AC 2009-449: A METHODICAL METHOD FOR DETERMINING RESEARCH AREAS IN HEART DISEASE BASED ON THE EIGHT-DIMENSIONAL METHODOLOGY FOR INNOVATIVE PROBLEM SOLVING

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A Methodical Method for Determining Research Areas in Heart Disease Based on the Eight Dimensional Methodology for Innovative Problem Solving

Abstract

This paper describes a method of teaching individuals to systematically look at a problem and then discover research directions in bioengineering and science. The use of a previously-developed engineering problem-solving method – the Eight Dimensional (8D) Methodology for Innovative Problem Solving – coupled with scientific knowledge can aid in the development of novel solutions. The 8D Methodology is a method that uses eight major categories to direct the search for solutions to problems. In the use of science, this paper presents the novel use of this methodology to seek out more specific solutions.

This paper investigates the feasibility of this methodology when applied by an individual to the problem of heart disease, a serious problem throughout the world despite the fact that there are already many treatments available. One way to increase the number of treatments is to introduce a systematic method for developing research directions. Applying this process involves seeking out and categorizing current solutions and then using this problem solving method to develop novel solutions.

A brief introduction to the 8D Methodology is given in this paper with discussion on how this method can be adapted for training scientists and engineers to use this tool in medicine. As an example of the use, the problems of heart disease are categorized to clearly see the many ways that a patient's life is affected. Next, current solutions for both prevention and treatments are then categorized as well. Finally, the methodology is used to generate several novel directions for research.

Introduction

Heart disease is the number one cause of death in the United States.[1] Over 64 million Americans are estimated to have heart disease of some form or the other. This problem has severe impacts on people everywhere. It costs hundreds of billions of dollars each year and affects almost everyone either personally, or financially. Finding ways to effectively prevent or cure the disease would greatly increase the quality and length of lives, as well as reroute resources to improve other aspects of health and well-being.

World-wide, 17 million people die each year from cardiovascular disease, with 7.2 million of those deaths due to coronary heart disease.[2] At 13% of all deaths, heart attacks alone are the greatest killer of humankind (including non-natural causes).[3]

Researchers work on diagnosis, prevention and treatment of heart disease. Serendipity sometimes yields incredible results, but for the most part researchers hope to find solutions by systematically testing and evaluating options. These options must first be thought out and developed before they can be studied. To have a greater possibility of finding a solution, the problem should be looked at holistically and methodically. In order to teach students how to methodically study a problem, a framework to guide the process needs to be provided.

This paper describes a framework, which when added onto existing knowledge, systematically looks at the problem and finds solutions to gain an overview of current possibilities and also provides direction for new paths of research. The process uses the 8D Methodology.[4] It utilizes a compilation of various approaches to methodically develop solutions. This approach helps to avoid the situation of being at a loss for new ideas or of overlooking a possibility that could lead to the next breakthrough.

The methodology involves looking for solutions to a problem through the framework of eight major categories. These categories (Uniqueness, Dimensionality, Directionality, Consolidation, Segmentation, Modification, Similarity and Experimentation) are briefly outlined in Part C of the Appendix. Principles of these categories can be used to quickly generate a large number of possible solutions, though not solutions all are guaranteed to be feasible or high-quality. For instance, in the case of Experimentation, solutions based upon the concepts of "work it out", "estimate or guess" and "be prepared for serendipity" are used to as guidelines in brainstorming to develop an idea.

The Process

Effectively developing treatments for heart disease requires that directions for research be defined and that they then be investigated. Toward the goal of defining research aims, a systematic approach that can be applied is the 8D Methodology. This methodology consists of finding ideas that meet defined solution patterns (dimensions). Eight main dimensions are broken up into sub-dimensions to facilitate in the categorization and generation of ideas. These sub-dimensions are fully listed in the left column of the solutions in Part A and B of the Appendix. Currently available solutions can be categorized using these dimensions and new ideas can be developed by applying the principle of the dimension to the problem at hand. Not every problem has a solution in every dimension (or at least not one that is readily determined), and some dimensions may have more than one solution. Due to the somewhat different nature of purely biological problems and solutions to those typical of engineering-type problems, some dimensions do not apply or require further sub-sections for clear classifications. This process of using the 8D methodology is a way to quickly find a great number of solutions while allowing "open-minded" thinking.

