 3-5 years experience of working with students on STEM projects and working with school systems
- He/She could be a teacher in the school with proven expertise and a deep interest in electrical, electronics, computer, and physics along with a strong drive to help young people build skills, confidence and an opportunity to do something new and out of box
- Enthusiasm and willingness to learn and make things
- Experience and/or strong interest in working with young people aged 12-18 years
- He/She should be proficient in English as well as the local language
- Should possess strong interpersonal and life skills
- Should be able to demonstrate and promote positive thinking skills and commitment to growth mindset with creative problem solving, solutions orientation, and persistence
- Prior expertise with technical and STEM subject matter would be a plus, with the interest and curiosity to learn more and support participants in their interests and direction
- Skills with technology, art, craft, engineering, music, science, green design, and other such themes OR curiosity and commitment towards developing such skills
- Commitment to work as a team

ANNEXURE - 3

Recommended List of Equipment

(*Suggested quantity for a class of 20-30 students, could be scaled up as needed)

Package -1 Electronics Development, Robotics, Internet of Things and Sensors				
Category	**Name**	**Description**	**Suggested Quantity***	**Type**
Electronics Development	Arduino UNO or compatible Microprocessor and microcontroller	• Hardware development board with Memory and IO ports	20	Consumable
Electronics Development	Breadboards & Mini Breadboard	• Solderless 400 points and 800 points • Self-adhesive proto shield	20	Consumable
Electronics Development	General Purpose solderable Board	• Boards of each size of A1, A2 and A3	10	Consumable
Electronics Development	16x2 LDC display	• Dot matrix LDC display with 16 characters x 2 lines	10	
Electronics Development	USB Cables	• USB Cable Set (A to B)	20	Consumable
Electronics Development	9 Volt battery, multiple resistors and capacitors for electronic projects (various sizes)	• Amperage • Range of resistance • Capacity of capacitor	20 kits	Consumable
Internet of Things & Sensors	IR Sensors Obstacle sensor	• Detection range • Detection angle	10	Consumable
Internet of Things & Sensors	Triple Axis Magnetometer	• 3-Axis Magnetoresistive • Sensors • I2C Digital Interface • Integrated 12-bit ADC • Range of -8 to +8 Gauss • 160 Hz Maximum Output Rate	5	Consumable

Internet of Things & Sensors	Humidity sensor	• Operating range: 20 - 95% RH • Temperature: 0 - 60 Celsius • Power supply: 1.5V AC (Max sine) • Operating frequency: 500Hz - 2kHz	5	Consumable
Internet of Things & Sensors	MQ-4 Natural Gas sensor	• High sensitivity to Methane, Natural gas • Small sensitivity to alcohol, smoke • Fast response • Stable and long life • Simple drive circuit	3	Consumable
Internet of Things & Sensors	IR (transmitter) receiver -TSOP 1738	• Switching rate – 38 KHz	10	Consumable
Internet of Things & Sensors	Ultrasonic Sensor Module HC-SR-04 or compatible	• Power supply • Quiescent current • Working current • Effectual angle • Ranging distance • Resolution • Working angle & dimension	20	Consumable
Internet of Things & Sensors	Triple Axis accelerometer	• 3-axis sensing • Small, low profile package • 4 mm × 4 mm × 1.45 mm LFCSP • Low Power : 350 μA (typical) • Single-supply operation: 1.8 V to 3.6 V • Temperature stability	5	Consumable
Internet of Things & Sensors	PIR Motion Detector Module	• High digital pulse when motion detected • Low digital pulse when idle/no motion detected • Sensitivity range (upto 6 m) • Power supply: 5V – 12V	5	
Internet of Things & Sensors	CMOS IR Camera Module - 728x488	• 728 x 488 resolution • 6V to 20V input • 50mA (at 12V)	2	Consumable

ANNEXURE - 3

Recommended List of Equipment

(*Suggested quantity for a class of 20-30 students, could be scaled up as needed)

Internet of Things & Sensors	RFID Reader – Tags	• Current :13-26mA/DC 3.3V • Idle current : 10-13mA/DC 3.3V • Sleep current<80uA • Peak current<30mA • Operating frequency: 13.56MHz<30mA • Read range between 20 cm - 1 m	3	Consumable
Internet of Things & Sensors	RF Modules Tx & Rx 315 MHz ASK	• Frequency range: 433.92/315 MHz • Supply voltage: 3 – 6 V • Output power : 4 – 16 dbm • Low power consumption • Easy application	5	Consumable
Internet of Things & Sensors	Voice Recognition	• Works on 4.5 to 5.5VDC • Digital interface: 5V TTL level UART interface • Working current < 40mA • Small size • Can recognize 5 commands at one time • Can record up to 15 commands	1	Consumable
Robotics	Stepper motor with Driver board	• 28BYJ-48 ULN2003 5V Stepper Motor + ULN2003 Driver Board	5	Consumable
Robotics	DC motor	• 3-6 V, 2000 RPM for electric toy car, EK2153 or equivalent	5	Consumable
Robotics	4 Wheel robot car chassis kit	• Car kit with DC motors, encoder, battery case	5	Consumable
Robotics	Servo motors	3 types: • Positional rotation servo • Continuous rotation servo • Linear servo	20	Consumable
Robotics	DIY robotic kits		3-5	Consumable

