

# CO-PO Mapping and Attainment Booklet for Tier-II students with Rubrics Assessment

VA Kulkarni<sup>1</sup>, B. B. Ahuja<sup>2</sup>, MR Dhanvijay<sup>3</sup>

<sup>1</sup>Production Department, DY Patil COE, Akurdi, Pune, Savitribai Phule Pune University, India

<sup>2,3</sup>College of Engineering, Pune

<sup>1</sup>kulkarnivinay@rediffmail.com

<sup>2</sup>bba.prod@coep.ac.in

<sup>3</sup>mrd.prod@coep.ac.in

**Abstract:** National Board of Accreditation, June 2015 format has mandated Outcome Based Education (OBE) after India is full signatory member of Washington Accord in 2014. Tier-II students are facing tough competitions from Tier-I students with respect to attainment of knowledge and involvement of technical aspects and gap visible with respect to employability of students. CO-PO mapping and attainment, defined by NBA, gives substantial opportunity for Tier-II students to bridge this gap of employability. In this present paper, a case study is developed through CO-PO mapping and attainment for SE Production Students of Tier-II. The formulated rubrics assessment is indicative of continuous improvement strategy that can be easily adoptable by faculty and students across engineering streams.

**Keywords:** CO-PO Attainment, Tier-II, Rubrics

**Abbreviations:** CO- Course Outcome, PO- Program Outcome, Envr-Environment, Sus- Sustainability, Ind-Individual, Comm-Communication, Proj - Project, Fin- Finance, SAP-Systems, Applications, Products, IFC - International Finance Corporation, IAPA - Industrial Accidents Prevention Association, EHS - Environmental, Health and Safety, MQL - Minimum Quantity Lubricant, AWS-American Welding Society, ECH- Electrochemical Honing, CAPP- Computer Aided Process Planning, NABARD- National Bank for Agriculture and Rural Development, AWS - American Welding Society

## 1. Introduction

National Board of Accreditation (NBA) had recently opted for Outcome Based Education (OBE) after India is full signatory member of Washington Accord. June 2015 format of Tier-II of NBA, based on Outcome Based Accreditation (OBA), is proposed for effecting transformation in engineering education to catalyse adaption of outcome based processes to enable the students to achieve their dream goal after completion of program. Many faculties of Tier-II are having opinion that they are constrained with curriculum set by university systems. However, university curriculum is minimum prescribed and additional efforts by faculty are always a welcome step. Due to time and intake quality constraint of students, faculty members face dilemma in adaption of additional systems and their effectiveness. NBA recommends usage of a very effective solution to attain in form of "Program Outcomes". Program

---

**VA Kulkarni**

Production Department, DY Patil COE, Akurdi, Pune,  
Savitribai Phule Pune University, India  
kulkarnivinay@rediffmail.com

Outcomes are the attributes that the graduates are expected to possess at the time of graduating. This is required to be gradually build right from admission till graduation as quality requires consistent effort. Many of companies during campus placement tests "Basic Concepts" of students related to First Year and Second Year courses. Many faculties tend to give emotional relaxation to these students of First and Second Year considering that they are juniors. Professional attributes development is then left to students in their crucial initial years. However after First Year and Second Year, students start developing Hard Facts (Examination Results) due to which students not having eligible marks (Generally > 60% in each semester) starts losing their interests in studies and become very passive in any employability efforts put in by faculty if started from third year onwards. Thus faculty role and students interests don't get mapped effectively if the efforts of developing professional skills (especially PO5-PO12), started in Final Year onwards instead of second year.

Also, with increase in number of IITs/NITs/Tier I institutions in India, it is not wise to expect these Program Outcomes to be attained by students of Tier-II on their own, without active involvement of faculty.

Through CO-PO attainment and not just mapping, it is expected that every faculty will contribute to development of students in all aspects, covered by Program Outcomes (POs).

The faculties of Tier-II therefore, are having great responsibility towards their students for development of POs amongst them.

