Problem-Solving Knowledge Base

This document contains a list of resources and tips for enhancing students' problem-solving skills. Each section of the document addresses one of the major criteria taken from the College of Business Administration problem-solving assessment rubric. Sections start on a new page and follow the order in which they are listed in the rubric.

Three to five resources are presented for each criterion and are relevant for one or more specific dimensions listed under each criterion. For instance, under *Solution Selection and Justification*, resources listed address how to justify the "best" solution chosen, how to present steps for implementation of the solution, and how to ensure that there is adequate follow-up after the solution is implemented (the three criteria from this section).

The majority of the resources are links to brief online reading materials that list relevant questions to ask at different steps of the decision-making process, tips on what to include and examples in some cases. Some are visual presentations or videos. Other resources depict techniques or models for evaluating and ranking alternative solutions.

One section is omitted from this document. Specifically, the Tools and Data Analysis criterion is not included in the assessment version of the problem-solving rubric. The data analysis approach is specific to each student project, and so general recommendations are not applicable.

Students may find one or more resource from each section useful or relevant for their project. These resources are merely suggestions or a starting point for asking appropriate questions at each stage of the problem-solving process. Students are not required to closely follow the recommendations provided in this document.

Problem Definition

> *"Given one hour to save the world, I would spend 55 minutes defining the problem and 5 minutes finding the solution."*
>
> ~ Albert Einstein

1. https://hbr.org/2012/09/the-power-of-defining-the-prob
   Defining the problem: examples of problem re-definition that led to major breakthroughs (Harvard Business Review).

2. http://www.studygs.net/problem/problemsolvingv1.htm
   How to define the problem, its **root cause(s)**, and the **scope**. Specific questions are provided for general problem definition. Root causes are broken down by source (e.g., people, procedures, environment, etc.).

3. https://blog.iqmatrix.com/defining-problem
   This website gives specific questions for gauging a problem's scope. Example questions to ask:
   a. What is this problem preventing me from doing?
   b. What will happen if I do nothing about this problem?
   c. Is this the real problem or is there something else below the surface that I am not seeing?

4. https://www.youtube.com/watch?v=o4dddmOpQ5s – this video describes the Problem Definition Template, which asks what motivated people to find solutions, who is affected by the problem (stakeholders), whether the problem can be reframed (thought of in a different way), etc.

Assumptions

1. http://www.studygs.net/problem/problemsolvingv1.htm
   Source #2 from *Problem Definition* section addresses the issue of assumptions at the bottom of the page, stating that what some may consider "facts" is actually accepted on faith and can jeopardize the foundation of the problem. It is therefore important to question the source of one's facts/knowledge before basing decisions on them.

2. https://ctb.ku.edu/en/table-of-contents/participation/encouraging-involvement/identify-stakeholders/main
   This website explains who are primary, secondary, and key stakeholders; types of interests stakeholders may have (e.g., safety and security, economics, social change); why it is important to know the stakeholders in one's problem; examples of stakeholders in each of 3 categories; strategies for identifying less obvious stakeholders; etc.

   Provides a handy pictogram of stakeholder groups and defines each group in text:
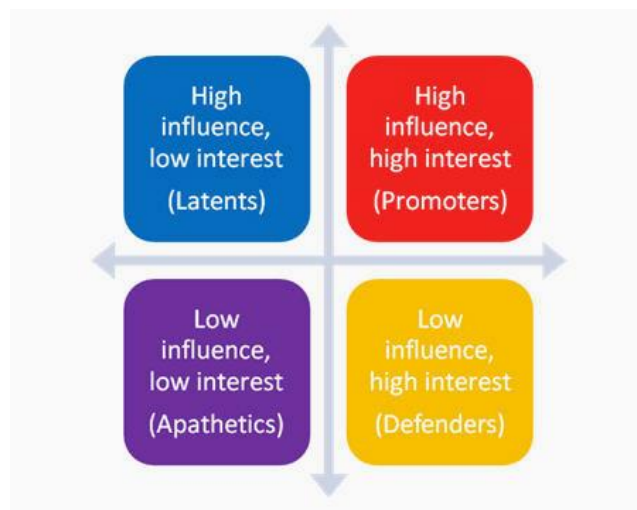
Potential Alternatives Formulation

1. http://www.studygs.net/problem/problemsolvingv2.htm
   Suggests that one briefly brainstorm as many alternatives as possible, no matter how ridiculous they may seem at first. This way, many options are generated, and one can discover possibilities not considered before. Evaluation of alternatives should be done without prejudice or preferential treatment of one solution over another.
   a. Best solution should be: suitable, feasible, and flexible (site defines these).
   b. When selecting the best alternative, consider: your intuition; opinion of trusted outsider(s); don't see one alternative as "perfect"; compromise among several alternatives may work even better.