Package-2
Rapid Prototyping Tools

Category	Name	Description	Suggested Quantity*	Type
Rapid Prototyping Tools	3D Printer Kit and tools	• 1.75 mm PLA Printer, with 180mm ×200mm ×160mm, Build Volume, Spatula, Tweezers, Cutter, Screwdriver, Wrench etc.	1	Equipment
Rapid Prototyping Tools	Filament for 3D printer	• 1.75mm PLA filament. 750-1000 g spools	5	Consumable
Rapid Prototyping Tools	Set of Arts & Crafts Accessories – egstationary items and basic prototyping material	• Cardboard • Foam core boards • String • Rubberband • Popscicle sticks • Wood glue • Balsawood sheets and rods	5 5 50m 100 100 1 btl assort	Consumable

Package-3
Mechanical, Electrical and Measurement tools

Category	Name	Description	Suggested Quantity*	Type
Mechanical Tools	Hacksaw	• Junior	1	Equipment
Mechanical Tools	Micro Chisel Set		1	Equipment
Mechanical Tools	Pliers	• External straight • Nose circlip plier • Long nose plier • Combination mini plier • Wire stripping plier • Bent nose plier • Needle nose plier	1 set	Equipment

Contd.

ANNEXURE - 3

Recommended List of Equipment

(*Suggested quantity for a class of 20-30 students, could be scaled up as needed)

Mechanical Tools	Mini Hacksaw		1	Equipment
Mechanical Tools	Ball Pein Hammer		1	Equipment
Mechanical Tools	Steel Shaft Claw Hammer		1	Equipment
Mechanical Tools	Fiberglass Nail Hammer		1	Equipment
Mechanical Tools	Rubber Mallet		1	Equipment
Mechanical Tools	C-Clamp		5	Equipment
Mechanical Tools	Allen Key Set		1	Equipment
Mechanical Tools	Workstation for Drilling		1	Equipment
Mechanical Tools	12-piece Combination Spanner Set		1	Equipment
Mechanical Tools	12-piece Open-ended Spanner Set		1	Equipment
Mechanical Tools	30 Piece Ratcheting Screwdriver Set		1	Equipment
Mechanical Tools	Baby Vice 60 mm		1	Equipment
Mechanical Tools	6 Piece Precision Screwdriver Set		3	Equipment
Mechanical Tools	Adjustable Spanner		2	Equipment
Mechanical Tools	Wire Strippers	Wire Stripper Cutter Plier with Spring - 26x6x20 cms (LxWxH)	5	Equipment
Mechanical Tools	Screwdriver	Multi-purpose	5	Equipment
Mechanical Tools	Tool Set	Multi-purpose	3	Equipment

Electric Tools	Hot Glue Gun + Glue Sticks	Range in Open Space (Standard Conditions): 100 metres	2	Equipment
Electric Tools	Soldering Iron Kit Temperature Controlled Soldering Station	Variable Wattage of Soldering Iron: 15-30 watts/230 volts Soldering Iron Temperature Range: 280°C to 450°C	2	Equipment
Electric Tools	DC Power Supply	0 - 30 V, 1A Digital DC Power Supply with Variable Adjustment	3	Equipment
Electric Tools	Cables	Micro USB, Mini USB, USB A - USB B, USB - USB (Each 10 Pieces)	10	Consumable
Electric Tools	Adapters	DC Power Adapter with 5V, 12V (Each 10 Pieces)	10	Consumable
Electric Tools	Electric Screwdriver Set		1	Equipment
Electric Tools	1800W Dual Temperature Heat Gun		1	Equipment
Measurement Tools	Return Measuring Tape 5mx19mm		2	Equipment
Measurement Tools	Stainless Steel 12"/150 mm Rule		5	Equipment
Measurement Tools	150 mm/6" Digital Vernier Caliper		2	Equipment
Measurement Tools	12" Spirit Level		1	Equipment
Measurement Tools	Digital Pen Electric Tester	Voltage		Equipment
Measurement Tools	Digital Multimeter	• Digital Multimeter Voltage Current Resistance - 7 Functions + 19 ranges to cover DC voltage 200mV to 1kV • AC voltage 200 V - 750 V • DC current 200 µA - 10 A • Resistance 200 - 2 M Ohm • Transistor & diode test	5	Equipment

Recommended List of Equipment

(*Suggested quantity for a class of 20-30 students, could be scaled up as needed)

Package-4 Construction kit, Power Supply, Consumables, Accessories and Safety Equipment				
Category	**Name**	**Description**	**Suggested Quantity***	**Type**
Construction Kit	STEM modular construction kits		2	Equipment
Power Supply & Accessories	9 volt battery clips		20	Consumable
Power Supply & Accessories	Hookup wires	• Red & black set (100 metres each)	2	Consumable
Power Supply & Accessories		• Jumper cable: • Male-Male • Male-Female • Female-Female	400 80 50	Consumable
Power Supply & Accessories	Power strip for power adaptors		10	Consumable
Safety Equipment	Standard first-aid kit		1	Consumable
Safety Equipment	Fire extinguisher (handy units)		1	Consumable
Safety Equipment	Safety goggles (with/ without LED torch)		10	Consumable

ANNEXURE - 4

Do's and Don'ts for Teacher/ Lab In-Charge

Be yourself.

Work with students in a way that is comfortable to you.

Be reliable.

Students should know when to count on you. Your absence will be noticed!

Be consistent.

Be consistent not only with your own attendance but also make sure that you treat everyone fairly and equally. Although you may find yourself engaged with an individual student, try not to give the impression that you have a favourite Young Maker. Be open to having others participate. The more consistent you are, the more students will trust you and start to call on you for help and conversation.

Be approachable.

It is important to know that you are available for questions.

Be patient.

Everyone learns in different ways, including you. Be patient with your own learning and with the learning process of others. Sometimes this means stepping in to help, or stepping back. Be patient especially when showing someone how to do something that you may know how to do very well. Try not to do it for the Young Maker, unless safety is an issue. Each person will go through a very different learning process and will take different amounts of time to learn something new.

