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Information Measurement Theory (IMT)

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Everything is at equilibrium. Nothing happens by chance. All conditions exist. All information of existing conditions is always there. Those who can "see" the conditions and the natural laws can predict the future. Everything happens only one way. Those who cannot see are "blind." Probability exists only in the minds of the "blind." Those who are blind, do not change, cannot apply concepts of logic, and hide in complexity and technical jargon.

Information Theory

In 1948, Claude Shannon was credited with discovering the 'Information Theory' (Waldrop 2001). He stated that all communication systems are fundamentally the same. They all have a delivery speed, measured in terms of binary digits per second. Above the constrained delivery speed, the information cannot be perfectly transmitted. Below the speed, perfect transmission of information is possible, regardless of the signal strength or the static of the environment. Shannon then proposed that "perfect information" could be passed in all mediums. He realized that the constraint of communicating (or moving information) was the transmission speed of the medium and not the noise of the environment. Shannon's work became the foundation of digital technology.

Information Measurement Theory (IMT) applies the theoretical constraint identified by the Information Theory to the process of understanding information. IMT identifies that an **individual who lacks the ability to perceive and the processing speed, creates the misperception that there is a lack of information.** In actuality, all of the information always exists. In addition, the author suggests that when an individual is constrained by a lack of perception or slow processing speed, he or she is unable to see readily available information, and is forced to use his or her expertise through risky decision making. Expertise comes from an individual's database of unique and past experience, to form expectations of future outcomes when they cannot observe the future outcome. When an individual uses personal experience rather than accurate information to draw conclusions, they are applying their personal, subjective bias which is incomplete and limited. This is more commonly known as decision-making. IMT identifies decision making and bias as the major obstacles to perfectly understanding reality and the source of risk.

Traditional thinking uses the following methodology:

1. When confusion exists, identify data that can be used to understand the event.
2. If the data is insufficient, analyze the data, and complement the data with expertise.
3. Use expertise (someone's personal bias or decision making) to solve the problem.

In this chapter, the author proposes that a faster, more efficient process would identify who can observe more accurate information, and minimize the risk of the decision making "expert." Since this efficient process relies only on existing information, it eliminates the need for bias that is usually required to fill in the unknown. Therefore, the author asserts that the purpose of information-based systems is to communicate accurate information which is in simplistic terms that everyone can understand. The author will use the term "dominant" information. Dominant information can be understood by almost everyone due to its simplicity and it does not require

technical detailed knowledge that only a few may possess. Dominant information can be described as a no brainer, common sense, easy to understand, or where there is no requirement to use one's unique experience to predict the next state or future action. The motivation behind the employment of this technology is to:

1. Minimize the use of data to dominant information
2. Identify the best value or best alignment of resources
3. Minimize decision making and risk

For example, it is much easier to identify that a project manager is an expert project manager because he has finished ten projects in the last five years of \$250M scope, with complicated mechanical and electrical systems, with less than .1% time and cost deviation, and a customer satisfaction rating of 9.5 out of 10.0, than to try and identify if a project manager can perform a complex \$250M project which has complicated mechanical and electrical systems by asking the project manager detailed technical questions about the future construction project. The process of trying to identify the PM's skill by using the decision maker's technical expertise is cumbersome, risky, time intensive, and requires decision making. It is much simpler to use the dominant performance information that can easily be verified.

Information Measurement Theory (IMT)

The author developed the Information Measurement Theory (IMT) during the last thirty six years, where most of it was tested and refined optimizing the Kashiwagi home. IMT was first published in 1991 at Arizona State University as the structure for optimizing the effectiveness of information by creating "easy to understand" information environments (See Attachment 2.1). **The purpose of IMT** is to:

1. Minimize subjective decision-making through the use of dominant information.
2. Minimize the amount of data required to accurately transfer information.
3. Identify the relationship between information usage, processing speed, and performance.
4. Identify a structure (Kashiwagi Solution Model (KSM)) that minimizes the requirements for decision making, direction, and control of another entity.
5. Optimize processes by identifying and removing entities which increase risk and add no value (i.e. any party making decisions, directing, and controlling another party, with no accountability or risk).

