

## Industry Support Institutions Fostering Innovations Culture among SME's of Punjab, India: A Strategic Perspective

B.S. Sangha<sup>1\*</sup>, T.P. Singh<sup>2</sup> and Ajay Batish<sup>3</sup>

<sup>13</sup>Thapar University, Patiala. Punjab, India.

<sup>2</sup>Symbiosis International University, Pune, India.

**Abstract.** *The present paper attempts to investigate the role of six Industry Support Institutions in fostering innovation culture in manufacturing sector of Punjab in India. Some path breaking technological innovations have been introduced by the Institutions. These highly interactive, self-reliant institutes are the virtual In-house R&D to SMEs. Knowledge accumulations in the institutes also offer a platform for exchange of ideas which further facilitate the process of open innovation. The speedy and efficient dissemination of technical know-how by these institutes have brought creativity and innovativeness among SMEs of the region.*

**Keywords:** *Industry Support Institutions, Open Innovation, Small and Medium Enterprises.*

### 1. Introduction

Innovation has been a major strategic tool used by global organizations for dominating global markets. In the 21<sup>st</sup> century, the face of innovation has changed; it's happening faster, it's more open and collaborative. The outdated concepts around tightly controlled intellectual property are giving way to a more emphasis on sharing intellectual capital (Bontis, 2001; Leinter, 2011). It is a known fact that Science and Technology institutions play a key role in effective distribution of innovation products among different sectors and knowledge accumulation in such institutes offer a platform for exchange of ideas, facilitating

open innovation. Punjab is one of the northern states of India having presence of 1,62,000 SMEs employing approximately 9,44,000 people. (DI&C, Pb; 2009). There are six industry support institutions in Punjab helping SME's to become competitive by improving quality and price. This paper makes a proposition that setting up of industry support institutions may be recognized as a strategic tool for fostering innovation culture in a region. This prospective is analyzed and discussed first in the background of literature and later illustrations are summarized to substantiate the rationale behind the proposed strategic perspective.

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\*Corresponding author:

B.S. Sangha is a Ph.D Scholar with School of Behavioral Sciences & Business Studies, Thapar University, Patiala. His corresponding address is General Manager, Institute for Autoparts and Hand Tools Technology, A-9, Phase-V, Focal Point, Ludhiana-141 010. India. Email: balwinder\_sangha@yahoo.com

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## **2. Background Literature**

The concept of Industrial District or cluster has been mooted by a number of researchers who observed the productivity raising benefits to small industrial units positioned in an Industrial network or cluster (Sforzi, 1990; Pyke *et al* 1990, 1992; Brass *et al* 2004). According to Porter (1998), clusters are geographic concentrations of interconnected companies or institutions in a particular field. There is now enormous evidence on the contributions of universities, public research organizations, the military, other public actors and financial organizations (such as venture capital) in the generation and diffusion of technological advance in industries. Their roles, however, have been shown to be quite different in different industries (Levin *et al.* 1987; Cohen *et al.* 2002).

SMEs provide a strong base for innovation in manufacturing sectors. Empirical studies have shown that SMEs contributed to the main innovations of the twentieth century (Rothwell and Zegveld, 1982; Oakey, *et al.*, 1988; Rothwell, 1994). Small firms usually have good internal communications and many have a dynamic and entrepreneurial management style (Rothwell, 1994). The average capability of technical people is higher in small firms and that innovations in these firms can be less expensive. SMEs absorb technologies and improve their productivity more effectively and efficiently (Cooper, 1964; Vossen, 1998).

Incremental innovations involve “improving and exploiting an existing technological trajectory,” whereas radical innovations “disrupt an existing technological trajectory.” Gatignon, *et. al.* (2004). Similarly, Abernathy and Clark (1985) noted that incremental innovations “build on and reinforce the applicability of existing knowledge,” while radical innovations “destroy the value of an existing knowledge base”.

The phenomenon by which large firms discover, develop and commercialize technologies internally is identified as closed

innovation model (Chesbrough, 2003). On the other hand open innovation is defined as ‘the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively.’ (Chesbrough *et al.*, 2006, p.1). It thus comprises both outside-in and inside-out movements of technologies and ideas, also referred to as ‘technology acquisition’ and ‘technology exploitation’ (Lichtenthaler, 2008). Companies can no longer keep their own innovations secret unto themselves; the key to success is creating, in effect, an open platform around your innovations so your customers, your employees and even your competitors can build upon it, because only by that building will create an ongoing, evolving community of users, doers and creators.” (Rothenberg, 2003).