Participate actively and avoid lectures.

You are not here to be a textbook. Engage in your own learning while you are mentoring. Collaborate on projects and experiment.

Listen.

As adults we often don't take the time to really listen to the ideas and thoughts of young people. Take the time; you might find yourself learning amazing things. Show your interest and excitement, observe, and ask questions.

Go with the flow.

Be prepared for the unexpected! Bring ideas for what you would like to do, but be prepared to go with the flow of students' changing ideas.

Get to know kids and let them get to know you.

Engage a Young Maker in conversation. Ask questions. Offer to share something you know. However, understand that it will take time for the students to begin to feel comfortable with you.

Treat all participants with respect.

Make sure everyone—young and old—feels welcome, important, and a part of the program. Learn names and greet each other by name. Show your interest in their projects—and in their presence. Respect the students for who they are and where they are developmentally. We all come from diverse backgrounds and experiences. Take the time to get to know everyone individually. Avoid prejudging who they are, their skills, or their cultures.

Treat kids as individuals, not as a group.

Each person has different learning and communication styles. Get to know their interests, and the way in which they feel most comfortable interacting. For some it may be through conversation, for others, through working on a project or showing you what they are doing.

Discover and innovate together.

Don't be afraid to share your ideas, give advice, and be a resource for creative ideas and new knowledge, opportunities, and possibilities. Show a Young Maker a new tool. Challenge them to try something new, or take on something new on your own. Try saying:

- "Have you tried this?"
- "Do you know about this?"
- "I don't know the answer to that question—let's go find out together."

Figure out your own interests.

Experiment with our resources, work on your own project, and then share your ideas and excitement with Makerspace.

One of the best ways to be a role model is to share your own engagement in working with tools, people, and ideas.

Give off energy.

Show your excitement about what Makerspace is doing, and your interest in learning from their work. Share your own excitement and engagement in your ideas, and your own work as a Maker.

Recommended Guidelines for Safety

| Report All Injuries	Use Protective Gear, Dress Right	Prepare	Use Tools Right	Clean Up
• Do not attempt to remove foreign objects from the eye or body.	• Wear eye protection: safety glasses with side shields, goggles, or face shields at all times, whether working or not! • Do not wear loose-fitting clothing around moving or rotating machinery. • Remove ties, jewellery, gloves, etc. especially around moving or rotating machinery. • Tie back or cover long hair to keep it away from moving machinery. • Wear shoes that cover the entire foot, no open-toe shoes or sandals. • Wear suitable gloves when handling hot objects, glass, or sharp-edged items.	• Safety is your top priority when using the lab. If you are not sure what you are doing, ask. • Know all the locations of all first aid, fire, and safety equipment. • Never use a tool unless you've been trained to use it safely. • Never work alone when using power tools. Two persons must be present and be able to see one another. • Sign in before using any equipment. • Do not fool around, startle, or distract anyone (not even with a conversation) while either one of you is using a tool. • Think through the entire job before starting. Prepare prints or drawings with all dimensions and specifications prior to using machines.	• Use tools only as they were designed to be used (a wrench is not a hammer). • Never use a broken tool. • Report any broken tools or machines immediately. • Do not remove any material and/or tool from the lab. • Never walk away from a tool that is still on. • Operate machines only with all required guards and shields in place.	• Clean up every time you leave an area. • Clean and return all tools to where you got them from. • Shut off and unplug machines when cleaning, repairing, or oiling. • Keep the floor around machines clean, dry, and free from trip hazards. Do not allow chips to accumulate.

Right to Know Documentation Center

Most importantly, print out the information on the data sheets for all potentially hazardous materials that will be used/ stored in the lab. Finally compile them together in a binder using plastic sheet protectors. Store this manual in a visible location prefreably near the door - entry or exit.

Compliance Center Binder

Soldering Iron
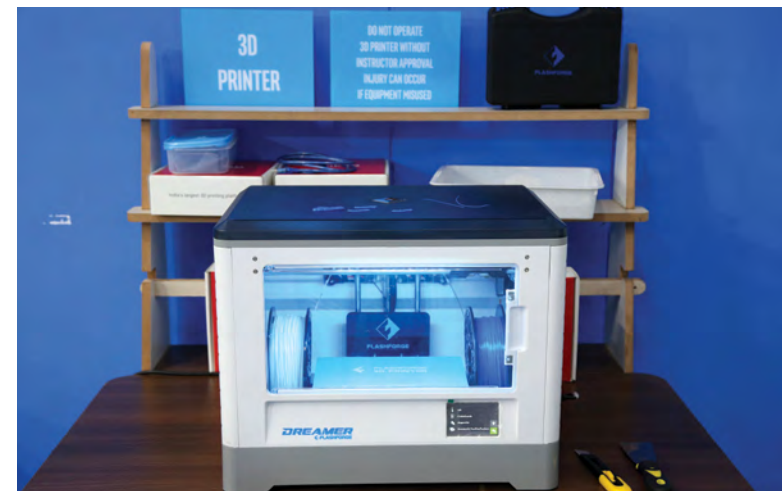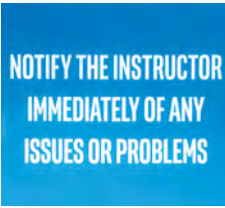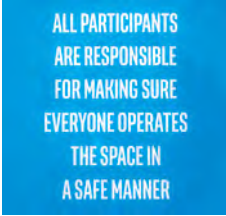
3D Printer

