

**COE Program Assessment COMMITTEE**

**Activity Report**

Term T132

**COMPUTER ENGINEERING**

**Program**

at

**King Fahd University of Petroleum & Minerals**

**DHAHRAN, SAUDI ARABIA**

**24th of September, 2014**

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# Summary

This report gives a brief summary of the ABET related activities at the Computer Engineering Department in the academic term 132. All in all, the program assessment committee (PAS) has coordinated the assessment of six student outcomes (SOs), overseen the implementation of the corrective actions that were proposed in T131, and completed the first draft of the department’s report on the self-study questionnaire in preparation of the next cycle of ABET accreditation.

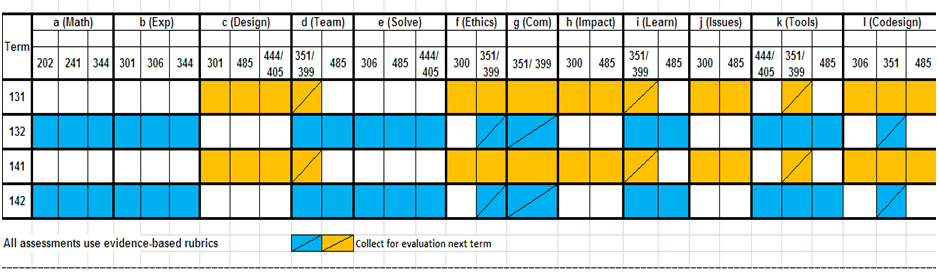
# Introduction

Section 2 of this report summarizes the assessment results for the six outcomes that were assessed in T132 including a compilation of corrective actions that were approved by the department council. Section 3 describes the departmental activities/actions related to the corrective actions that were proposed in T131.

# T132 Assessment Results

In semester 121, the Computer Engineering department has introduced a new undergraduate program. As a result, the PAS has developed an unusually aggressive assessment plan (please see Table 1 below) in order to fully assess the new program before the next ABET’s program evaluation visit (PEV). Also, due to the relatively low enrollment in the COE program, SOs have to be assessed several times in different semesters to get any statistically acceptable data.

Table 1. Direct Assessment Plan for the Students Outcomes over the Cycle T131-T142



Hence in accordance with the assessment plan, SOs a, b, d, e, i, and k were assessed using direct assessment (rubrics, included in Appendix A). In addition assessment data for SOs f, g, and l were collected from the COOP course COE 351 to be added to the assessment data in T141. Table 2 below shows the assessment summary for T132. It shows, the assessed SOs, courses used to assess each SO, how the instructors assessed the SO, individual and combined assessment scores and the proposed corrective actions.

