

NGPG – The 8 Year journey



A group of executives of machine tool manufacturing companies and precision components manufacturers met at in July 2008 at Ghaziabad, a small town in the outskirts of Delhi. This meeting was organized by Mr. N.K. Dhand, CEO, Micromatic Grinding Technology, a leading machine tool manufacturer in India. Their discussion centered on Precision Manufacturing in India. This was many years before the now famous Make in India movement spear headed by the current Prime Minister of India, Mr. Narendra Modi. This journey started in 2008 has resulted in a commercially viable machine tool, capable of manufacturing higher precision engineered components. This machine (NGPG) was inaugurated on June 24th 2016 at IIT – Madras, India.



**Dr. R. Chidambaram, Principal Scientific Advisor, Government of India
inaugurates the successful installation of the first NGPG machine at IIT - Madras**



This report is a brief summary of this 8 – Year journey of collaborative development, leading to end to end innovation – from concept to commercially viable end product.

Following are a few pictures from the kick off meeting held at Ghaziabad on July 1, 2008. The meeting was attended by CEOs of several precision machine tool manufacturers, Senior Managers from Precision components manufacturers, Senior advisors from IMTMA.



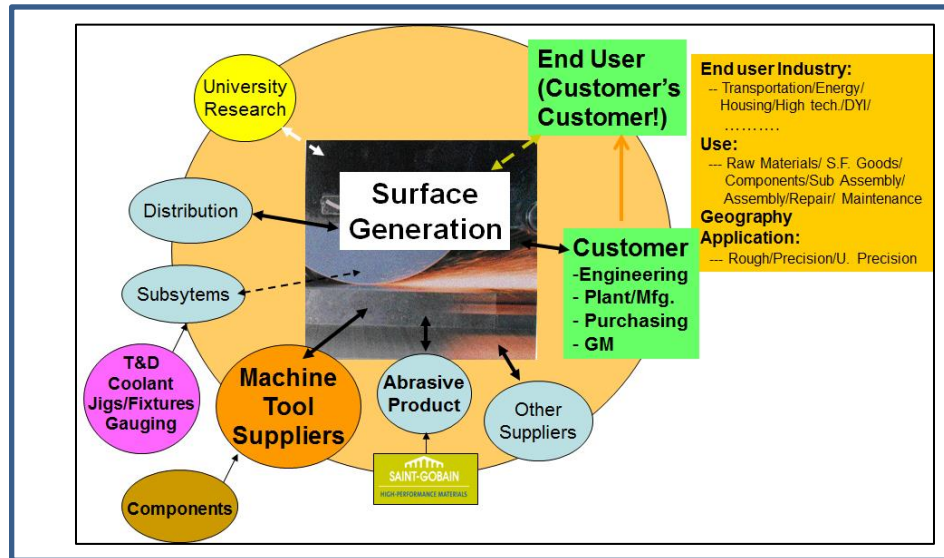
Meeting held at MGT at Gazhiabad, Delhi July 1, 20008

Dr. K. (Subbu) Subramanian, President, STIMS Institute (then working at Saint-Gobain Co.) was invited to this meeting to offer his views on manufacturing and innovation. He offered an outline for a road map for machine tool developments in India. He suggested the following outline:

- Step 1: Target Industries, applications and their market opportunity (Driven by National and Global Policies): Inside of India; in Selected Geographies?
- Step 2: There are similar applications (e.g): Cylindrical Grinding, everywhere. What is the "Served Market" for the IMTMA members?
- Step 3: What industries and markets that IMTMA members want to drive? Proactive Vs. Reactive ?
- Step 4: There is a natural evolution path for Core Capabilities depending on the __ component/supplier capabilities.
- Step 5: Leverage capabilities of Individual members or industry suppliers? (e.g): Grinding Technology

- Step 6: Leverage capabilities of a collection of members and their capabilities for “Integrated Solutions”? Technology Value Chain?