IMT can be defined as: *"A deductive, logical, and dominant observation/explanation of an event. It includes the use of relative and related data to identify information that predicts the future outcome of the event."*

There are two major methods of problem solving accepted by the scientific arena: inductive logic or investigative and deductive logic or confirmatory (Davies 1992). Inductive logic, also known as the scientific method, follows the sequential steps:

1. Establishing a hypothesis that defines an outcome.
2. Devising an experiment that tests the hypothesis and creates representative data.
3. Conducting the experiment to discover previously unknown information.
4. Identifying whether or not the hypothesis has been validated.
5. Determining under what conditions the test results are repeatable.

Deductive logic is defined as: "The redefining or reordering of existing information to define an outcome (Davies 1992)." Deductive logic differs from inductive logic in the following ways:

1. There is no new information or theories included in the explanation.
2. The existing information is used.
3. The information is organized in a certain fashion to produce a result.
4. There is no required exploratory experimentation.
5. The experimentation is confirmatory, to run a test using the assumed deductive logic.
6. If the result matches the hypothetical expectation, it is confirming the deductive logic.
7. It is *faster, simpler, and more economical* than the inductive or scientific method.
8. It requires less technical or specialized information, which is not understood by the average person.
9. It is more dominant than inductive logic.

Deduction simplifies complex situations, allowing individuals to understand what is going on with minimal information. Deduction allows those without a tremendous amount of education and technical training of complex ideas to understand dominant concepts. Furthermore, the author advises that the term "existing information" varies depending on the perception of the individual. If an individual is more perceptive, they will tend to practice more deductive logic than an individual that perceives less information.

Natural Laws

The first concept of IMT pertains to the laws of physics or what we observe as natural laws that define the change of a physical environment over time. Laws predict the future outcome of the conditions of an event. Gravity and combustion are examples of these laws.

By definition, the number of natural laws never changes, but rather stays constant over time. As time progresses, scientists continue to discover more of these existing physical laws (description of how conditions change over time.) For example, the law of gravity existed before it was "discovered," predicting where objects would and would not fall.

It is also possible that scientist may unknowingly identify a law inaccurately or incompletely during one period of time, and discover at a later time that the law had been defined inaccurately or incompletely. It is important to understand that laws are not created, but discovered. Hawking's "No Boundary Theory" demonstrates this concept (1988). Hawking states that time and space are boundless. Anywhere that someone has attempted to identify a boundary, the same conditions have been found to exist outside of that boundary. Therefore, at any one time or at any one location, 100% of the natural laws exist (Figure 2.1). Information is the accurate perception of the laws and their measured impact on the conditions of the environment.

Therefore:

1. All laws exist at all times and all locations.
2. All environments are measurable.
3. The application of laws on the environment will change the environmental conditions, which can be measured.
4. If the laws and environment are understood, a person can predict what the change in conditions will be before the change is made.



Figure 2.1: Number of Natural Laws

“Event”

The second concept of IMT is an “event.” *IMT defines an event as “anything that happens which takes time.”* An event has initial conditions, changing conditions throughout the occurrence, and final conditions. The number of laws stays consistent throughout the event and dictates how the conditions will change through the event (Figure 2.2).

The following are characteristics of events:

1. Every event has a unique set of initial conditions and a unique set of final conditions.
2. At any one time period during the event, there is only one set of unique conditions.
3. The number of the laws of physics remains constant throughout the event.