Table 2: Summary of T132 assessment; assessed SOs, assessment methods, results and suggested corrective actions.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **SO** | **Courses** | **Assessment Method** | **Assessment Results** | | **Suggested Corrective Actions** |
| **(a) an ability to apply knowledge of mathematics, science, and engineering** | COE 202 Logic Design | A rubric was assessed based on analyzing student answers to two questions in Major Exam-1 (Q1 & Q2) and one question in major Exam-2 (Q4). These are the questions that measure the ability of students to perform arithmetic operations in different number systems for both signed and unsigned numbers as well as the ability to convert number representation from one system to another | No. of Students | **22** | More emphasis and solved examples on signed numbers should be included in class or in special problem-solving sessions with more emphasis on the in-class examples as not all students attend the specially organized help/problem-solving sessions |
| Ave. Score | **3.26** |
| Min/max scores | **2.5/4** |
| % of Students > 60% | **100%** |
| COE 241 Data & Comp Communications | Selected questions in which the students – based on a given set of assumptions- solved some data communication problem using formulae they have learned in class and their own mathematical skills. Examples; Fourier Series Expansion for periodic signals, and Use of the decibel notation in power calculations | No. of Students | **22** | Better calculus preparation can help improve this outcome, as it seems that some students were not comfortable with applying calculus concepts |
| Ave. Score | **2.52** |
| Min/max scores | **0.6/4** |
| % of Students > 60% | **60%** |
| COE 344 Computer Networks | Selected questions from homework assignments, quizzes and exams. These questions required applying math/statistics to perform computations or to derive generalized formulas | No. of Students | **6** | Too small sample to make concrete conclusions!!!  Need to dedicate few lectures to review the needed math and statistics materials for the course |
| Ave. Score | **2.42** |
| Min/max scores | **1.5/4** |
| % of Students > 60% | **50%** |
| **Conclusion: Outcome A is at best, marginally achieved. Use of calculus needs to be emphasized more in relevant COE courses (COE 241 & COE 344).** | | | | | |
| (**b) an ability to design and conduct experiments, as well as to analyze and interpret data** | COE 301 Computer Organization | Assessment was carried out in the LAB by the lab supervisor and the course instructor using a specified set of 5-6 experiments/assignments:  Each assignments started with a written description, then students were asked to answer a number of questions distributed over the duration of the assignment, where each question is mapped to an attribute of the 4 outcome rubrics (experiment goals, setting up the experiment, use of tools, collecting results, and interpreting the results). | No. of Students | **8** | None |
| Ave. Score | **3.13** |
| Min/max scores | **2.9/3.6** |
| % of Students > 60% | **100%** |
| COE 306 Intro. to Embedded Systems | Assessment was carried out per student where several lab experiments were used to assess this outcome. In each experiment, students were given an objective that required experimenting with various setups and configurations of the target development ARM board and some peripherals. E.g. How to use a keypad (required experimenting with reading the output lines to figure out how a key press is encoded), Using UART to figure out PCLK (peripheral clock) and its relation to the main clock. | No. of Students | **7** | Need to induce the skills of experimenting in earlier labs like COE 203 & COE 301 |
| Ave. Score | **3.18** |
| Min/max scores | **1.75/4** |
| % of Students > 60% | **70%** |
| COE 344 Computer Networks | The rubrics-based assessment method used post lab activities for three (3) different lab experiments (lab6, lab7 and lab8). The students were requested to answer specific sets of questions approved by the ABET committee. This was done after each of these lab experiment and the students were given all necessary time to formulate their answers in the proper way that correspond to their perception of the lab experiment activity | No. of Students | **6** | Too small sample to make concrete conclusions!!!  •Implement pre lab activities to address aspects of outcome b Rubrics b  •Request students to investigate the experimental platform used and explore other alternatives if applicable  •Generate specific questions for students to answer during the lab experiment and record the answers in the post lab report  •Consider whether the assessment of this outcome should better be done in the latter part of the lab experiments  •Emphasize data interpretation in both lecture and lab  •Encourage students to develop their own interpretations and express them in their own language rather than copy and paste from the experiment handout.  • Improve the assessment method by generating a detailed matrix of specific aspects of the outcome for each lab experiment. Rubric scoring using this matrix should reduce subjectivity and simplify a concise and accurate assessment. |
| Ave. Score | **2.42** |
| Min/max scores | **2/2.75** |
| % of Students > 60% | **67%** |
| **Conclusion: Outcome B is at best, marginally achieved. Need to inject more experimental design in COE 203, COE 301, COE 306 and COE 344 Labs.** | | | | | |
| (d) an ability to function on multi-disciplinary teams | COE 351 COOP | Students were assessed based on Progress and Final Coop reports, Company evaluation reports and the student’s Power point public presentation | No. of Students | **2** | Not enough sample to draw any solid conclusion |
| Ave. Score | **2.92** |
| Min/max scores | **2.5/3.5** |
| % of Students > 60% | **100%** |
