

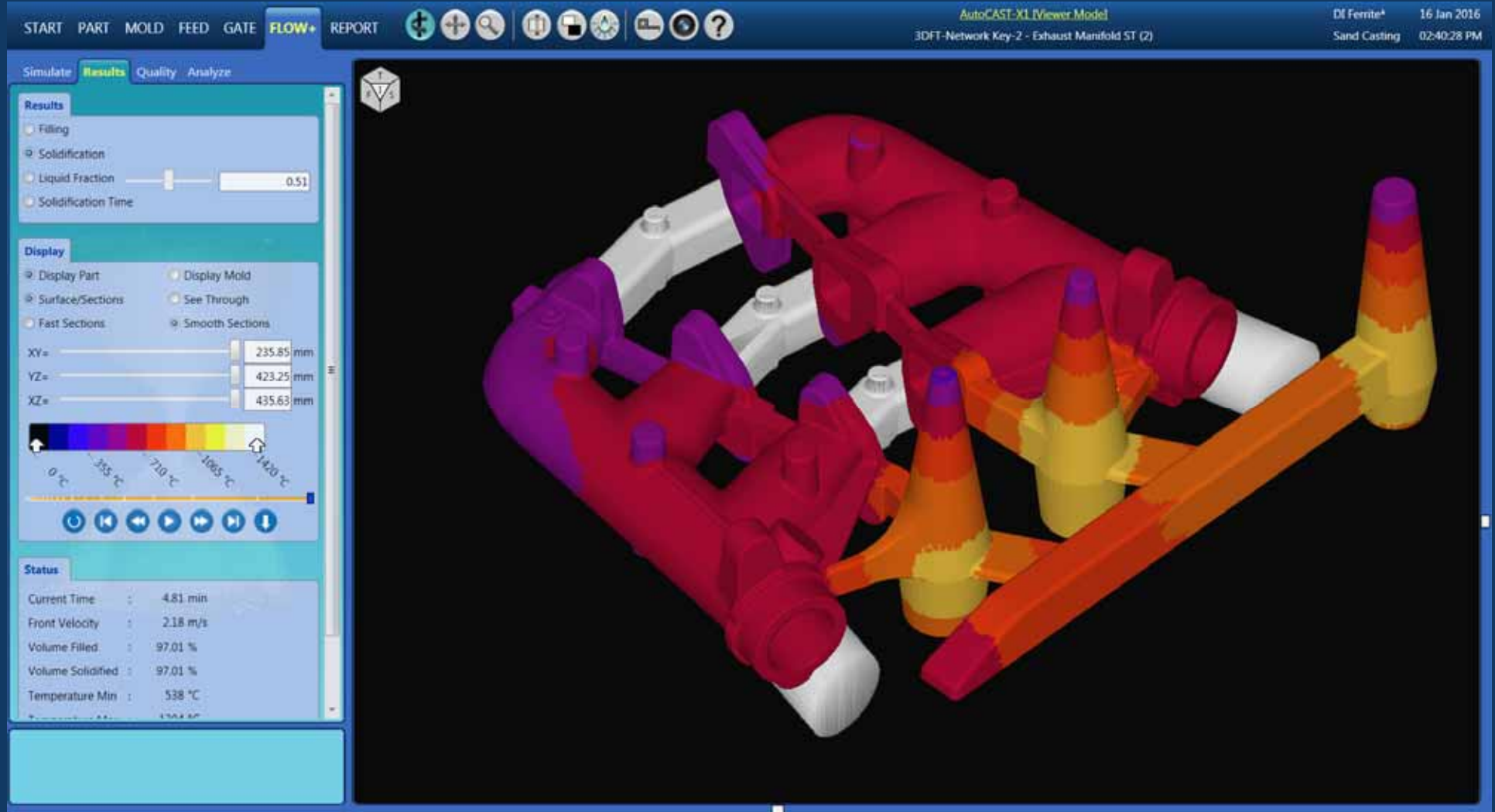
**AFFORDABLE
Medical
Devices**



**From
Idea to
Impact**

Prof. B. RAVI
Mechanical Engineering, IIT Bombay

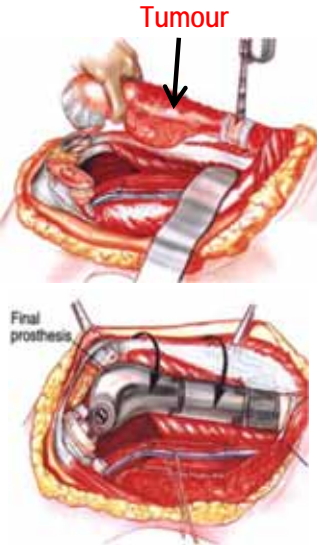
Previous Work – Metal Casting Simulation



Innovation... at the intersection of **art**, **science**, **technology**...

