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RECOMMENDATIONS FOR THE PRACTICAL USE OF ELLIOTT  
JAQUES' ORGANIZATIONAL AND SOCIAL THEORIES IN THE  
INFORMATION TECHNOLOGY FIELD

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# **RECOMMENDATIONS FOR THE PRACTICAL USE OF ELLIOTT JAQUES' ORGANIZATIONAL AND SOCIAL THEORIES IN THE INFORMATION TECHNOLOGY FIELD: TEAMS, SOFTWARE, DATABASES, TELECOMMUNICATIONS AND INNOVATIONS**

**Sergey Ivanov<sup>1</sup>**

## **1. INTRODUCTION AND THE PROBLEM OF UNIVERSALS**

The problem of universals is a profound abstract question that quests into the nature of our knowledge, which our civilization has been querying for the past several millennia – this large abstract problem, Artz (2002)<sup>2</sup> writes, has been known to the modern world from the ancient Greek philosopher Plato. Such as, how do we know the true identify of the object and fit the identity into a true classification so that we could understand and attribute to this object? There are multiple problems with identifying a true identity, for example, how do we know what the true identity of the object is? Is there such a thing such as the true identity or are there multiple true identities? Could we really classify the objects even if we knew the true identity(s) of them? And what is classification? Does it exist in the world as a true relationship between identifiable objects or it is just a human way of ‘languaging’ a common understanding? Artz (2002) elaborates in depth on the problem of universals in information modeling, finding that both essence in the same issue – difficulty of classification, or how do you know a thing is a thing and that it belongs to the class of the thing? How do we know what makes a thing thing; and what properties relate things?

The problem of universals is at the core of information and social sciences today – to make progress in either or both, it is required to understand the basic constructs and logically relate them together to construct a more abstract and logical relation of the constructs to form a theory how things ought to work to allow humanity to achieve its purposes in the specified field(s). The word progress in this context means that society is

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<sup>1</sup> Sergey Ivanov, The George Washington University, Washington, D.C., 20052, U.S.A.

<sup>2</sup> Artz, John (2002). Information Modeling and the Problem of Universals: an Analysis of Metaphysical Assumptions. The George Washington University: Unpublished Paper.

able to achieve its goals within a certain time, such as building a better information system within one year, or creating a new technology product within three years, and so on. Furthermore, the necessity to understand basic constructs or “smallest universals” does not imply an inductive approach – the author believes that a deductive approach, such as a greater understanding how larger things work together, helps identify smaller units, but this paper avoids discussing deductive or inductive approaches to understanding and establishing theories – this discussion is out of scope of this research.

The major issue of the information and social studies of today is the deduction of the problem of universals in these fields – there is no well-tested, defined and explained understanding how to group and relate things, and furthermore, many phenomena remain unexplained and ambiguous, for example, not well defined concepts of phenomena of organization, conflict, excellence, intelligence, capability and many others that are used in management and information systems studies nowadays. Tackling the problem of universals in the fields of information technology and management could transform our society for the reasons of gaining understanding how things that constitute each field relate, and how it is possible to influence some things to achieve results for the larger society within a reasonable time. Solving the problem of universals is very difficult, though, some significant progress has been achieved, and is presented in this paper; also items remaining to be discovered and clearly identified are briefly discussed in this paper as well.

## 2. THEORETICAL BACKGROUND

### 2.1. Two-dimensional Time

Dr. Elliott Jaques, a Research Professor at The George Washington University and author of many books, is the prime discoverer of key findings that offer science-based theoretical propositions for the social sciences. These discoveries, some of which are not new to the civilization – many have been discussed by St. Augustine and other ancient thinkers, are new to the modern world, and include a new understanding of time<sup>3</sup>, biological life, and some ideas about complexity, but this last issue is still in the works.

The first proposition is that our present understanding of time is inaccurate and not sufficient to understand the biological life. The clock time, the one that is most understood by the researchers and the society in general, measures how long it took for the events to occur – Elliott Jaques calls it time of succession<sup>4</sup>. Dr. Jaques mentions that ancient Greeks called this aspect of the time phenomenon Chronos, and he proposes to think of it as a dimension of time. The other (or perhaps future researchers may call it another should they discover more time dimensions) is the time of intention, or as Dr. Jaques writes ancient Greeks called it Kairos, the time of opportunity. This is one of the most crucial findings that allows for a better understanding of social sciences: time is two-dimensional consisting of the dimensions of succession and intention, or how long it took for the event to occur (natural sciences event), and by when someone intends to achieve certain results (social sciences event).