Recommended Branding Guidelines

S. No.	Details of the Collateral	Size	Qty.	Recommended Material	Picture for Reference
	I Signages – For Making the Lab Colorful and Bright				
1	Banner for Lab - I am an Innovator	16 feet x 28 inch	1	Soft board	
2	Gears design on wall (gears in 5 sizes)	Different sizes	1 Each	Acrylic	
3	Wall posters – 3 posters (Create-Connect-Develop)	39 inch x 28 inch	1 Each	Soft board	

	II Signages – For Instructions, Access and Information				
1	For safety & security purposes – instruction for students - STOP - PPE signage (in red)	18 inch x 8.6 inch	2	Soft board	
2	For 3D printer workstation	10 inch x 8 inch	1	Acrylic	
3	For 3D printer workstation - Do not operate 3D printer without instructor approval. Injury can occur if equipment misused	10 inch x 8 inch	1	Soft board	
4	For soldering station	10 inch x 8 inch	2	Acrylic	

ANNEXURE - 7

Recommended Branding Guidelines

5	For tools station	10 inch x 8 inch	1	Acrylic	
6	For exit	40 cm x 18 cm	2	Soft board	
7	Fire extinguisher instruction	A4 Size	2	Soft board	
8	For safety purposes - Notify the instructor of any issues or problems	10 inch x 8 inch	1	Soft board	

9	For keeping the Lab organised & clean - All participants are responsible for making sure everyone operates the space in a safe manner	12 inch x 10 inch	1	Soft board	
10	Right to Know compliance center box	12 inch x 24 inch	1	Acrylic	

Information Management - Sample Periodic Reporting Format

Reports

Filed on monthly, quarterly and annual basis with the aim to get information about activities in the ATL. Schools will have to upload information on periodic basis on the AIM website. Information on the following parameters should be uploaded by the schools:

- General information about the school, ATL Advisory Committee and faculty members

- Inventory of equipment and consumables

- Financial expenditure – capital and operational

- Details on activities conducted by schools like curriculum sessions, intra-school events, inter-school events, guest lectures, hands-on workshop, projects by students etc.

- Student engagement

- Mentors associated with ATL

The following information to be collected on monthly (tentative) basis:

S. No.	List of Activities	Jan	Feb	March	April	May
1	No. of students using the ATL facility					
2	No. of students from other schools using the ATL facility					
3	No. of children from community using the ATL facility					
4	Ratio of girls/boys in total students using the ATL facility					
5	No. of outside schools supported by ATL					
6	No. of ATL sessions taken as per the designated curriculum- for students					
7	No. of ATL sessions taken as per the designated curriculum - for out of school					
8	No. of days for which ATL was open to community children					
9	No. of days for which ATL was open to students from other schools					
10	No. of ATL related intra-school competitions organized					
11	No. of ATL related workshops conducted					
12	No. of ATL related guest lectures/ mentor visits organized					

ANNEXURE - 8

Information Management – Sample Periodic Reporting Format

The following information to be collected on quarterly (tentative) basis:

S. No.	Dashboard	1st Quarter	2nd Quarter	3rd Quarter	4rd Quarter
1.	No. of faculty members allocated for ATL (including ATL in-charge)	56			
2.	No. of faculty members trained on ATL philosophy	565			
3.	No. of trainings conducted for ATL faculty members	65			
4.	No. of student projects initiated	656			
5.	No. of student projects successfully completed	56			
6.	No. of students participating in national competitions	56			
7.	No. of students participating in international competitions	565			
8.	List of all other schools being supported by your ATL	45			

Apart from the above, two separate brief reports of all the events conducted and projects initiated with their present status and next steps, in the present quarter should also be reported by schools.

Please Note: Yearly reports should be in the form of a short video and with a description highlighting the major activities conducted in the ATL for a particular event/project or with a particular group of students.

Equipment Inventory List – Atal Tinkering Lab

Sample Equipment Replenishment List – Atal Tinkering Lab

ATL In-Charge Name:	
ATL address:	
Month:	

S.No	In Date	Equipment Name	Specification details	Quantity Purchased	Remarks

Sample Equipment Discard/Obsolete List – Atal Tinkering Lab

ATL In-Charge Name:	
ATL address:	
Month:	

S.No	Out Date	Equipment Name	Specification details	Discarded Qty	Reason for Discard

Signature
Principal/Vice-Principal

Signature
ATL in-charge

Signature
Principal/Vice-Principal

Signature
ATL in-charge

ANNEXURE - 10

Samples for Project Synopsis

Project Code: IF43

Anti-Collision Trains

Abstract: To minimise train accidents such as head-head/tail-head collision, over speed and level crossing accidents. Here we are using simple circuits which are placed near the track to prevent accidents. Gadgets like weight switch, timer circuits, gate and wireless electricity transmission are used. As the train passes the weight switch, it will activate the timer circuit. This will be the first input from timer circuit and gate and then the output of circuit and the gate is connected to the wireless electricity circuit. The second input of the circuit and gate will come from another similar circuit placed in the other end of the track. Intel® Galileo board is used to connect the weight switch, timer circuit, and-and gate.

Name:
Class:

Project Code: IF37

Seizure Band

Abstract: An easy-to-use cost effective product for controlling seizure attacks - with the help of "Mozart Effect".

A device made up of a band and a set of headphones - the band, placed anywhere on the body, detects sudden movements & immediately sends a signal to the processor to play Mozart which reaches the patient through head phones and the soothing music helps in calming down.

Name:
Class:

Project Code: IF11

Fibonacci Spiral Aerator

Abstract: Help clean water remain clean!

With solid waste getting dumped in water, clean water is fast moving towards being extinct. To help solve this we have the Fibonacci Spiral Aerator – it helps to remove the solid waste out of water, adds oxygen into it and purifies it to make it drinkable.