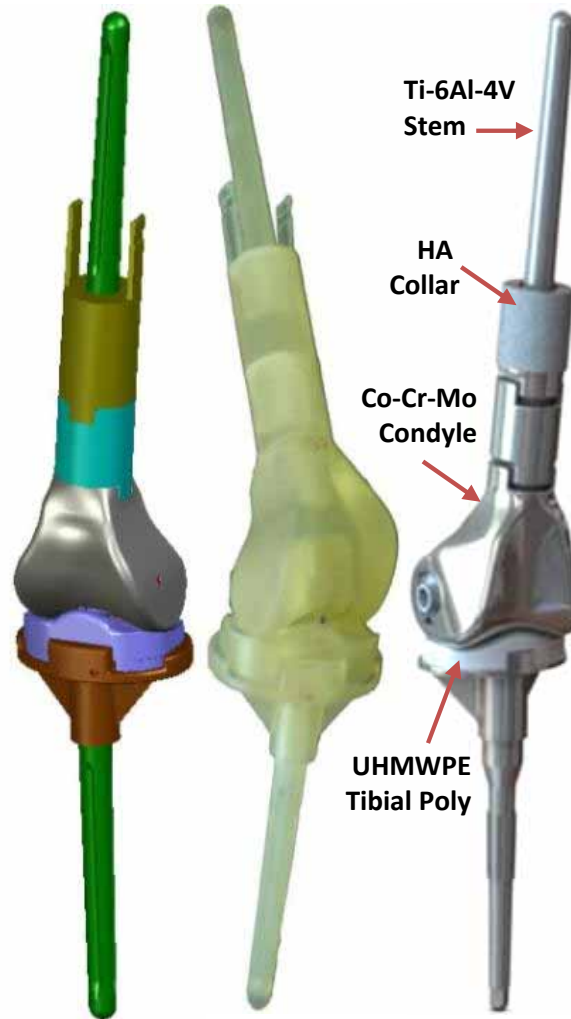
OrthoCAD Project – Tumour Knee Prosthesis

Clinical Need: Mega prosthesis to reconstruct bone after resecting knee tumour in young patients



Tata Memorial Hospital

Novel design: Rotating-hinge TKP suitable for Indian patients



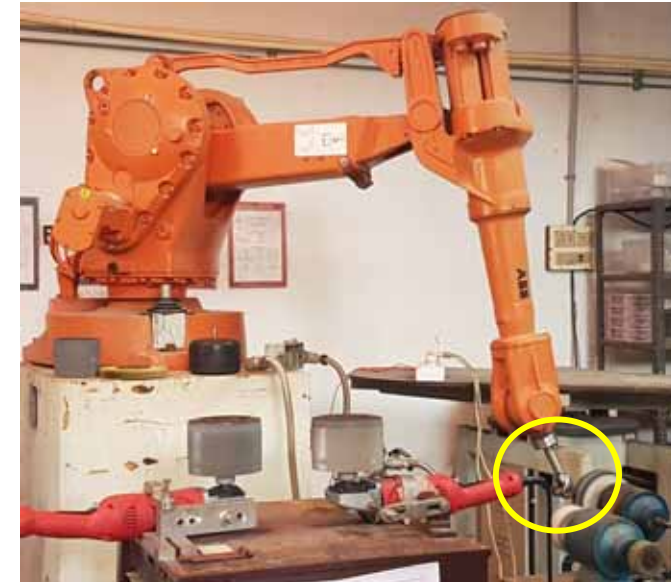
3D CAD model

Plastic model

Final Device In Metal

IIT Bombay

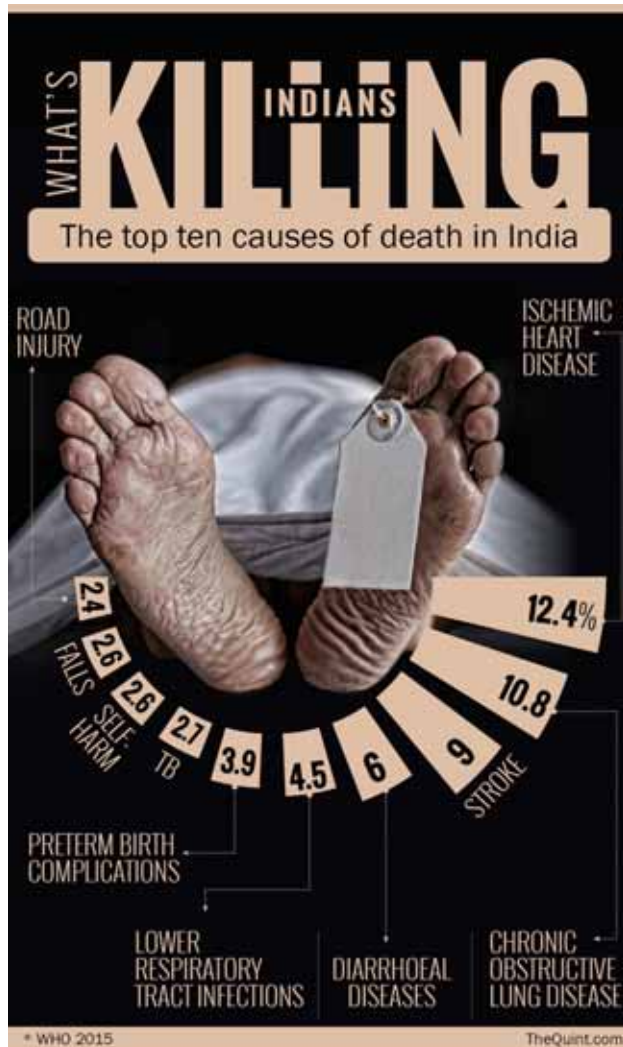
Detailed Engineering, Pilot Batch Production and Prosthesis Testing



Fatigue and Wear Testing Machine

NFTDC, Hyderabad

Healthcare – Medical Devices – Requirement



HEALTHCARE

India: **5%** of GDP
USA: **18%** of GDP
World: **10%** of GDP

Per Capita:

India: **\$ 75** / year
USA: **\$ 7500** / year

India: **15%** growth
70% of expenses
paid out of pocket

India's need \approx \$ 6 billion (Rs. 40,000 Crore) / year

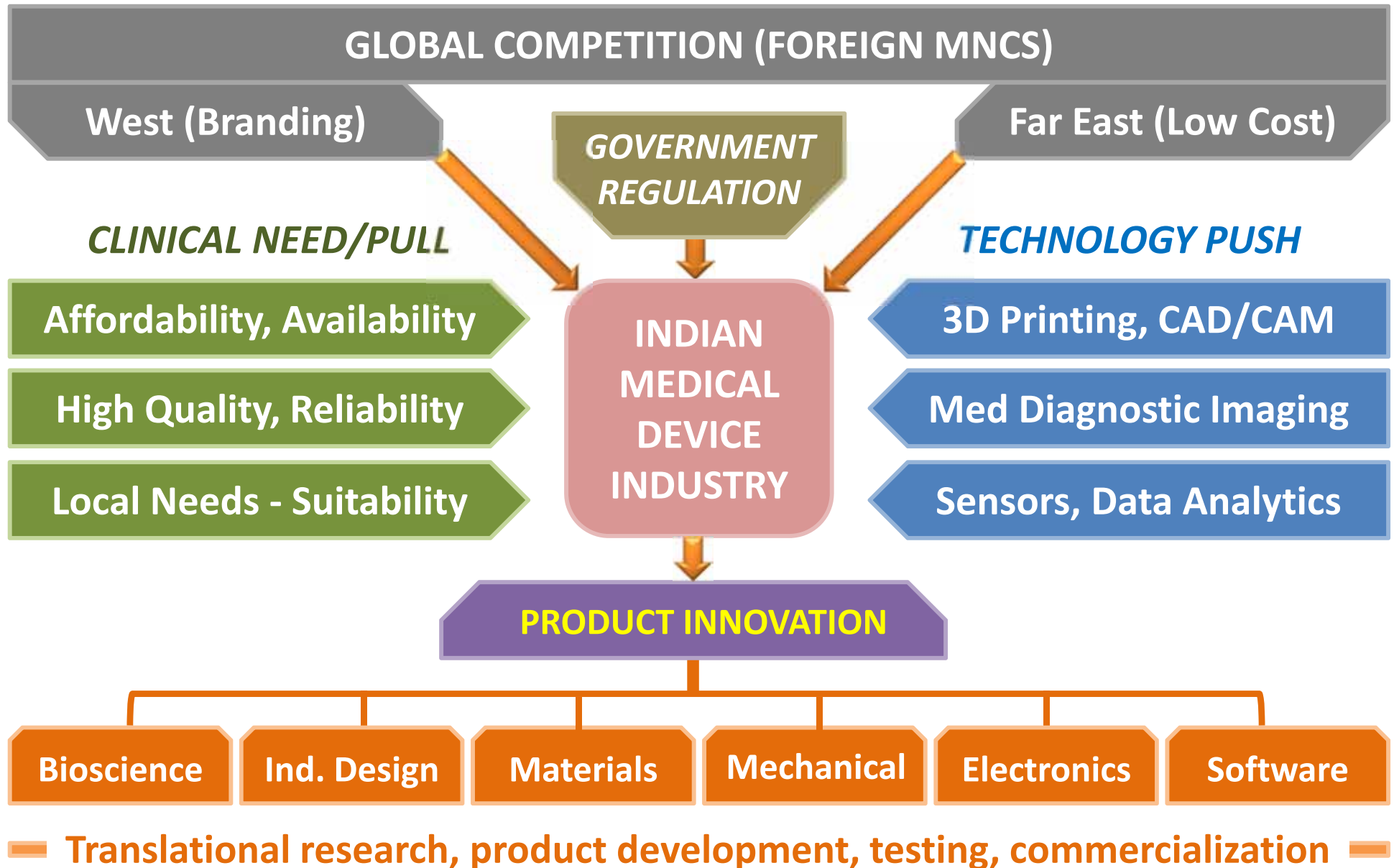
80% devices
are **imported**

75% costs paid
out of pocket

< 300 firms
with GMP facilities

90% firms
revenue **< 50 Cr.**

Medical Device Industry Landscape – India



Indigenous Medical Device Innovation

Biomedical Engineering and Technology (incubation) Centre
Funded by : RGSTC, Mumbai and DST, New Delhi