External networking is an important aspect associated with open innovation (Chesbrough *et al.*, 2006) and includes all activities required to acquire and maintain connections with external sources of individuals and organizations. Networks in the shape of formal or informal allow firms to fill in specific knowledge needs quickly without any major investments. The crux of open innovation is in the background that organizations cannot conduct all R&D activities in-house, but have to depend on external knowledge sources which can be licensed or bought (Gassmann, 2006).

## **3. The Study**

The study entailed identification of parameters of services of the six industry support institutions. The questionnaire was generated after a careful study of specialization area and technical services being rendered by each Industry Support Institution. Author of the study remained, General Manager of R&D Centre, Ludhiana from May, 1998 to April, 2005 and at present is the General Manager of Institute for Autoparts & Hand Tools Technology, Ludhiana. The column of ‘Institute Name’, Establishment Year / Age is

targeted to know period of operational existence of an individual institution. The column of 'Manpower' was designed to know levels and education of staff deployed in these institutions. The column of 'Technology Development Initiative' was designed to collect information about technical intensive services being rendered by institutions under sub-headings of 'Manufacturing Process improvements', 'Quality Control', 'Skill Development', 'R&D Support', 'Common Facility', 'Technical Dissemination' and 'Patents' filed.

To know the operational sustainability of individual institution, their revenue earning during period 2007-2012 was aimed for recording under the column of 'Operational Revenue'. The questionnaire was designed to study six industry support institutions operating in the state of Punjab, India. The data was collected on a pre-tested and well-structured questionnaire using interview method. The interviews were held with General Managers / Senior Managers of the Institutes. The main source of primary data provided by the institutions during the interview was based on records available in their accounting, finance, administration, consultancy, and marketing departments. The illustrations of six industry support institutions covered under the study are as follow.

#### **4. Illustrations of Industry Support Institutions**

##### **4.1. Research and Development Center, Ludhiana.**

The Research & Development Center, (R&D Center), Ludhiana was set up in year. This center has well equipped Design and Testing labs, Precision Tool Room, CNC Machining and HRD Training Sections and has a cliental pool of about 2400 SMEs. This centre has introduced about 72 nos. of testing equipment, 28 nos. of Special Purpose Production Machines, 47 nos. of Cold Forging Forming Tools, handled about 1,10,000 test samples, undertaken 56 Technical Assistance Turn-Key

Projects aiming low cost automation and energy efficient technologies.

There has been huge material saving by introduction of Cold forging technology in manufacturing of various bicycle parts. The path breaking manufacturing technique of cold tube swaging and tube butting has eliminated cumbersome process of sheet cutting and welding to make bicycle frame and forks earning millions of carbon credits to the state. This centre has also filed 04 patents under Design Act, 2000 with controller general of patent design and trade mark India the Registrar, Govt. of India.

The accumulated knowledge has also raised absorption capacity of this Center and networking with user industry led to formation of a well knitted cohesive community of creators, doers and operators around the Centre; where incremental improvements and process innovations are a routine.

##### **4.2. Institute for Autoparts & Hand Tools Technology, Ludhiana.**

Institute for Autoparts & Hand Tools Technology, was set-up by Punjab Government with the assistance of UNIDO in 1994 at Ludhiana. The Institute was established with high precision technologies in Testing & Evaluation, Non-Destructive Testing, Advance Heat Treatment and CNC Machining to assist SMEs to manufacture quality products. There are about 2000 SMEs operating in Auto-components manufacturing sector and some of these are Tier 2 or Tier 3 category supplier of Engine Parts, Transmission Parts, Chassis Parts and Sheet Metal Components. The mandate for this Institute is to acquire, run and demonstrate high end technologies to facilitate dissemination of know-how among SMEs.

This institute has introduced some cutting edge technologies like Vacuum Hardening, Cryogenic Processing, White Light Scanning, 3-D printing and industrial radiography in the Region. Now SMEs of Punjab need not to

depend for development and treatment of tools, dies and moulds to long destinations in south or western India. Rapid Prototype is State of the Art equipment for speedy “Reverse Engineering” applications.

This institute is a co-inventor for the filed Patent title “Cryogenic treatment of brass wire for improved machining characteristics”; which has been published (U/S 11A; year 2011) by controller general of patent design and trade mark India.