Name:
Class:

Project Code: IF15

Drones for Agriculture (Crop Eagle)

Abstract: 24/7 intel on farms to help early detection of any kind of threat.

Using technology to monitor farms & help the farmers by providing early information about any threats and also suggesting remedies for the same. The drone will be programmed to fly over farms at predefined time intervals, giving live updates to farmers.

Name:
Class:

Project Code: IF03

Automated Retractable Clothesline

Abstract: A retractable clothesline that would automatically pull back and get all the clothes in the shade if it starts raining. Using a motor, a rain detecting sensor and a clothesline, all powered by an Intel® Galileo, a circuit system is created. The moment the rain detecting sensor detects rainfall, the circuit gets completed and the motor fitted with a pulley rotates, pulling the clothesline into the shade, thus saving clothes from getting wet.

Name:
Class:

Fourth Industrial Revolution

Brief Background

Every time the world has experienced an industrial revolution it has also seen tectonic shifts; shifts that have meant the emergence of a "new normal". The advent of steam engines and the mechanical loom completely transformed production processes between 1790 and 1820. In the early years of the 20th century, electricity and mass production triggered yet another industrial revolution. The 3rd Industrial Revolution, which followed in the mid-1970s, was spurred by automation and computerization. These technological advancements transformed manufacturing processes. As time went by, they impacted almost every aspect of daily life. In the same series, the Fourth Industrial Revolution is the next in line.

Fourth Industrial revolution – The Mega Trend

The first Industrial Revolution began in Britain in the last quarter of the 18th century with the mechanisation of the textile industry, harnessing of steam power, and the birth of the modern factory. The second revolution began roughly a century after the first and peaked at the beginning of the 20th century, embodied in Henry Ford's creation of the moving assembly line that ushered in mass production. Factories could produce countless numbers of identical products quickly and cheaply — Ford's famous line was about being able to sell customers cars of any colour they liked, so long as it was black. The third industrial revolution, beginning c. 1970, was digital — and applied electronics and information technology to processes of production. Mass customisation and additive manufacturing — the so-called '3D printing' — are its key concepts, and its applications, yet to be imagined fully, are quite mind-boggling. The fourth industrial revolution is conceptualised as an upgrade on the third revolution — and is marked by a fusion of technologies straddling the physical, digital and biological worlds.

It is the concept of blurring the real world with the technological world

The Fourth Industrial Revolution, also called Industry 4.0, has its roots in Germany where a number of large companies such as Bosch, Daimler, and Deutsche Telecom have already begun to adopt it in a big way. Technologically advanced countries such as Japan, USA, China, the Nordic countries and the United Kingdom are not far behind in the race. With various digital technologies at work, companies globally have begun to experience sweeping changes. Additive printing, augmented reality, cloud computing, big data, analytics, robotics, artificial intelligence, gene editing, simulation, sophisticated sensors, and many others are evolving as drivers of this mega trend. Seemingly independent of each other, these innovative technologies are together disrupting established norms – from driverless cars and connected handheld devices to seamless global value chains, their impact is far reaching.

What is emerging today often seems like a scene out of a science fiction movie. In fact, Augmented Reality (AR) has been used by motion pictures such as Star Wars, Jurassic World, and The Avengers to generate excitement and create a brand. Today automotive manufacturers are setting up labs where design engineers "experience the vehicle" before it finds its way to the shop floor. Soon, technology might allow the alteration of genes to create favourable traits and we might have machines that are as smart as humans!

Though it is difficult to fathom what form the Fourth Industrial Revolution might take in the future, some of its aspects are beginning to become a reality. The manufacturing ecosystem is poised to undergo a fundamental transformation. Going forward the smart factory will be characterized by a new ecosystem, called the Internet of Things, where every factory operation will be connected through the Internet. In the next industrial revolution, value chains will be complex multi

ANNEXURE - 11

Fourth Industrial Revolution

technology networks blending together new digital technology with existing low-cost technologies. With data getting processed in real time, supply chains will become more flexible and agile. All these will bring about significant changes in the way we live, the way we work and the way we interact with each other. These new synergies and technologies will impact industries, economies and societies at large and will therefore involve every stakeholder. It might change many basic assumptions about our being and perhaps require a completely different way of thinking.

New kinds of people-to-people and people-to-machine interactions will emerge. This will have substantial consequences for the nature of work and organizational structures. In this new scenario, the ability to work under uncertainty, being able to communicate across industries and working in teams will be necessary skills. It is thus increasingly crucial for companies to focus on capabilities rather than qualifications. A workforce that is open to change, has readiness to re-skill and to learn will make for a winning team.

A recent World Economic Forum study, titled The Future of Jobs, has highlighted how jobs will change in this shifting scenario. In the near future some jobs are likely to become redundant while new ones will appear. With labor-intensive manufacturing giving way to Industry 4.0, several tasks will get automated. New positions such as Robot Supervisors might get created. In sync by 2020, almost one third of the desired core skills relevant for occupations will include those not considered crucial today. With advanced technologies and robust computer systems at work, data analysis and data-based decision making will be much sought after skills. Apart from technical skills, the WEF Report lists a completely new ability, cognitive flexibility and a new skill, emotional intelligence, amongst the top 10. These will replace quality control and active listening skills, considered game-changers in the existing business landscape. In the highly networked and digitized Fourth Industrial Revolution era, collaborative and cross-cultural competencies will be essential.

With much of the routine decision-making taken over by machines, the top three abilities in 2020 will be complex problem solving, cognitive flexibility and creativity. The ability to apply concepts learned in one setting to solve a completely new problem in another setting requires cognitive flexibility. It is especially useful when trying to solve complex problems or trying to find a creative solution. Social skills such as negotiation, persuasion, emotional intelligence, training and teaching will take precedence. Traditional technical skills such as programming, equipment operation, maintenance etc., will be relegated to the backseat.

