

Example of a generic assignment for Problem Solving.

1/31/2020

Often, faculty are challenged with envisioning a specific assignment that allows students to practice the skills inherent to one of our institutional student learning outcomes. For example, consider Problem Solving. The aspects (or skills) inherent to Problem Solving include Problem Definition, Identification of Possible Strategies, Proposal of Multiple Solutions, Evaluation of Various Solutions, Implementation of one Solution, and Evaluation of the Outcome (i.e. was the problem solved?). These are the aspects of the American Association of Colleges & Universities Problem Solving Rubric.

An assignment which allowed a student to practice and demonstrate competency in all these aspects would take forethought. We outline below a generic example of such a Problem Solving assignment. Note that this exercise can be conducted individually or as a team.

The assignment is based on the concept of “Wicked Problems” in society. A Wicked Problem is, by definition, a social or cultural problem that is difficult or impossible to solve for as many as four reasons: incomplete or contradictory knowledge, the number of people and opinions involved, the large economic burden, and the interconnected nature of these problems with other problems. Examples of Wicked Problems include poverty, education, the economy, pollution, and, of course, climate change.

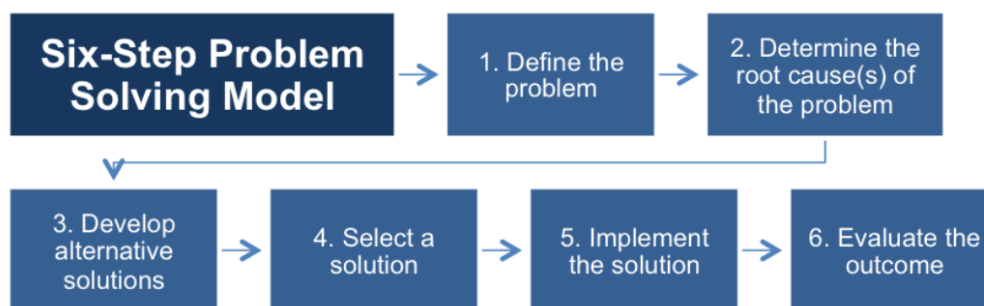
While one could make this a generic assignment, one could also imagine constructing this assignment around a discipline specific “Wicked Problem.” We tested the notion that there are wicked problems in almost every discipline by using Google. We googled the phrase “wicked problems in (your discipline)” Every discipline we tested seemed to have links and publications about wicked problems within that discipline.

If you have questions about the AAC&U Problem Solving rubric or about the concept of wicked problems, please contact Dr. Steve Lochmann at the office of assessment (ext. 8170).

Problem Solving Assignment

The University of Arkansas at Pine Bluff wants all students from all majors to be competent problem solvers. The University asks instructors to teach problem solving skills and to assess problem solving using the American Association of Colleges & Universities (AAC&U) Problem Solving Rubric (see attachment 1). The aspects (or skills) inherent to Problem Solving include Problem Definition, Identification of Possible Strategies, Proposal of Multiple Solutions, Evaluation of Various Solutions, Implementation of one Solution, and Evaluation of the Outcome (i.e. was problem solved?).

These aspects or sub skills of problem solving closely mirror one common model for problem solving. The 6-step model of problem solving looks like this:



Note the similarities between the 6-step model (see attachment 2) and the AAC&U Problem Solving Rubric.

To practice problem solving one first needs a problem. While there are a myriad number of unsolved problems across our discipline, there are some larger societal problems which have been characterized as “Wicked Problems”. A Wicked Problem is, by definition, a social or cultural problem that is difficult or impossible to solve for as many as four reasons: incomplete or contradictory knowledge, the number of people and opinions involved, the large economic burden, and the interconnected nature of these problems with other problems. Examples of Wicked Problems include poverty, education, the economy, pollution, and, of course, climate change. A 2015 article in Elephant Journal entitled, “Top 5 Wicked Problems the World Desperately Needs to Solve” lists and explains five prominent wicked problems. The list includes government, economy, education, health, and climate change.

1. Read the Elephant Journal article (see attachment 3) and choose one of the five problems on which to focus.
2. Write a problem statement that briefly describes the wicked problem and outlines the important challenges that make the specific problem difficult to solve.
3. Imagine 3-4 possible solutions to the problem. Describe each of the possible solutions in enough detail as to be able to evaluate each possible solution’s relative merits.
4. Make a list of the strengths and challenges of each possible solution and choose the one you think has the highest probability of solving the problem.
5. Design a scheme to implement your solution. Explain how the solution could be scaled up from a local to regional to a national or global scale. Estimate what implementation of your solution at the local level would cost by generating a budget for implementation.
6. Pretend your solution was implemented at a local level. Design and explain a method of determining whether your solution solved the problem at the local level. Explain what data would be needed to determine whether the solution worked. Outline how the data would be collected and analyzed and the timeline for evaluation. Estimate what the determination of success of your solution at the local level would cost by generating a budget for determining success.