#### **4.3. Institute for Machine Tools Technology, Batala.**

Institute for Machine Tools Technology (IMTT) is one of the two UNIDO assisted Projects set up by the Punjab Government in year 1994 in a small township of Batala. A comprehensive skill up-gradation programme was taken up to impart training in scientifically advanced technical areas to local youth and entrepreneurs. Institute also impart trainings for TQM system and solve technical problems of small foundries and extends its facilities for testing of sand, moulds, tensile strength and metallographic evaluation of castings. The institute facilitated improvement in quality, energy efficiency and reduction of input costs for the machine tools builders. This institute also developed six special purpose machines for single / double head boring operations and regularly takes up alignment and leveling of machine tools beds using electronic leveler. This small industrial town of Batala has a strong technical infrastructure support of the institute which is as good as having a dedicated in house R&Ds in an enterprise perusing innovations.

#### **4.4. Central Tool Room, Ludhiana.**

Central Tool Room (CTR), was established by Govt. of India at Ludhiana in year 1980. The core competency of CTR is skill training, making precise press tools, injection moulds, jig, fixtures and dies for regional SMEs. It is an institution par excellence in providing solutions for design, development,

manufacturing, skill development and project consultancy. The Central Tool Room has established its brand image as one of the top skill certification institute in Northern India and is running a four years diploma course in the tool & die making. The pass out students of CTR is always in demand and is readily absorbed in regional SMEs. This tool room was instrumental in dissemination of heat treatment technology is also a pioneer in introducing RPT 3-D printing since year 2000. Central Tool Room is the leader among all industry support institutions operating in the state of Punjab. All the services provided by CTR have played important role in enhancing creativity and innovativeness among young engineers and entrepreneurs of the region.

#### **4.5. Central Institute for Plastics and Engineering Technology (CIPET), Amritsar.**

Central Institute for Plastics and Engineering Technology (CIPET), Amritsar was set up in the year 1988-89 for providing training and technical services to plastics and allied industry of the Region. The institute is very popular for short term training programmes and has created a large pool of skilled manpower in the fields of plastics processing, technologies and mould making in this region. They are also assisting the entrepreneurs in trouble shooting of process related problems making long life moulds and providing facility of testing and analysis of raw materials / finished plastics products. Their specialization services are also availed by entrepreneurs to deal with compounding and formulation problems in plastic processing. The productivity & competitiveness of plastics industry of the region was enhanced immensely due to technical support of CIPET.

The SMEs operating in plastics engineering industry have undertaken many technological developments and quality control practices due to availability of trained manpower generated by this institute. This has facilitated innovativeness among SMEs which are undertaking quality improvements, adopting

quality systems leading to incremental innovations.

#### 4.6. Central Institute for Hand Tools, Jalandhar.

Central Institute for Hand Tools (CIHT), was established in year 1983 and is playing a vital role in technical and economic development of SME's. Their strength is design and fabrication of forging Dies and Moulds. The entrepreneurs started undertaking incremental innovation activities targeted at quality

improvement, waste minimization and productivity improvement with support of this institute.

#### 5. Result and Discussion

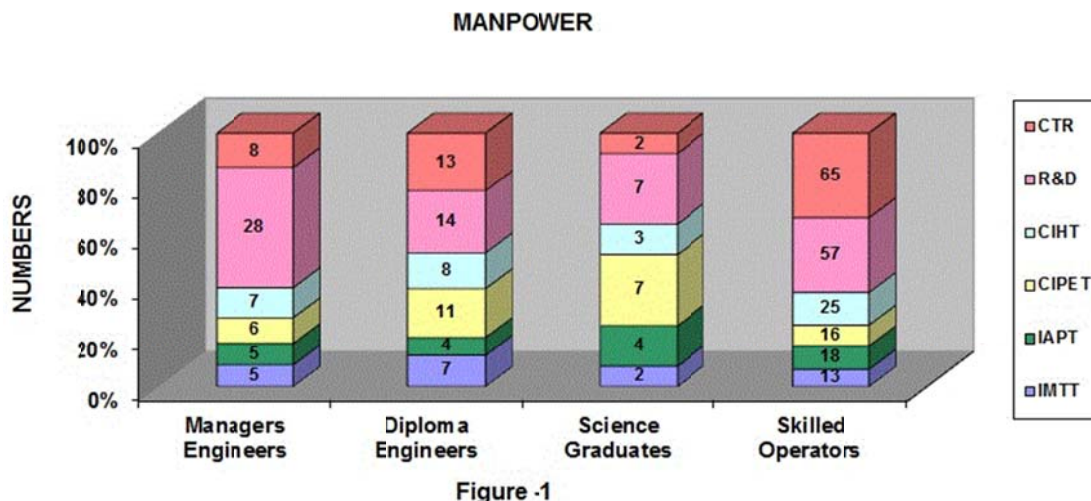
The performance of all the six industry support institutions during the last five years is shown in Table-1. The age shown in this table indicates the operational existence of an individual institute since inception. All the six institutions are serving SMEs of Punjab State successfully for more than two decades.