Dr. Subramanian also explained the need for an eco-system for collaborative development in India, as an unique alternative to the industry – university models noted in developed nations such as USA and Germany.



At the end of this meeting the following conclusion was reached:

Indian Machine Tool manufacturers and their customers with the machines made in India cannot achieve tolerances for less than 1 micron (roundness, taper, size holding, ...) with out in-process gaging. But in-process gaging cannot be used for many precision components including non-rounding applications such as cam lobe grinding and match grinding of precision parts. Such machines can be imported but technologies to manufacture such machines are not available for sale that can be purchased from the overseas manufacturers. Lack of such higher precision machine tools also impacts further progress inside of India in the use of advanced grinding solutions – such as high speed CBN grinding – in the manufacturing sector.

After such clearly outlined industry need, Dr. Subramanian and Mr. N.K. Dhand contacted Prof. Babu at IIT – Madras. Further discussions together with Mr. Mohanram, Scientific Advisor, IMTMA resulted in a research proposal, which was timely for submission to a RFP for research in the year 2010, supported through the Office of the Principal Scientific Advisor, GOI. The proposal was accepted by GOI. The review process that followed was valuable as noted in the following exchange:

Reviewer Comment:

The proposal should make the technical details of *what is meant by the next generation precision grinding machine*. This information given in the proposal is too general and is not sufficient to judge the quality of the proposal. It is also not proper to identify an existing machine tool of the sponsor without establishing its superiority over the existing machine tools of the other brands.

I recommend that *the first phase of the project should compare and identify the best grinding machine presently available and then spell out the requirements of the next*

generation precision Grinding machine so as to take up the second phase project involving the development.

Response:

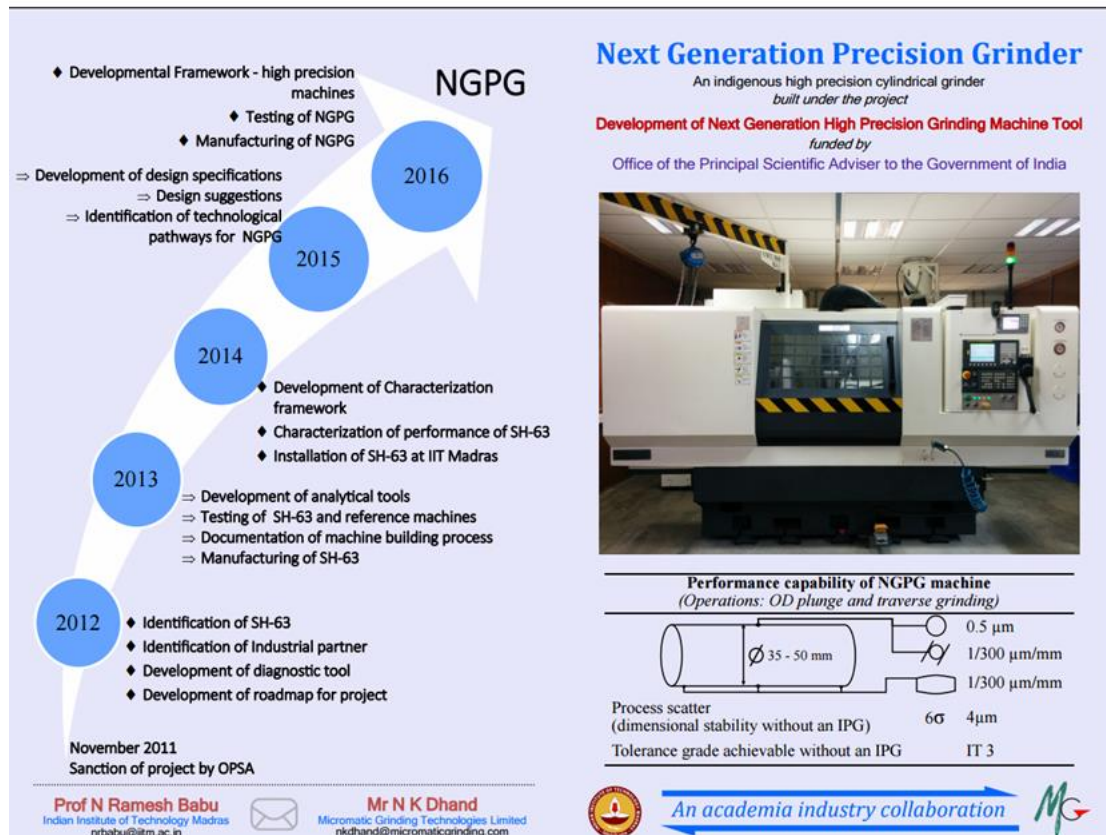
..... There will be a parallel effort to calibrate cylindrical grinding machines available in India and the state of the art of such machines available worldwide. With this data set of the cylindrical grinding machine capabilities inside of India and those available abroad should be the reference for developing the next generation precision grinder. The framework developed in the project will provide the necessary guidance for building the next generation precision grinders.