| COE 485 Senior Design Project | Project advisor filled the rubric based on his regular interaction with the students during the required biweekly meetings. Also, examiners filled in the rubric based on the "Teamwork" chapter in the students’ final reports. The chapter is suggested (in the final report template) to include the following for each team member: 1) Responsibilities: tasks managed by the team member, 2) Contributions: tasks contributed to by the team member, and 3) Expertise: areas in which the team member is knowledgeable and often consulted | No. of Students | **13** | - Need to develop concrete mechanisms or activities that facilitate the assessment of this outcome and provide reasonable evidence. The questions of the first rubric are particularly non-straightforward to support by evidence. As it as, the burden of finding suitable evidence falls on the project supervisors, who are not inclined to make much effort thinking about how to support their assessment. Furthermore, if they do, the evidence is going to differ from one group to another.  - Encourage and facilitate projects involving more than two students to practice teamwork. |
| Ave. Score | **3.07** |
| Min/max scores | **2.9/3.7** |
| % of Students > 60% | **100%** |
| **Conclusion: Outcome D seems to be achieved but the rubrics need to be re-evaluated and possibly improved.** | | | | | |
| (e) an ability to identify, formulate, and solve engineering problems | COE 306 Intro. to Embedded Systems | Assessment was carried out per student. All experiments involved many details, which are often sources of problems due to insufficient student attention to such details. As a specific example, for the lab experiment on reading analog inputs from analog sensors, students encountered the following problems: Hardware problems (e.g. a sensor was connected to a pin that can’t have ADC input function, the sensor was missing a pull up resistor, the LEDs were reversed), Software problems (Programming the pin mode as ADC input, Programming ADC control registers, Frequent syntax errors due to limited familiarity with the C language). Students documented the problems they faced and how they dealt with them. | No. of Students | **7** | Leave some issues open in the lab manual to allow student to figure out the solution |
| Ave. Score | **3.25** |
| Min/max scores | **1.75/4** |
| % of Students > 60% | **85%** |
| COE 444 Internetworks Design and Management | Students were assessed based on Homework assignments, Quizzes, Major exam problems, and Final exam problems. Examples: Traffic flow analysis problems, Network topology design problems, Terminal assignment problems, and Concentrator location problems | No. of Students | **14** | none |
| Ave. Score | **3.09** |
| Min/max scores | **1.8/4** |
| % of Students > 60% | **85%** |
| COE 485 Senior Design Project | Assessment was carried out per group; Examiners filled the rubric based on the "Issues" section in the final report. The section is suggested (in the final report template) to include "Problems, faults, bugs, challenges and difficulties faced. For each such issue, students listed the issue, attempted, unsuccessful resolutions, and the final resolution (solution, workaround, issue ignored ...etc.) | No. of Students | **13** | Project supervisors need to demonstrate more support towards the students' effective resolutions when faced with issues beyond their control, such as faulty hardware, by accommodating such changes in project requirements |
| Ave. Score | **2.89** |
| Min/max scores | **2/3.9** |
| % of Students > 60% | **85%** |
| **Conclusion: Outcome E is achieved and there are no major corrective actions needed at this time.** | | | | | |
| (i) a recognition of the need for, and an ability to engage in life-long learning | COE 351 COOP | Students were assessed based on Progress and Final Coop reports  - Power point public presentation | No. of Students | **2** | Put more emphasis in COE 300 on improving and assessing the “Critical Thinking” and the “Decision making” outcomes |
| Ave. Score | **2.67** |
| Min/max scores | **2/3.3** |
| % of Students > 60% | **50%** |
| COE 485 Senior Design Project | Assessment is per student  Basis: Project advisor fills in the rubric based on his regular interaction with the students during the required biweekly meetings. | No. of Students | **11** | -Design activities to better assess this outcome.  -Inject activities in various courses that require student independent work beyond the syllabus.  Simplify the rubric format to solicit more accurate assessment |
| Ave. Score | **2.82** |
| Min/max scores | **2/4** |
| % of Students > 60% | **72%** |
| **Conclusion: Outcome I is moderately satisfied, need to inject more critical thinking and self-reliance in courses and perhaps improve the rubric.** | | | | | |
| (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice | COE 351 COOP | Progress and Final Coop reports, Power point public presentation | No. of Students | **2** | COOP advisors should emphasize to the COOP advisees the importance of documenting the aspect of the proper selection of the tools needed to do the advisee’s tasks, and the process used to select such tools |
| Ave. Score | **2.75** |
| Min/max scores | **2/3.5** |
| % of Students > 60% | **50%** |
| COE 444 Internetworks Design and Management | Special homework assignments and project | No. of Students | **13** | Include a component in the COE 444 project that requires the use of a proper tool related to the traffic flow analysis aspect of the project. The tool can be either selected from readily available tools and customized for the project or developed by the students |
| Ave. Score | **2.96** |
| Min/max scores | **1.75/4** |
| % of Students > 60% | **69%** |
| COE 485 Senior Design Project | Examiners filled the rubric based on the "Tools and Standards" section in the students’ final reports. The section is suggested (in the final report template) to include: 1) Relevant available tools, which were used, and why, 2) Relevant standards, which were used, and why. | No. of Students | **6** | •Students should be exposed to alternative tools in all courses, even if these tools are not used.  •Making alternative tools available to students to facilitate their exploration.  •Advising students and emphasizing the importance of documenting the proper selection of software/hardware tools needed in projects, and the process used to select these tools |
| Ave. Score | **2.75** |
| Min/max scores | **2.3/3.8** |
| % of Students > 60% | **67%** |
| **Conclusion: Outcome K is moderately achieved. Students need to be exposed to more tools and be asked to justify their selections.** | | | | | |