Table 1. Performance of Industry Support Institutions of Punjab

Institute Name	Manpower				Technology Development Initiatives by the Institutes (2007-12)																	Operational Revenue (2007-12)						
	Position				Manufacturing Process Improvements (Nos.)				Quality Control (Nos.)			Skill Development (Nos.)		R&D Support (Nos.)		Common Facility (Nos.)		Technical Dissemination (Nos.)			Patents	('Million)						
	Manager	Engineers	Scientists	Others	FT / 20 / 100	Special Purpose Machines	Inspection Gages	Problem Solving	X 1000 Test samples	X 1000 Test runs	Testing Rigs	Pass out Trainees	Design & Drawings	X 1000 R&D Projects	Production Development	Cold Chamber (To na)	Special HT of Tool la & Dies (To na)	X 1000 CNC Precision Machinery	Technical Publications / Periodicals	Support to PG Resear ch Scholar s								
Establishment Year / Age	Manager	Engineers	Scientists	Others	FT / 20 / 100	Special Purpose Machines	Inspection Gages	Problem Solving	X 1000 Test samples	X 1000 Test runs	Testing Rigs	Pass out Trainees	Design & Drawings	X 1000 R&D Projects	Production Development	Cold Chamber (To na)	Special HT of Tool la & Dies (To na)	X 1000 CNC Precision Machinery	Technical Publications / Periodicals	Support to PG Resear ch Scholar s	Patent Applications Filed	2007-08	2008-09	2009-10	2010-11	2011-12		
CTR 1980 / 32	8	13	2	65	150	11	115	127	7	1.3	--	741	620	790	26	108	--	323	8.6	12	93	20	0	47	51	61	58	72
CIHT 1983 / 29	7	8	3	25	124	0	610	780	10	1.1	--	92	510	0	21	0	15	--	5.3	6	971	8	0	18	19	20	11	37
CITE T 1989 / 23	6	11	7	16	76	4	7	119	52	4.5	8	685	116	6	27	0	13	--	7.2	4	812	6	0	9	16	28	27	32
R&D 1983 / 29	28	14	7	57	47	28	95	280	110	8.1	16	970	650	255	0	46	26	--	9.1	14	780	18	4	30	31	36	46	51
IAPT 1994 / 18	5	4	4	18	12	0	48	346	89	7.3	6	0	224	218	1.4	163	1	127	19.6	2	105	24	1	9	7	11	19	20
IMTY 1994 / 18	5	7	2	13	0	6	28	158	45	10	0	0	476	114	0	29	--	--	3.6	2	985	18	0	8	8	9	10	11
TOTAL	59	57	25	194	1009	49	193	296	313	32.3	30	248	138	142	27	184	27	483	53.6	40	467	94	5	121	132	165	199	223
840																												

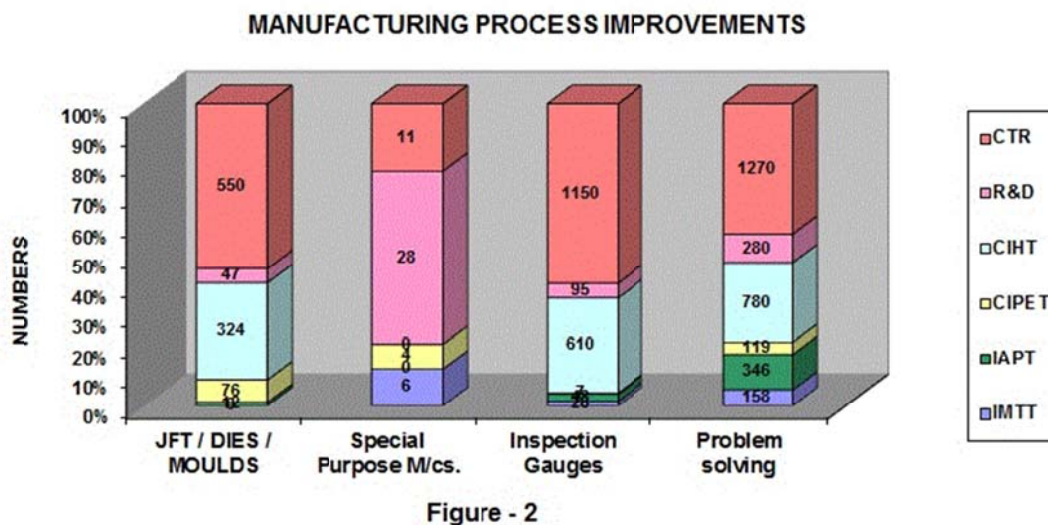
The manpower indicates the deployment of managers, engineers and scientists in each institution. Put together; there are 59 managers

/ engineers, 57 diploma engineers, 25 science graduates and 194 technical operators working for SMEs of Punjab. Figure-1 below depicts the details of the manpower.