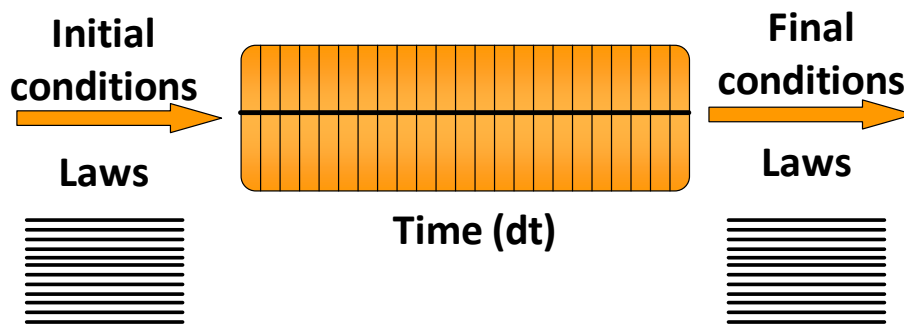


Figure 2.2: The Event

4. Before the event occurs, two individuals with different levels of perception may look at the same event's initial conditions, and perceive two different outcomes. However, the event will only have one outcome. The individual, who can observe the initial conditions more accurately, will have the more accurate description of the outcome.
5. No event has ever taken place where the outcome is not affected or dictated by the initial conditions or previous state. Nor has any segment of the event been found that is unaffected by the previous segment.
6. All events and all segments of events are bound by natural law or cause and effect.
7. Every event is constrained by initial conditions and laws, and its outcome is predictable if all information of the initial conditions is perceived. If the information of the initial conditions is not understood, there is still just one outcome. However, the future outcome cannot be predicted.
8. Conditions usually can be measured in terms of the number of items or amounts.
9. The more information that is perceived of the initial conditions and laws, the more accurate the prediction of the final outcome.
10. The shorter the event, the less information is required to accurately predict the final outcome.
11. The change in the events conditions from one time to another, the event can be identified in terms of measured differential.
12. Randomness and probability are methods of estimating the final outcome when there is a lack of information about the initial conditions (and the laws of physics governing those conditions). True randomness does not exist (Bennett 1998). The fact that we do not have the methods or means to accurately measure two linearly related characteristics of particles at the same time is the only reason the Heisenberg Theory is valid (Feynman 1994). Einstein was criticized for refusing to accept the premise of randomness (Penrose 1989), but today, science understands that the inability to measure creates the illusion of randomness.

No actual random number, event, or object exists (Davies 1992). Einstein was correct. All the other highly technical, blind scientists were wrong. There is no true randomness. It is a perception caused by a lack of perceived information.

13. Every person and every factor impacts an event to a relative degree. IMT does not attempt to explain in entirety why a person is in an event, but it does state that the person is a part of the event and will impact that event. Because each individual is predictable or constrained (constraints make everyone unique) an individual's decision-making patterns and future actions are predictable with all information. Therefore, when "all" information is perceived, any event can be predicted, even the future action of human beings.
14. Characteristics describe people. People can be differentiated by differences in characteristics. Characteristics are similar to conditions. Both can be measured, change over time when exposed to the environment, predict future outcomes/conditions, and both identify unique combinations that define people or environments.
15. Longer or more complex events require more facts about the initial conditions and laws in order to predict the outcome.
16. This identifies that differentiating between two very similar entities, requires more information.
17. No event exists independently from other events. Every occurrence is relative and related to every other occurrence.

Perception of Information and Processing Speed

One of the most difficult factors to predict is the future action of an individual or an organization. Every individual is different (location in time and space being the most obvious). Each person exists in an environment that contains "all" laws and an environment that is measureable. However, no person can accurately perceive all the laws and measurements. The cycle of learning (Figure 2.3) was created to explain how a person's perception changed and how the rate of change could be used to predict their future behavior. To change, individuals must perceive information that was not perceived before, process the information, and, if they understand the information, apply it. The application of newly perceived information causes change, and, by observation, change leads to the perception of more information. This is called the "Cycle of Learning" (Figure 2.3).

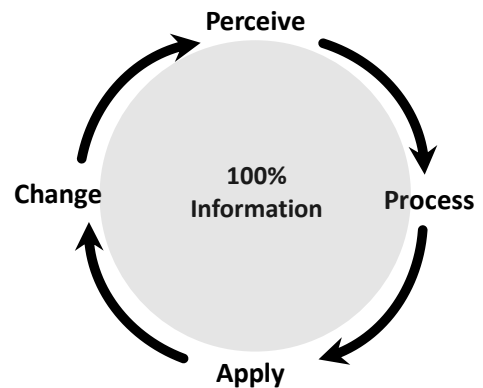


Figure 2.3: Cycle of Learning

The study of mathematics is an example of this learning cycle. A person first learns to add and then to subtract. The person then learns to multiply and divide. This cycle of learning continues as individuals are taught to perceive and understand algebra, geometry, trigonometry, and calculus.