The 8D Methodology may be used by individuals or teams, as described in a previous work.[4] In this paper, the 8D Methodology process was carried out by one of the authors who learned the system in an engineering context and whose knowledge of medicine is limited to some college-level study. This individual then spent several days researching heart disease and current treatments from literature and medical textbooks. During this research phase, existing solutions (treatments and prevention programs) for heart disease were categorized into the 8D categories. Because of the different emphasis and the desire to promote prevention as a different type of treatment, solutions that maintain health where separated from those that would help an ill patent recover. As a specific example of how the process was performed, the seventh category, Similarity, is looked at in detail. Here, an existing preventative solution found in literature, "take more preventative action if there is a family history of heart diseases" was thought by the individual to best fit into the category "Similarity – Look for a pattern or rule" as seen in item 7.1 of Appendix A. Also in this category "use calcium antagonists to block calcium channels and dilate blood vessels" was thought to belong to category "Similarity – Make it similar" as seen in item 7.3 of Appendix B.

The next step involved the process of using the methodology to develop new ideas for treatment. To see how quickly ideas could be generated, this individual brainstorming session was limited to around thirty minutes. Each category and sub-category was considered for both prevention and cures, including the categories that already contained solutions. Again using the seventh dimension as an example in the cure solutions, "find an organism that eats harmful substances in the blood and produces good substances, thus balancing the system (just as plants and animals exchange gases or using microorganisms to produce enzymes to degrade oil after an oil spill)" was developed in prevention for "Similarity – Look for a pattern/rule" and "develop devices that act as small cleaners and 'eat' the plaque build-up in arteries" was found for "Similarity – Look for and use an analogy" as shown in examples 7.1 and 7.2 of Appendix B. More details about the solutions that were developed are discussed in the next section.

It should be noted that this methodology is a tool and leads to solutions when provided with knowledge in the right context. While some ideas that are generated are not immediately feasible or lead directly to a perfect solution, they can spawn new ideas or provide future breakthroughs as technology develops. Also, individual opinion on the placement into categories of some items may differ, but the purpose is to best organize ideas for an individual's brainstorming session, not make definitive and universal classifications.

The Solutions

As mentioned previously, the solutions to heart disease were divided into two main areas. One is the prevention of heart disease and the other is the treatment should heart disease still occur. While some solutions could be used as both a treatment and for prevention, the methodology was applied twice focusing on these two specific areas to better generate results. All known types of heart disease (i.e. cardiac arrest, arrhythmia, etc.) were considered, and so some solutions target a specific condition and are notated as

such, though most are relevant to heart diseases as a whole. Many solutions could apply to multiple categories; however each solution was listed only once so that there is no repetition.

In the example of heart disease, preventative measures were categorized and then new ideas were also generated. The categories of Uniqueness and Similarity did not yield as many results from current research, but new ideas were found independently. Modification was clearly a fruitful category for solutions. The other categories had moderate amounts of solutions. This would seem to suggest that most research and ideas use modifications of various types to prevent the onset of cardiac diseases. Many of these involve medications or other chemical-changing substances. Focusing on these areas could lead to slightly different prevention techniques, while focusing on other areas could help to develop novel solutions.