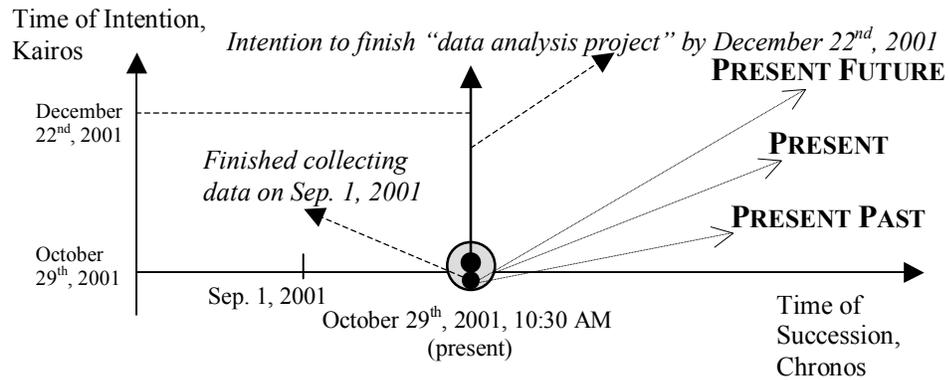
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<sup>3</sup> The author understands that the discoveries mentioned postulate and imply a quantum leap in the social sciences with wide implications, and asks the reader to evaluate these ideas with an open mind when reading and analyzing this paper; all comments, suggestions, and criticisms are respectfully welcome.

<sup>4</sup> Jaques, Elliott (1982). The Form of Time, New York, New York: Crane, Russak & Company.

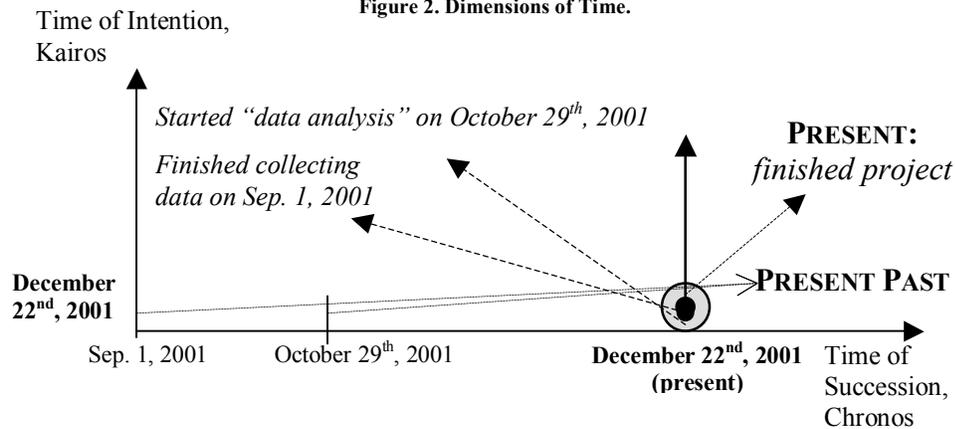
To elaborate on the idea of two dimensions of time, it is necessary to distinguish that the idea that there exist past, present and future is invalid. Dr. Jaques writes in “The Form of Time” that St. Augustine also recognized this phenomenon – the only thing that exists is present past, present present, and present future; both, the past and future are with us today – they do not exist separately from us. The following chart elaborates and explains the time phenomenon further:

Figure 1. Dimensions of Time.