PROBLEM SOLVING VALUE RUBRIC

for more information, please contact value@aacu.org



The VALUE rubrics were developed by teams of faculty experts representing colleges and universities across the United States through a process that examined many existing campus rubrics and related documents for each learning outcome and incorporated additional feedback from faculty. The rubrics articulate fundamental criteria for each learning outcome, with performance descriptors demonstrating progressively more sophisticated levels of attainment. The rubrics are intended for institutional-level use in evaluating and discussing student learning, not for grading. The core expectations articulated in all 15 of the VALUE rubrics can and should be translated into the language of individual campuses, disciplines, and even courses. The utility of the VALUE rubrics is to position learning at all undergraduate levels within a basic framework of expectations such that evidence of learning can be shared nationally through a common dialog and understanding of student success.

Definition

Problem solving is the process of designing, evaluating and implementing a strategy to answer an open-ended question or achieve a desired goal.

Framing Language

Problem-solving covers a wide range of activities that may vary significantly across disciplines. Activities that encompass problem-solving by students may involve problems that range from well-defined to ambiguous in a simulated or laboratory context, or in real-world settings. This rubric distills the common elements of most problem-solving contexts and is designed to function across all disciplines. It is broad-based enough to allow for individual differences among learners, yet is concise and descriptive in its scope to determine how well students have maximized their respective abilities to practice thinking through problems in order to reach solutions.

This rubric is designed to measure the quality of a **process**, rather than the quality of an **end-product**. As a result, work samples or collections of work will need to include some evidence of the individual's thinking about a problem-solving task (e.g., reflections on the process from problem to proposed solution; steps in a problem-based learning assignment; record of think-aloud protocol while solving a problem). The final product of an assignment that required problem resolution is insufficient without insight into the student's problem-solving process. Because the focus is on institutional level assessment, scoring team projects, such as those developed in capstone courses, may be appropriate as well.

Glossary

The definitions that follow were developed to clarify terms and concepts used in this rubric only.

- Contextual Factors: Constraints (such as limits on cost), resources, attitudes (such as biases) and desired additional knowledge which affect how the problem can be best solved in the real world or simulated setting.
- Critique: Involves analysis and synthesis of a full range of perspectives.
- Feasible: Workable, in consideration of time-frame, functionality, available resources, necessary buy-in, and limits of the assignment or task.
- “Off the shelf” solution: A simplistic option that is familiar from everyday experience but not tailored to the problem at hand (e.g. holding a bake sale to "save" an underfunded public library).
- Solution: An appropriate response to a challenge or a problem.
- Strategy: A plan of action or an approach designed to arrive at a solution. (If the problem is a river that needs to be crossed, there could be a construction-oriented, cooperative (build a bridge with your community) approach and a personally oriented, physical (swim across alone) approach. An approach that partially applies would be a personal, physical approach for someone who doesn't know how to swim.
- Support: Specific rationale, evidence, etc. for solution or selection of solution.

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Definition

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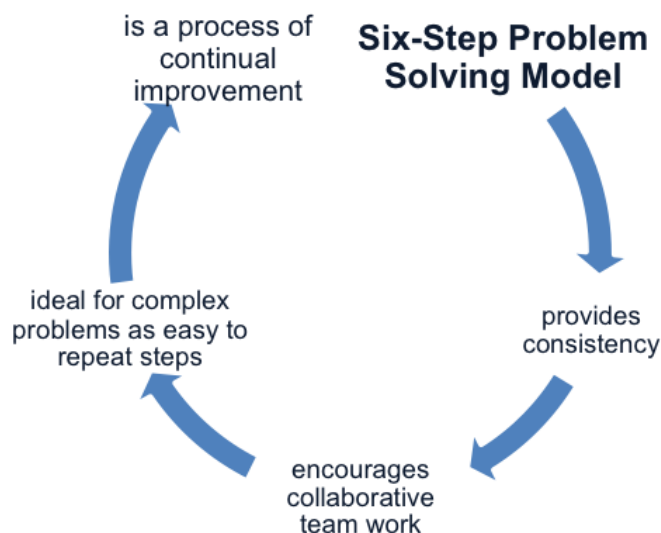
Evaluators are encouraged to assign a zero to any work sample or collection of work that does not meet benchmark (cell one) level performance.