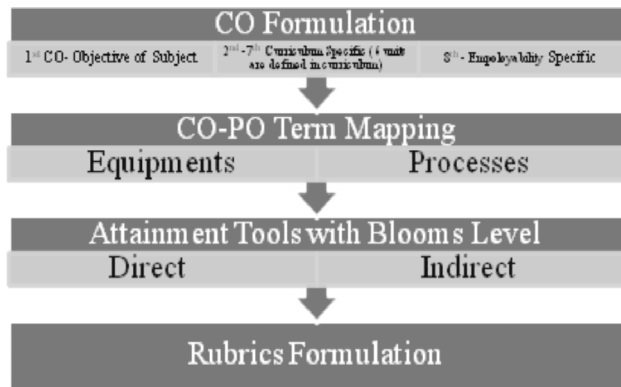
Its normal perception, of Faculty in Tier-II, that they will modify curriculum, if authority is bestowed upon them to do so, to cover the gap between, what is been taught and what is expected in field.

Therefore, there is a need of getting this curriculum gaps and employability aspects filled through CO-PO mapping ensuring active faculty involvement in overall development of student.

With the OBE systems of NBA, all faculties are now getting great opportunity to address this aspect through CO-PO Mapping and Attainment as they can themselves plan and fill the gaps of prescribed curriculum with active or passive participation of stakeholders.

The proposed method is concentrated on COs to PO5-PO12 mapping, as they are seldom mapped with university curriculum.

## 2. Methodology



**Fig 1: Methodology of CO-PO Attainment**  
Resulted set of documentations are termed as booklet.

The methodology followed in this research framework is as per following.

## 3. CO Formulation

COs are knowledge and skills that are formulated for each course. These COs are mapped to POs and attainment of each PO is calculated by various tools considering set target levels [1]. COs should be drawn in such a way that they should be generic enough to state the outcomes rather than speaking very much specific about the syllabi set by the BOS/University [2]. Case Study of Manufacturing Process of SE Production S/W course in Savitribati Phule Pune University is taken into consideration.

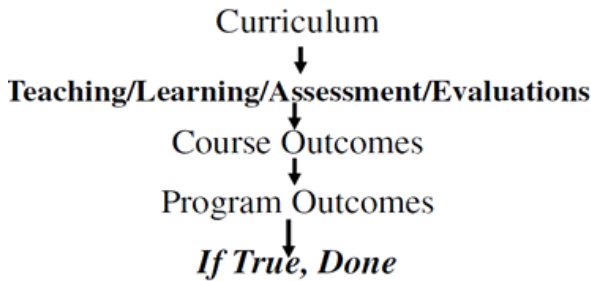
**Table 1. COs and Blooms Level**

| CO No. | Course Outcomes | CO/Curriculum Description  | Targeted Blooms' Level |
|--------|-----------------|--|------------------------|
| CO1    | Evaluate        | Objective to evaluate Manufacturing Processes  | B5                     |
| CO2    | Organize        | Casting  | B4                     |
| CO3    | Apply           | Forming  | B3                     |
| CO4    | Develop         | Welding  | B6                     |
| CO5    | Organize        | Lathe  | B4                     |
| CO6    | Appraise        | Milling and Drilling   | B5                     |
| CO7    | Draw            | Grinding   | B4                     |
| CO8    | Justify         | Development of Employability Skills related to manufacturing like performance analysis of machines/equipment | B5                     |

Considering these backgrounds, COs are formulated on the basis of Blooms verb and Targeted Blooms Level.

#### 4. CO-PO Mapping

The course and program outcome (CO-PO) assessment includes all data of tests, labs, assignments, course exits and exams imported from an instructor's course file along with Blooms level [3].



**Fig 2: CO-PO Attainment Motive [3]**

Important points in consideration for CO-PO Mapping and Attainment are listed below.

- 1) Each CO can be identified to address a subset of POs.
- 2) Based on the number of COs and the terms (Equipment/Processes) dedicated to them, it is possible to identify either the strength of mapping (1, 2 and 3) to POs or attained targeted blooms level.
- 3) Based on strength of selected POs, a CO-PO matrix can be established.
- 4) CO-PO mapping should be done in such a way that, all stakeholders' participation is ensured.
- 5) Stakeholders listing can be Internal (Faculty, Student) and External (Employer, Industry, Alumni, Tier-I Faculty, Conference/Journal Papers/Authors)
- 6) For attainment, learning of students should be measured and evaluated. Based on students learning (Active/Passive), direct (active) and indirect (passive) assessment methods are required to be formulated. [4]
- 7) If classroom like environment is created for studying of specific module/course along with university like evaluation, it can be then augmented as direct attainment with 80% claim [4].
- 8) Indirect attainment also can be claimed to be 20%

for curriculum and raised up to 50% for feeling up gaps in curriculum [5].

