

ADVANCED PRAISE FOR KAIZEN AND THE ART OF CREATIVE THINKING

“In this book we learn how Dr. Shingo thinks about problems. You will not be overwhelmed by flowery prose and deep theoretical discussions in a Shingo book; what you will get is a straightforward methodology and examples to illustrate each concept.”

Jeffrey Liker
Ph.D., Industrial and Operations Engineering
The University of Michigan

“This book contains a myriad of case studies taken from office examples as well as shop floors. It is a gold mine of improvement ideas that cumulatively must have saved millions, and could still do so today!”

Don Dewar
President & Founder
Quality Digest Magazine

“Practicing kaizen (the habit of making small improvements) eludes many people. Dr. Shingo’s Scientific Thinking Mechanism replaces the hope of the flash of creativity with a reliable and learnable habit-building approach. Thanks for making this Rosetta Stone for kaizen available to the world.”

Hal Macomber
Principal
Lean Project Consulting, Inc.

ADVANCED PRAISE FOR KAIZEN AND THE ART OF CREATIVE THINKING

“Kaizen and the Art of Creative Thinking is a revealing book and is the genesis manuscript to the Lean Manufacturing mindset. It captures the fundamental thought process to structure problem solving activities and is the foundation to all essential aspects of the Kaizen philosophy. The management principles and models advocated by Dr. Shingo are precursors to the Toyota Production System. Dr. Shingo’s students like, Taiichi Ohno, are engaged as active players substantiating Dr. Shingo’s role at Toyota. Reading this book provides the underlying ethos to Toyota’s success. Truly a wealth of knowledge, wisdom and frameworks to embolden you to change existing practices!”

Michel Mestre, Ph.D.
Professor, School of Business
Northwest University

“Kaizen and the Art of Creative Thinking” focuses on the thinking portion of problem solving, making improvements and meeting opposition to the guardians of the status quo. There are a great number of improvement examples in this book to clearly explain Shingo’s points which I found extremely helpful and entertaining. Some of the information has been written about before but there are plenty of new insights to make this book a must read for those of us on our lean journey.

Mike Wroblewski
President
Victory Alliance Technologies, Inc.

ADVANCED PRAISE FOR KAIZEN AND THE ART OF CREATIVE THINKING

"This book is great. Norman Bodek has discovered another goldmine of information for us to enjoy. Shingo's earlier books were real masterpieces that described in detail the techniques and the principles behind each revolutionary practice of the Toyota Production System. They were a real windfall to practitioners of Lean as they distilled decades of knowledge and presented it with a large number of actual examples making it easy to assimilate and apply. This book goes a step further as it deals with the thinking process that underlies Shingo's genius. I think this is just what the Lean movement needs to help it spread beyond manufacturing, and into other sectors such as services and healthcare."

T.V. Suresh
President
Tao Consultants

"For those of us who have revered the work of Dr. Shingo, this is an exciting work. More so than any other of his books, "Kaizen and the Art of Creative Thinking" gives us insight into the 'how' of Dr. Shingo's developments and accomplishments. His perspective is based in practical, real-world opportunities, not encumbered by complex theory and management rhetoric."

Bill Kluck
President
Northwest Lean Network

KAIZEN
AND
THE ART OF
CREATIVE
THINKING

THE SCIENTIFIC THINKING MECHANISM

SHIGEO SHINGO

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Foreword

Shigeo Shingo has been in the background in most discussions of the Toyota Production System (TPS). Many who know of Dr. Shingo think of him as the man who contributed to rapid die change (SMED). It is clear that Taiichi Ohno was in charge of developing TPS at Toyota and he utilized Dr. Shingo's help in creating TPS. It is also clear that Dr. Shingo goes much deeper than SMED.

Shingo was a true Industrial Engineer (IE). He had a deep understanding of industrial processes and also contributed to the conceptual underpinnings of the Toyota Production System. TPS is, as *The Machine that Changed the World* declared, a different paradigm altogether than mass production. Traditional industrial engineering was very much steeped in mass production thinking. Many of the tools of I.E. were the underlying tools of TPS—standardized work, eliminating wasted motion, laying out the workplace to eliminate waste, and laying out the factory for flow. However, below the surface there were some subtle but critical differences in philosophy.

The philosophy of I.E. was based on a machine model—the factory is a machine and people are interchangeable parts of

the machine. Get the design of the machine right and figure out scientifically the one best way for the person to do the job and direct the person to do it – punishing deviations from the design and rewarding compliance. These were the principles of Frederick Taylor’s “Scientific Management” and very much reflect Western engineering thinking.