Let’s assume that today is October 29<sup>th</sup>, 2001, 10:30 AM. Today, on October 29<sup>th</sup>, 2001 I know I finished collecting data for a project – I keep a record of this event, finishing collecting data. At the same time, today, I am intending to analyze the data collected by December 22<sup>nd</sup>, 2001 – this is the intended future event that can be measured with a ratio scale measure – 55 days – this is the future that is with us in the present; when December 22<sup>nd</sup> comes, I will record whether I am done with the task or whether I re-schedule it, and eventually would record an actual date of finishing on the axis of succession. The time of succession may feel more real because as a generation, we have become used to it, but which one is more real, intention or succession? Let’s assume that I indeed finished the intended project on December 22<sup>nd</sup>. The following time chart would help explain the events:

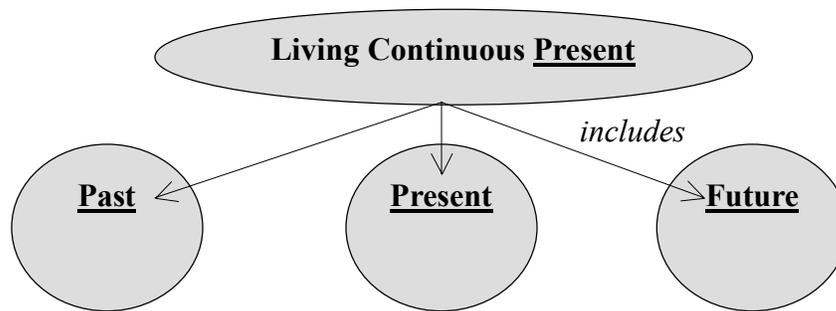
Figure 2. Dimensions of Time.



Today, on December 22<sup>nd</sup>, 2001, I have the records of the events on September 1<sup>st</sup> and October 29<sup>th</sup>, 2001, and I finished the 55-day assignment as I intended on October 29<sup>th</sup> (to finish by December 22<sup>nd</sup>) – all these events exist now, in the present past. Additionally, including the time of intention, we can measure goals with precise ratio-scale data – by when! This is one of the most profound premises of the scheduled to be published in June/July 2002 book, “A Theory of Life” by Dr. Elliott Jaques<sup>5</sup> – the premise is that the difference between inanimate physical objects and living organisms is intentions: living organisms intend to do something by a certain deadline, while inanimate objects have no intentions, and thus, exist in a four-dimensional world, rather than five-dimensional of the living biological creatures.

Before we proceed further, it is important to understand the concept of the present or more correctly the constant continuous present or present present – which is a continuous (living) present that includes past, present, and future, as depicted in the following diagram:

Figure 3. Present.



Analyzing the diagram, it is evident that physical objects exist in a four dimensional world: time of succession, and three space coordinates; or as Dr. Jaques calls it (3 + 1) dimensions.<sup>6</sup> The living organisms, on the other hand, have intentions (goals to achieve), and thus, live in a (3 + 2) dimensional world, having added another time coordinate: the axis of intentions, which are measurable with ratio-scale measures – by when!<sup>7</sup>

## 2.2. Human Cognitive Abilities

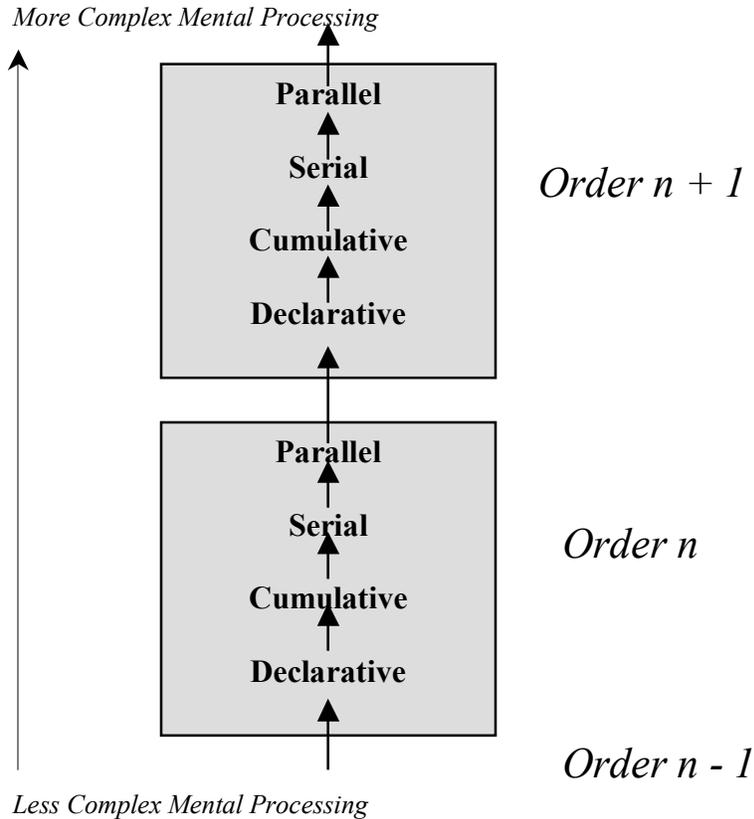
Another major discovery also comes from Dr. Elliot Jaques, and most explicitly and clearly in his most recent book, “The Life and Behavior of Living Organisms: a General Theory,” published in 2002. The main proposition and finding are that all humans (and all biological organisms) develop cognitively in precise patterns – this paper concentrates on issues pertaining to human lives and societies, and leaves the discussion of other biological creatures to other researchers and possible future endeavors. The discovery has found that humans’ cognitive abilities develop from birth through old age in predictable patterns of mental processes, as depicted on the chart below:

<sup>5</sup> Jaques, Elliott. "A Theory of Life: An Essay on the Nature of Living Organisms, Their Intentional Goal-Directed Behavior, and Their Communication and Social Collaboration." 2002.

<sup>6</sup> Jaques, Elliott (1982). The Form of Time. New York, New York: Crane, Russak & Company.

<sup>7</sup> The discussion of actual measuring and collecting of data is discussed later in the paper.

Figure 4. Cognitive Development.

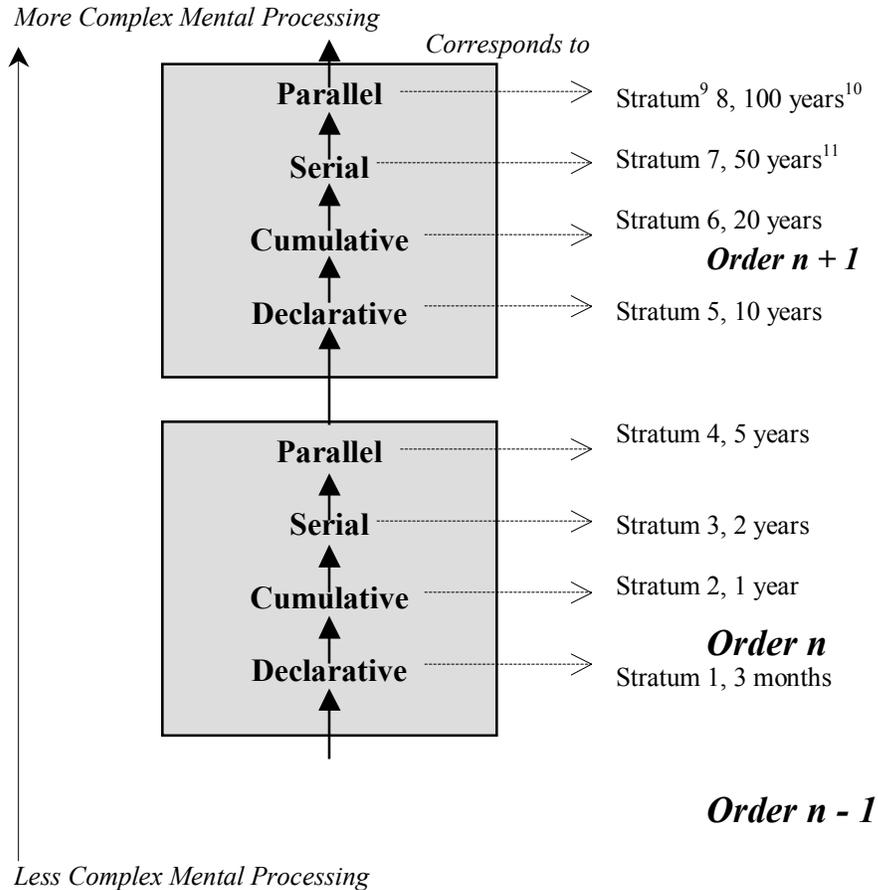


Every human is born to a certain cognitive trajectory that the person's development goes through certain mental stages as depicted above, in the sequential succession, from declarative state, to cumulative, to serial, to parallel, and then to declarative of a different order – please refer to “Human Capability” by Elliot Jaques for an in-depth discussion and research into these processes. The mental trajectory will determine through how many stages the person will develop and at what age.