- 9) For CO mapping to PO5 to PO12, faculty should refer journal and conference papers, employer's website, campus placement papers, preplacement talks, GATE/IES/UPSC/competitive exam test papers, offline campus recruitment procedures, desirable profiles required by employers etc, specific to their subject.
- 10) Various indirect assessment tools like Focused listing, application cards, standardized tests, list, empty outline, memory matrix, minute paper, muddiest points, one sentence summary, pro-con grind, chain listing, punctuation pauses etc should be evaluated and used judiciously for mapping and attainment.
- 11) Each CO should be mapped with specific employment opportunity through off-campus opportunities like employment news and job portals like naukri.com
- 12) Faculty should ensure that all COs should be mapped with at least one subset of each POs. e.g. CO1 should be mapped with at least one subset of PO6 (safety, health, legal and culture).
- 13) Every course in curriculum should form CO-PO matrix instead of formulating in similar subject. Even, two different faculties teaching same subject should form different CO-PO matrix as it is indicative of the learning process to be inculcated in students.

Table 2 and 3 indicates CO-PO term mapping and set of evaluation methods through equipments/processes.

**Table 2: CO-PO Term Mapping**

| CO No. | Related Equipments/ Processes          | PO Terminologies                    |  |                                       |  |                                 |  |  |                                |
|--------|--|-------------------------------------|--|---------------------------------------|--|---------------------------------|--|--|--------------------------------|
|        |  | 5 (Modern)                          | 6 (Society)                            | 7 (Envr & Sus)                        | 8 (Ethics)   | 9 (Ind, Team)                   | 10 (Comm)                                  | 11 (Proj, Fin)                                       | 12 (Life Long, Learning)       |
| 1      | Manufacturing Processes                | SAP                                 | Safety Manual                          | Carbon Emission                       | Business Ethics                                    | Gauge R & R                     | Profit and Loss Statement                  | Indexed in BSE                                       | IIT Bombay M.Tech Course       |
| 2      | Casting                                | Mould flow in NX software           | IFC Safety Guidelines                  | IFC Envrn Guidelines                  | Tenza Casting Pdf                                  | Casting operations              | Casting Inspection Reports                 | Casting Projects                                     | Future Development in Foundry  |
| 3      | Forming                                | Formability Analysis in NX          | IFC Steel Mill Guidelines              | IFC Envrn Steel Mill Guidelines       | Tata Steel Ethical Policy                          | Formability Analysis            | Forming Limit Diagram                      | Research projects in Formability                     | Research in Rolling            |
| 4      | Welding                                | NX Tips & Tricks: Welding assistant | IS 818:1968                            | Procedia Paper Env and Sustainability | AWS: QC 1 2007 Code of Ethics                      | Welding Team Work               | Weld Inspection Report                     | Cost of Welding Electrodes                           | Newer Trends in weld Shielding |
| 5      | Lathe                                  | Retrofitting Kits                   | Enterprise 1330 Safety Manual          | EHS Sandvik                           | Code of Conduct in Kirloskar                       | Lathe operations                | Maintenance Checklist                      | Finances by NABARD                                   | Newer Cutting Tools like PCBN  |
| 6      | Milling & Drilling                     | Sandvik CoroMill & CoroDrill        | IAPA Safety Assessment                 | IAPA Envrn Assessment                 | Code of Conduct in Sandvik                         | Gear Milling Operations         | Drill Bit Selection Guide                  | Tool Cost  | Drilling Inserts               |
| 7      | Grinding                               | ECH- Procedia                       | Inspection Checklist IAPA              | MQL Grinding                          | KMT Grinding code of conduct website               | Buffing Operations              | Grinding Wheel coding                      | Grinding Time Calculations                           | Research in Honing             |
| 8      | Performance of Machines/Equipments/Men | CAPP                                | Zero Accidents, Safe working practices | Energy Efficiency Calculations        | Timely Reporting, Handover and Takeover Procedures | Men Management, Work Allocation | Reporting with Cross Functional Department | Delays, Machine Breakdowns, Productivity Calculation | MIS Preparation and Updates    |