Facilities – Concept, Design, Prototyping



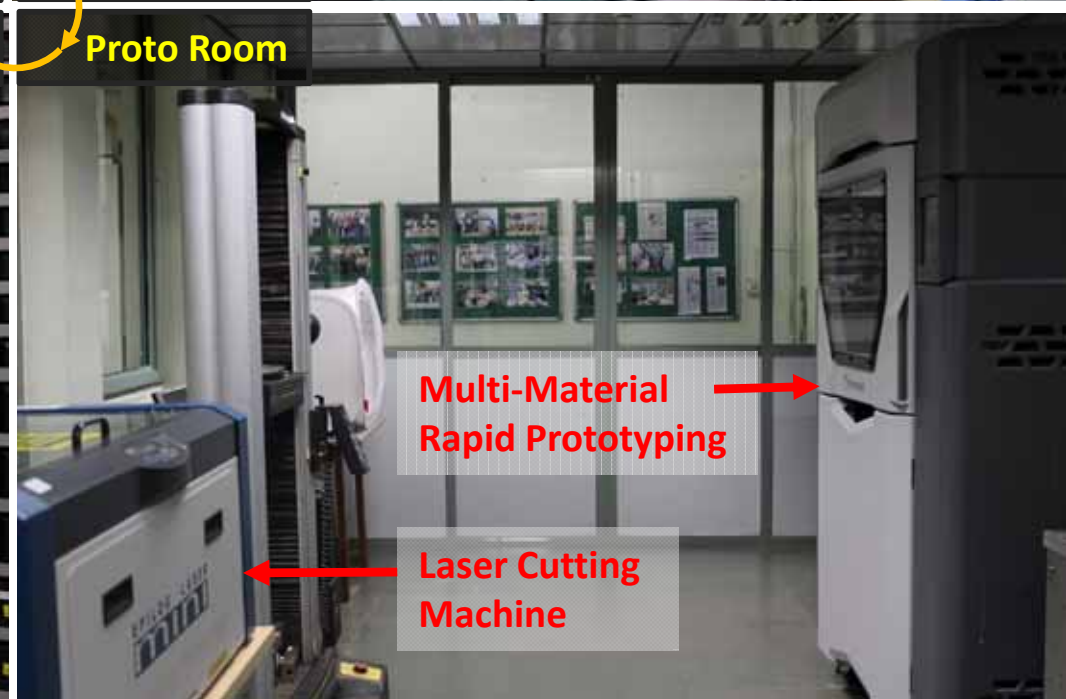
IDEA Room



CAD Room



Electronics

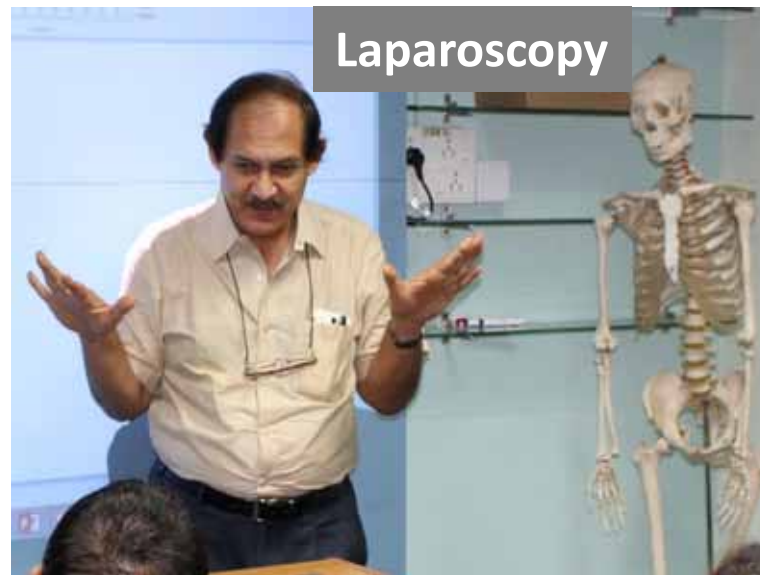
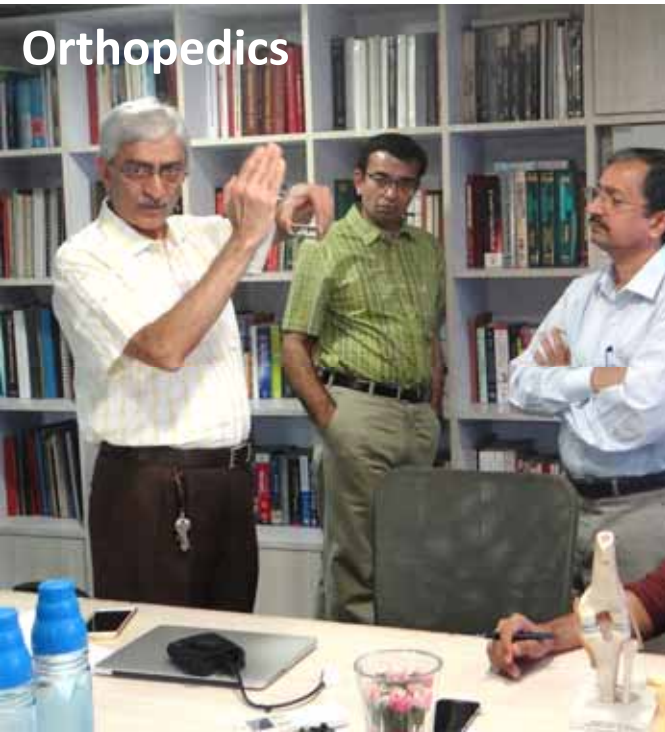


Proto Room

Multi-Material Rapid Prototyping

Laser Cutting Machine

Expert Surgeons in BETiC



BETiC Team in Hospitals



BETiC Process: Bed → Bench → Business → Bed



I. Define (Doctor)

Team Building

Clinical Immersion

Problem Definition

Concept & Feasibility

400
Ideas

1:4



II. Develop (Researcher)

Detailed Design

Virtual Prototype

Rapid Prototype

Functional Prototype

100
Proof-of-Concepts

1:3



III. Deliver (Entrepreneur)

Good Mfg. Practice

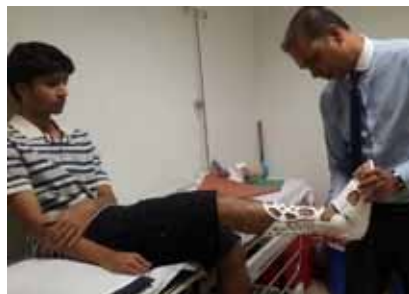
Pre-Clinical Testing

Clinical Trials

Device Certification

35
Prototypes

1:2



IV. Deploy (End User)

IPR Management

Business Model

Scaling Up (Funding)

Improvements

15
Products

Medical Products – Licensed or In-Use

SURGERY SOFTWARE AND INSTRUMENTS



Surgery Planner
(*AlgoSurg, SINE*)



Flexible Laparoscope
(*Eclipse Instrumentation, Thane*)



Aortic Valve Template
(*Fortis Hospital, Mumbai*)



Comp. Screw
(*Swarup, Kolhapur*)



Nasal Forceps
(*Om Surg, Mumbai*)