Forty-nine existing ideas were found through research and categorized. These include "drink more water" (2.2), "have a friend or mentor to follow a prevention friend together" (2.5), "use normal chores as an opportunity for moderate exercise" (4.2), "educate" (5.1), "lose weight" (6.2) and "exercise" (8.1). Next, using the categories to generate ideas, fourteen new and novel ideas were found within a few minutes mostly concentrating on categories that had few or no solutions. Some of these ideas include "modifying plaque to become more flexible so as not to impede blood flow by allowing the arteries to dilate" (2.3), "arrange household goods and furniture to require more walking (and thus exercise)" (6.1) and "perform a 'preventative' heart transplant before problems arise" (6.3). The high number of solutions is promising since it is likely that prevention is heavily concentrated upon. The various solutions are listed in Part A of the Appendix.

Treatments can be found for those who have already developed heart disease. Again, using the methodology allowed new ideas to be formed. Every category in the Eight Dimensions had some current treatment solution that is already available. These included "use beta blockers to decrease blood pressure and heart rate" (2.1), "perform angioplasty" (2.3), "focus on treating other diseases that may be contributing to the problem" (4.2), "perform bypass surgery" (6.1), "use biofeedback" (6.6) and "perform CPR" (8.1). Currently available treatment methods amounted to thirty-nine ideas. Using the Eight Dimensions to develop new ideas in a short time period resulted in fifteen additional novel ideas, including "intentionally destroy dying heart tissue over time, so that the body can more easily compensate" (3.1), "add an additional heart to the body" (4.1), "implant small pumps in various parts of the body where flow is decreased to help maintain flow" (6.7) and "utilized enzymes to 'eat' the plaque build-up" (7.2). The full list is shown in Part B of the Appendix.

Some of the new ideas developed using this process may already exist, but were not encountered during research. During the project, several ideas were developed while generating ideas and then later found in literature upon further research. Due to a limited knowledge-base of the authors in medicine, not all ideas could be fully researched. Though an important step before starting new research is verifying that an idea is indeed

new, this was beyond the scope of this paper. In teaching a methodology to students, however, this aspect should be included.

Conclusion

Using the 8D Methodology for a medical problem had many similarities and some differences to solving engineering problems. While the overall process and categories were generally the same, the manner in which items were looked at was sometimes a bit different. Some categories were taken more literally than is typically done when solving an engineering problem. For example, sub-dimension 2.4 (reduce details) was taken more literally in the solution to "reduce the details of life that cause stress" [5,6] when in engineering this sub-dimension usually involves applying the concepts of looking from a distance or moving fast. Sometimes, however, engineering concepts can help develop new ideas in medicine. For example, using computer-aided-drafting programs for simulation has opened many new possibilities and increased understanding of many diseases and processes.[7]

The 8-D questions and categories, combined with knowledge of scientists, can be used to develop ideas for further research in the realm of heart disease as well as other scientific issues. This paper demonstrates only limited idea generation for the proposed problem of heart disease just to prove the feasibility of teaching this method. It is possible that the limitations in the initial research limited some idea generation, and lack of in-depth prior knowledge of the field was definitely a hindrance. It should be noted, however, that idea generation of new solutions could be done in a matter of minutes while the research for a similar number of currently available solutions took by far much longer. Idea generation should also be an on-going process since new observations, knowledge, experience and insights can affect the ideas generated. These will then be a start to new solutions to alleviate the problems of heart disease and possibly increase overall health of human beings.

Future Directions for New Research

This paper describes the feasibility of the use of the 8D Methodology as a problem solving method in the field of medicine. This simple process yields a quick and effective way to develop many ideas, of which a limited number of possible research directions are shown as a demonstration. The solutions presented are in no way complete as the additions from more people with greater insight and knowledge will undoubtedly yield greater results. The categorization itself may differ among individuals and spark different ideas into the direction for research. Since the results of this methodology include ideas that are of high-quality, as well as others that are not so useful, the quality and current feasibility of ideas also must be considered after this process takes place.