The COE department adopts the following criteria for judging a student’s achievement of an outcome based on rubric scores (out of 4):

* Achieved (A): Score > 2.5,
* Marginally Achieved (M): Score: ≈ 2.5
* Need Improvement (NI): Score < 2.5

An important measure used to evaluate the overall achievement of a certain student outcome is the percentage of students who achieved 60% (i.e. 2.5/4) or more in the rubrics. This determines the urgency of corrective actions; any percentage less than 70% warrant corrective actions. We also keep an eye on the maximum and minimum rubric scores; larger spread is indicative of either an outcome delivery/injection problem, an assessment problem, or both. Based on the above criteria, the assessment scores in Table 2 above indicate that both outcomes **a** and **k** were marginally achieved and needs urgent corrective actions. Outcomes **b**, **d**, **e**, and **i** have been satisfactory achieved.

# Corrective Actions in 132

The following corrective actions, which were mandated by the COE Council in T131, were implemented in 132:

1. For COE 202, 241, 301, 306, and 344 Courses:
   1. Use common syllabus and adopt Close coordination (common exams) for multiple section offerings – this have been implemented
   2. Organize problem-solving sessions to be attended by all students – this also has been implemented
2. For the COE 351 & 399 Courses:
   1. Students should present their work in formal public presentations and the event will be announced in advance at the department and college level – This has been implemented. Poster presentations or private presentations to committee members are no longer accepted
3. A Blackboard course, called COE ABET, has been created and all COE faculty were added instructors so they can submit assessment results and corrective actions through this course. This enhances the data collection process and provides a repository for all assessment data and reports.

# Appendix A: Rubrics for Assessing SOs a, b, d, e, i, and k

Outcome (a) Rubrics

**Ability to apply knowledge of mathematics, science, and engineering to obtain solutions and formulate models of processes and systems.**

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|  |  |  |  |  |  |
| **Outcome** | **Score (1 - 4)** | **Exemplary (4)** | **Proficient (3)** | **Apprentice (2)** | **Novice (1)** |
| **ability to apply mathematics, science, and engineering** |  | **Always** uses the proper mathematical, and scientific formulation to solve problems | Uses the proper mathematical, and scientific formulation to solve problems **most** of the times | Uses the proper mathematical, and scientific formulation to solve problems **some** of the times | **Rarely** uses the proper mathematical, and scientific formulation to solve problems |

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| Outcome (b) Rubrics  **An ability to design and conduct experiments, as well as to analyze and interpret data** | | | | | |
| **Outcome** | **Score (1 - 4)** | **Exemplary (4)** | **Proficient (3)** | **Apprentice (2)** | **Novice (1)** |
| **Identifying clear goals for the experiment** |  | Clearly identify the objectives of the experiment, the expected results, and possible pitfalls to watch for | Clearly identify the objectives of the experiment and some of the expected results but does not think of the possible pitfalls | Identify some of the objectives of the experiment but omits the expected results and possible pitfalls | Does not identify any objectives for the experiment and/or expected results |
| **Choosing the appropriate experimental test bed (Hardware, Software, Emulation, Simulation, or hybrid) to achieve the identified objectives of the experiment** |  | Chooses the best test bed suitable for achieving the objectives with proper justification | Chooses the best test bed suitable for achieving the objectives with no justification | Chooses a test bed that is not optimum but somehow achieves the identified objectives | Chooses a test bed that does not achieve the objectives at all |
| **Designing and conducting the experiment** |  | Student groups design and conduct the experiment with no errors at all | Student groups design and conduct the experiment with some minor errors that do not adversely affect the objectives | Student groups design and conduct the experiment with some errors that affect the results and the objectives | Student groups design and conduct the experiment with major conceptual or procedural errors that render the results useless and leave the objectives unachieved |
| **Ability to analyze and interpret the data** |  | Analysis and interpretation of results exceed requirements of experiment and demonstrate significant higher-order thinking ability | Analysis and interpretation of results meet requirements of experiment and demonstrate some higher-order thinking ability | Results are analyzed but not interpreted; very limited evidence of higher-order thinking ability | No evidence of significant analysis and interpretation of results; fail to meet requirements of the experiment; demonstrate only lower-level thinking ability |