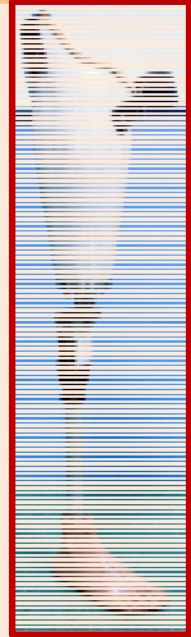
REHAB & CMD



Maxillofacial Jig
(*Cooper Hospital*)



Hybrid Splint
(*MediAsha, Pune*)



Prosth. Leg
(*RNC Trust*)

DIAGNOSIS, MONITORING AND SCREENING DEVICES



Smart Stethoscope
(*Ayu Devices, SINE*)



Clubfoot Monitor
(*Metwiz, SINE*)



Diabetic Foot Screener
(*MGM Hospital*)



Glaucoma Screener
(*Bhandara Hospital*)



Biopsy Gun
(*Hinduja Hosp.*)

Flexible Laparoscopy Instrument



**Dr. Suresh Deshpande
with Sritam Rout**

“Reusable laparoscopic instrument with additional degree of freedom to reach occluded organs with ease.”



Clinical Immersion



Technology Licensing



Pre-Clinical Testing

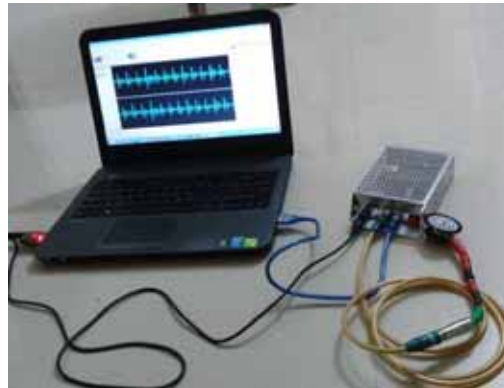
*Indian Patent Filed: “A surgical instrument with multiple degrees of freedom”, 1463/MUM/2015
Product licensed to: Prism Instrumentation Pvt. Ltd., Thane*

Digital Stethoscope Module



Tapas, Adarsha, Dr. Nambiraj

“Device for remote auscultation of chest sounds.”



Proof-of-Concept



Discussions at Hinduja Hospital



Device testing at Fortis Hospital



Team at Biotechnology Ignition Grant Event



*Indian Patent filed: “A digital stethoscope” 201621029618
BIRAC BIG Award. Licensed to Ayu Devices Pvt Ltd. (SINE startup company)*

Patient-Specific Leg Prosthesis



Jaipur Leg



Socket CAD

Knee Joint (IIT-M)

Connector



New Design

Google Impact Challenge Award, 2015-2018
Technology Recipient: Ratna Nidhi Charitable Trust, Mumbai

Medical Products – Patients ‘Touched’



Aortic valve leaflet template
being tested at Fortis Hospital

Prosthetic Leg with 3D-Printed Socket
and Knee Joint, RN Charitable Trust



Digital stethoscope
testing at Hinduja Hospital



Clubfoot brace monitor
testing at Wadia Hospital



Diabetic foot screening
at MGM Hospital



Glaucoma screening
at Bhandara Hospital

Medical Products – Innovators in News



IITian develops software to convert 2D X-ray into 3D

New Delhi: An Indian Institute of Technology (IIT) research scholar has developed software 'Diplomat' to help surgeons convert 2D X-ray into a 3D model or tablet. This novel revolutionises bone replacement procedures for orthopaedic patients. Orthopaedic surgeons can use Yitao Karande's software to create 3D models of the patient's bone structure.

High-quality, low-cost medical devices created at IIT-B lab

Shobhan Singh
A multi-disciplinary, multi-institutional Biomedical Engineering and Technology Incubation Centre (BETIC) set up in IIT-B is converting innovative ideas from doctors into

PATENTED DEVICES AWAIT MASS PRODUCTION

Ever since it was set up, BETIC has patented 30 medical devices.

"These devices are in different stages of development and testing," said professor B Ravi, who heads the BETIC initiative at IIT Bombay.

"While some have reached functional prototypes and are ready for clinical trials,

Jaipur foot gets a leg-up, 3D-printed version ready

200 Amputees Will Switch Over To The Prosthetic This Month

Malathy Iyer@timesgroup.com

THREE-DIMENSIONAL THERAPY

Three-dimensional printing is a method to make objects or models—using materials such as plastic, metal, powders or even living cells—in layers

In Mumbai, it has been used by doctors to make ceramic tooth caps, models of bone fractures, heart anomalies

JAIPUR FOOT THROUGH 3D

NGO Ratna Nidhi Trust was a winner of the Google Impact Challenge for disabilities in September 2015

The trust makes Jaipur Foot and distributes throughout India and Africa

Its winning entry said it would use digital printing technology to make the Jaipur Foot quicker, more precise and affordable

It tied up with IIT's biotechnology department and came up with India's first 3D-printable prosthetic

People can remotely order their foot and get delivery at their doorstep

CoEP develops instant splint for injured limbs

SwatiShindeGole@timesgroup.com



A person just has to dip the splint in water, squeeze and apply it on the injured limb. It provides support for over 24 hours

Pune: The College of Engineering, Pune (CoEP), has developed a patented hybrid orthopaedic splint that can be used as an instant plaster on fractured limb to ensure the broken bone stays in normal position and avoid propagation of crack.

Extremely light in weight, the splint can be carried in a first aid kit for emergencies. One just has to dip it in water, squeeze and apply it on injured hand. The splint is made with a combination of plaster of Paris and paper resin. It comes with

wrapping cotton around wet plaster splint and allowing it to solidify in open air. Bandages are applied over the splint to fix it at the proper position. Often, the two layers of cotton get mixed, making it difficult to remove the splint after the treatment is over. Plaster splint with cotton padding are heavy, less durable and have poor strength to weight ratio. Fibreglass splint overcomes these drawbacks, but is expensive.