After further reflection, the following factors were also identified by the R&D team:

- In most industries the commercial developments are incremental. But the history of such development is not a well-documented continuum. Hence while many companies can manufacture higher precision machine tools, they cannot “teach” a comprehensive methodology for someone else to follow!
- Often the legacy knowledge is also lost with the retirement or departure of experienced and senior level workers☹ as each generation of machine tool is developed or due to changes in company business conditions and strategy.
- The research pursued by individual academic researchers often delve into depth of one or the other aspect of precision machine tools such as stiffness, dynamic stability, etc. Rare few if any study all aspects of machine tool developments needed for the development of a higher precision machine tool. This requires an integrated or System View of the research and development.
- Hence the System Approach developed and advocated by STIMS Institute and the related Transformational Skills were adapted as the frame work for the development of the Next Generation Precision Grinder (NGPG).

The NGPG project was approved by the end of 2012. It has progressed well to achieve all the goals set forth in the visionary meeting held at Ghaziabad in 2008. The machine was inaugurated on June 24th 2016 at IIT – Madras by Dr. R. Chidambaram, Principal Scientific Advisor, GOI. The project, its progress and the end result – a commercially viable next generation machine tool developed as an outcome of GOI funded research carried out through active team of collaborators from Industry, Academia, Govt. Research labs. and world experts – is a true testament to the application of System Thinking and Transformational Skills and their impact. We are pleased to document below the progress and the results through the following slides:

What is NGPG?

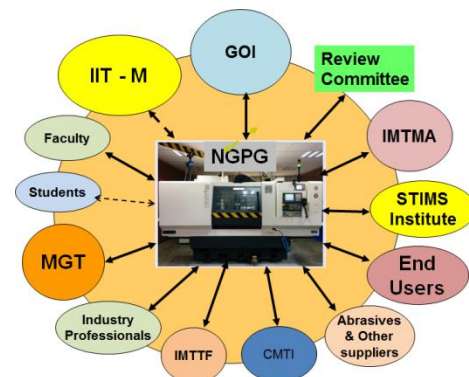


Transformational Skills displayed through the NGPG Project

Develop a Common Language	<p>NGPG:</p> <p>Develop and Demonstrate “Make in India” Capability (GOI) Through a project that fosters industry – University Collaboration (IIT - M)</p> <p>To achieve a machine tool of higher precision capabilities inside of India that is commercially viable (IMTMA)</p> <p>Leading to new resources and business opportunities for Indian manufacturers (MGT and user industries)</p> <p>Fostering an education that is academic and yet hands-on (Mfg. Research / Faculty)</p> <p>Leading to skills that is sustainable through the career of the students. (Students)</p> <p>Demonstrate the value and efficacy of System Thinking and Transformational Skills (STIMS Institute).</p>
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Common Language: Defines the Why?