**Table 3: CO-PO Attainment through assessment**

| Sr. No. | CO-PO Mapping | Learning Parameter                  | Stakeholder Participation | Assessment Tool  |                                 | Assessment Question with maximum blooms attainable level   | Assessment By  | Blooms Level |            |
|---------|---------------|-------------------------------------|---------------------------|------------------|---------------------------------|--|----------------|--------------|------------|
|         |               |                                     |                           | Direct/ Indirect | Name of Tool                    |  |                | Targeted     | Achievable |
| 1.      | CO1-PO5       | SAP                                 | Employer                  | Indirect         | Focused Listing                 | 1) Long form of SAP, 2) SAP applications 3) Different modules of SAP 4) Most suitable module for MP subject (B5)               | Faculty        | B5           | B5         |
| 2.      | CO2-PO5       | Mould flow in NX                    | Employer                  | Indirect         | Empty outline                   | 1) Parameters Affecting Mould Flow in NX 2) Software Capabilities of NX, 3) Steps in Mould Flow Analysis in NX                 | Faculty        | B5           | B5         |
| 3.      | CO3-PO5       | Formability Analysis in NX          | Industry                  | Indirect         | Pro-Con List                    | List Pro-Con for using NX software for formability analysis  | Faculty        | B5           | B5         |
| 4.      | CO4-PO5       | NX Tips & Tricks: Welding assistant | Industry                  | Indirect         | Minute Paper and Muddiest Point | Watch the Video on You Tube and select trips and tricks for welding  | Bright Student | B5           | B5         |
| 5.      | CO5-PO5       | Retrofitting Kits                   | Industry                  | Indirect         | List                            | Justify Specifications of Retrofitting Kits for Lathe Machine w.r.t controller, servos, displays, cost and taxation            | Alumni         | B5           | B5         |
| 6.      | CO6-PO5       | Sandvik CoroMill & CoroDrill        | Employer                  | Indirect         | List                            | Judge specifications of Coro Mill and Coro Drill w.r.t speed, feed, doc and other technical information with conventional tool | Bright Student | B5           | B5         |

| Sr. No. | CO-PO Mapping | Learning Parameter                    | Stakeholder Participation | Assessment Tool  |                      | Assessment Question with maximum blooms attainable level   | Assessment By | Blooms Level |              |
|---------|---------------|---------------------------------------|---------------------------|------------------|----------------------|--|---------------|--------------|--------------|
|         |               |                                       |                           | Direct/ Indirect | Name of Tool         |  |               | Target ed    | Ach ieva ble |
| 1.      | CO7-PO5       | ECH (Electrochemical Honing)-Procedia | Journal                   | Indirect         | One Sentence Summary | Read procedia research paper, P.S. Rao, P. K. Jain, D. K. Dwivedi, "Electro Chemical Honing (ECH) of External Cylindrical Surfaces of a Titanium Alloys", Procedia Engineering ((2015) and critically weigh resources used | Faculty       | B5           | B5           |
| 2.      | CO8-PO5       | CAPP                                  | Industry                  | Indirect         | Focussed Listing     | 1) Long form of CAPP 2) CAP applications 3) Types of CAP used for MP subject   | Faculty       | B5           | B5           |

n table 2, different CO-PO mapping is obtained through equipments/processes. e.g. In CO1, students are expected to learn different manufacturing process as objectives and PO5 is IT related tools.