Is India Ready?

India's global advantage in the software services sector and the focus of Industry 4.0 in combining traditional manufacturing with IT and the Internet of Things (IoT) could position India as the industrial hub of Asia.

With more than 4,000 technology start-ups, India is already the third largest tech start-up nation of the world. Indian start-ups have received close to USD 4 billion in funds this year accounting for 996 deals. Last year the figure stood at USD 7.55 billion towards 1027 deals. The Government's announcement of a slew of initiatives to encourage start-ups, is leading to an enabling ecosystem building up in India. From setting up a start-up fund to easy exit options, self-certification and liberal tax laws, Indian start-ups have been provided a runway to take off from. The Ministry of Science & Technology has also announced a program titled "Promoting and Accelerating Young and Aspiring Innovators & Start-ups (PRAYAS)" in collaboration with academic institutions, financial institutions and the industry to establish research parks and start-up centres.

However, for the country to reap the benefits of this Revolution a three pronged strategy might be necessary – hastening the creation of a robust digital ecosystem, investment in advanced technologies and aligning Digital India and Make in India.

Fourth Industrial Revolution

With "Make in India" driven in a mission mode by the Government, India's ecosystem for manufacturing is building up. India is expected to be the Digital Factory to the World, capturing about 20% of the US$300 billion Internet of Things market by 2020. Having leapfrogged a technology generation in telecom, India became a leader in this space. With legacy systems in place, Indian factories might find it easier to leapfrog the technology to transform into Smart Factories too. SMEs might adopt Internet of Things with an expectation of improved productivity and efficiency. Given India's IT skills and the fact that the country has been an engineering outsourcing hub, India is reasonably well equipped to leverage the evolving Fourth Industrial Revolution.

Despite all the advantages, we need to brace for a few key challenges - first, creating jobs for millions of youngsters who join the workforce every year; second, making the youth readily employable; and third, re-skilling and upskilling the workforce to meet changing industry requirements.

The need of the hour is a well-designed education and training strategy to deliver on a three-pronged approach focused on developing social skills, restructuring technical content and reskilling the workforce. This would become a reality only if there is a well-regulated industry mechanism that encourages application-oriented learning for graduates; a complete re-think of the education system to inculcate social skills such as emotional intelligence and cognitive flexibility; and a shift from a rote-based system to one that nurtures citizens capable of contributing to the society.