Every one of the stake holders and their interest MUST be addressed



Eco – system leading to NGPG

NGPG: Outcome of successful collaboration across University, Industry, Government and International experts.

Mentoring and Guidance

Dr K (Subbu) Subramanian
President
STIMS Inc. USA



Project Team IIT Madras

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Principal Investigator



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Co-Principal Investigator



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Project Review and Monitoring Committee

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BARC



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IIT Delhi



Mr B Mohanraj
Member
CMTI





An academia industry collaboration



Machine Tool Testing

Mr Y Balaramaiah
Director
AMTTF



Transformational Skills displayed through the NGPG Project



IIT - M
Faculty, students and Mgt.



STIMS Institute
System Approach;
Transformational Skills



MGTL
Industry - Collaboration Partner

Ingredients for Successful Make in India R&D (e.g.): NGPG



Inter-industry Resources
IMTMA, IMTTF, CMTI



Strategy and funding
Govt. of India - DST

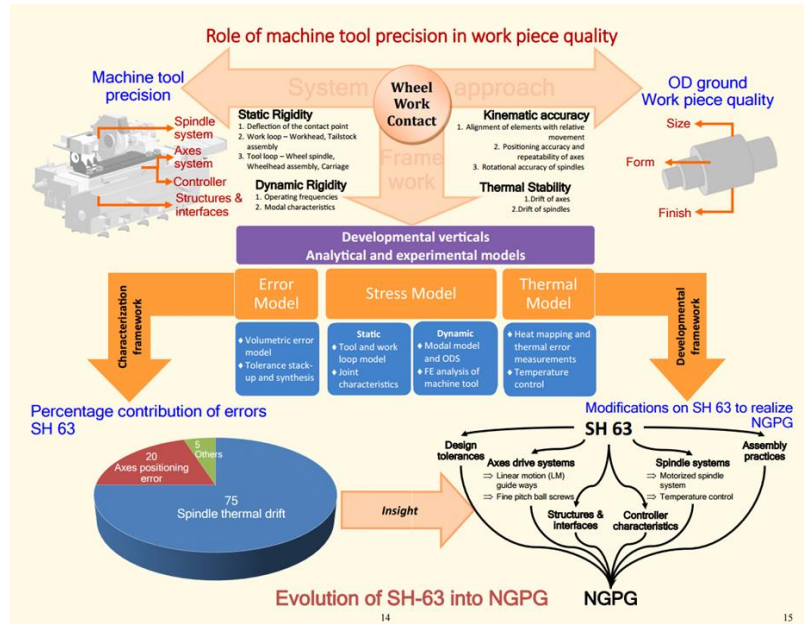


Review Committee with
Industrial and Admin. Exp.

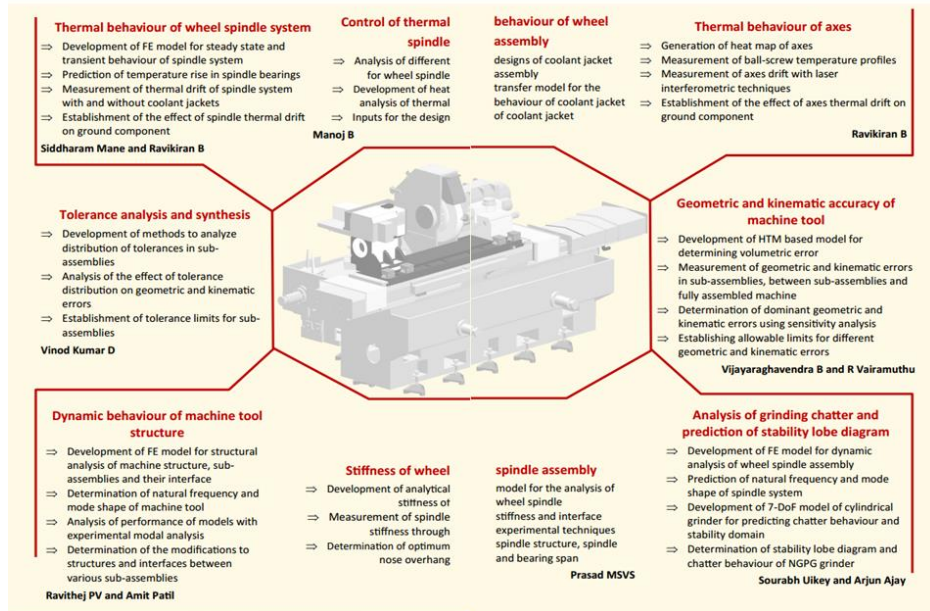
Promote development and Use of core capabilities at all levels:	<ul style="list-style-type: none"> • Students, Faculty and review Committee: <ul style="list-style-type: none"> ○ Knowledge, Experience and Inter-personal Skills • Projects, Thesis and Industry – University Collaboration <ul style="list-style-type: none"> ○ Science, Engineering and Management • Industry, University, Government <ul style="list-style-type: none"> ○ Precision Machine Tool Technology(Physical Technology), IT driven data and communications (Digital Technology) AND ○ GOI / Industry investments (Finance) and Precision Parts Manufacturing (Market Driver).
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Transformational Skills displayed through the NGPG Project