Dr. Shingo naturally gravitated toward the TPS philosophy rooted in the East. The factory is viewed as a system of humans using equipment to satisfy customers. The world is viewed as dynamic and complex and no engineer, no matter how smart, can anticipate in detail what will happen. The engineer’s design is a ball park that serves as a starting point. People then make fine adjustments and improvements every day to learn the weaknesses of the system in order to strengthen it. The people doing the work have the best vantage to directly experience the complexities of the process and to identify its weaknesses. This produces an environment where it is safe to admit problems and get help to solve those problems. Through daily improvements (Kaizen), the system adjusts and adapts to changes in the environment and grows ever stronger. While in the mass production system the process is set to roll along as designed by the engineer and entropy inevitably sets in; with TPS, however, it is the people within the system that continually improve the system, making it better and better.

Dr. Shingo was a master of Kaizen. He had the scientific training and innovative genius to deeply understand processes and the humility to realize that he needed the operators to take ownership. I heard a great story about Dr. Shingo from a former executive of Kentucky Fried Chicken. They engaged Dr. Shingo as a consultant and at that point he was quite old, rolling into one of their restaurants in a wheel chair. He immediately wanted to see the entire operation and quickly determined it was a batch process based on push. It took a long time to cook the chicken so they prepared batches in advance and then heated them when they were ordered. That meant the chicken wasn’t as fresh as it could have been and created undue waste. Dr. Shingo wanted to

know why they did not cook to order; again they explained this was physically impossible given the time to cook the chicken. Dr. Shingo then sketched out a quick cook process that would allow them to cook to order. The executive's paradigm was instantly changed in that moment. He is now one of the top executives of one of the largest banks in the world and he immediately set to work applying TPS to banking. He had no hesitation about applying TPS to this very different type of process after learning the power of Kaizen and innovative thinking from Dr. Shingo.

In this book we learn how Dr. Shingo thinks about problems. You will not be overwhelmed by flowery prose and deep theoretical discussions in a Shingo book; what you will get is a straightforward methodology and examples to illustrate each concept. Those familiar with Toyota's practical problem solving will note the similarity perhaps because of the broad influence Shigeo Shingo had on TPS. You will learn about clearly defining the problem based on facts, questioning assumptions, the power of deep observation, using association to generate ideas, and overcoming resistance to new ideas. Those familiar with Toyota's thinking know that so much of the emphasis is on the up-front processes of properly defining the problem and thinking in terms of many alternatives. This is mostly the focus of this book and it is brought to life through real life examples of true innovation.

This book will help you understand the deep thinking that underlies the real practice of TPS. Many people seem more comfortable copying other people's "lean solutions." This is completely contrary to the spirit of TPS, which is actually about grasping the specific situation, thinking creatively, and constantly challenging your assumptions. We are fortunate to have this new opportunity to gaze deeply into the thinking of one of the true geniuses behind TPS—Dr. Shigeo Shingo.

Jeffrey K. Liker, Ph.D.
Professor, Industrial and Operations Engineering
The University of Michigan

A Note from the Publishers

Norman Bodek

We have a truly wonderful gift to share with you: a “new” book written by Dr. Shigeo Shingo in 1958. A few years back, I visited Mrs. Shingo in Fujisawa, Japan; it is something I have done every other year since Dr. Shingo’s passing in 1990. On each of those visits I would look through Dr. Shingo’s library hoping to find some past treasure to translate into English. When Mrs. Shingo showed me this book I had originally thought it to be too old to have translated. But, at the urging of my co-publisher, Collin McLoughlin, we both invested our time and efforts to bring this book to you. As you will see, Collin’s intuition about this book was flawless, for this book is a masterpiece.

During the past seven years, I have been writing and teaching Quick and Easy Kaizen, a process that Toyota and other Japanese companies use to empower their employees in continuous improvement activities. Kaizen is a powerful process that can and will save the average company over \$4000 per year, per employee, if applied. I simply urge organizations to ask their employees to begin to identify small problems in their own work area, find solutions, and then implement their improvement

ideas on their own or with their work team. I ask people to make their work easier, more interesting, and to build their skills and capabilities. I request managers to simply ask their employees to come up with two implemented ideas per month. The result of this improvement activity is lower costs for the company, improved safety, improved quality, improved productivity, and much more involved and dedicated employees. *But until now, I did not teach people how to identify and solve the problems they detect.*

I unwittingly left people to their own devices on how to find and solve problems. Even though I had previously published many of Dr. Shingo's books, I did not realize that over 60 years ago he had developed a methodology called the *Scientific Thinking Mechanism* to find and eliminate problems.