Despite the urgency, the entire education system and the industry cannot be redesigned and restructured overnight and this is where government initiatives such as Make in India, Digital India, Skill India, and Atal Innovation Mission – Atal Incubation Centres & Atal Tinkering Labs – will play an important role and help to bridge the gap between current and expected ecosystems.
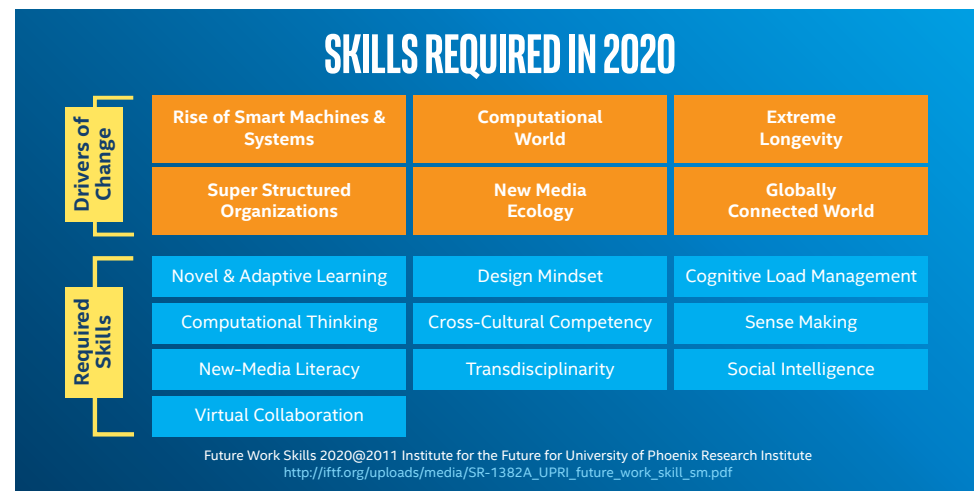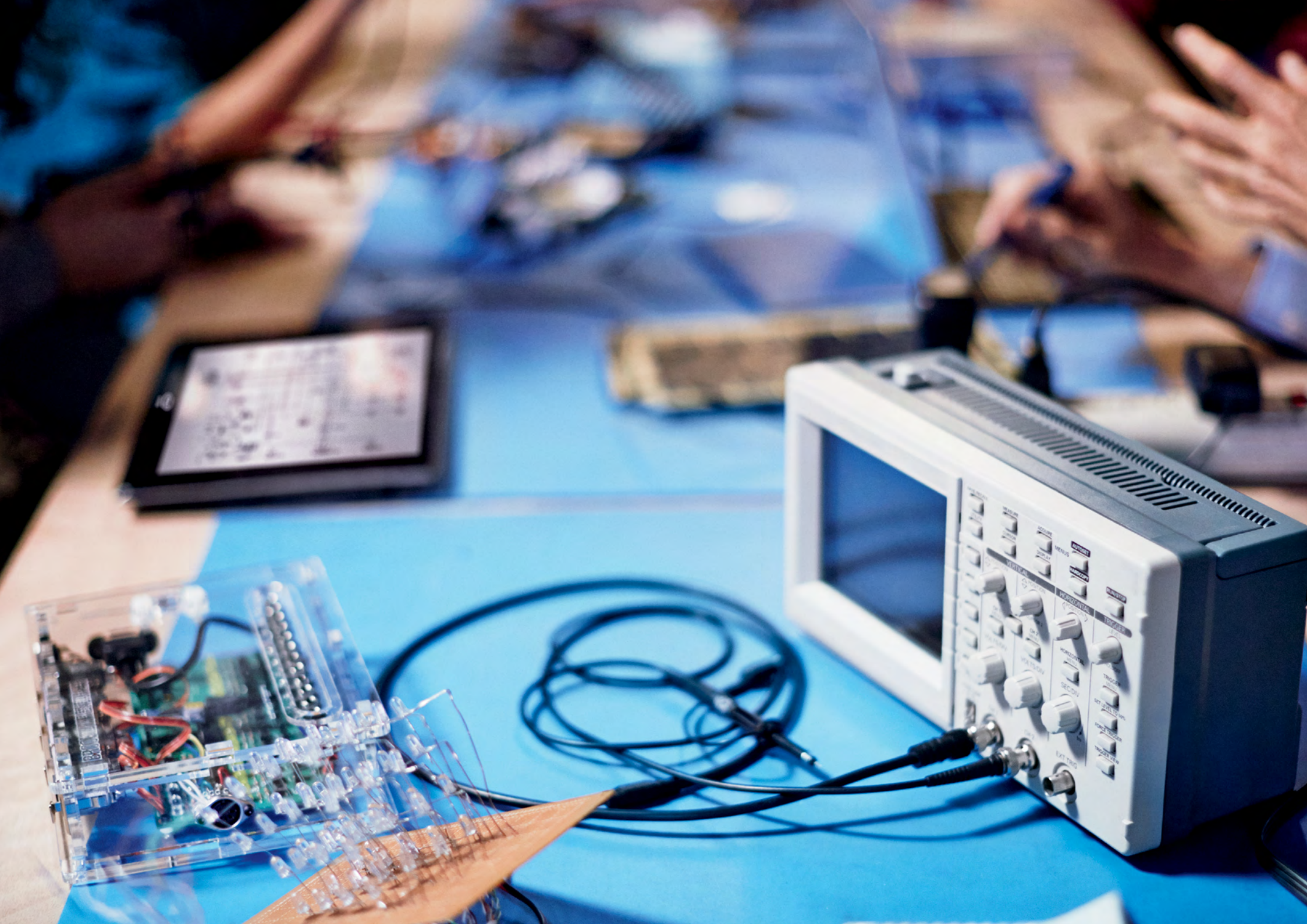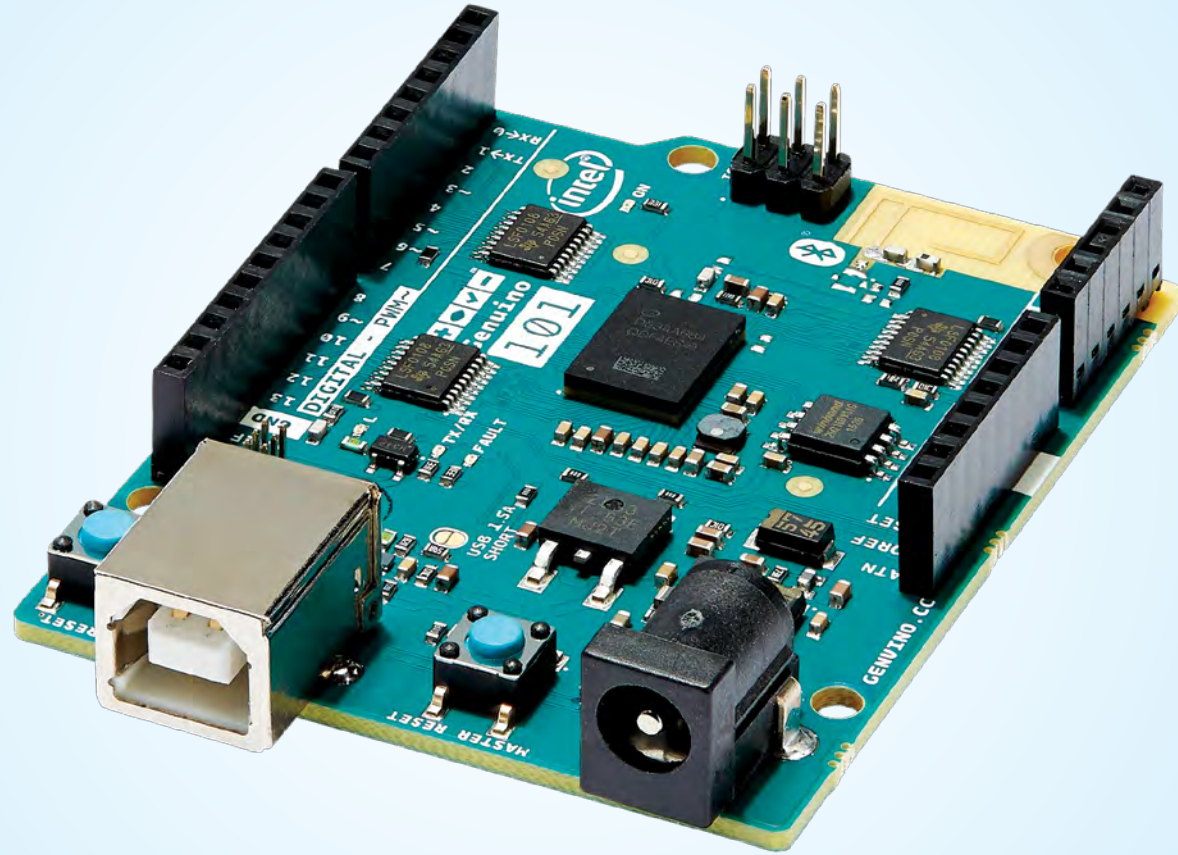
SKILLS REQUIRED IN 2020