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| Outcome (d-I) Rubrics  **Ability to function on multi-disciplinary and/or diverse teams. Take responsibility, share work, and value other viewpoints.** (*Our interpretation of multidisciplinary teams includes teams of individuals with similar educational backgrounds focusing on different aspects of a project as well as teams of individuals with different educational backgrounds*). | | | | | |
| **Outcome** | **Score (1 - 4)** | **Exemplary (4)** | **Proficient (3)** | **Apprentice (2)** | **Novice (1)** |
| **Contributions** |  | Routinely provides useful ideas when participating in the group and in classroom discussion. A leader who contributes a lot of effort. | Usually provides useful ideas when participating in the group and in classroom discussion. A strong group member who tries hard! | Sometimes provides useful ideas when participating in the group and in classroom discussion. A satisfactory group member who does what is required. | Rarely provides useful ideas when participating in the group and in classroom discussion. May refuse to participate. |
| **Problem-solving** |  | Actively looks for and suggests solutions to problems. | Refines solutions suggested by others. | Does not suggest or refine solutions, but is willing to try out solutions suggested by others. | Does not try to solve problems or help others solve problems. |
| **Attitude** |  | Is never publicly critical of the project or the work of others. Always has a positive attitude about the task(s). | Is rarely publicly critical of the project or the work of others. Often has a positive attitude about the task(s). | Is occasionally publicly critical of the project or the work of other members of the group. Usually has a positive attitude about the task(s). | Is often publicly critical of the project or the work of other members of the group. Is often negative about the task(s). |
| **Focus on the task** |  | Consistently stays focused on the task and what needs to be done. Very self-directed. | Focuses on the task and what needs to be done most of the time. Other group members can count on this person. | Focuses on the task and what needs to be done some of the time. Other group members must sometimes nag, prod, and remind to keep this person on task. | Rarely focuses on the task and what needs to be done. Lets others do the work. |
| **Working with others** |  | Almost always listens to, shares with, and supports the efforts of others. Tries to keep people working well together. | Usually listens to, shares, with, and supports the efforts of others. Does not cause "waves" in the group. | Often listens to, shares with, and supports the efforts of others, but sometimes is not a good team member. | Rarely listens to, shares with, and supports the efforts of others. Often is not a good team player. |

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| Outcome (d-II) Rubrics | | |  |  |  |
| **Outcome** | **Score (1 - 4)** | **Exemplary (4)** | **Proficient (3)** | **Apprentice (2)** | **Novice (1)** |
| **Teamwork** |  | 1. The project was carried out by more than TWO members 2. The work load and variety on each member seems fair 3. Leadership role being assumed by each member for different tasks is evident 4. Scheduled meetings minutes are Always recorded and the contribution of each team members are identified | 1. The project was carried out by more than TWO members 2. The work load and variety on each member seem fair 3. Leadership role being assumed by each member for different tasks is NOT apparent 4. Scheduled meetings minutes are Usually recorded and the contribution of each team members are identified | 1. The project was carried out by more than TWO members 2. The work load and variety on each member does not seem to be fair or at least one member has been assigned trivial non-technical tasks (e.g. writing the report) 3. Scheduled meetings minutes are Often recorded and the contribution of each team members are NOT identified | 1. The project was carried out by more than TWO members 2. The work load and variety on each member does not seem to be fair or at least one member has been assigned trivial non-technical tasks (e.g. writing the report) 3. Scheduled meetings minutes are Rarely recorded and the efforts are scattered. |