Ashish Ranade, an orthopaedic surgeon of Deenanath Mangeshkar Hospital, said, "This splint is a good innovation

VNIT team develops forceps for surgical bone cutting

Continued from P1

The VNIT team that developed these and few other biomedical tools includes Piyush Ukey, Chetan Kuthe, Rahul M R, Saunabh Bagde, Nikhil Adhe and Agurva Sharan. It had the support of ENT surgeons Dr S N Lulay and Dr Prashant Naik and orthopaedic surgeon Dr Alankar Ramteke.

The engineers have also

developed forceps to be used in osteotomy or surgical cutting of a bone and have patented the technology. "The forceps will replace chisel and hammer to correct any deformity in the nasal bone. It reduces surgery time, simplifies the osteotomy process, thereby reducing the surgical trauma," said Lulay.

The project was funded by the Biomedical Engineering and Technology (Incubation) Centre (BETIC).

The team has developed a model of the human temporal bone which is used for academic purposes. "The real size bone has been developed using 3D printing technology and is a very useful dissection training tool," said Naik.

The engineers have developed a software for non-invasive test of muscle strength. "It can help athletes improve their game," said Ramteke.

Cosmetic surgery to get affordable as VNIT develops implants

Snehalata.Sherawat@timesgroup.com

THE NEW SILICON CENTRE

MEDICAL IMPLANTS

Nasal, cheek bone (Malar), chin, breast implants are good tools for correcting deformities. They restore the shape of the respective organ

The T-tube implant is used to open up the trachea or windpipe and restore normal breathing

Assistant professor of mechanical department Rashmi Uddamawalker showing the model of T-tube that opens checking of windpipe

The start-up venture will be incubated at the Centre for Innovation at VNIT (CVIT) before moving out as an independent entity

"Over the last year, we developed the basic technology to make these implants. With a few modifications we can begin manufacturing in about a year in the CIVN as per FDA norms. The team has conducted a market survey and is expecting good demand for all the implants. As 70-75% of implants are imported, these can fetch us good returns," said Rashmi Uddamawalker, assistant professor and project supervisor

Except for the T-tube, all other implants have cosmetic purpose. The T-tube was developed with the support and guidance of nasal and neck surgeon Dr Manoj Kojur. "This is used to open the windpipe and restore normal breathing. The T-tube is then pulled out and the opening is closed," said Uddamawalker

Forceps to cut bone, P 2



COSMETIC CHANGES

The price of medical implants manufactured in Nagpur is expected to be 50-60% less than imported ones

A person can correct crooked, protruding, depressed, broad or narrow nose bones or any other nasal deformity

Cheek bones can be augmented as per the cosmetic needs of the person

Breasts can be augmented as per the requirements. These can also be implanted in those who have undergone mastectomies and are recovering from breast cancer

Engineers, doctors join hands to solve real-life medical problems

BENGALURU, DHNS: Doctors, engineers, designers and business professionals put their heads together to solve real-life medical problems at the medical device hackathon fest, MedHa'16 held at the Indian Institute of Science, Bengaluru.

The four-day event, which concluded on Sunday, was organised by the Centre for Product Design and Manufacturing (CPDM) of IISc and Biomedical Engineering and Technology Incubation Centre



A prototype of the jig for knee-balancing and ligament alignment, developed at the hackathon fest.

Meet produces prototypes for 20 new medical devices

Scientists And Engineers Break Down Barriers

Top colleges prescribe Medic 2017 to treat business apathy

MEDICAL INNOVATION COEP, IIT and VNIT come together to move medical startups up food chain



ANANYA BANERJEE
www.banerjee.com

PUNE: College of Engineering Pune (CoEP), Indian Institute of Technology (IIT) Bombay, and Vignansaraya National Institute of Technology (VNIT) Nagpur, are jointly organising a medical device innovation camp (Medic) at the CoEP campus in the city.

The two-day camp was inaugurated on September 15 and will continue till September 17, for students, doctors and engineers in the fields of biomedical

Speakers, faculty and guests of honour at the launch of Medic 2017 at the CoEP campus in the city on Wednesday.

Dissemination of Best Practices

THE ESSENCE OF Medical Device Innovation



B Ravi



BETIC Biomedical Engineering and Technology (Incubation) Center 17497 Visitors

IIT Bombay
COEP Pune | VMIT Nagpur

Medical Device Innovation: Translating Ideas into Reality

Login

LEARNING SESSION
Clinical Immersion

PROJECT STORY
Suture Anchor

EVENT SPOTLIGHT
XrayTo3D wins awards

Expert Clinicians

Engineering Team

Industry Partners

Opportunities
Fellowship
Internship
Workshop

Lab & Facilities

Resources
Lab Booklet
Newsletters
Tech Papers

1. Meet clinicians to understand the background and nature of medical problem.
2. Study relevant anatomy, medical terms and current solutions.
3. Collect information about equivalent solutions, devices and patents.
4. Record diagnosis and treatment protocols, observe surgeries.
5. Capture the 'voice of customer' - patient, surgeons and other caretakers.

Suture Anchors are required for arthroscopic rotator cuff repair in cancellous / osteoporotic bone found in Indian patients. The metal prototypes are being produced at CMTI Bangalore.

XrayTo3D technology developed by Vikas Karade, which reconstructs 3D models of bone from their 2D X-ray images, was recognized by 'Gandhian Young Technological Innovation Award' in 2014, and is among the top 10 innovations in India for President's Scholar In-Residence Program 2015.