Some of the more promising ideas that were developed generally follow the pattern of 'using harm for good.' For example, sub-dimension 6.6 (self-modification) aided in the generation of an idea to "use a virus to modify DNA in order to reduce heart disease-causing genetic factors" as a preventative measure. Another example, familiar to nearly

everyone, is the "use of a large electrical surge (which is normally considered a hazard) to correct or restart the heart rhythm in cardiopulmonary resuscitation (CPR)," as listed in 8.1 (work it out) of the treatment categorization. Harmful agents such as viruses, mutations and foreign material in the body could be (and are currently) manipulated to perform desired tasks. This is likely the case in other fields of medical research, as well. Further studies can show if this is truly the case by teaching this methodology to engineering and science students and giving them a specific amount of time to develop ideas for solutions. It would also be interesting to follow-up and see if they liked the methodology to continue to generate ideas on their own after this session or use it in other applications that they encounter.

In addition to having this process used by others with more scientific knowledge, this process could also be used with other health conditions and other fields of study. This may involve the alteration of categories to accommodate each field. Future research will look into other applications as well.

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Appendix

Part A and B give a listing of solutions categorized and developed as solutions to heart disease. Part A is specifically for prevention and Part B is focused on treatment. Part C provides further information about the Eight Dimensional Methodology for Innovative Problem Solving.

In the listings below in Part A and Part B (solutions for heart disease), ideas are listed next to the corresponding categories. Idea sources are not explicitly referenced as most appeared in multiple sources. Items proceeded by an asterisk (*) are new ideas developed using the method.

Part A: Prevention Classification

1 Uniqueness	
1.1 Discover what dose not change	* Increase the levels of substances in the body that naturally keep arteries in an unchanging (flexible and unblocked) condition to avoid any problems from developing
1.2 Compare characteristics/features	Use a selection of patient-preferred herbs, medications, and/or activities (depending upon individual desires and needs) to work together to increase benefits of the prevention plan
1.3 Look for unique and ideal solutions	* Inhibit all aging effects and symptoms in the body so that associated effects do not occur and the individual can enjoy benefits throughout life
2 Dimensionality	
2.1 Start with less	Don't add salt to foods
2.2 Start with more	Drink more water
	Work with a team of doctors, dietitians, and therapists to better overall health, rather than only one
2.3 Manipulate time/space/cost dimensions and structure/topology/state	* Modify plaque to become more flexible so as not to impede blood flow by allowing blood to dilate the arteries
2.4 Reduce details	Reduce stress
2.5 Duplicate/repeat it	* Follow the model of healthy individuals with no signs of heart diseases
	Have a friend or mentor to follow a prevention plan together
3 Directionality	
3.1 Take it the other way around	Start a prevention plan after getting the disease to try to reverse some effects
3.2 Direct it	* Modify genetic sequences to eliminate markers / features for increased risk
	Use bile acid sequestrants to bind cholesterol and have it excreted from the body through the intestines
3.3 Change your point of view	Attend stress and/or anger management training
4 Consolidation	
4.1 Combine	Cure or reduce the effects of other diseases such as diabetes that promote heart disease
4.2 Make it multi-purpose	Use normal chores as an opportunity for moderate exercise
	Have sex with your partner to increase emotional bonds (reduces stress) as well as exercise
	Carpool or adjust commute times to reduce driving stress as well as save time and energy
4.3 Use multi-meaning/ambiguity	Eat dark chocolate for phenol content and antioxidants to aid in cardiovascular health - but not too much because the fat could be harmful!
5 Segmentation	

