CHAPTER 5

FINDINGS, RECOMMENDATIONS AND CONCLUSION

5.1 FINDINGS

The Researcher based on the analysis, summarized the salient findings, conclusion and also made recommendations to the policy planners and for future research. This section contains the important findings made out of this research study.

5.1.1 Demographic Findings

The information under the head “Demographic Findings” is concerning the Heads of the In-House Development Centres in the six Sectors namely Education, Engineering, Finance, Health, Logistics and Tourism.

1. 93.7% of the In-House Development Centre (IHDC) Heads are Male and the remaining are Female.
2. 48.6% belong to the Age group of 31 to 40 years and 9.9% are in the Age group of above 50 years.
3. 69.6% are Graduates and 3.2% have Qualifications above Post Graduation.
4. 39.9% have Experience from 16 to 20 years and 4.4% have more than 30 years of Experience.
5. 5.9% of the IHDC Heads are Certified Project Management Professionals and 94.1% are not Certified Project Management Professionals

6. 33.6% hold Level-2 Designations such as Manager/Project Manager/Sr. Project Manager and 17% hold Level-1 Designations namely Executive/Officer (Bottom most)

5.1.2 Findings about Software Metrics Management Practices

1. Of all the Metrics Management Practices, ESC is the major Metrics Practice performed (47.7%) and RM is the least performed Metrics Practice (0.8%).

2. ESC is the major Metrics Practice area (12.7%) in the Finance sector which is the maximum score in any single Metrics area in any Sector and RM has a 0% score in Logistics sector which is the minimum score in any single Metrics area in any Sector.

3. Finance and Engineering sectors each accounts for 25.2% and 25.0% respectively of the total Metrics Management Practices whereas the minimum is 7.4% in the Health sector.

4. ESC Practice is the major Metrics Practice area at 4.4% in the Education sector. RM and QP are the least practiced (0.2%) Metrics Practices in the Education sector.

5. In the Engineering sector 11.8% is the ESC Practice which is the major Metrics Practice. RM is the least practiced (0.2%) Metrics Practice in the Engineering sector.
6. ESC Practice is the major Metrics Practice area (12.7%) in the Finance sector. RM is the least practiced one (0.2%) in the Finance sector.

7. In the Health sector, ESC is the major Metrics practiced (3.4%) area. RM is the least practiced (0.2%) area in the Health sector.

8. ESC Practice is the major Metrics Practice area (9.5%) in the Logistics sector. RM is the least practiced (0%) Metrics in the Logistics sector.

9. In the Tourism sector, ESC is the major Metrics practiced (5.9%). RM is the least practiced (0.1%) Metrics area.

5.1.3 Findings about Sector-wise Metrics Management Practices

1. In the Education sector, 43.1% of the Metrics Practices are about ESC. QP and RM each contributes to 1.9% in the Education sector.

2. In the Engineering sector, 47.2% is ESC which is the major Metrics activity performed and 0.8% is the Metrics activity performed in RM area.

3. In the Finance sector, 50.3% Practices are in the ESC area and 0.8% activities are in RM area.

4. In the Health sector, 45.4% Practices are in ESC area and 2% activities are related to RM area

5. In the Logistics sector, 41.2% Practices are about ESC and RM is 0%.
6. In the Tourism sector, 65.8% are about ESC and RM is about 0.5% only.

7. ESC is the most practiced metric activity in all the Sectors that ranges from 41% to 66% and RM is the least practiced activity that ranges from 0% to 2%

5.1.4 Findings on Spread of Each Metrics Area in Sectors

1. 23.5% of the PDB practices are in the Finance sector and 8% is PDB’s spread in the Tourism sector.

2. 31.8% is the spread of PCB in the Engineering sector and 8.1% is the spread of PCB in the Health sector.

3. 31.1% is the spread of PP in the Engineering sector and 5.0% is the spread of PP in the Tourism sector.

4. 30.8% is the spread of QP Metric activities in the Engineering sector whereas 7.7% is the spread of QP in the Logistics sector and Tourism sector.

5. 26.6% is the spread of ESC in the Finance sector and 7.1% is the spread of ESC in the Health sector.

6. 25% is the spread of RM Practices each in Education, Engineering, Finance sectors and in the Logistics sector, RM has 0% spread.

7. 28.4% of the spread of PMC is in the Engineering sector and 5.2% is the spread of PMC in Health sector and as well as in Tourism sector.

8. 35.4% is the spread of PC in the Logistics sector and 3.9% is the spread of PC in the Tourism sector.
5.1.5 Findings on Organizational Focus Factors and Sectors

1. Foundation Planning in the Engineering sector with a score of 10.7% tops among the most important Organizational focus factor present in any single Sector.