By observation, *the more cycles of the learning cycle that are experienced, the faster the individual's cycle's speed becomes.* By deduction, those with higher processing speeds have faster change rates, perceive more information, and are more skilled and faster at applying new and existing concepts. The following are deductive conclusions:

1. The application of information and the ability to change is easier to measure than the perception rate and/or processing speed.
2. There is not enough dominant (simple) information to identify a person's processing speed or level of perception. Therefore, it requires more technical expertise and details, and becomes a technical/biased decision for an expert.
3. The more information that is perceived, the faster the rate of change. Those who are resistant to change have difficulty in perceiving information that is already there.
4. Those who change slowly are not as open to new ideas.

Figure 2.4 shows three different individuals (labeled Type A, B, and C), which represent people who utilize different amounts of information. The Type A person is very perceptive, uses more information, is the best at applying concepts, and changes the fastest. Type B is between Type A and Type C.

Figure 2.4 shows the three individuals' amount of perceived information over time and plots their rate of change over time. The speed of change increases as the individual goes through more cycles of learning. Therefore over time, the curve is exponential. The Type A person changes the fastest. The Type C person changes the slowest, and also perceives the least amount of information. A deductive approach to society will recognize that there are more Type C people than Type A. This is easy to identify as most people cannot see into the future, think of themselves first and do not like change.

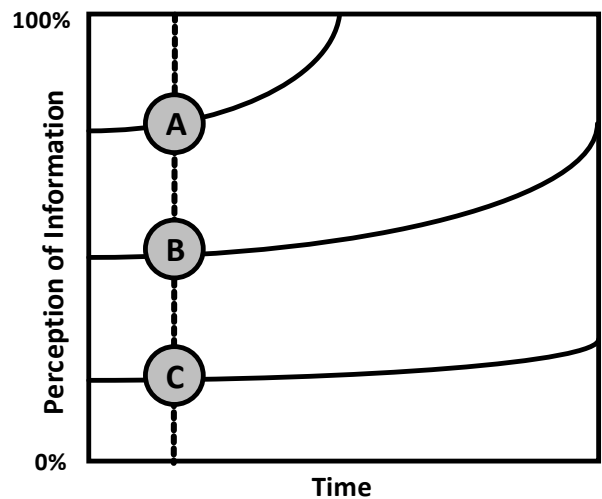


Figure 2.4: Rate of Change

Within any environment, there are individual's at all different relative learning levels. No person is more important, or better, than any other person in the environment or event. Every person is a part of (and essential for) the event. No one has any proof that the event can happen without all of its parts. Therefore, there are no people who are less important or not right for the event. The event can happen in only one way. The level of a person's perception at a specific time is defined by the following (see also the explanation of Who is on my Molecule (WIOMM) in Chapter 5):

1. A perceived environment represents the level of perception of the person. Or commonly stated, a person's perception is their reality.
2. All of the individuals who are in the environment of an individual in some way are related to the individual.
3. A combination of factors (i.e. genetics, occupation, financial status, birth date, etc.), are related to the person's environment, ability to perceive information, and processing speed.

A person's environment can be deduced using the following assumptions:

1. A person can be defined by a combination of factors and measurements.
2. The person's environment can be defined by the same combination of factors and measurements.
3. The person's environment, the person, and the description of the environment are three different views of the same event.
4. Every point in time is at equilibrium.
5. At every location, a person, an environment and the level of information are at equilibrium as defined by Figure 2.4.