5.1 Learn to share and manage resources	Have as few risk factors as possible by doing as many of the items on this (and other) prevention method lists as possible
	Educate people so that they know what they can and should do to prevent heart disease
5.2 Segment/cut (in space/time)	Use garlic to help dissolve blood clots
5.3 Separate	Increase intake of high-density lipoproteins (HDL) to keep plaque from adhering to arteries
6 Modification	
6.1 Rearrange	* Move furniture in home so that more walking is necessary (you have to go around tables, etc.)
	* Put less-healthy foods in hard-to-reach places to reserve them for special occasions and also to require some exercise in retrieving them before consumption
6.2 Extract/pull	Lose weight
	* Flush out plaque yearly with specially-designed detergents or equipment
6.3 Substitute/exchange	Eat healthier by exchanging frequently-eaten unhealthy foods by similar healthy ones
	* Perform "preventative" heart transplant or blood vessel transplant
6.4 Add/subtract	Stop smoking (and don't start to smoke)
	Add foods rich in antioxidants to diet
	Reduce cholesterol from diet
	Reduce excessive alcohol consumption
	Increase folate intake to lower homocysteine levels in plasma causing vascular damage
	Eliminate C-Reactive Protein, which occur from inflammations or pregnancy / contraceptives
	Reduce sodium intake to reduce water retention in body and decrease the work the heart must do
	Decrease saturated fat intake which decreases cholesterol and reduce plaque build-up
	Decrease low-density lipoproteins (LDL) levels to reduce plaque build-up in arteries
	Reduce triglyceride levels to avoid atherosclerosis (hardening of the arteries)
	Add grape seed oil to your diet to increase HDL and decrease LDL
	Add chlorella supplements to increase albumin levels in blood which has antioxidant properties
	Add ginger to diet to lower cholesterol and reduce blood clots
	Eat more oatmeal and/or legumes to lower cholesterol
6.5 Change	Change lifestyle for a holistic prevention approach
	Adjust medications if they cause a risk factor such as high blood pressure
6.6 Self modification	Keep a journal of food intake, activities and health to determine what adjustments to make
	Use biofeedback therapy to learn to sense the condition and needs of the body better
	Use meditation to relieve stress and/or sense what the body needs
	* Use a virus to manipulate DNA and eliminate factors for heart disease
6.7 Add something in between	Use statin medication to restrict the function of HMG-CoA reductase and thus lower cholesterol
	Use ACAT inhibitors to prevent cholesterol from attaching to vessel walls to prevent blockages

6.8 Localize	Use medications to improve the health specifically of the smaller peripheral arteries, which may clog faster and cause problems such as stroke and heart attacks
6.9 Take partial or overdone action	Reduce aging effects to decrease risks for heart disease
	Eat minimally processed foods, which usually have more nutrients to increase vitamin and mineral intake and also have less sodium which is in harmful quantities in many processed foods.
6.10 Automate it	* Use a personal device to monitor blood pressures and key risk factor levels
6.11 Purify/mix	Mix in herbs, healthy seasonings and vegetables into foods for increased health benefits
	Use aspirin to keep platelets from forming clots and causing a blockage
6.12 Make it more personal	Try to have a more relaxed personality by changing personal outlook and reducing stress
	* Use personalized medications made specifically to prevent problems for the individual
7 Similarity	
7.1 Look for a pattern/rule	Take more preventative action if there is a family history of heart diseases
7.2 Look for and use an analogy	* Use a colored ribbon to raise awareness of the problem, as is done for breast cancer
7.3 Make it similar	* Develop a prevention plan that also prevents other diseases for which a person is at risk
8 Experimentation	
8.1 Work it out	Exercise to reduce stress and increase the health of the cardiovascular system
8.2 Estimate/guess	* Determine populations that may be at a higher risk for heart disease and focus more education and prevention resources to these populations
8.3 Be prepared for serendipity	Perform regular dental care for gum disease prevention, reduce the risk of an inflammation that causes heart disease – *and* also have a great smile!