	Capstone 4	Milestones		Benchmark 1
		3	2	
Define Problem	Demonstrates the ability to construct a clear and insightful problem statement with evidence of all relevant contextual factors.	Demonstrates the ability to construct a problem statement with evidence of most relevant contextual factors, and problem statement is adequately detailed.	Begins to demonstrate the ability to construct a problem statement with evidence of most relevant contextual factors, but problem statement is superficial.	Demonstrates a limited ability in identifying a problem statement or related contextual factors.
Identify Strategies	Identifies multiple approaches for solving the problem that apply within a specific context.	Identifies multiple approaches for solving the problem, only some of which apply within a specific context.	Identifies only a single approach for solving the problem that does apply within a specific context.	Identifies one or more approaches for solving the problem that do not apply within a specific context.
Propose Solutions/Hypotheses	Proposes one or more solutions/hypotheses that indicates a deep comprehension of the problem. Solution/hypotheses are sensitive to contextual factors as well as all of the following: ethical, logical, and cultural dimensions of the problem.	Proposes one or more solutions/hypotheses that indicates comprehension of the problem. Solutions/hypotheses are sensitive to contextual factors as well as the one of the following: ethical, logical, or cultural dimensions of the problem.	Proposes one solution/hypothesis that is “off the shelf” rather than individually designed to address the specific contextual factors of the problem.	Proposes a solution/hypothesis that is difficult to evaluate because it is vague or only indirectly addresses the problem statement.
Evaluate Potential Solutions	Evaluation of solutions is deep and elegant (for example, contains thorough and insightful explanation) and includes, deeply and thoroughly, all of the following: considers history of problem, reviews logic/ reasoning, examines feasibility of solution, and weighs impacts of solution.	Evaluation of solutions is adequate (for example, contains thorough explanation) and includes the following: considers history of problem, reviews logic/ reasoning, examines feasibility of solution, and weighs impacts of solution.	Evaluation of solutions is brief (for example, explanation lacks depth) and includes the following: considers history of problem, reviews logic/ reasoning, examines feasibility of solution, and weighs impacts of solution.	Evaluation of solutions is superficial (for example, contains cursory, surface level explanation) and includes the following: considers history of problem, reviews logic/ reasoning, examines feasibility of solution, and weighs impacts of solution.
Implement Solution	Implements the solution in a manner that addresses thoroughly and deeply multiple contextual factors of the problem.	Implements the solution in a manner that addresses multiple contextual factors of the problem in a surface manner.	Implements the solution in a manner that addresses the problem statement but ignores relevant contextual factors.	Implements the solution in a manner that does not directly address the problem statement.
Evaluate Outcomes	Reviews results relative to the problem defined with thorough, specific considerations of need for further work.	Reviews results relative to the problem defined with some consideration of need for further work.	Reviews results in terms of the problem defined with little, if any, consideration of need for further work.	Reviews results superficially in terms of the problem defined with no consideration of need for further work

The Six Step Problem Solving Model

Problem solving models are used to address the many challenges that arise in the workplace. While many people regularly solve problems, there are a range of different approaches that can be used to find a solution.

Complex challenges for teams, working groups and boards etc., are usually solved more quickly by using a shared, collaborative, and systematic approach to problem solving.



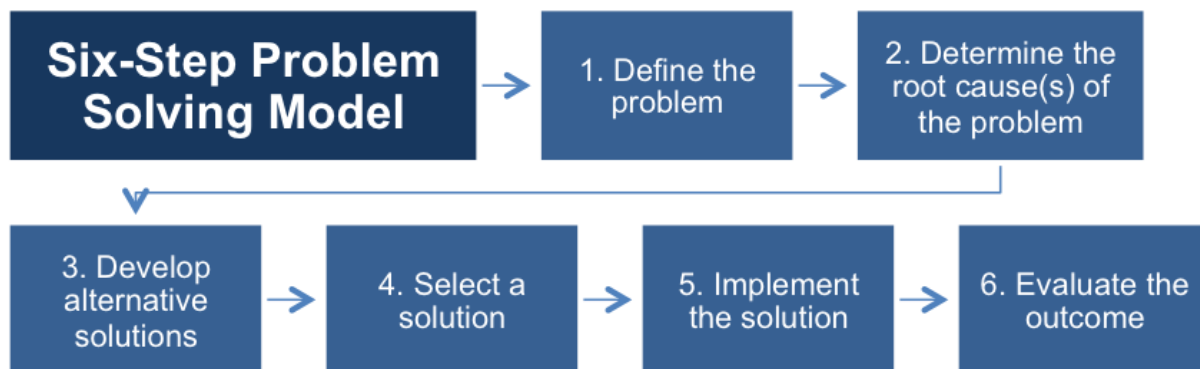
Advantages of Six-Step Problem Solving

The Six-Step method provides a focused procedure for the problem solving (PS) group.

- It ensures consistency, as everyone understands the approach to be used.
- By using data, it helps eliminate bias and preconceptions, leading to greater objectivity.
- It helps to remove divisions and encourages collaborative working.
- It stops PS groups diverging into different problems.
- It also helps PS groups reach consensus

- It eliminates the confusion caused when people use different problem solving techniques on the same issue.
 - It makes the decision making process easier.
 - It provides a justifiable solution.
- All six steps are followed in order – as a cycle, beginning with “1. Identify the Problem.” Each step must be completed before moving on to the next step.