This innovation has been in the media.
[Time of India](#)
[ETHHealthWorld](#)
... and many more

Patent filed: V. Krishnaswamy, R. Ghyar, D. Bhatta, B. Ravi, "Suture Anchor for Arthroscopic Rotator Cuff Repair".

Expert Clinicians | Engineering Team | Industry Partners | Learning | Projects | Events | Opportunities | Lab & Facilities | Resources

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Summary: Medical Device Innovation Eco-System

PEOPLE & FACILITIES

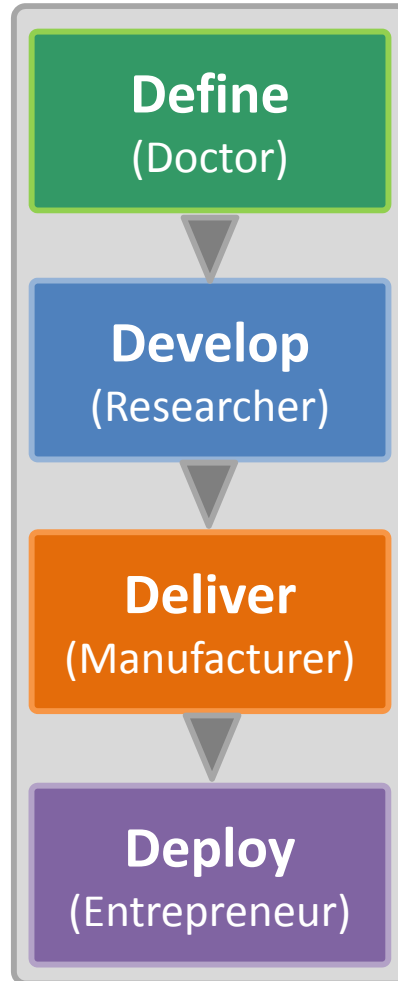