2. Control Panel in the Tourism sector with a score of almost 0.4% is the least scoring most important Organizational factor present in any Sector.

3. 26.9% is the maximum cumulative score by the Customer Focus factor present in all the Sectors.

4. 15.4% is the minimum cumulative score each by the VH Alignment factor and by the Value Leadership factor in all the Sectors.

5.1.6 Each Organizational Focus Area-wise Findings

1. The Foundation Planning has its maximum spread in the Engineering sector with a score of 45% and it has its least spread in the Health and the Tourism sector with a score of 6.7% each.

2. VH Alignment has its maximum spread with a score of 35.9% in the Education sector and its minimum spread score of 7.7% is in the Tourism sector.

3. Value Leadership has its maximum spread score of 25.6% in the Finance sector and its least score of 10.3% is in the Tourism sector.
4. Customer Focus has its maximum spread score of 22.1% in the Education sector and its least spread score of 11.8% is in the Health sector.

5. Control Panel has its maximum score of 36.2% in the Logistics sector and its minimum spread score of 2.1% is in the Tourism sector.

5.1.7 Findings on Sectorwise Organizational Focus Area

1. In the Education sector, 30.0% is the spread of Customer Focus and 12.0% is the spread of Foundation Planning.

2. In the Engineering sector, 51.9% is the spread of Foundation Planning and 9.6% is the spread of each VH Alignment, Value Leadership and Control Panel.

3. In the Finance sector, 25.5% is the spread of Control Panel and 13.7% is the spread of VH Alignment.

4. In the Health sector, 30.8% is the spread of Customer Focus and 15.4% is the spread of each Foundation Planning, VH Alignment and Control Panel.

5. In the Logistics sector, 34.0% is the spread of Control Panel and 12.0% is the spread of each VH Alignment and Value Leadership.

6. In the Tourism sector, 50% is the spread of Customer Focus and 4.2% is the spread of Control Panel.
5.1.8 Perception of IHDC Heads on Performance Factors

1. In the Human Relations Management area, 95.3% of the IHDC Heads need ‘Stability and continuity of Team’ and 44.3% of the IHDC Heads need ‘Small Development Team (less than 10 members)’.

2. In the Project Management Practices area, 100% of the IHDC Heads need ‘Information Security’ and 39.1% of the IHDC Heads need ‘Testing by an independent team’.

3. In the Support Skills & Environment area, 96.0% of the IHDC Heads need ‘Work-life balance’ and 32.4% of the IHDC Heads need ‘Flexi work hours’

5.1.9 Findings on Metrics Categories and Demographic Factors

1. There is no association between PDB and Gender of IHDC Heads

2. There is no association between PDB and Qualification of IHDC Heads

3. There is no association between PDB and Experience of IHDC Heads

4. There is no association between PDB and Age of IHDC Heads

5. There is an association between PDB and Project Management Certification of IHDC Heads

6. There is no association between PDB and Designation of IHDC Heads
7. There is no association between PCB and Gender of IHDC Head

8. There is no association between PCB and Qualification of IHDC Heads

9. There is no association between PCB and Experience of IHDC Heads

10. There is an association between PCB and Age of IHDC Heads

11. There is no association between PCB and Project Management Certification of IHDC Heads

12. There is no association between PCB and Designation of IHDC Heads

13. There is no association between PP and Gender of IHDC Heads

14. There is no association between PP and Qualification of IHDC Heads

15. There is no association between PP and Experience of IHDC Heads

16. There is no association between PP and Age of IHDC Heads

17. There is no association between PP and Project Management Certification of IHDC Heads

18. There is no association between PP and Designation of IHDC Heads

19. There is no association between QP and Gender of IHDC Heads
20. There is no association between QP and Qualification of IHDC Heads

21. There is no association between QP and Experience of IHDC Heads

22. There is an association between QP and Age of IHDC Heads

23. There is no association between QP and Project Management Certification of IHDC Heads

24. There is no association between QP and Designation of IHDC Heads

25. There is no association between ESC and Gender of IHDC Heads

26. There is no association between ESC and Qualification of IHDC Heads

27. There is no association between ESC and Experience of IHDC Heads

28. There is no association between ESC and Age of IHDC Heads

29. There is no association between ESC and Project Management Certification of IHDC Heads

30. There is no association between ESC and Designation of IHDC Heads

31. There is no association between RM and Gender of IHDC Heads

32. There is no association between RM and Qualification of IHDC Heads
33. There is no association between RM and Experience of IHDC Heads