The steps are repeatable. At any point the group can return to an earlier step, and proceed from there. For example, once the real problem is identified – using “2. Determine the Root Cause(s) of the Problem”, the group may return to the first step to redefine the problem.



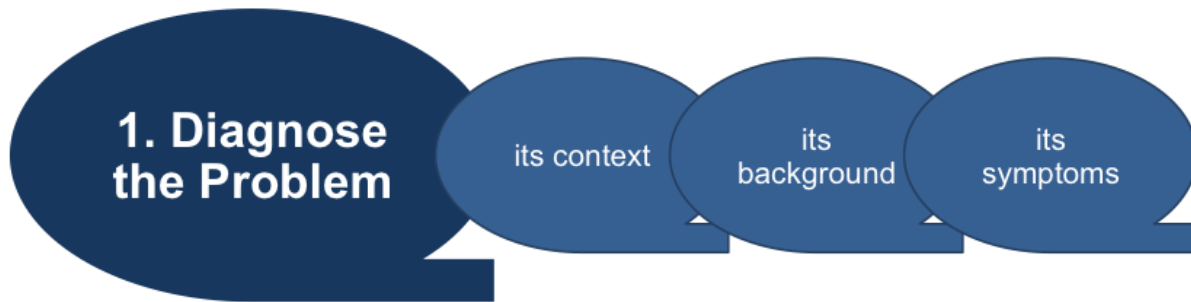
The Six Steps

1. Define the Problem
2. Determine the Root Cause(s) of the Problem
3. Develop Alternative Solutions
4. Select a Solution
5. Implement the Solution
6. Evaluate the Outcome

The process is one of continuous improvement. The goal is not to solve but to evolve, adjusting the solution continually as new challenges emerge, through repeating the Six Step Process.

Step One: Define the Problem

Step One is about diagnosing the problem – the context, background and symptoms of the issue. Once the group has a clear grasp of what the problem is, they investigate the wider symptoms to discover the implications of the problem, who it affects, and how urgent/important it is to resolve the symptoms.



At this stage groups will use techniques such as:

- **Brainstorming**
- Interviewing
- Questionnaires

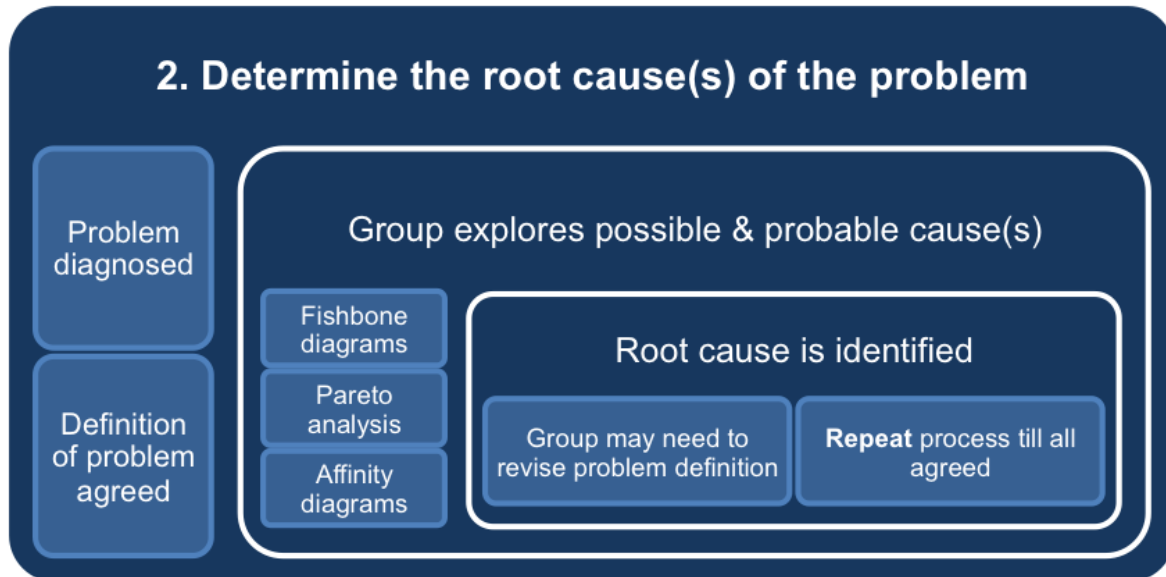
As this step continues, the PS group will constantly revise the definition of the problem. As more symptoms are found, it clarifies what the real problem is.