After I published Dr. Shingo's *A Revolution in Manufacturing: The SMED System*, I received a telephone call from a consultant in Chicago thanking me for publishing the book. He said, "From the SMED book, I was able to help companies quickly reduce their change overs. Believe it or not Norman, I made a million dollars last year just by following Dr. Shingo's advice."

I am sure that many of you reading this book will also make a million dollars for your company by taking the material in this book and teaching the information to all of your employees.

As you read the book you will also see why Dr. Shingo is considered as one of the co-creators of the Toyota Production System and how his work has been a key in Toyota's financial success. Early on, Mr. Taiichi Ohno, vice president of Toyota, asked Dr. Shingo to teach Toyota engineers his problem solving techniques. He taught over 3000 Toyota employees.

Dr. Shingo was a master at finding and solving problems, but his greatest gift was his ability to teach others to do the same.

Collin McLoughlin

Without Dr. Shingo, the Toyota Production System would not be what it is today. In fact, a few years back Mr. Toyoda, former chairman of Toyota, was dedicating the opening of Toyota's first Chinese plant, and looked at Dr. Shingo's son, the president of Toyota China and said, "If it wasn't for Shingo's father Toyota would not be where they are today."

There has been much talk about the origins of the Toyota Production System and Dr. Shingo deserves significant credit for its creation. When you look at the life of Dr. Shingo and learn that he consulted with over 300 companies world-wide, such a debate becomes trivial. Yes, Toyota would not be the same without the benefit of Dr. Shingo's incredible mind, but if we look at the larger context of his life we see that Toyota is not the driving force behind his legacy. The fact that so many global companies entrusted their operations to his capable hands is Shigeo Shingo's true legacy.

This book has never been published in English; it is a newly discovered classic that will take its rightful place on every bookshelf along with Dr. Shingo's other great books. The book is designed to shake the foundation of the status quo. It will unveil the secret operational model that has never been seen in its entirety. Dr. Shingo's *Scientific Thinking Mechanism* is a proven model that has remained hidden for the last 50 years. Designed to systematically provide you with the method and structure to generate the ideas needed to get ahead and stay ahead. For brainstorming techniques, he teaches us how to stimulate the "silent area" of the brain where ideas are born. Most importantly, he instructs us to take objections to new ideas as advice, a powerful tool to be used when persuading people to accept improvements.

The analytical portions of this book rise above its technical nature due to Dr. Shingo's conversational writing style. His ability to illustrate points using humor and shop floor anecdotes will sharpen your mind as well as clarify your management

approach. For the first time we have the principles, framework, and insight into the mind of the *original* Lean Manufacturing genius. For decades, Shigeo Shingo was the man to call to take a good company and turn it into a *great* company. His legacy and influence still guide us today; we only need to listen.

Norman once went to a Chinese restaurant where his fortune cookie said, “You have the ability to recognize the ability in others.” How true! Norman’s influence in the West is a direct reflection of the influence Dr. Shingo had on Norman. Their professional and personal relationship continues to have a profound and everlasting impact on industries around the globe.

Finally, we would like to thank the author, Dr. Shigeo Shingo, for his passion to improve the quality of life for everyone on the shop floor. By teaching us how to tear down the walls of the status quo, he demonstrates to us how to sharpen our minds to create and direct our own destiny.

Collin McLoughlin and Norman Bodek
Co-publishers

Acknowledgments

We would like to acknowledge the hard work of the following people: Satomi Umehara, for the precision of her translation from the original Japanese text; Tracy S. Epley, for his careful editing of the manuscript; and Khemanand Shiwram for design layout and his faithful reproduction of the original illustrations. We would also like to acknowledge our indebtedness to Mrs. Umeko Shingo, wife of Dr. Shingo, for discovering this book for us.

Collin McLoughlin and Norman Bodek
Co-publishers

I PRINCIPLES OF ANALYTICAL THINKING

Science is defined as the systematic arrangement of knowledge. Systematic thinking and analysis is the key to successful problem solving and improvement.

The Edge of Night

A: What marks the boundary between day and night?

B: The setting of the sun, of course.

A: If that's the case, then why is it still light outside at sunset?

B: Well, how dark does it need to be? How about now, is this day or night?

A: This debate could go on all night. Why don't we simplify things and just call this ambiguous time period, "twilight"? Besides, it has a nice ring to it.