Therefore, if students know about SAP software, attainment is achieved with respect to targeted blooms level.CO1 mapping with all POs is shown in table 2.

| Sr. No                         | Rubrics Criteria →<br>Performance Indicator<br>↓ | % Students                 |           |                    |           |                      |           |           |           |
|--------------------------------|--|----------------------------|-----------|--------------------|-----------|----------------------|-----------|-----------|-----------|
|                                |  | Does not meet expectations |           | Meets Expectations |           | Exceeds Expectations |           | Inspiring |           |
|                                |  | 2016-2017                  | 2017-2018 | 2016-2017          | 2017-2018 | 2016-2017            | 2017-2018 | 2016-2017 | 2017-2018 |
| 1                              | Extent of Completion                             | 10                         |           | 60                 |           | 15                   |           | 15        |           |
| 2                              | Justified the purpose                            | 25                         |           | 25                 |           | 45                   |           | 5         |           |
| 3                              | Completed for sake of compulsion                 | 20                         |           | 40                 |           | 30                   |           | 10        |           |
| 4                              | Involvement of Student                           | 46                         |           | 27                 |           | 20                   |           | 7         |           |
| 5                              | Students used multiple and varied sources        | 35                         |           | 40                 |           | 20                   |           | 5         |           |
| 6                              | Used Key points, facts and data                  | 40                         |           | 45                 |           | 10                   |           | 5         |           |
| 7                              | Originality of Data                              | 55                         |           | 30                 |           | 8                    |           | 7         |           |
| 8                              | Attainment in CO1-POs                            | 22                         |           | 28                 |           | 40                   |           | 10        |           |
| 9                              | Attainment in CO2-POs                            | 20                         |           | 30                 |           | 25                   |           | 25        |           |
| 10                             | Attainment in CO3-POs                            | 22                         |           | 20                 |           | 32                   |           | 26        |           |
| 11                             | Attainment in CO4-POs                            | 30                         |           | 19                 |           | 27                   |           | 14        |           |
| 12                             | Attainment in CO5-POs                            | 34                         |           | 18                 |           | 23                   |           | 25        |           |
| 13                             | Attainment in CO6-POs                            | 24                         |           | 26                 |           | 26                   |           | 24        |           |
| 14                             | Attainment in CO7-POs                            | 24                         |           | 36                 |           | 14                   |           | 16        |           |
| 15                             | Attainment in CO8-POs                            | 22                         |           | 32                 |           | 23                   |           | 23        |           |
| Instructions: Write Set of POs |  |                            |           |                    |           |                      |           |           |           |
| 16                             | Weakly attained CO-PO by Students                | PO9                        |           | PO4                |           | PO12                 |           | PO10      |           |
| 17                             | Strongly attained CO-PO by Students              | PO5                        |           | PO6                |           | PO8                  |           | P11       |           |
| 18                             | Moderately attained CO-PO by students            | PO3                        |           | PO2                |           | PO9                  |           | PO7       |           |

Similar to table 2, other tables for PO6 to PO12 is prepared for participation of remaining stakeholders.

For a case study, discussed in paper and after analyzing rubrics following conclusions can be drawn.

1) More emphasis has to be given for inculcating originality habits amongst the students, involvement