The shown manpower forms an invaluable asset as a team of highly experienced professionals with multiple set of skills is responsible for a continuous capacity building and knowledge accumulation in these institutions. The team is quite effective in assisting SME's for bringing about process improvement, product development and problem solving. Combined together, this

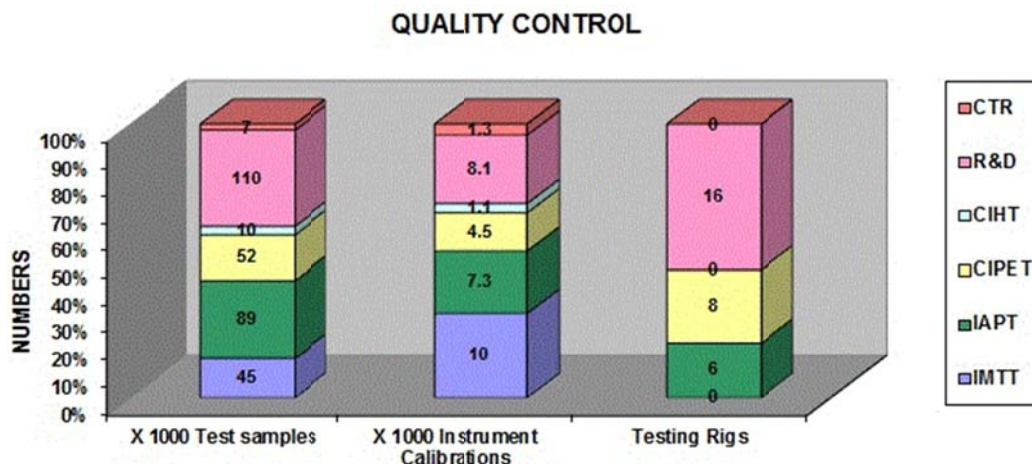
manpower has solved 2953 problems, made 1009 JFT / Dies / Moulds; 49 special purpose machines and 1938 inspection gauges during last five years. Many process innovations have resulted in bringing about 'low cost automation' and higher productivity levels among SMEs. The contribution in supporting manufacturing process improvements is shown in the Figure-2.



The region has witnessed a sea change in quality culture as a large number of SME's have gone for ISO-9000, TQM, ISO TC 16949 and quality systems in recent past. These institutions have assisted entrepreneurs by through 3,13,000 test samples, 32,300 calibrations and supplying 30 test rigs in last

05 years. The quality improvement initiatives have also brought along with a culture of small innovations. The testing lab. of institutions are just like an extended in-house testing facility of SME's. The performance of individual institutions in strengthening quality control programme is shown in Figure-3.



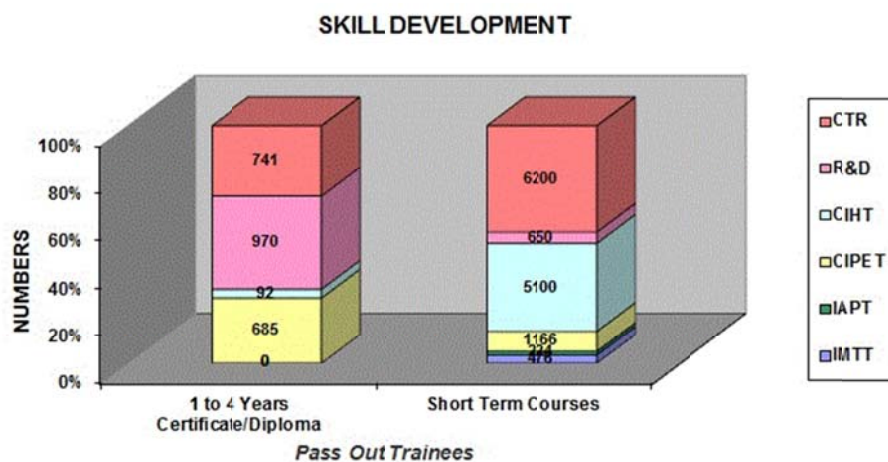


**FIGURE - 3**

The training not only makes an individual skillful but also ignites an attitude towards learning. In the 21<sup>st</sup> century organizational vision revolves around quality human resource. Irrespective of their size and turnover, organizations are now quite open in sparing time & money for Training & HRD activities. In this changed scenario; these institutes have churned out 2488 diploma engineers having exposure to latest plant / machinery. The most effective programmes run by all these institutes are short term and skill oriented one. Training modules are even

tailor made with flexible timings to suit working hours of SMEs. During the last five years, a total number of 13816 trainees have been trained in the fields of CAD/CAM, Precision CNC Machines, Plastic Engineering, TQM, Quality Control, Tools and Dies Making, Testing Calibration, Special Heat Treatment and Maintenance.