And so the conversation ends. Now, where do you draw the line between day and night?

Principle of Division

Let’s assume that we are dividing the people in your department into different groups. First, we can divide them into male and female. Other possible classifications are:

1. Adult or youth
2. Business assistant or engineer
3. Those who are healthy or those who tend to be sick

Principle of Division Grouping Example		Table 1
Male or Female		Gender
Business Assistant or Engineer		Skills
Adult or child		Age
Healthy or Sick		Health Performance

The method used to create grouping criteria is called the “Principle of Division.” When choosing criteria by which a group will be divided, it is important to consider what kind, and how many, divisions will be made. Furthermore, in order to prevent subsequent divisions from becoming vague or impossible, a “parent group” could be divided into a “grandparents and parents” group that is clearly distinct from one another, as in the manner of “A or not A.”

Contrast and Continuation

I said to divide clearly, but there is a problem here. In the parent group there are “contrasting groups” which can be separated clearly, as in A or not A:

- Male or female
- Business assistant or engineer

And then there are “continuous groups” in which the distinction between two is not as easy to discern:

1. Adult and youth

2. Those who are healthy and those who tend to be sick

The Principles of Division governing the separation of continuous groups, such as age or health performance, are often hard to discern. As such, making a clear division in these groups can become difficult. In other words, dividing contrasting groups is easy, but dividing continuous groups often times is not.

At what age, do you think, does one transition from youth to adulthood? When the criteria for divisions are continuous like this we need to make a clear definition. For example, we could define those over 20 as adults. In terms of health performance, we would also need to make definitions, such as those based on healthy pulse, blood pressure, etc. However, it is somewhat odd to define someone who will turn 20 the following day as youth, and one who just turned 20 the previous day as adult.

As these examples illustrate, in the case of continuous groups it is essential for dividing criteria to be as clear and distinct as possible. However, even after assigning a definition, it is possible for something to remain innately unclear. Therefore, if a parent group is a continuous group (such as distinguishing between 35 and 36 year old people), we should be fully aware of the difficulties that can arise when dividing it.

No Confusion, Yes?

Three brothers went to see their uncle in the country. He had two dogs.

Ichiro, being the oldest and tallest brother, was the first to see them. "Look, the big dog and the little dog!" he said.

Jiro, who showed up later, said, "Oh, it's the red and white dogs."

The youngest brother, Saburo, heard his brothers' voices and came out of the house. "Oh boy! The white nosed dog and the black nosed dog," he said excitedly.

The confused dogs must have thought, "They are giving us

so many different names. What will we do if they call them all at once?"

Cross Division

A similar case could happen in a more familiar situation as well. Mr. Koga, who is in charge of material procurement, made four files related to the following:

1. Yawata Steel Works
2. Fuji Steel
3. Steel plate
4. Mold steel

Now, if you have an invoice of mold steel from Yawata, would you file it in number one or number four?

Trying to divide a parent group based on two different criteria is called "cross-division," and can often lead to confusion.

In the case of "the boundary between day and night," one source of confusion stems from the fact that two different division criteria, the time of sunset and the brightness of the sky, are imposed simultaneously. Another source of confusion originates from the inherent problems of brightness being a continuous group.* Consequently, the difficulties encountered when addressing this issue could be greatly reduced if the criterion for division is limited to brightness, and a clear boundary between day and night is defined. By categorizing our thoughts in this manner, the question posed in the opening dialog could have been answered easily.

It is not uncommon for similar issues to pop up in daily conversation. For example, someone might say, "He is a stubborn capitalist, and an enemy of democracy!" This is a perfect example of cross-division.

*Astronomers have done this by classifying the intensity of light coming from distant stars.

What we need to compare to capitalism are other economic paradigms such as socialism, communism, and dictatorships that sit vis-à-vis democracy. There are, of course, other contrasting political ideas, such as internationalism versus nationalism.

When examining the differences between groups such as these it is crucial to acknowledge and properly evaluate the “gray area” that is likely to color the gap separating opposing views. Doing so can raise one’s awareness for cross-divisional errors and help to minimize passing unfair judgment onto others during emotional discussions.

Perception is Reality

Reality is the man of twenty faces.* Let’s assume that at Factory X the number of defects have steadily increased. In this case, things that should be taken into consideration are the following:

- If materials were satisfactory
- If processing methods were appropriate
- If inspections were done appropriately
- If handling of materials was proper
- If handling during transportation was appropriate
- If defects happened because materials were left unused for too long

Other things to take into account are:

- Components, hardness, strength, length, diameter, or surface roughness of the materials
- Processing machines, tools, workers’ skills, and characteristics

*Fictitious criminal mastermind, Kaijin Niju Menso (The Mystery Man of Twenty Faces), nemesis of detective Akechi Kogoro, whose exploits first appeared in an eponymous 1936 magazine serial in Japan.