Step Two: Determine the Root Cause(s) of the Problem

Once all the symptoms are found and the problem diagnosed and an initial definition agreed, the PS group begins to explore what has caused the problem. In this step the problem solving team will use tools such as:

- **Fishbone diagrams**
- **Pareto analysis**
- **Affinity diagrams**

These techniques help collate the information in a structured way, and focus in on the underlying causes of the problem. This is called the root cause.



At this stage, the group may return to step one to revise the definition of the problem.

Step Three: Develop Alternative Solutions

Analytical, creative problem solving is about creating a variety of solutions, not just one. Often the most obvious answer is not the most effective solution to the problem. The PS group focuses on:

- Finding as many solutions to the problem, no matter how outlandish they may seem.
- Looking at how each solution relates to the root cause and symptoms of the problem.
- Deciding if different solutions can be merged to give a better answer to the problem.

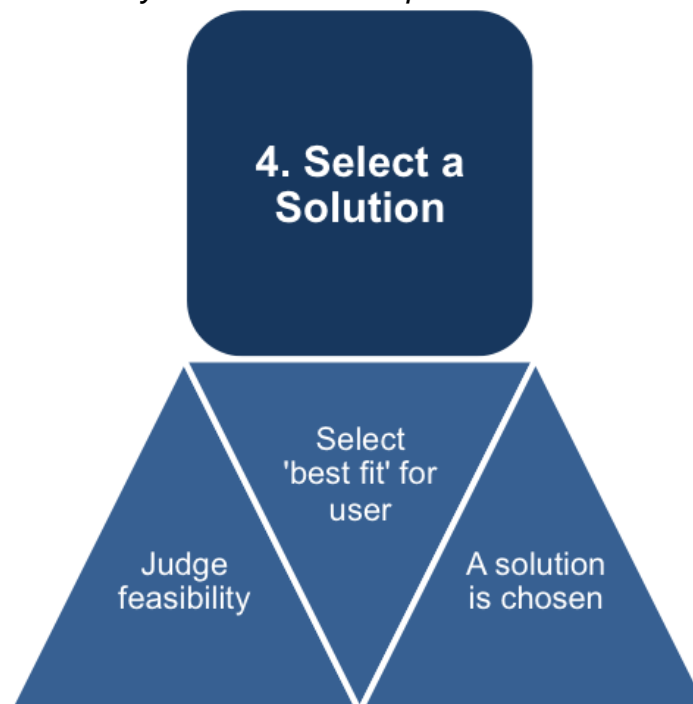


At this stage it is not about finding one solution, but eliminating the options that will prove less effective at dealing with both the symptoms and the root cause.

Step Four: Select a Solution

In the fourth step, groups evaluate all the selected, potential solutions, and narrow it down to one. This step applies two key questions.

1. *Which solution is most feasible?*
2. *Which solution is favoured by those who will implement and use it?*



Feasibility is ascertained by deciding if a solution:

- Can be implemented within an acceptable timeframe?
- Is cost effective, reliable and realistic?
- Will make resource usage more effective?
- Can adapt to conditions as they evolve and change?
- Its risks are manageable?
- Will benefit the organization/
Which solution is favoured?

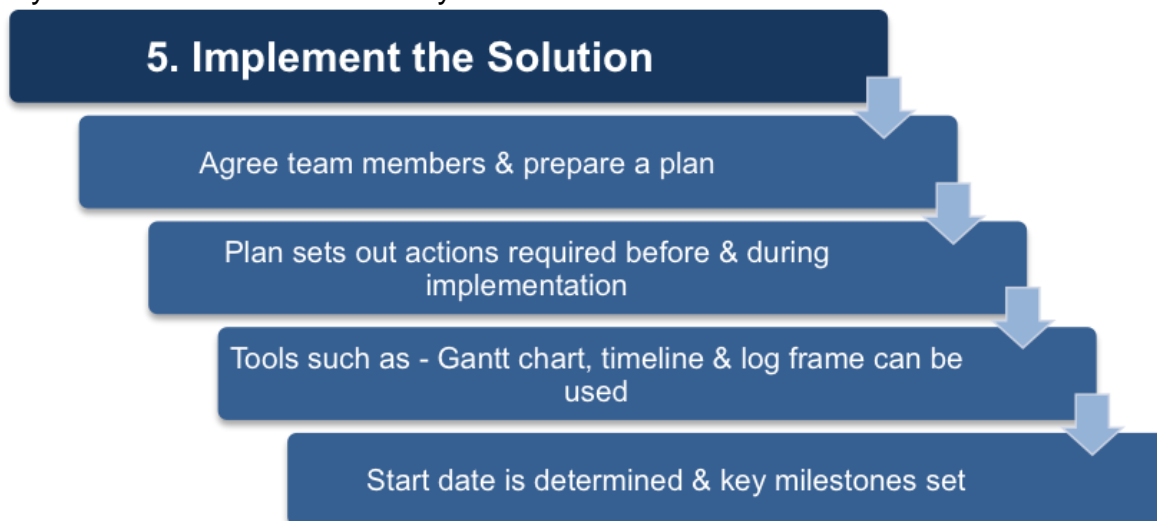
Acceptance by the people who will use and implement the solution is key to success.