IMT does not address the “which-came-first-the-chicken-or-the-egg?” argument. The environment describes the person or entity, and the environment cannot be described without the person. There is no differential between the measurements of an entity and the environment of the entity at a particular location and at a specific point in time. **Therefore, the environment or event is the person at a point in space.**

Every person possesses a unique level of perception and information (Hawking 1988). The restriction is not whether the information exists, but the individual's ability to perceive and process the information. IMT identifies differentials (criteria) between individuals. No two individuals have the exact same combination of measurements. Table 2.1 is an example of the differences between two people. The combined values for all of the different factors create an individual's unique identity. Each of the aforementioned factors has a relationship to the individual's capacity to perceive, process, and apply information. **Therefore, all characteristics are relative and somehow related to information.**

CRITERIA	INDIVIDUAL 1	INDIVIDUAL 2
Education level:	21 Years	13 Years
Financial status:	\$100K/Year	\$27K/Year
Location:	North America	Asia
Time of birth:	5/5/1965	5/5/1950
Type of government in environment:	Democracy	Communism
Family size:	8	2
Birth order:	Last	First
Genetic makeup:	Unique	Unique
Occupation type:	Engineer	Farmer

Table 2.1: Differences in Individuals

Use of Dominant Information and Minimization of Decision Making

Figure 2.5 shows two individuals (B1 and B2) who are very similar in terms of processing speed, amount of information perceived, and rate of change. To differentiate and predict the difference in a future time period between B1 and B2 requires more information than to differentiate between A and C. This information may not be easily and economically acquired. Within our current methodologies and measuring tools, this necessitates extensive statistical analysis with large amounts of data from a purported random and representative sample. It usually is too costly and impractical. To avoid decision making and extensive statistical sampling, IMT focuses on the two extremes, the Type A and C, where deductive logic and observation of dominant differences can be applied instead of the more costly and complex inductive logic. Because IMT already has identified that everything is related and relative, the most important information is to identify what are the characteristics of the Type A and Type C. IMT concepts are, therefore, identified from the deductive and dominant comparison between the extremes of Type A and Type C. This is the foundation of the Kashiwagi Solution Model or KSM, which will be discussed in the next chapter.

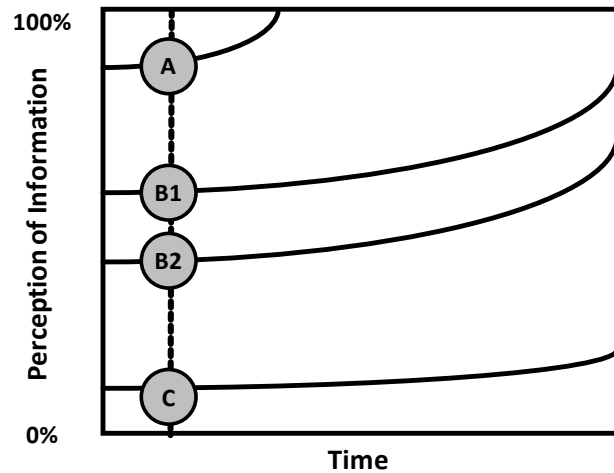


Figure 2.5: Rate of Change
of Similar Individuals

Conclusion

IMT states that natural laws and initial conditions define all events, and all event outcomes are predictable with all information. Events happen one way, but may be perceived as potentially happening in various ways by individuals with different abilities to observe and accurately accept the initial conditions. Randomness exists due to a person's inability to perceive and measure "all" information; it is a methodology of potentially understanding what may be going on, by analyzing large samples of data in the absence of the ability to perceive or measure information. If an individual obtains "all" information, they are able to simply observe and predict a person's actions or an event. A person with all information understands that events have only one outcome. A person with common sense and skills of observation can predict the outcome.

However, the author does realize the following:

1. No individual can perceive "all" information.
2. There are always more Type C people than Type A people in every environment, because most people cannot predict the future outcome of an event, if it involves people.

Chapter 2 Review

1. Define IMT.
2. Does the number of laws: Increase over time, decrease over time, or remain constant over time?
3. Does not having enough information on the input of an event change the output of the event?
4. How many ways can an event happen?
5. Can an event have two outcomes?
6. Are all events and individuals predictable?
7. Is there any event that is random? Why or why not?
8. What happens to the speed of the learning cycle as individuals go through more cycles of change?
9. Are any two individuals exactly the same? Why or why not?
10. Who is more important in an event, a scientist or a janitor? Why?
11. Is it better to live in Afghanistan or America?
12. Are wars necessary in the History of Mankind? Explain.
13. What would qualify as a "wrong" event in the "History of Mankind?"
14. Should individuals be treated the same or differently? Why or why not?
15. Illustrate the number of Laws of Physics over time.
16. Illustrate an Event.
17. Illustrate the cycle of learning.
18. Illustrate the rate of change figure.
19. Why is the person the same as their environment? Give an example.
20. What happens to time if you have more information?
21. What is the relationship between the level of information and decision- making?