- Lighting, noise, humidity, air quality, dust, temperature of the work area
- Methods of cutting, heat treatment, plating, and rust-removing
- Measuring devices for inspections, measuring environment, issues with inspectors
- The way products are placed, storage containers used, and the environment in which they are stored
- Packaging for transportation and types of transporting machines
- Whether the defect is in fact critical, considering the intended end-use of the product

This list demonstrates the extraordinary number of causes that could be contributing to the recent increase in defects. Things in reality have far more facets than we may realize. When faced with a problem like the one above, we often attempt to solve them by simply focusing on a few causes we happen to put our finger on.

Things in reality are never that simple. They include:

- Many levels of divisions
- Continuous groups, and thus qualities inherently difficult to divide
- Numerous opportunities for cross-division, which inevitably leads to confusion

It is important to acknowledge the complexity of reality; it is comprised of a multitude of internal variables.

Bigger Than a Breadbox?

When searching for the correct answer in question games such as “Who Am I?” or “Twenty Questions,” having a good memory is helpful, but having the ability to apply analytical thinking skills

is far more effective.

Among principles of division, there are parent-child or “upper and lower” divisions, and sibling or “side to side” divisions. When playing the above-mentioned games, if you get stuck asking questions from upper to lower divisions, switch to a parallel line of questioning and you can often reach the answer much quicker.

An effective strategy for using these principles as analytical tools can be demonstrated in the following example of “Who am I?” Assuming the answer is Kinjiro Ninomiya*, note how the questions are grouped, divided, and ordered to provide the most efficient path for reaching the answer. Also, note the use of horizontal divisions, as in question 5, when the child group of “Place” is switched horizontally from Tokyo to Nagoya.

Who Am I Example		Table 2a
Gender	Male or Female	
Existence	Imaginary or Real	
Time Period	Past or Present	

If the subject is in the past, what is an approximate time? (It is a continuous group, so you need to divide into different time frames.)

Nationality	Japanese or Not	Table 2b
Place	East or West of Tokyo if Japan If not Japan, East or West of Nagoya	
Job	Samurai, Merchant or Farmer	
Status	Feudal Lord or Regular Samurai	
Accomplishments	War, Financial Reconstruction, Forestation, Flood Control, etc.	

*Kinjiro Ninomiya was a prominent 19th century agricultural leader, philosopher, moralist, and economist.

If you go through these divisions in proper order, getting to the right answer is not difficult. In reality, you might be given some of the hints beforehand, so it might even be easier.

The same principle can be applied to “Twenty Questions.” In this case, divisions like the following should be added:

Life Form	Plant, Animal, Mineral	Table 2c
Dimensions	Size, Length	
Shape	Circle, Square, Undefined	
Number	Group or Individual	
Price	Approximate Value	
Ownership	Public or Private	
Movement	Mobile or Stationary	
Sense	Sight, Touch, Smell, Hearing, Taste	

Thinking in Two

The most advanced electronic statistical machine is supposed to divide in geometric progressions of two:

Divide A into A1 and A2

Divide A1 into A1-1 and A1-2

Divide A2 into A2-1 and A2-2

You can keep on dividing infinitely in this manner. Thinking in terms of two like this is the easiest method of division for humans. Nevertheless, we should be cautious not to fall into the trap of polarized thinking. We all have unconscious assumptions like the following:

Things that are not good are bad

Things that are not bad are good

We also have unconscious definitions that establish our concept of:

- Approval and denial
- Good and evil
- Long and short

Parent and child, husband and wife, brother and sister – we tend to think in terms of two, and often in polarized, fixed confrontation. But we should not restrict the natural flexibility of our mind as it tries to expand infinitely beyond that boundary. For within these divisions there are always other things that can be divided, and even still more after that, and everywhere in between. As long as we are aware of this nature of constant divisions, thinking in terms of two will be a powerful solution when trying to elucidate the mystery of reality.