This is where the previous steps come into play. To users and implementers, a solution may seem too radical, complex or unrealistic. The previous two steps help justify the choices made by the PS group, and offer a series of different, viable solutions for users and implementers to discuss and select from.

Step Five: Implement the Solution

Once the solution has been chosen, initial project planning begins and establishes:

- The project manager.
- Who else needs to be involved to implement the solution.
- When the project will start.
- The key milestones
- What actions need to be taken before implementing the solution
- What actions need to be taken during the implementing the solution
- Why are these actions necessary?



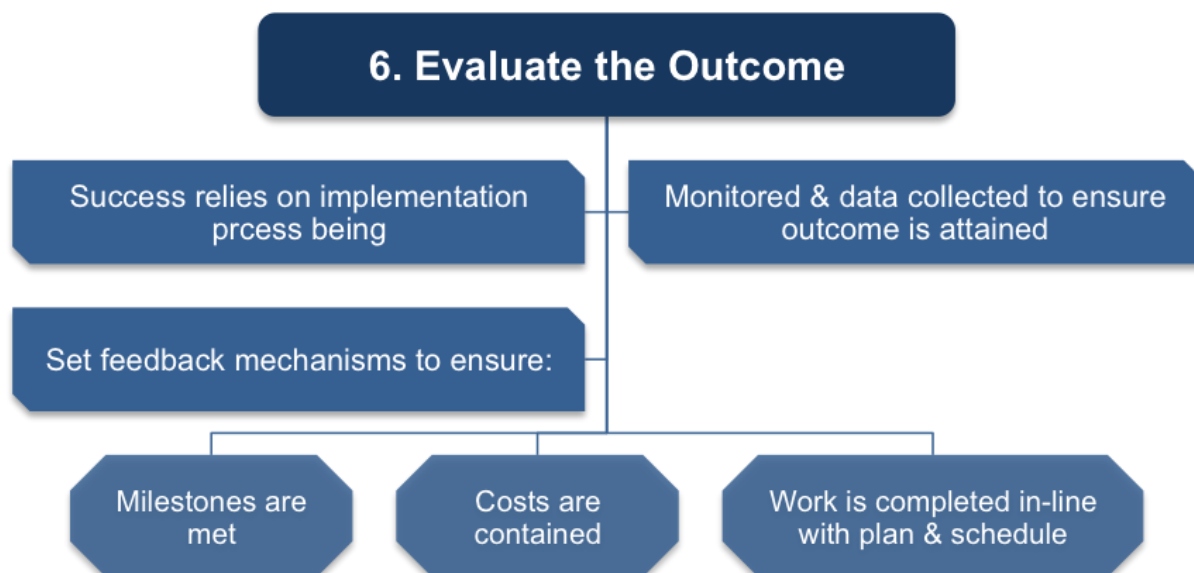
The group may use tools, such as a Gantt chart, timeline or log frame. Between Steps Five and during Step Six the operational/technical implementation of the chosen solution takes place.

Step Six: Evaluate the Outcome

The project implementation now needs to be monitored by the group to ensure their recommendations are followed. Monitoring includes checking:

- Milestones are met
- Costs are contained
- Necessary work is completed

Many working groups skip Step Six as they believe that the project itself will cover the issues above, but this often results in the desired outcome not being achieved.

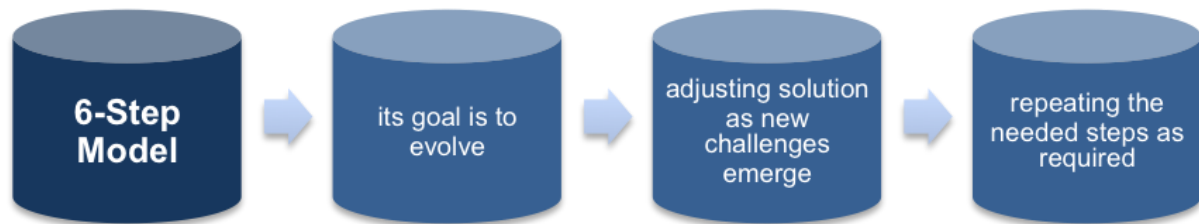


Effective groups designate feedback mechanisms to detect if the project is going off course. They also ensure the project is not introducing new problems. This step relies on:

- The collection of data
- Accurate, defined reporting mechanisms
- Regular updates from the Project Manager
- Challenging progress and actions when necessary

In Step Six, as the results of the project emerge, evaluation helps the group decide if they need to return to a previous step or continue with the implementation. Once the solution goes live, the PS group should continue to monitor the solutions progress, and be prepared to re-initiate the Six Step process when it is required.