Drivers of Change		
Rise of Smart Machines & Systems	Computational World	Extreme Longevity
Super Structured Organizations	New Media Ecology	Globally Connected World

Required Skills		
Novel & Adaptive Learning	Design Mindset	Cognitive Load Management
Computational Thinking	Cross-Cultural Competency	Sense Making
New-Media Literacy	Transdisciplinarity	Social Intelligence
Virtual Collaboration		

Future Work Skills 2020@2011 Institute for the Future for University of Phoenix Research Institute
http://iftf.org/uploads/media/SR-1382A_UPRI_future_work_skill_sm.pdf

Image Source: Future Work Skills 2020

SKY IS THE LIMIT... LITERALLY!

Yes... that's right. There are 25 Indian children who have excelled in the field of science and technology and made a permanent place for themselves among the stars.

Each one of them has a minor planet to their name as Raghrama 28254, Vaishnav 25636... and so on; courtesy the collaboration between Intel ISEF and Ceres Connection of the Massachusetts Institute of Technology's Lincoln Laboratories.

17091 Senthalir
Senthalir P
Intel ISEF 2003
Avila Convent Matriculation
Higher Secondary School
Coimbatore

17092 Sharanya
Sharanya S
Intel ISEF 2003

21575 Padmanabhan
Hamsa Padmanabhan
Intel ISEF 2006
Kendriya Vidyalaya, Ganeshkhind
Pune

28428 Ankurvaishnav
Ankur Vaishnav
Sri P V Modi School
Rajkot

31437 Verma
Abhishek Verma
Maharaja Agarsain Public School
Delhi

25630 Sarkar
Debarghya Sarkar
Intel ISEF 2009
South Point Hight School
Kolkata

12509 Pathak
Madhav Pathak
Intel ISEF 2002

25629 Mukherjee
Anish Mukherjee
Intel ISEF 2009

25620 Jayaprakash
Vishnu Jayaprakash
Intel ISEF 2009
Chettinad Vidyashram
Chennai

31400 Dakshdua
Daksh Dua
Maharaja Agarsain Public School
Delhi

20604 Vrishikpatil
Vrishikumar Patil
Intel ISEF 2004

23133 Rishinbehl
Rishin Behl
Intel ISEF 2007
Kendriya Vidyalaya, Mankhurd
Mumbai

12599 Singhal
Akshat Singhal
Intel ISEF 2002

28485 Dastidar
Manosij Dastidar
Intel ISEF 2011
South Point High School
Kolkata

31918 Onkargujral
Onkar Singh Gujral
La Martiniere for Boys
Kolkata

20616 Zeeshansayed
Zeeshan Sayyed
Intel ISEF 2004

17095 Mahadik
Bhushan Mahadik
Intel ISEF 2003
Fr. Agnel Junior College
Mumbai

25636 Vaishnav
Hetal Vaishnav
Late Shree S. G.
Dholakiya School
Rajkot

28254 Raghrama 2012
Raghavendra Ramachandran
St. John's International
Residential School
Bangalore

*INDIAN STUDENTS WITH A MINOR PLANET TO THEIR NAME!

In 2017, six students made India proud by making it to the tally of minor planets ▶

Intel ISEF 2017
Prashaant Ranganathan
Carmel Junior College,
Jamshedpur, Jharkhand

Intel ISEF 2017
Sahithi Pingali
Inventure Academy,
Bangalore, Karnataka

Intel ISEF 2017
Chaitanya Shyamaraj
Little Rock Indian School,
Udupi, Karnataka

Intel ISEF 2017
Geeve George
Little Rock Indian School,
Udupi, Karnataka

Intel ISEF 2017
Suhani Jain
Taywade College,
Nagpur, Maharashtra

Intel ISEF 2017
Divya Kranthi
Center Point School,
Nagpur, Maharashtra

These young students partipated in Intel ISEF (International Science and Engineering Fair), an international platform which celebrates innovation & creativity; gives an opportunity to students from 70+ countries to come together, compete and get appreciated for their extraordinary ideas.

We at AIM believe that all Indian students have the potential to reach the stars and claim a planet. With ATLs, we would like to bring them even closer to such recognition; put India on the world map; showcase the immense talent our country has; pave the way for future technologies to get recognized and provide solutions to global issues.

intel
ISEF
— a program of —
SOCIETY
FOR SCIENCE & THE
PUBLIC

*Winners of top awards in the field of technology at Intel ISEF ▶

Jyoti Ranjan Sahoo
Intel ISEF 2013
D A V Public School
Orissa

Animesh Tripathi
Intel ISEF 2014
Sanskriti School
New Delhi

Prachatos Mitra & Shailpik Roy
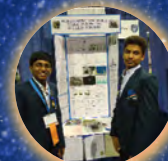Intel ISEF 2014
South Point High School
West Bengal

Amrit Sahu
Intel ISEF 2014
D.A.V Public School,Unit-8
Orissa

Debapratim Jana
Intel ISEF 2014
South Point High School
West Bengal

Aditya Ashish Bhople
Intel ISEF 2015
Narayana Vidyalayam
Maharashtra

Aditya Bhargava & Komal S
Intel ISEF 2015
Sharada Vidyanikethana
Karnataka

Arsh Shah Dilbagi
Intel ISEF 2015
DAV Public School
Haryana

Shreyas Kapur
Intel ISEF 2016
Modern School
New Delhi

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