Figure-4 below shows the number of skill up-gradation programmes and the number of trainees trained by individual institutes in the last five years.



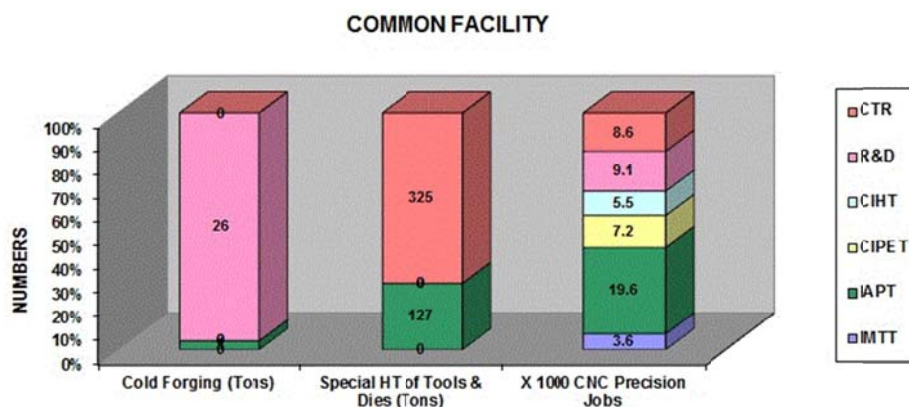
**FIGURE - 4**

The running of common facility in these institutes is a model in itself as it has resulted in a speedy and effective dissemination of knowledge. The common facility covers the

area of special heat treatment, cold forging and CNC precision machining jobs done in small batch production lots. The R&D Centre and IAHT are effectively running the facility

of cold forging and heat treatment processing. Similarly, the IMTT, Batala, CIEPT, Amritsar, CIHT, Jalandhar, R&D Centre and IAHT are handling a number of CNC Precision Machining lots. In total they have undertaken

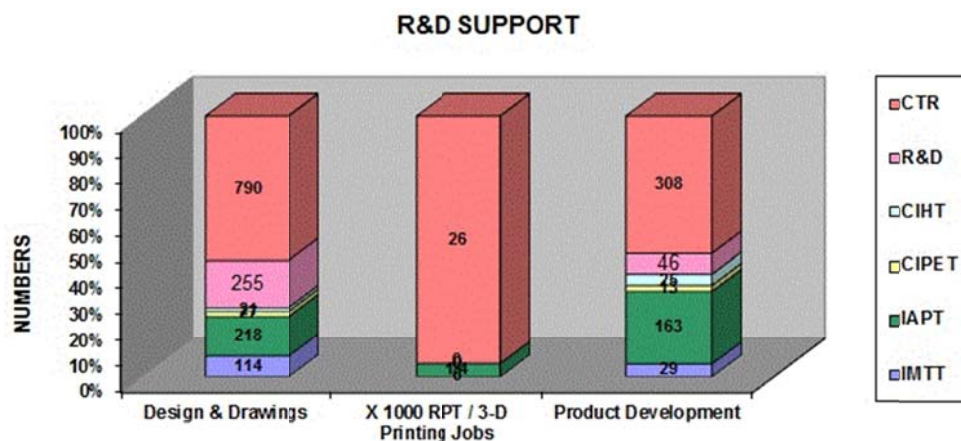
about 53,600 precision machining jobs, cold forged 27 tons of steel and Heat treated 452 tons of alloys steels. The support given by individual institutes through common facility is shown in Figure-5.



**FIGURE - 5**

The R&D Support given by these institutions is invaluable when viewed from the angle of infrastructure and deployment of manpower. The reverse engineering tools of white light scanner, CAD/CAM and RPT are a boon for SMEs. These facilities have made them confident to handle complex product developments per requirements of global

markets. These initiatives have fueled creativity and innovativeness among SMEs. During the last five years, these institutes have provided 1425 designs, 27400 RPT 3-D prints and carried out 584 product developments for SMEs. The facts about the R&D support by the institutes to SME's are shown in Figure-6.