Part B: Treatment Classification

1 Uniqueness	
1.1 Discover what dose not change	* Increase the body's healing response to start to grow new blood vessels in areas where cells begin to lack nutrients due to blockages or other damage, since the body always has some power to self-heal
1.2 Compare characteristics/features	Perform counseling to deal with psychological issues of heart disease and find special features in the individual that need particular focus or special consideration
1.3 Look for unique and ideal solutions	* Develop medication to immediately reverse the effects disease, such as clearing arteries of plaque with a small pill
2 Dimensionality	
2.1 Start with less	Use beta blockers to decrease blood pressure and heart rate
	Use ACE inhibitors to decrease blood pressure
2.2 Start with more	Use nitrates to dilate arteries and increase blood flow when arteries are hard or partially clogged
2.3 Manipulate time/space/cost dimensions and structure/topology/state	Perform angioplasty (use a balloon positioned is by a catheter and is inflated to open an artery) to open clogged arteries
	Use hawthorn berry to dilate blood vessels and improve blood flow
2.4 Reduce details	* Increase the heart rate to get more blood flowing (due to increased

	volume over the same time – increases blood pressure), regardless of amount plaque build-up
2.5 Duplicate/repeat it	Use hyperbaric oxygen therapy (traditionally used for divers) to help stroke recovery

3 Directionality	
3.1 Take it the other way around	* Intentionally destroy dying heart tissue over time so that the body can more easily compensate
3.2 Direct it	Perform cardiomyoplasty to force the heart to decrease in size to cure enlarged hearts
	Use magnetic field therapy to direct fields and increase blood flow
	* Implant valves along the aorta to direct blood flow to different body parts at each beat and increase pressure by selecting body sections one at a time
3.3 Change your point of view	* Determine that the disease is a chance for you to make life changes and spend more time with your family (this reduces stress and may increase exercise and lead to a better diet)

4 Consolidation	
4.1 Combine	* Add an additional heart to the body and have them work together
4.2 Make it multi-purpose	Treat other diseases that may be contributing to the problem, such as diabetes
4.3 Use multi-meaning/ambiguity	Add stem-cells, which can become any cell type to fix or rebuild damaged tissue after a heart attack

5 Segmentation	
5.1 Learn to share and manage resources	Use computer-aided-drafting software to visualize and plan procedures so that they can be performed better
5.2 Segment/cut (in space/time)	* Perform small operations over time to give the body a chance to heal itself in-between
5.3 Separate	Use chelation therapy (intravenously use EDTA to separate plaque from arteries and remove via urine)

6 Modification	
6.1 Rearrange	Perform bypass surgery (take a healthy artery from one part of the body and insert it into the heart) to allow blood flow again into heart muscle where the artery was blocked
	* Bypass the entire heart and induce the arteries themselves to act as pumps and direct the blood flow
6.2 Extract/pull	Use diuretics to reduce fluid in the body and decrease the work the heart must perform
	Cut out part of the heart to allow it to work better
6.3 Substitute/exchange	Use aldosterone blockers to block hormones from allowing fluid to stay in the heart during failure
	Add a mechanical pump to the heart to perform or aid the pumping action
	Perform a heart transplant to correct an ailing heart
	Perform a valve transplant to correct a valve deformity or malfunction
6.4 Add/subtract	Use cayenne (red pepper) to stimulate blood flow
	Use garlic to lower blood pressure and reduce blood clots
	Use ginkgo to alleviate claudication (inadequate blood supply in calf muscles)
6.5 Change	* Reduce the size of blood cells with medication so that they can pass by clogs easier
6.6 Self modification	Have the patient makes lifestyle changes that fit their needs
	Use biofeedback therapy to allow some control over blood pressure and health
	Use meditation to reduce stress and decrease blood pressure