References

- Allen, James (1845). *As A Man Thinketh*.
- Bennett, D.J. (1998). *Randomness*. Massachusetts: Harvard University Press.
- Davies, P. (1992). *The Mind of God*. New York: Simon & Schuster.
- Feynman, R.P. (1994). *Six Easy Pieces: Essentials of Physics*. California: Addison-Wesley Publishing Company.
- Hawking, S. (1988). *A Brief History of Time – The Updated and Expanded Tenth Anniversary Edition*. New York: Bantam Books.
- Kabat-Zin, Jon (1994). *Wherever You Go There You Are*.
- Penrose, R. (1989). *The Emperor's New Mind: Concerning Computers, Minds and the Laws of Physics*. Oxford: Oxford University Press.
- Waldrop, M.M. (2001 July/August). Claude Shannon: Reluctant Father of the Digital Age. *An MIT Enterprise Technology Review*, pp.64-71.

Attachment 2.1: Theorems of IMT

The following theorems provide the framework of IMT:

Theorem 1: Laws are accurate explanations of reality, which allows a person to predict the future outcome or conditions of a physical event.

Theorem 2: Physical/natural laws supersede both time and space. Every physical law exists in every space. Each space has the same number of physical laws at all times.

Theorem 3: All events are predictable. Therefore, Theorem 2 must include not only physical laws, but also all laws, that govern human behavior. All laws are natural laws or "not made" by man.

Theorem 4: Physical laws are discovered, not created. Laws exist before they are discovered and are merely perceived by the first individual who can quantify the event and implement the quantification to accurately and consistently predict the outcome of the occurrence.

Theorem 5: Information is defined as: the laws and conditions that describe the event at a point in time, including the environment. Information can predict the future outcome of an event.

Theorem 6: All information exists at all times. Information must be perceived. People's lack of perception, not a lack of information, creates different expectations.

Theorem 7: "More" information is better than "some" information, and "some" information is better than no information.

Theorem 8: The IMT's objective is to predict the outcome of an event, not to judge whether an event is right or wrong, good or bad.

Theorem 9: Anything that happens is an event.

Theorem 10: There are no actual random events or patterns. No random pattern has ever been created or discovered.

Theorem 11: Every event represents cause and effect (input/output).

Theorem 12: Every point in time and space is at equilibrium. The measurement of two adjacent points will always be the same.

Theorem 13: Since everything occurs for a reason, if an event does not happen, there is no reason for the event. There is also a reason or cause for every part of an event.

Theorem 14: All components of an event are required for the event to transpire.

Theorem 15: There is no evidence that leads to the conclusion that a "different" event can replace an "existing" event in the larger event of the "History of Man."

Theorem 16: Any event with the same initial conditions happens the same way in all space and over all time. Caution must be taken to ensure that the event initial conditions are exactly the same.

Theorem 17: There is no "new space." All space exists prior to discovery.

Theorem 18: All individuals possess a certain level of perception (understand a percentage of the existing physical laws), which allows each of them to predict certain outcomes of events in their lives, with a particular level of accuracy.

Theorem 19: A person's perception represents who the person is.

Theorem 20: A person's ability to predict is relative to their understanding of the event.

Theorem 21: The intensity of emotion, or the degree to which an individual becomes disoriented with an accurate and full integration with an event environment, is an indicator of their lack of understanding of some part of the event environment.

Theorem 22: The more information perceived by an individual, the shorter and simpler an event seems. The less information perceived by an individual, the longer or more complicated an event seems.

Theorem 23: Longer events must be shortened in order to minimize decision making, for more accurate predictions.

Theorem 24: If the event duration dt is zero, only one set of conditions exists. The input is the output.

Theorem 25: The shorter the event, the fewer decisions must be made. If the event time is zero, there are no decisions to make because nothing changes.