Overall, the Six Step method is a simple and reliable way to solve a problem. Using a creative, analytical approach to problem solving is an intuitive and reliable process.



It helps keep groups on track, and enables a thorough investigation of the problem and solution search. It involves implementers and users, and finds a justifiable, monitorable solution based on data.

You can read more about the Six-Step Problem Solving Model in our free eBook '[Top 5 Problem Solving Tools](#)'. Download it now for your PC, Mac, laptop, tablet, Kindle, eBook reader or Smartphone.

Key Points

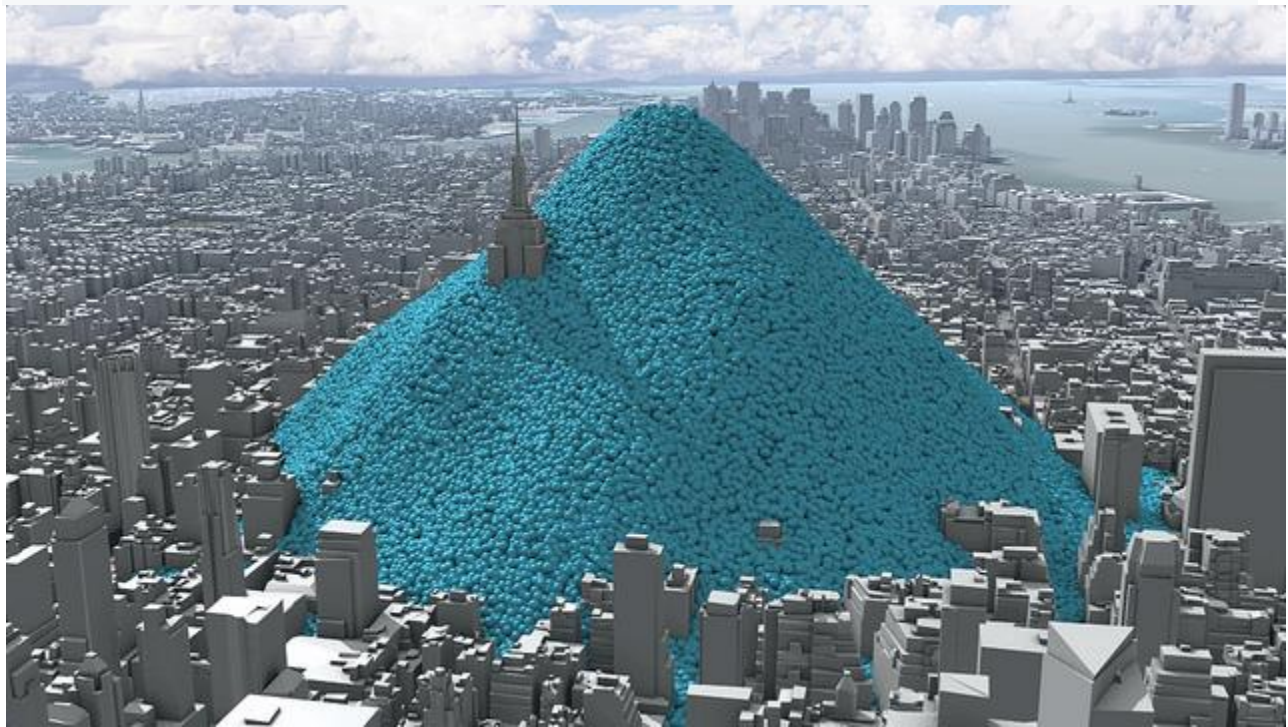
- The Six Step Problem Solving Model provides a shared, collaborative, and systematic approach to problem solving.
- Each step must be completed before moving on to the next step. However, the steps are repeatable. At any point the group can return to an earlier step, and proceed from there.
- The goal is not to solve but to evolve, adjusting the solution continually as new challenges emerge, through repeating the Six Step Process.
- Step 1) Define the Problem – Identify problems through problem formulation and questioning. The key is asking the right questions to discover root causes.

- Step 2) Determine the Root Cause – During this process, assumptions are uncovered and underlying problems are further revealed. Also, this is an opportunity to collect and analyze data.
- Step 3) Develop Alternative Solutions – Decisions are made within the group to determine the appropriate solution and process through creative selection.
- Step 4) Select a Solution – Once the group has formed solutions and alternatives to the problem(s), they need to explore the pros and cons of each option through forecasting consequences.
- Step 5) Implement the Solution – Develop an action plan to implement and execute the solution process.
- Step 6) Evaluate the Outcome – This final stage requires an evaluation of the outcomes and results of the solution process. Ask questions such as: Did the option answer the questions we were working on? Did this process address the findings that came out of the assumptions?
- This process helps keep groups on track, and enables a thorough investigation of the problem and solution search.