	* Direct cancer-inducing agents to increase blood vessel growth to perform a "natural bypass"
6.7 Add something in between	* Implant small pumps in various parts of the body where flow is decreased to help increase the pressure and maintain blood flow
6.8 Localize	Destroy abnormal cells that are causing a problem in a part of the heart or vessels
6.9 Take partial or overdone action	Perform defibrillation / cardioversion (the use of a large jolt of electricity to correct the small electrical signals that regulate the heart beat) to get the heart back to the proper rhythm
	Use a large mechanical pressure on the chest cavity (CPR) to induce the small heart muscles to begin pumping once again
	Use digitalis or inotropes medications to make the heart contract stronger and increase blood pressure
6.10 Automate it	Use an automatic implantable defibrillator to jolt the heart when needed
	Implant a pacemaker to control the heart rhythm
6.11 Purify/mix	Use medical-grade hydrogen peroxide in the blood to dissolve fats on the artery walls
	Use ozone in the blood to help dissolve arterial plaque
6.12 Make it more personal	* Involve family and friends in the healing process - especially physical therapy
	* Develop specific personalized medicines for each individual
7 Similarity	
7.1 Look for a pattern/rule	* Find an organism that eats harmful substances in the blood and produces good substances, thus balancing the system (just as plants and animals exchange gases or using microorganisms to produce enzymes to degrade oil after an oil spill)
7.2 Look for and use an analogy	* Develop devices that act as small cleaners and "eat" the plaque build-up in arteries
7.3 Make it similar	Use calcium antagonists to block calcium channels and dilate blood vessels
8 Experimentation	
8.1 Work it out	Perform cardiopulmonary resuscitation (CPR) to restart a heart that has failed
	Use acupressure and/or acupuncture (pressure on the fifth thoratic vertebra) to help mend the heart
8.2 Estimate/guess	Estimate an optimal treatment plan and then test and evaluate frequently for effectiveness
8.3 Be prepared for serendipity	Use aspirin to keep blood from clotting (which also happens to have the beneficial result that some reduction in pain occurs)

Part C: Eight-Dimensional Methodology for Innovative Problem Solving

The Eight-Dimensional Methodology for Innovative Problem Solving is a unified approach that builds on comprehensive problem solving knowledge from many fields. The methodology approaches problems systematically and quickly generating solutions.

Solutions are found by systematically listing solutions to a problem by using the guidelines of the eight-dimensions listed below. The use of sub-dimensions (as shown in the left column of the lists in Part A and B above) also help to provide focus and define how to apply each dimension.

The Eight-Dimensions are:

1. Uniqueness

What is unique about the process, objects, dimensions, situations, resources, concepts, principles, features, patterns, problems or solutions?

1.1 Discover what dose not change
1.2 Compare characteristics/features
1.3 Look for unique and ideal solutions

2. Dimensionality

What could be done with space, time, color, temperature, or any other dimension?

2.1 Start with less
2.2 Start with more
2.3 Manipulate time/space/cost dimensions and structure/topology/state

3. Directionality

Could things be done from different directions or points of view?

3.1 Take it the other way around
3.2 Direct it
3.3 Change your point of view

4. Consolidation

Would it be helpful to consolidate processes, objects, dimensions, situations, resources, concepts, principles, features, patterns, problems, or solutions?

4.1 Combine
4.2 Make it multi-purpose
4.3 Use multi-meaning/ambiguity

5. Segmentation

How could division of processes, objects, dimensions, situations, resources, concepts, principles, features, patterns, problems, or solutions help?

5.1 Learn to share and manage resources
5.2 Segment/cut (in space/time)
5.3 Separate

6. Modification

What if modifications to the existing processes, objects, dimensions, situations, resources, concepts, principles, features, patterns, problems, or solutions are introduced?

6.1 Rearrange
6.2 Extract/pull
6.3 Substitute/exchange

6.4 Add/subtract
6.5 Change
6.6 Self modification
6.7 Add something in between
6.8 Localize
6.9 Take partial or overdone action
6.10 Automate it
6.11 Purify/mix
6.12 Make it more personal

7. Similarity

Why not look at similar processes, objects, dimensions, situations, resources, concepts, principles, features, patterns, problems, or solutions?

7.1 Look for pattern/rule
7.2 Look for an use analogy
7.3 Make it similar

8. Experimentation

Could estimating, guessing, simulating or experimenting help?

8.1 Work it out
8.2 Estimate/guess
8.3 Be prepared for serendipity