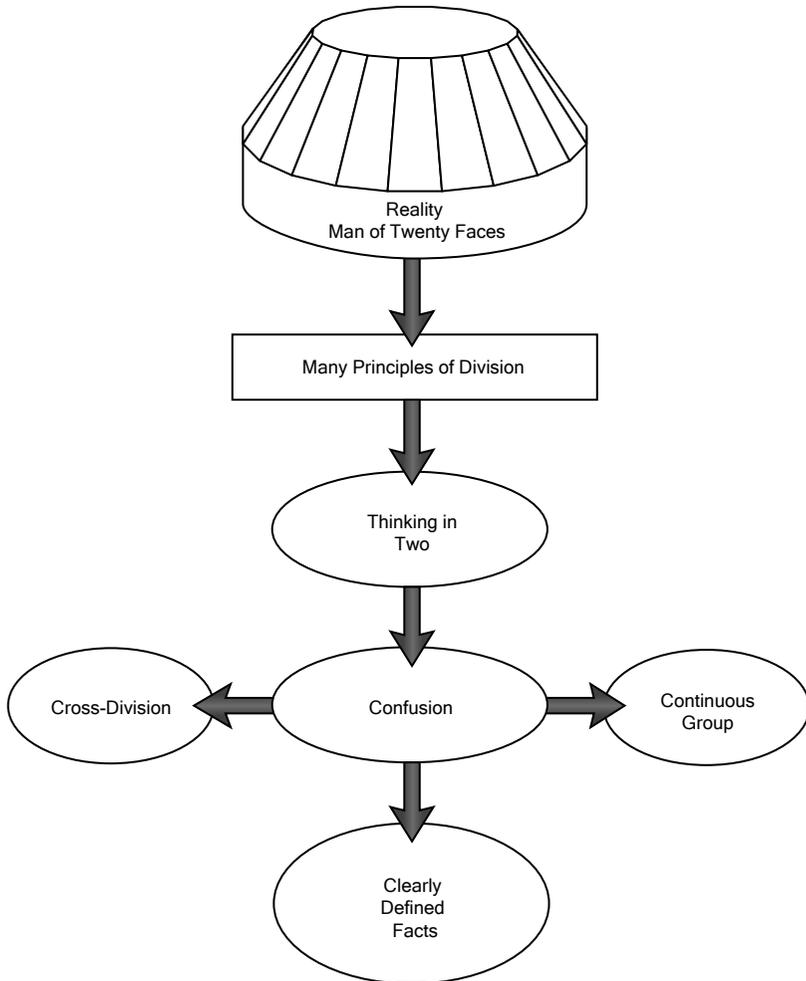


Figure 1 Reality Tree

The “Man of Twenty Faces” is a metaphor reflecting how perception defines reality and no two eyes see the same details. To get to the truth of the matter, critical analysis is needed to comprehend the entire issue in order to arrive at clearly defined facts.

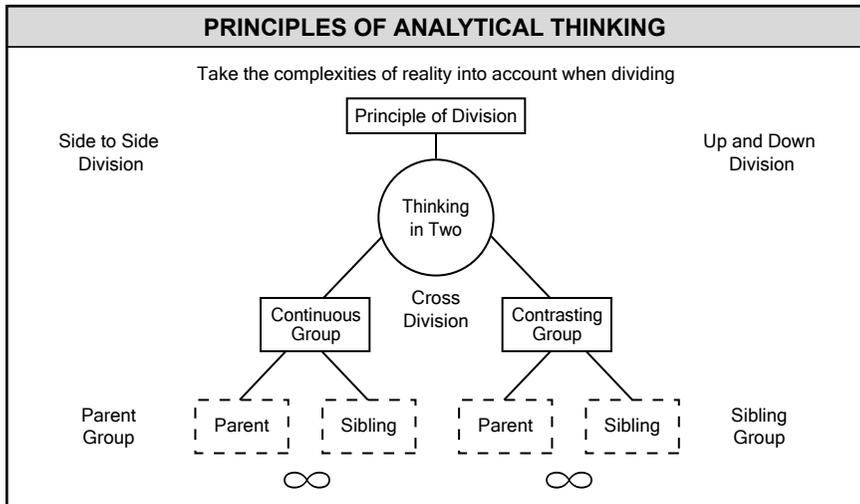


Figure 2 Scientific Thinking Mechanism Component (STM) Chapter 1

Being aware of the complexities of reality is the first step and the Principle of Division's strength lies in its ability to reduce those complexities to manageable elements. The ability to think in terms of two will provide the relative criteria grouping. Contrasting groups (man or woman, war or peace), and continuous groups (adult or youth, healthy or sick), may contain subdivisional groups which can be divided indefinitely. The ability to categorize criteria during the creative process is where this model sources its power for the individual.