34. There is no association between RM and Age of IHDC Head

35. There is no association between RM and Project Management Certification of IHDC Head

36. There is an association between RM and Designation of IHDC Heads

37. There is no association between PMC and Gender of IHDC Heads

38. There is no association between PMC and Qualification of IHDC Heads

39. There is no association between PMC and Experience of IHDC Heads

40. There is no association between PMC and Age of IHDC Heads

41. There is no association between PMC and Project Management Certification of IHDC Heads

42. There is no association between PMC and Designation of IHDC Heads

43. There is an association between PC and Gender of IHDC Heads

44. There is no association between PC and Qualification of IHDC Heads
45. There is an association between PC and Experience of IHDC Heads

46. There is no association between PC and Age of IHDC Heads

47. There is no association between PC and Project Management Certification of IHDC Heads

48. There is no association between PC and Designation of IHDC Heads

5.1.10 Findings on Differences between Metrics Categories

1. There is a significant difference between PDB and PCB in the Metrics Management Practices followed by the IHDCs in all the Sectors

2. There is a significant difference between PDB and PP in the Metrics Management Practices followed by the IHDCs in all the Sectors

3. There is a significant difference between PDB and QP in the Metrics Management Practices followed by the IHDCs in all the Sectors

4. There is a significant difference between PDB and ESC in the Metrics Management Practices followed by the IHDCs in all the Sectors

5. There is a significant difference between PDB and RM in the Metrics Management Practices followed by the IHDCs in all the Sectors
6. There is a significant difference between PDB and PMC in the Metrics Management Practices followed by the IHDCs in all the Sectors

7. There is a significant difference between PDB and PC in the Metrics Management Practices followed by the IHDCs in all the Sectors

8. There is a significant difference between PCB and PP in the Metrics Management Practices followed by the IHDCs in all the Sectors

9. There is a significant difference between PCB and QP in the Metrics Management Practices followed by the IHDCs in all the Sectors

10. There is a significant difference between PCB and ESC in the Metrics Management Practices followed by the IHDCs in all the Sectors

11. There is a significant difference between PCB and RM in the Metrics Management Practices followed by the IHDCs in all the Sectors

12. There is a significant difference between PCB and PMC in the Metrics Management Practices followed by the IHDCs in all the Sectors

13. There is a significant difference between PCB and PC in the Metrics Management Practices followed by the IHDCs in all the Sectors
14. There is a significant difference between PP and QP in the Metrics Management Practices followed by the IHDCs in all the Sectors

15. There is a significant difference between PP and ESC in the Metrics Management Practices followed by the IHDCs in all the Sectors

16. There is a significant difference between PP and RM in the Metrics Management Practices followed by the IHDCs in all the Sectors

17. There is a significant difference between PP and PMC in the Metrics Management Practices followed by the IHDCs in all the Sectors

18. There is a significant difference between PP and PC in the Metrics Management Practices followed by the IHDCs in all the Sectors

19. There is a significant difference between QP and ESC in the Metrics Management Practices followed by the IHDCs in all the Sectors

20. There is a significant difference between QP and RM in the Metrics Management Practices followed by the IHDCs in all the Sectors

21. There is a significant difference between QP and PMC in the Metrics Management Practices followed by the IHDCs in all the Sectors
22. There is a significant difference between QP and PC in the Metrics Management Practices followed by the IHDCs in all the Sectors

23. There is a significant difference between ESC and PMC in the Metrics Management Practices followed by the IHDCs in all the Sectors

24. There is a significant difference between ESC and PC in the Metrics Management Practices followed by the IHDCs in all the Sectors

25. There is no significant difference between ESC and RM in the Metrics Management Practices followed by the IHDCs in all the Sectors

26. There is a significant difference between RM and PMC in the Metrics Management Practices followed by the IHDCs in all the Sectors

27. There is a significant difference between RM and PC in the Metrics Management Practices followed by the IHDCs in all the Sectors

28. There is a significant difference between PMC and PC in the Metrics Management Practices followed by the IHDCs in all the Sectors

5.1.11 Findings on Sectors and Organizational Focus Areas

1. There is an association between Sector Types and Major Organizational Focus Areas
5.1.12 Findings on Correlation among Metrics Categories