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| Outcome (e) Rubrics  **Ability to Identify, formulate, and solve engineering problems. Make appropriate and necessary assumptions. Suggest and evaluate new approaches.** | | | | | | | | | | |
| **Outcome** | | **Score (1 - 4)** | | **Exemplary (4)** | **Proficient (3)** | | **Apprentice (2)** | | **Novice (1)** | |
| **Applying concepts, governing math or physics equations and algorithms to solve a problem** | |  | | Applies correct concepts, chooses correct governing equations and optimum algorithms (or methods) to solve a problem. | Applies correct concepts, chooses correct governing equations but use sub-optimum algorithms (or methods) to solve a problem. | | Applies some correct concepts and chooses some correct governing equations but makes mistakes | | Applies incorrect concepts and/or chooses incorrect governing equations cannot solve problems | |
| **Demonstrating effective open-ended problem solving techniques (including the debugging of a faulty design; hardware, software or both)** | |  | | Always solves problems using step-by-step logical procedure and obtain correct solution | Mostly solves problems using step-by-step logical procedure. Sometimes he solves problems in an ad-hoc manner, but still he obtains correct solutions | | Mostly solves problems using step-by-step logical procedure but sometimes makes minor procedural errors that lead to incorrect solution of the problem | | Solves problems without logical step-by-step logical procedure and makes procedural errors resulting in incorrect solution | |
| Outcome (i) Rubrics  **Recognize the need for, and an ability to engage in, life-long learning** (*Our interpretation of this includes teaching students that the underlying theory is important because the technology changes, coupled with enhancing their self-learning ability*) | | | | | | | | | | |
| **Outcome** | **Score (1 - 4)** | | **Exemplary (4)** | | | **Proficient (3)** | | **Apprentice (2)** | | **Novice (1)** |
| **Importance of lifelong learning** |  | | Demonstrates extensive understanding of the importance of lifelong learning | | | Demonstrates substantial understanding of the importance of lifelong learning | | Demonstrates basic understanding of the importance of lifelong learning | | Demonstrates little or no understanding of the importance of lifelong learning. |
| **Independency** |  | | Routinely demonstrate the ability to find, evaluate and use resources to learn independently | | | Usually demonstrate the ability to find, evaluate and use resources to learn independently | | sometimes demonstrate the ability to find, evaluate and use resources to learn independently | | Rarely demonstrate the ability to find, evaluate and use resources to learn independently |
| **Personal responsibility** |  | | Displays exceptional recognition of the need to accept personal responsibility | | | Displays sufficient recognition of the need to accept personal responsibility | | Displays minimal recognition of the need to accept personal responsibility | | Does not recognize the need to accept personal responsibility |
| **Critical Thinking** |  | | **Demonstrate the ability to:** o Gather new data, use information well, understands concepts within standards. o Know and understand the facts, new thoughts developed on basis of new information. o Use information/knowledge used in multiple “real” contexts. | | | **Demonstrate the ability to:** o Gather new data, use information well, understands concepts within standards. o Know and understand the facts, new thoughts developed on basis of new information. | | **Demonstrate the ability to:** o Gather new data, use information well, understands concepts within standards. | | **Demonstrate the ability to gather new data** |
| **Decision making** |  | | Demonstrates in-depth level of engagement and decision making skills | | | Demonstrates appropriate decision making skills | | Demonstrates some level of decision making skills | | Demonstrates little or no level of decision making skills |
| **Accepting new Challenges** |  | | Displays exceptional capability to accept new challenges | | | Displays substantial capability to accept new challenges | | Displays minimal capability to accept new challenges | | Displays little or no capability to accept new challenges |

Outcome (k) Rubrics

**Use the techniques, skills, and modern engineering tools necessary for engineering practice**

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| **Outcome** | **Score (1 - 4)** | **Exemplary (4)** | **Proficient (3)** | **Apprentice (2)** | **Novice (1)** |
| **Tool Selection** |  | Selection of tools is based on sound technical criteria. Relevant industry standard class tools (software CAD, simulation, test equipment, emulators, measurement and lab equipment, planning and project management tools) are selected for carrying out specific tasks | Selection of tools is based on prior knowledge of the tools. Relevance of the selected tools is close to the standard practices. | Selection of tools is not based on technical criteria. Tools are selected based on personal preference | Selection of tools is not discussed. Use of the wrong set of tools is commonly noticed. |
| **Tool Usage** |  | Usage of the tools shows a good awareness of the tools capabilities and features. Tools are used correctly and in a consistent way with the stated objectives. Any issue with the tools is resolved using the tools documentation, FAQs or the customer support. Accurate description of credible problems encountered is noticed. | Usage of the tools is shows a fair awareness of the tools capabilities and features. Tools are used correctly and in a consistent way with the stated objectives. Some issues with the tools where the answers are present in the documentation are not properly resolved. Accurate description of credible problems encountered is not always seen. | Usage of the tools is shows a little awareness of the tools capabilities and features. Tools are used correctly and in a consistent way with the stated objectives. Improper use of the tools documentation. Several issues with the tools where the answers are present in the documentation are not properly resolved. Accurate description of credible problems encountered is missing. | Usage of the tools is shows no awareness of the tools capabilities and features. Tools are used incorrectly and in an inconsistent way with the stated objectives. Improper use of the tools documentation. Most issues with the tools where the answers are present in the documentation are not properly resolved. Accurate description of credible problems encountered is missing. |