2. http://asq.org/learn-about-quality/problem-solving/overview/overview.html
   States that having several alternatives can enhance the standard to which the final solution will be held, because many issues are considered in the process. Some specific considerations are listed in Step 3 (evaluating and selecting an alternative):

   i. A particular alternative will solve the problem without causing other unanticipated problems.
   ii. All the individuals involved will accept the alternative.
   iii. Implementation of the alternative is likely.
   iv. The alternative fits within the organizational constraints.

3. https://courses.lumenlearning.com/boundless-management/chapter/decision-making-process/
   Advises brainstorming in groups for best results when it comes to generating alternatives. Introduces the concept of **decision trees,** which are visual depictions of potential options; they consist of broad alternatives that are further broken down into specific components that may have alternatives of their own, and we stop adding more when viable alternatives in a given branch are exhausted. Also suggest that the more input we get from others, the less bias there will be in our final choice of solution.

4. http://web.csulb.edu/~msaintg/ppa670/p&sch6.htm
   A great list of 14 sources from which alternatives can be generated (e.g., moving from generic to custom-made alternatives; case studies of real-world experiences; using typologies of stakeholders to determine reactions to alternatives; considering constraints; etc.).

Solution Evaluation

1. https://www.structureddecisionmaking.org/steps/evaluationcriteria1/good-evaluation-criteria/
   Covers characteristics of good criteria for evaluating a solution. Mentions that criteria should be additive—that is, multiple criteria can be applied to evaluating an alternative without overlap.

2. http://iteconcorp.com/T3T4IdentAlts.html
   Template 4 is a matrix of alternative solutions and six criteria by which they can be judged. Once the judgments are made in each cell, the final column rank orders alternatives from most to least suitable.

3. http://www.eastgate.com/DeenaLarsen/guide/step7.htm
   This website explains that evaluation of alternatives can help to refine existing options, since the best solution rarely comes up in the first round of brainstorming. Potential consequences can also be discovered by asking pointed questions:
   - How will the solution interact with other processes and actions?
   - Could this solution create larger problems elsewhere?
   - Are there indirect effects? (if X happens, then Y might occur, which would influence Z)
   - What is appropriate data to collect to measure these consequences?

4. https://personal-development.com/chuck/consequences-actions.htm
   Consequences can be intended (what we hope the solution will bring) and unintended. Unintended consequences are further broken down into 4 kinds of consequences: positive, negative, perverse, and unforeseen (described and examples given on the website). Perverse consequences are the opposite of what was intended. Unforeseen consequences are usually out of our control, but they can be positive, negative, or neural. Just like we have to deal with assumptions made when a problem is being defined, we need to be aware of unintended consequences of our solution just as much as intended ones.

5. When evaluating solutions, it is important to rely on data and facts, rather than opinion and bias. Sources of data must also be of quality. For instance, Wikipedia is not a suitable source for factual information. Data should come from professional firms' technical reports, websites of associations and organizations, or be collected by the students themselves through interviews, surveys, etc.

Solution Selection and Justification

1. Justification the "best" solution should be based on evidence from the rigorous evaluation process in the previous step. The solution should be acceptable based on all or most evaluation criteria. The justification should include why one thinks that this solution's consequences (intended and unintended) are the most beneficial/least harmful relative to alternatives.