BETiC facilities and researchers

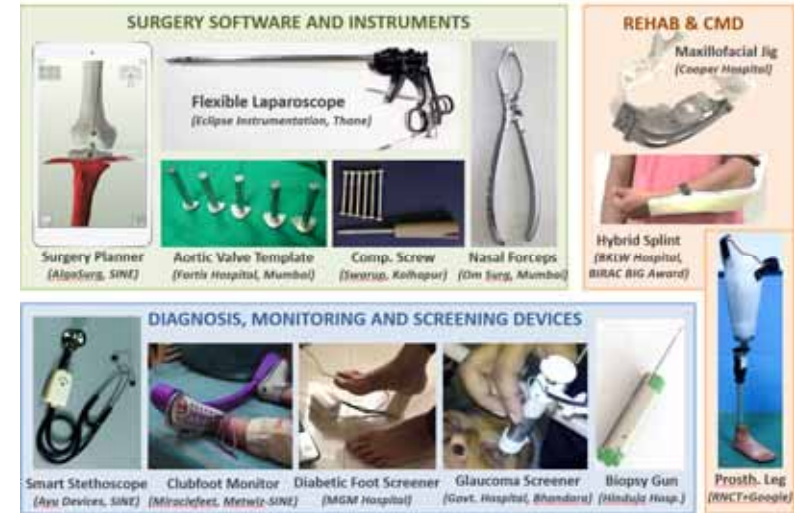


Clinical immersion for unmet needs

PROCESS



PRODUCTS & PROMOTION



Medical Expos for entrepreneurs

2015-2017

400 Unmet Needs

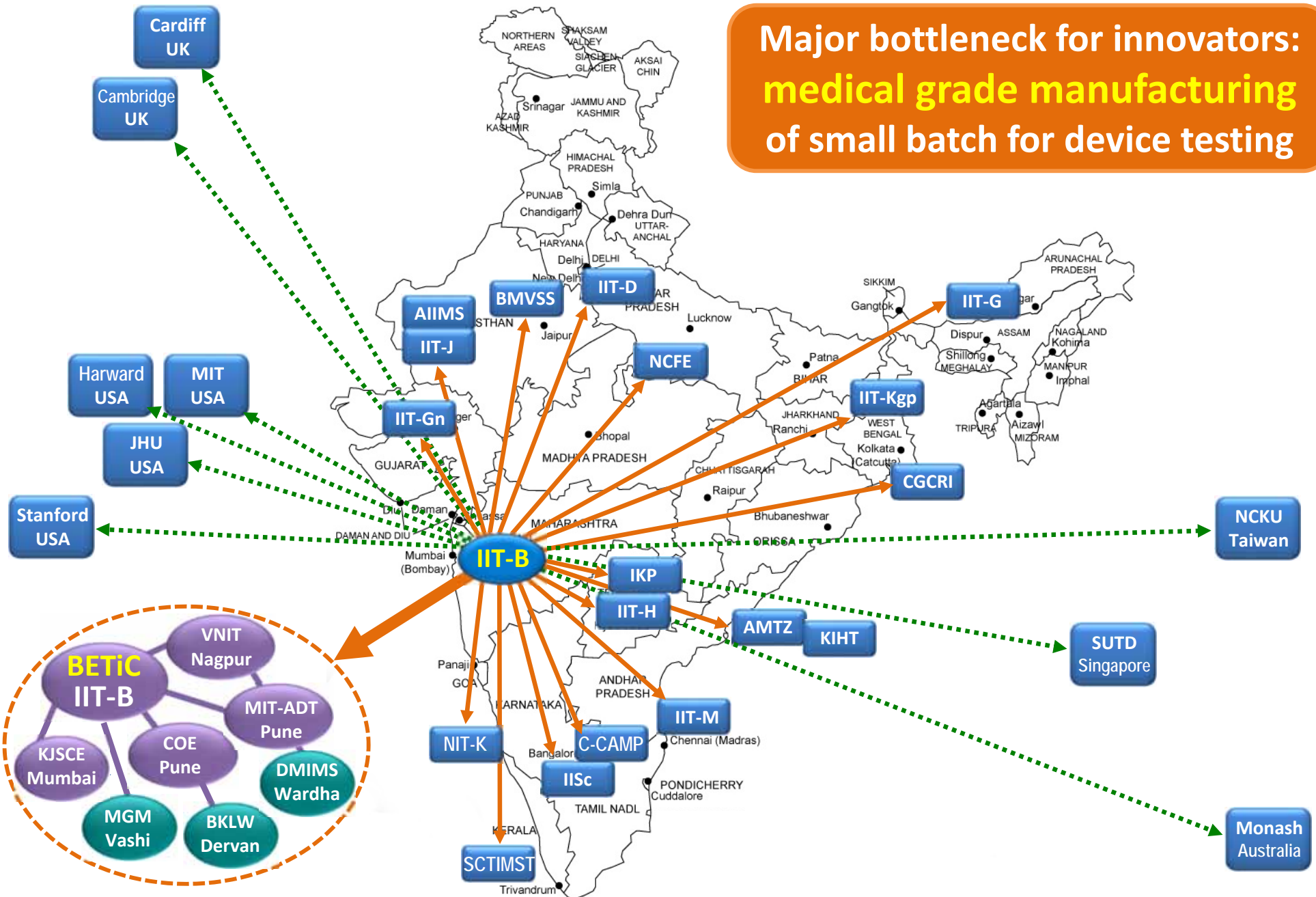
100 Proof-of-concept

35 Patents Filed

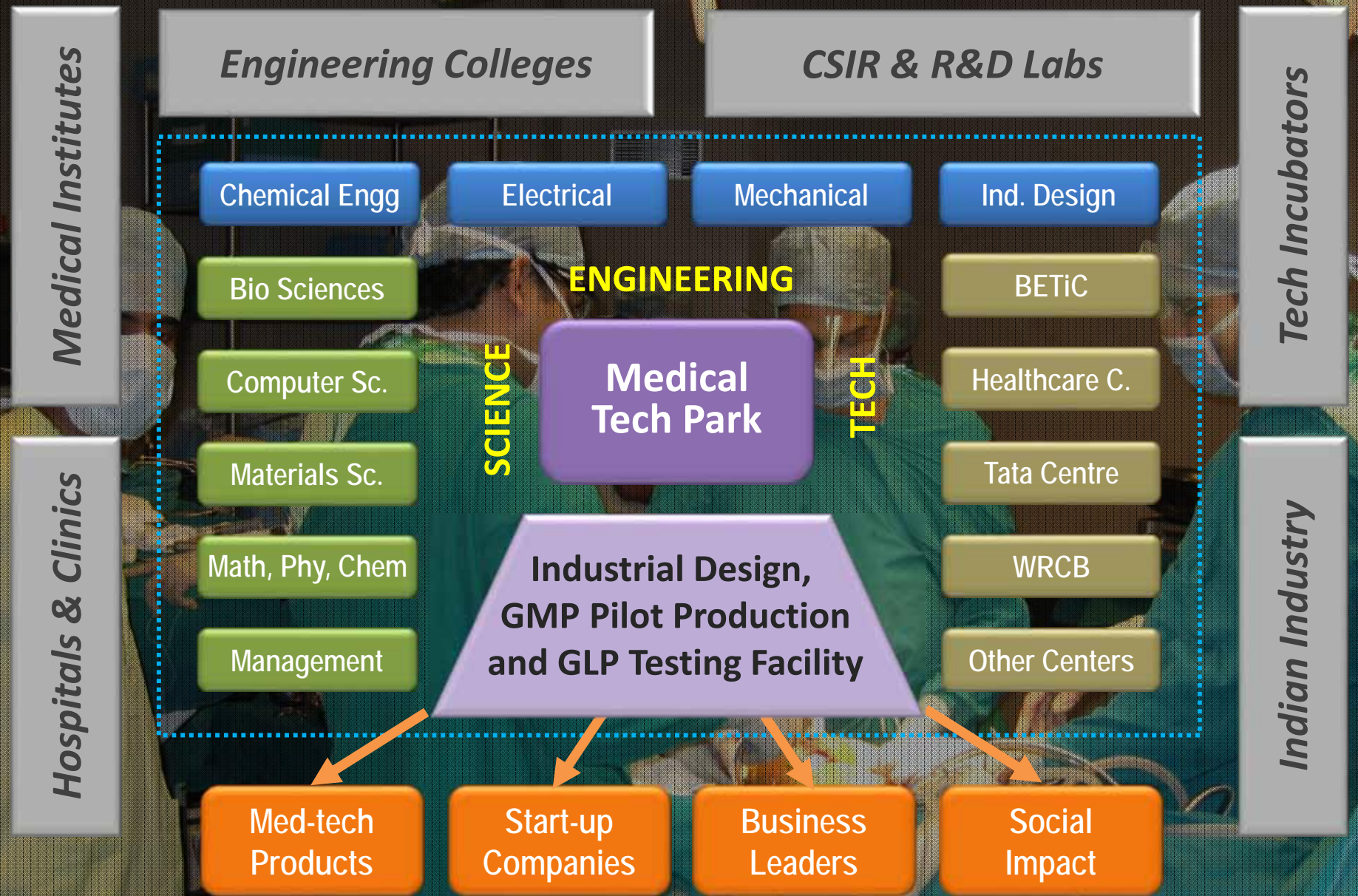
15 Med Products

Medical Device Innovation Network

Major bottleneck for innovators:
medical grade manufacturing
of small batch for device testing



Idea to Impact – Inclusive, Scalable, Sustainable



Thank You!