Theorem 26: Each event can be subdivided into many "finite elements" (events that have only one input and one output. The input of the first and the output of the last finite elements are the event's input and output.)

Theorem 27: Since each finite element has only one input and one output, each event, which is comprised of many finite elements, has only one input and one output. Holding dt constant, each event has only one input and one output. If an event has a different output, then it must have a different input. Therefore, given "all" information about the input, each event becomes predictable: one output for one input.

Theorem 28: Not perceiving the information about the input does not change the output of the event. It simply impacts an individual's ability to predict the output. However, if a person perceives more information, he or she could change the event (in which case the person would be a different individual and the event would be different).

Theorem 29: A person faces a decision when he or she does not perceive all information. The individual must then make a decision on which "expected" outcome he or she thinks is the best choice.

Theorem 30: If all of the information exists and someone perceives all of it, the person does not need to make any decisions because the outcome cannot be changed.

Theorem 31: There is no "chance" or unpredictable event.

Theorem 32: There is no randomness. Randomness, probability and statistics are used to understand what is currently happening in the absence of complete information.

Theorem 33: The cycle of change requires the perception of information, the processing of the information, and the application of the information. By nature, it is a cyclical process.

Theorem 34: The rate of change increases as the individual or entity repeats successive cycles of change, learns more information, and is able to process and apply the information quicker. A greater rate of change requires a greater level of perception.

Theorem 35: A person's rate of change correlates to his or her ability to perceive, process, and apply new information. The "more intelligent" person changes at a faster rate and is able to more consistently predict the outcome of events. The "less intelligent" person changes at a slower rate.

Theorem 36: Individuals who change at a very slow rate are "less perceptive," have more difficulty identifying differences, and feel very uncomfortable with a changing environment.

Theorem 37: All individuals have a change rate. No individual stays the same, even if the person's change rate is very slow. It is impossible not to accumulate information over time.

Theorem 38: All individuals are changing in a positive direction. All individuals are improving their perception of more information. There would be multiple outcomes if an outcome could be a plus or a negative. Also, there is no logical reason for someone to exist, to go into a slower or more negative direction.

Theorem 39: All individuals are constrained by their capability to perceive and can only change at a predictable rate.

Theorem 40: An individual is fully responsible and has full control over his or her own actions, decisions, and future environment. This will be discussed more in the next chapter on KSMs.

Theorem 41: A person or entity's environment represents that person or entity and can be used to predict a future state or outcome of the person or entity.

Theorem 42: If the environment represents the person, measuring the person or the environment can identify the performance of an individual.

Theorem 43: A very perceptive person does not have positions of right or wrong within an event.

Theorem 44: A perceptive person does not use personal bias, because the perceptive person has no position or bias.

Theorem 45: A perceptive person makes no decisions. The perceptive person uses information that accurately defines the initial conditions, and then uses the information to predict the future outcome, and initial conditions become the future outcome.

Theorem 46: An "information" person allows the information of the initial conditions to dictate the future outcome.

Theorem 47: Individuals who do not perceive a lot of information find it harder to believe that everyone is different, because they lack the information to tell the difference. Individuals, who cannot observe, may also take the opposite approach and identify themselves as different, because they cannot see that everyone else's environment is so aligned with their environment.

Theorem 48: If performance is predictable, the environment is the person, and performance is the person's capability to apply information, then every individual is "doing what he or she can" or is "doing the best that he or she can." Therefore, every person is constrained by his or her capability to perceive.

Theorem 49: What you see is what you get. There are no such persons as "hypocrites," "underachievers," or "overachievers." These are terms used by individuals who do not have enough information to identify people's real position.

Theorem 50: The initial conditions fix the final conditions.

Theorem 51: No person can control, change, or influence the event once the initial conditions are fixed to change the final conditions to something that is not related to the initial conditions.

Theorem 52: Risk is caused by an inaccurate perception of the initial conditions.

Theorem 53: Risk is the difference between what one perceives and expects and what is actually happening due to the initial conditions.

Theorem 54: Risk is caused by decision making at the beginning of the event.

Theorem 55: Risk is when an individual cannot see into the future of the event, and expects something else based on the lack of accurate information