**FIGURE - 6**

The role of these institutions in dissemination of technical knowledge by providing an access to their Library reference standard books and technical journals has been very useful. There is a stock of 4678 reference books / standards

and 40 technical journals / periodicals which are made available to SME's. The status of technical dissemination facilities available with the institutions is depicted in Figure-7.



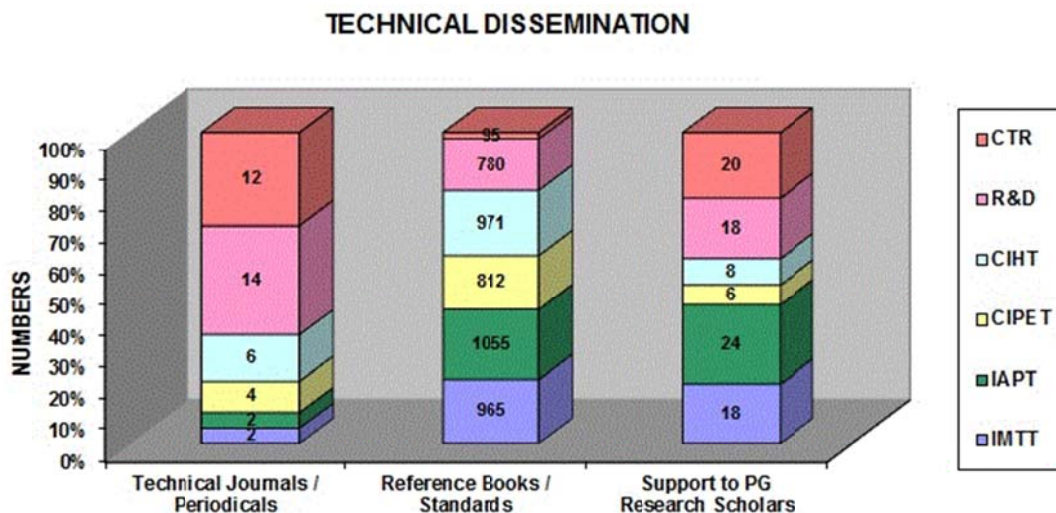


FIGURE - 7

The SMEs and research scholar frequently visit libraries of these institutes to update their knowledge and for reference to solve problems or peruse academic research work. These institutions have given a vital support to 94 PG research scholars by offering guidance to research work on latest technologies.

research work is being done. The R&D Centre has filed four patents and the Institute for Autoparts and Hand Tools Technology has filed one patent during the last five years. The performance of all these institutes in generation of operational revenues from the financial year 2008 to 2012 is shown in Figure-8.

The filing of patents by some of these institutes is an indicator that patent driven

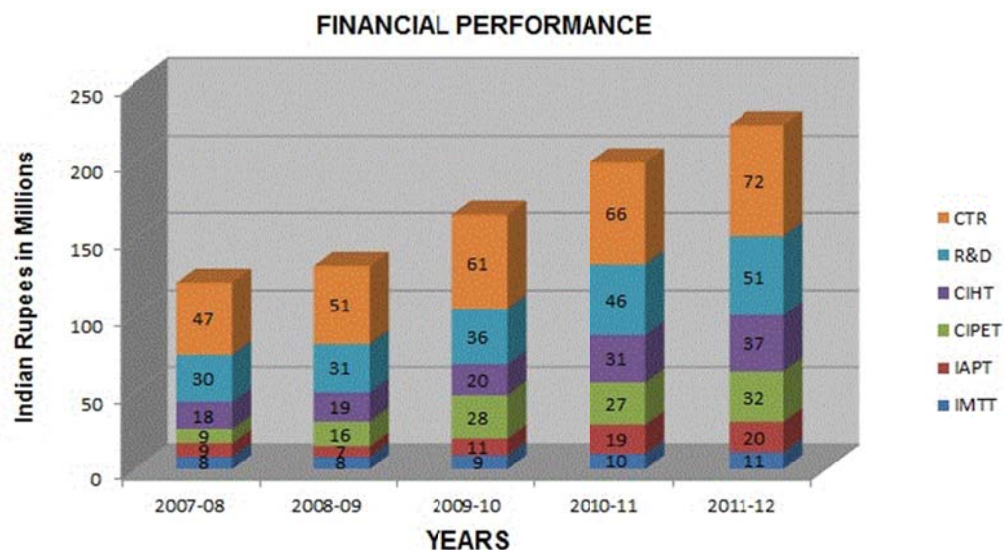
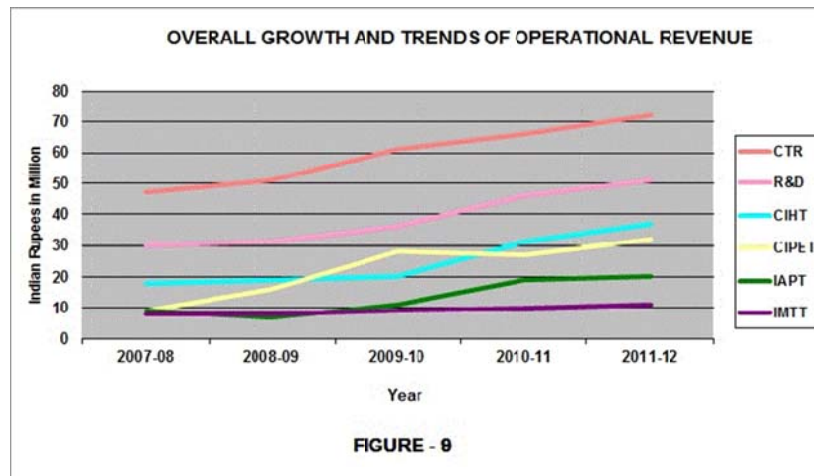