System Approach and Knowledge Integration	= Science: Precision Machine tool is a synergistic outcome of several pathways + Engineering: Outcome of active collaboration between IIT Researchers and Industry Professionals + Management: Strategy (Why?) is clear in terms of Science and end result AND Operations are well managed through reviews and steering committee.
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NGPG: Synergistic outcome of several research projects



NGPG: Outcome of effective Project Management and effective guidance by the Project Review and Management Committee (PRMC)



Transformational Skills displayed through the NGPG Project

Emphasis on Science and Mobile Diagnostics	<ul style="list-style-type: none"> • Design Methodology and the modules in it --- Please see the slides above for details. • Data Logger feasibility demonstrated at IIT – M has resulted in Grind Trak™ developed and in commercial use. • Measurement and analysis tools and methods at IIT, IMTTF and MGTL used on locations and as needed (Bringing Science to the shop floor) resulting in new protocols used for machine tool testing 	Emphasis on Science and Mobile Diagnostics	<ul style="list-style-type: none"> • Design Methodology and the modules in it --- Please see the slides above for details. • Data Logger feasibility demonstrated at IIT – M has resulted in Grind Trak™ developed and in commercial use. • Measurement and analysis tools and methods at IIT, IMTTF and MGTL used on locations and as needed (Bringing Science to the shop floor) resulting in new protocols used for machine tool testing
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End to End Innovation	<ul style="list-style-type: none"> • NGPG machine concept reduced to practice with commercial validation in progress. • Every stake holder has realized identifiable benefits as described above under “Develop a Common Language”.
Emotional Intelligence for Innovation	<p>Each stake holder was committed to the NGPG with a belief that the end result will be of use to them, even though such pathways were not clear and obvious up front</p> <p>(Help others, which in the end is also helpful to you) .</p>



As it is often said “Success Breeds Success”. The success of the NGPG project and the collaborative environment created across the industry / university research and manufacturing community has resulted in the development and formation of the Advanced Manufacturing Technology Development Center (AMTDC). This is a collaborative effort across six machine tool / components manufacturers, IIT – M supported by GOI R&D funding. STIMS Institute will continue its role of mentoring and guidance for the success of this consortium and its impact on the manufacturing sector.



Advanced Manufacturing Technology Development Centre (AMTDC)

Collaboration across IIT – M, Six companies, Eleven projects ranging from Machine Tools, Components, Controls and IOT).



Government of India
Ministry of Heavy Industries & Public Enterprises
Department of Heavy Industry

Funded by

Department of Heavy Industry,

Govt. of India

and

Partner Companies





A GoI Initiative under “Enhancement of Capital Goods Sector” and “Make in India” Scheme