2. http://www.itseducation.asia/implement.htm
   Implementing a solution requires formulating an action plan. This plan should include:
   - Actions required (goals, desirable outcomes of each action, sequence of actions)
   - Schedule of the actions (timeline for completing each task; may use a diagram or flowchart to depict this)
   - Resources required (time, space, manpower, money, materials, information)
   - Measures to buffer against negative consequences
   - What could potentially could go wrong (e.g., two activities coinciding, unintended consequences, resources are used up, etc.)
   - Action management (who supervises activities, when progress toward goal will be measured, who will measure the progress and how, deadlines)
   - Review of the action plan

3. http://www.studygs.net/problem/problemsolvingv3.htm
   In addition to an action plan, one should inform stakeholders of the chosen solution and help them prepare for the change, as well as be prepared to compromise with the most important stakeholders' wishes.

4. http://www.eastgate.com/DeenaLarsen/guide/step10.htm
   Long-term monitoring of the solution involves tracking changes following implementation. This involves:
   - Gauging whether all stakeholders understand the solution
   - Does everyone have access to information about the solution
   - Making sure that those involved know what their role is in implementation
   - Monitoring the community in which the solution will be implemented to detect any changes during implementation that may or may not be part of the solution

5. http://blog.minitab.com/blog/quality-business/5-tips-to-make-process-improvements-stick
   This website provides 5 tips for making sure that the solution we implemented "sticks" in the long term. This involves providing feedback on activities related to the solution, providing positive reinforcement to those working on implementing the solution, and updating procedures outlined in the action plan as necessary. These five tips should be applicable to any project's follow-up steps.

1. http://www.ncsl.org/legislators-staff/legislative-staff/legislative-staff-coordinating-committee/tips-for-making-effective-powerpoint-presentations.aspx
   Provides a comprehensive list of short and succinct tips for making effective PowerPoint visuals, separately for text, color and graphics. Tips include:
   - Use font size no smaller than 24 point
   - Avoid long sentences
   - Use a 6x6 rule for bullet point slides
   - Use contrasting text and background, with dark text on light background
   - Know your audience
   - Check spelling and grammar

2. https://chipcast.hosted.panopto.com/Panopto/Pages/Viewer.aspx?id=d2d08b42-fd3e-473f-810a-a85e0142da65
   One of CMU's resources. Follow the **OABC** framework for presenting information:
   - Have a logical **opening** that defines the problem, introduces group members
   - Present the **agenda**, which outlines the chapters of the presentation
   - The **body** of the presentation consists of data: alternative solutions, best solution chosen and why, consequences of this choice, following up on the choice, etc.
   - The **conclusion** should briefly reiterate what has been covered in the agenda and the body. In the conclusion, it is suitable to talk about issues the group faced after implementing the solution, changes in the environment, changes in people's beliefs and level of devotion to the solution, etc. This part should follow the same outline as the **agenda,** whereby presents talk about what was expected to happen, what actually happened, and what we can conclude from it for future research.

3. Consider using the client company's logo and/or color scheme for PowerPoint presentation. College students should use CMU logo or that of any brands involved in presenting the solution. Use of a brand will boost the recognizability of the product. A presentation that is representative of its employer or creators seems more credible and will be more readily accepted by the parties impacted by the change.

Other Problem-Solving Factors

1. http://asq.org/learn-about-quality/problem-solving/overview/overview.html
   American Society for Quality outlines the rational (classical) decision-making model, which is also covered in students' coursework. To ensure that a logical process is being used to solve a problem, there are four essential steps:
   a. Identify the problem or opportunity
   b. Think of alternative solutions to the problem
   c. Evaluate alternatives, select the one that meets needs best
   d. Implement the solution and periodically evaluate success of implementation

   These steps are the bare-bones outline of what should be covered in the problem-solving class project. It also ensures that a systematic approach is used for problem-solving that incorporates techniques learned in class.

2. Students should remember that they are the ones most familiar with the solution and alternatives, and assume that the reader is naïve to the problem and to the reasons it needs a solution (unless the reader is someone known to be familiar with the problem). Therefore, coverage should be comprehensive, with enough background information for someone completely unfamiliar with the project to understand it.

3. Integrating prior knowledge: students should use what has been taught in the course to demonstrate that they can apply principles learned to real-world situations. Presentation of the problem and solution will also be enhanced if background information and facts are included about the origin and nature of the problem, as well as any data about prior uses of alternatives proposed.