1. There is a very high degree of correlation existing between PDB and PC
2. There is a very high degree of correlation existing between PCB and PP
3. There is a very high degree of correlation existing between PCB and ESC
4. There is a very high degree of correlation existing between PCB and PMC
5. There is a very high degree of correlation existing between PP and ESC
6. There is a very high degree of correlation existing between PP and PMC
7. There is a very high degree of correlation existing between PP and PC
8. There is a very high degree of correlation existing between QP and RM
9. There is a very high degree of correlation existing between ESC and PMC
10. There is a very high degree of correlation existing between PMC and PC
11. There is a strong correlation existing between PCB and PC
12. There is a strong correlation existing between PP and QP
13. There is a strong correlation existing between ESC and PC
14. There is a sufficient correlation between PDB and PCB
15. There is a sufficient correlation between PDB and PP
16. There is a sufficient correlation between PDB and ESC
17. There is a sufficient correlation between PDB and PMC
18. There is a sufficient correlation between PCB and QP
19. There is a sufficient correlation between PCB and RM
20. There is a sufficient correlation between PP and RM
21. There is a sufficient correlation between QP and PMC
22. There is a weak correlation between PDB and QP
23. There is a weak correlation between PDB and RM
24. There is a weak correlation between QP and ESC
25. There is a weak correlation between QP and PC
26. There is a weak correlation between ESC and RM
27. There is a weak correlation between RM and PMC
28. There is a weak correlation between RM and PC

5.1.13 Findings about Prevailing and Perceived Factors

1. There is a weak correlation existing between the two set of factors namely prevailing performance key factors and performance key factors leading to success as perceived by the In-House Development Centre heads.
5.1.14 Findings on the Difference among the Sectors in the Metrics Management Practices

1. There is a significant difference among the Sectors in the Practice of Process Database (PDB) Metrics
2. There is a significant difference among the Sectors in the Practice of Process Capability Baseline (PCB) Metrics
3. There is a significant difference among the Sectors in the Practice of Process Planning (PP) Metrics
4. There is no significant difference among the Sectors in the Practice of Quality Planning (QP) Metrics
5. There is a significant difference among the Sectors in the Practice of Metrics related to Estimation & Scheduling (ESC)
6. There is no significant difference among the Sectors in the Practice of Metrics related to Risk Management (RM)
7. There is a significant difference among the Sectors in the Practice of Metrics related to Project Monitoring & Control (PMC)
8. There is a significant difference among the Sectors in the Practice of Metrics related to Project Closure (PC)

5.2 RECOMMENDATIONS

1. The research reveals that there is absolute Male domination with respect to heading IHDCs. Organizations and appropriate agencies may consider having a look at this issue and
formulate necessary policies and schemes to attract Female members as well to head such IHDCs.

2. The research also reveals that to head the IHDCs, Professional Certification in Project Management is not required. Serious look into this issue may be considered at appropriate levels by the Organizations so that professionalism is brought into practice.

3. As there is huge scope for improving the SW Metrics Management Practices followed in the IHDCs in India so is the scope for a new and changed way to look at the IHDCs by the respective Organizations, particularly the top brass.

4. Besides the proactive measures of the IHDC Heads to introduce the metrics programme, the Top management may also consider to insist on the IHDCs to have SW Metrics Management Practices introduced and followed in their IHDCs.

5. This can be easily achieved if only the Organizations where IHDCs exist begin to look at the IHDCs as PROFIT centres rather than COST centres. This will help the IHDC Staff to begin valuing their services as their services will become billable on their internal clients namely the User departments.

6. As the services become billable and only a reasonable billing will be accepted by the internal clients, there is going to be compulsions on the IHDC staff to look at their operations more professionally and quantitatively.

7. Such compulsions will make them follow and implement necessary SW Metrics Management Practices, initially the
most important ones first and over a period, other metrics practices as it happens in any stepwise refinement implementation.

8. IHDCs may consider to have a certain proportion of their Human Resources drawn from leading IT/SW development Organizations so as to learn from such resources ‘Standardised Metrics Management Practices’ as followed in their erstwhile IT/SW development Organizations.

9. As the IHDC resources keep doing their operational job as well besides software development, there is an implicit demand on the members of the IHDCs to be versatile in the Domain, Technology and Management areas.

10. The theoretical background and the necessary skills to perform in the IHD environment are mostly acquired over time and on the job rather than from any Institution of learning.

11. As on date, there is no comprehensive course offered at Diploma, Under-Graduate and Post Graduate levels that addresses operations management of an IHDC along with Software Engineering and Software Project Management.

12. This is an area where there is a potential scope for introducing specifically designed courses at Diploma, Under-Graduate and Post Graduate levels that can address the requirements of IHDCs.

13. The research reveals around 70% of the Respondents belong to the Age group up to 40 and hence, it is suggested that regular programmes, distance education programmes, training
programmes, special orientations and professional counselling be offered by the experts at regular intervals.

14. Diploma holders may be given courses at academic institutions whereas all others may be given training, orientation, professional counselling at the Industry/Government nodal centres.