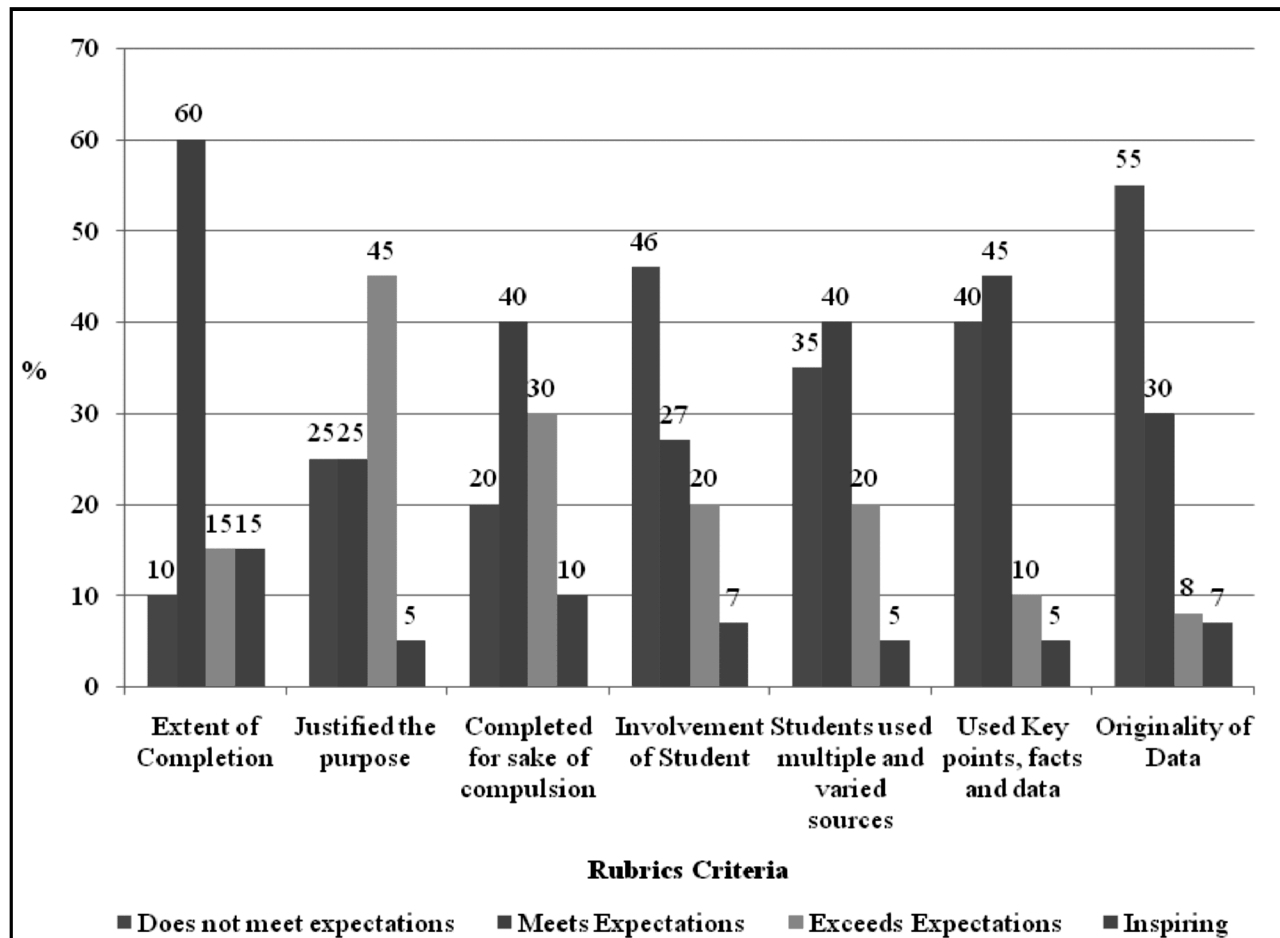


Fig 3: Rubrics for CO-PO Attainment

From figure 3, it is evident that, 60% of students are completing the CO-PO attainment work and showing their strong willingness to excel, which is quite encouraging. The involvement of students with respect to originality of data used, key points and facts, justifying the purpose have to be worked for.

## 5. Conclusion

CO-PO attainment reflects faculty insight towards development of students with professional skills. Each faculty is recommended to carry out CO-PO mapping and attainment for each subject. For attainment, students were asked to submit this completed booklet as mini project as part of term work and oral submission.

of students along with completed for sake of compulsion.

2) Students have well taken concept of CO-PO mapping and attainment booklet, as gap filling strategy between curriculum and actual field expectations.

3) Extent of completion of booklet and use of key points, facts and data are notable encouraging responses from students. This also indicates applicability of Outcome Based Education (OBE) as students are welcoming any extra efforts for achievement of desirable outcomes.

**References**

- [1] Dr. L.S.Admuthe, Deepali Yoginath Loni, Course Outcome-Program Outcome Mapping Matrix & Attainment -Issues and Model Based Solutions for Tier II Category Journal of Engineering Education Transformations, Vol 29, No Spl Iss (2016)
- [2] Kiran B. Malagi, V. Kumar Swamy, B. S. Anami, A Novel Method for Attainment Measurement of CO's and PO's for Tier-II Institutions, Journal of Engineering Education Transformations, Vol 29, No Spl Iss (2016)
- [3] NBA Training Manual, NBA Website
- [4] Training Text Material, NBA, Orientation workshop on Outcome Based Accreditation
- [5] Emphasis on How to prepare the SAR and effect improvements during the process, NBA Training