Top 5 Wicked Problems the World Desperately Needs to Solve.

Dr. Alan Watkins

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We are faced with countless wicked problems in the world—problems so severe and so complex that finding answers almost seems impossible.

1. Government

The theory of democracy is *majority rule*, but in practice the minority actually decides the outcome on most issues.

As a result, most modern political systems are open to manipulation of the swing vote, gerrymandering to change constitutional boundaries and horse-trading on key issues to ensure personal interests are served. Democracy bakes in dissent and is also inherently divisive. At any one time, up to 49 percent of the population are unhappy with the government and its decisions. Consequently those in power and those in opposition don't come together to solve the issues for the greater good, instead engaging in *Punch and Judy* politics. In these situations, each tries to undermine or cast blame on the other.

Governments do not reflect the will of the people. At best, they reflect the will of half the people. More often they reflect the will of a handful of wealthy vested interests who pump a huge amount of money and time into the political system to ensure that votes and legislation go their way—through legalized bribery, more commonly known as lobbying.

Government is in urgent need of a radical overhaul if it is to ever serve all of us not just a small minority of us.

2. Economy

Over the last 30 years, income inequality has widened in more than two thirds of all the countries in the world. World economists suggest that growing inequality is "*one of the biggest social, economic and political challenges of our time*" (Minton Beddoes, 2012). This escalating income inequality itself leads to a vast smorgasbord of additional and often cumulative problems within a society such

as poorer physical and mental health, increased drug use, poorer child welfare and education, increased violence and fuller prisons (Equality Trust, 2013).

If we want to create a fairer, more just world that takes care of all its citizens—not just the privileged few—there needs to be a comprehensive review of the whole economy and corporate system. We need to move away from quarterly capitalism and instead toward long-term capitalism (Barton 2011) or conscious capitalism (Mackey and Sisodia 2014). Specifically we need to address:

The deployment of capital.

The way we pay and incentivize leaders.

How we see long-term value creation as the enemy of profit.

Board and corporate governance.

The role and relationship between corporations and society.

Finally, and perhaps most importantly of all, how organizations keep score.

Unfortunately, at the moment, the only way businesses, executives and society keeps score is money. This needs to change.

3. Education

According to education expert, Sir Ken Robinson, every country on earth is reforming their public education system for two reasons:

First, they are trying to figure out how to educate their children to take their place in the economies of the 21st Century, which is pretty tough when we don't actually know what those economies will look like.

Second, they are trying to find ways to educate children to take their place in a globalized world while at the same time maintaining their cultural identity.

So far, the solutions involve doing what they did in the past and as a result they are alienating millions of children who don't see any purpose in going to school.

Naturally, this system doesn't work. For children that are academic, the rewards are no longer guaranteed and the un-academic are ignored, marginalized and resigned to flipping patties at a burger bar. There is little appreciation of abilities that fall outside maths, science, languages or sport so millions of brilliant people don't realize they are brilliant. As a result, to quote Henry David Thoreau, "*The mass of men lead lives of quiet desperation.*"

4. Health

Most health care systems are outdated, unable to adapt to the changing world or truly address the needs of an increasing population who are living much longer.

In Europe the ratio of pensioners to the working population is expected to rise from 30 percent to nearly 50 percent by 2050, adding additional funding pressure to funding a functional health care system. China and Japan are facing similar challenges.

To add to the challenges healthcare has become commercialized. In 2002, the \$35.9 billion in profits earned by the top ten drug companies in the Fortune 500 were greater than the profits of the other 490 Fortune 500 companies combined (Law, 2006).

5. Climate Change

Too little is being done because those in political power are too focused on staying in power and business is too busy placating the shareholder to be able to afford to look beyond the next quarter.

Powerful vested interests work between business and politics to deliberately dump fallacious research to hinder the debate and necessary action (Oreskes and Conway, 2011).

But action is absolutely needed. The effects of CO2 mingle with arctic methane release, water vapour reflection, solar energy effects and many other factors to create a complex spaghetti-like matrix of interconnectivity and feedback loops. These feedback loops themselves interact in a complex way but the overall effect is to accelerate global warming. There is no real doubt that we are heating up the planet 300 times faster than at any other time in our history; or, as John Schellhuber from the climate research institute in Potsdam puts it:

“The possibility of a tipping point in the Earth system as a whole, which prevents the recovery of stable equilibrium and leads to a process of runaway climate change, is now the critical research agenda requiring the concentration of global resources in a ‘Manhattan project’ style of engagement.”

He concludes that *“All other work on impact assessment, mitigation and adaptation depends on the outcome of this over-arching issue (Wasdell, 2013).*

All things considered, the only way to solve these wicked problems is to create an equally wicked but wise solution.