15. Individuals who gained more than 20 years of experience may be considered as potential resources in imparting training & orientation programmes to others in the IHDC teams.

16. Besides the suggested courses for IHDC members by the researcher, there are other international certificate courses that may be considered by the members of the IHDC on Software Project Management. Doing so will surely reduce the project complications, cost, time and improve the quality in delivery and service.

17. Professional bodies such as NASSCOM, CSI, CII, FICCI and the like may offer weekend workshops to spread the culture of metrics among the IHDC staff members.

18. Management may consider the IHDC specific course qualification for promotion to higher levels and even for new recruitment as well.

19. Special institutions such as IITs, NITs, premier technical universities such as Anna University may design a comprehensive curriculum on IHDC in the form of value added courses or credit courses or non-credit courses or distance education modules. The following outline (Table 5.1)
may be considered for charting the basic level course structure.

**Table 5.1 Course Outline for IHD Resource Training**

<table>
<thead>
<tr>
<th>SNo.</th>
<th>Major Focus Area</th>
<th>Hours</th>
<th>Description of Resource person</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IHDC &amp; its activities (including legal and ethical issues)</td>
<td>5</td>
<td>Industry experts with proven track record, relevant theoretical, practical experience and good skill in communication (preferably with 20+ years of experience and not less than a Graduate)</td>
</tr>
<tr>
<td>2</td>
<td>Fundamentals of Data Processing</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Data Entry Form Preparation</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Data Entry Techniques</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Data Validation &amp; Control</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Data Preparation for Data Processing</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Program Execution</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Managing Interrupts in Execution</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Report Preparation &amp; Control</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Applied Software Engineering</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Applied Project Management</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>IHDC Culture and Successful Practices</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Project Practices</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Hours</td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

20. The academic council of the respective Institution may discuss and finalise the curriculum and recommend the same to the syndicate for the approval of the government. Apart from academic Institutions, professional bodies such as ICT centres, CSI may come forward to implement the recommended courses.

21. Government institutions may come forward to offer the suggested programmes to all concerned at a regular interval as it happens in the case of NPTEL (IIT), Open Source Software (IIT-Mumbai), Animation programmes from Infosys,
Hospitalities programmes from TCS, Financial programmes from ICAI.

22. International, National and Government organizations may begin to insist on IHDC related qualifications as a mandatory qualification during recruitment and promotion.

23. Experienced persons in IHDC may form an academic cartel to disseminate the said knowledge to others in a professional manner.

24. Creating academic and professional awareness among the students, faculty members, junior executives, top level executives and the stalwarts in the IT industry with the help of professional media may also be encouraged.

25. IHDCs may consider to offer sabbatical leave, course sponsorships, securing aid for specific groups such as women, SC/ST and for such groups as identified by the Industry and the Government through appropriate schemes whenever the members want to go for training programmes.

26. IHDCs may give preference in recruitment to those who have completed and qualified in the suggested courses.

27. Resource persons may be absorbed in Educational Institutions to impart applied training by passing the regular academic standards as stipulated by agencies concerned.

28. The management may consider, over a period, to insist on Software Project Management Certification as a pre-requisite at least to hold the top position in any such IHDC, in order to bring in professional practices and better work culture.
29. The IHDC staff who become certified professionals may be given high order increments so as to promote the culture of enhancing their qualification.

30. Figure 5.1 is the model showing the transition from potential to professional IHD resource.
5.3 CONCLUSION

As a result of this research, which is one of the pioneering works in the selected topic, interesting observations could be made, facts found out and an empirical assessment of the prevailing Metrics Management Practices followed in In-House Development Centres in India could be unearthed and documented in a systematic professional way only to be used for the betterment of Metrics Management Practices followed in the IHDCs, provide basis for policy formulation by the top management of the Organizations housing such IHDCs, improve the quality of activities and services offered by the IHDCs, handle weaknesses present in the current level of activities in the IHDCs, identify the areas where large scope for planning and implementing software metrics program, assign special and unique status to IHDCs among the IT operative groups, highlight the major role played and the continuous contribution made by the IHDCs, and provide scope for doing further research in this area.

Many points have been given as recommendations in line with the content discussed above. If all or even a part of it is considered for implementation, the IHDC fraternity in India would feel greatly benefitted by such acts.

5.4 SCOPE FOR FURTHER RESEARCH

This research, although one of the pioneering works in the selected topic, is not devoid of its limitations some of which are obvious and have been already stated. There is a large scope for exploring further into the area to unearth more interesting and vital information about the Software Metrics Practices in order to provide the industry with all such necessary data for due policy formulation and planning. Research into this area needs to be encouraged both by the Industry and Academic Institutions in India.