FIGURE 8

The Overall growth and trends in generation of operational revenue of the institutes is shown in Figure-9.



The upward trend in generation of operational revenue by all the institutes is a promising finding. The sustainability of these institutions for more than two decades reflects their relevance to the SMEs. The trend coefficients and cumulative growth rates in revenue generation of institutions are shown in Table-

2. All the six institutions are growing overtime significantly. It is also found that there is an increase in the Compound Growth Rate of 11.07 ( $p < 0.01$ ) in case of Central Tool Room and the remaining institutions are also registering a significant growth ( $p < 0.05\%$ ).

Table-2. Trends in Revenue of Different Industry Support Institutions.

Name of Institute	Operation Revenue During the Financial Years (F.Y.) (` Million)								t-value	Trend Coefficients	
	F.Y.	F.Y.	F.Y.	F.Y.	F.Y.	Average	C.V.	C.G.R.		a	b
	07-08	08-09	09-10	10-11	11-12						
CTR	47	51	61	66	72	59.40	17.44	11.75	11.07**	39.90	6.50
CIHT	18	19	2	31	37	25.00	34.06	21.30	4.27*	10.00	5.00
CIPET	9	16	28	27	32	22.40	42.66	35.80	3.47*	5.30	5.70
R&D	30	31	36	46	51	38.80	24.00	15.67	6.97 **	21.70	5.70
IAPT	9	7	11	19	20	13.20	44.95	29.64	2.96 *	3.00	3.40
IMTT	8	8	9	10	11	9.20	14.17	8.98	7.00 **	6.80	0.80

\*\* Significant at 1% Level.

\* Significant at 5% Level.

The fast changing technological environment demand 'high mix low volume' products with shorter life cycles. The entrepreneurs need external resources and networking to catch-up with deadlines of bringing new products in market. This offer distinct challenges and opportunities for the entrepreneurs requiring a strong R&D set up with deployment of multi

skill manpower. This requirement is very well met by these industry support institutions of Punjab as these are the virtual extended in-house R&D for SME's. It has helped SMEs to stay competitive in both Domestic and International Markets. The technology development initiatives by the Institutes have helped to promote creativity and innovations

among regional entrepreneurs. These industry support institutions also offer a platform for exchange of ideas among entrepreneurs. The accumulated knowledge of these institutes is also facilitating the process of open innovation. The study reveals that Government has been very active for timely and vital support to these institutes. The mandate for both Central and State Governments institutes is to run on self-sufficient basis has worked very well and has proved strategically a right decision.

This has helped in ensuring utilization of Public funds spent on new facilities and a sustainable growth in operational revenue of these institutes. These highly interactive, self-reliant institutes are found to be the virtual In-house R&D for SMEs. The technical professionals of these institutes are imparting skill upgradation training and also act as a source to fuel creativity and innovation among young entrepreneurs, engineers and research scholars. In view of the excellent role played by six industry support institutions of Punjab; this strategy can be adopted for fostering technological innovations in other parts of the country. There is a big challenge to improve interaction between industry and educational institutes in India. A study can further be undertaken to explore the role of such industry support institutions in bridging the gaps between Industry and Academia. There is also an opportunity to develop a support mechanism to convert such Institutions into 'Business Incubators' for grooming of first generation entrepreneurs in the country.

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