These ideas of distinct cognitive levels are not new – other researchers have noticed disparate cognitive levels before. For example, Blooms Taxonomy describes six cognitive levels, the description of which is very similar to Jaques' research.<sup>8</sup> Humans have become the only known species able to disengage further in the time of intention than other species known to mankind based on the development of cognitive processes that support planning (intending) objectives up to a certain time of the present future, as depicted in the chart below:

<sup>8</sup> "Blooms Taxonomy." <http://www.arch.gatech.edu/crt/11n/Wordsworth/bloomstaxonomy.htm>: Georgia College of Technical Architecture Web Site, 1998.

Figure 5. Cognitive Strata.



In his book, "A Theory of Life," Dr. Jaques describes how human babies develop cognitively through the strata and orders of mental processing. Dr. Jaques argues that adults also continue developing through similar patterns long into the old ages, and depending on the acceleration trajectory, some reach extraordinary cognitive capability with age. The cognitive potential capability determines how far into the present future<sup>12</sup> the individual can realistically plan for to achieve actual goals, which in other words, is that maximum potential capability of the individual determines the longest distant objective on the axis of time of intention the individual can cope with, which is significant for our analysis, and the theory of social sciences.

<sup>9</sup> Dr. Elliot Jaques called each new level stratum.

<sup>10</sup> This time of intention represents the maximum distance a person is able to project and create goals into the present future, and to plan, execute, and fulfill these intentions.

<sup>11</sup> Jaques, Elliott. "A Theory of Life: An Essay on the Nature of Living Organisms, Their Intentional Goal-Directed Behavior, and Their Communication and Social Collaboration." 2000.

<sup>12</sup> The author is trying to be as precise as possible defining concepts and words to ensure the reader may come to similar conclusions or disprove the findings through testing the theoretical propositions presented in this paper.

One way to determine the maximum potential capability, which Dr. Jaques states is an in-born capacity, the analyst must involve an individual into a “vicious argument” and observe the pattern and structure of that person’s presenting ideas spontaneously – the language structure would show whether the constructs are declarative (you are wrong!), cumulative (this is right, and this is right, perhaps this is right too), serial (if this is ok, and this is not, then perhaps the conclusion is this), or parallel (considering this idea, we may come to this conclusion, but on the other hand, this idea leads to a different conclusion). Looking at the speech constructs further, it is possible to determine to which order of information complexity (complexity of mental processing) a person belongs to – see “Human Capability” by Elliott Jaques<sup>13</sup> for more information on precise evaluating of individuals. In this paper, the author is assuming that the measuring instruments of the person’s development are correct to proceed further to the analyses reaching beyond to the depth structures of our society.

### 2.3. Rigorous Refutable Definitions

Dr. Elliott Jaques introduced another concept for acceptance by social scientists, which at the present time indeed may be attributed to a major discovery within the social sciences – this innovation is to create and use univocal, universal, and rigid definitions of concepts in order to be able to compare, refute, and advance theories, case studies and hypotheses within social studies similar to the way it is done in the natural sciences. Presently, no keyword used in most studies have uniform definitions and understandings, thus, making comparing similar-oriented researches impossible; which makes it impossible to refute some studies while accepting and improving good ideas. For example, such notions like organization, manager, team, bureaucracy, employee and many others have unknown meanings, while most of the studies refer to the concepts of organization, manager, team, employee and others freely, which furthermore, has created and made acceptable ideas that it is all right not to define and/or understand key assumptions, and further, created a culture that it is impossible to measure precisely and even understand social processes.

For example, in Economics, everyone understands what a dollar is, and the amount of money can be accurately measured with its monetary amount – for example, \$1,000,000 dollars designated and budgeted for a certain public program. But, the statement that a virtual team of cohesive members has been assigned to run this program indeed seems impossible to understand under the present no-definitions-allowed policy.

Dr. Jaques compares the state of the social sciences today with the state of natural sciences in the 17<sup>th</sup> century, when no measuring tools were available to measure universally observed phenomena, such as speed, temperature, weight, and others – the re-discovery of the time of intention allows for a precise measurement of work (the definition of work is also not known at the present time), which altogether is believed to be the starting point for the social sciences to launch into the new millennium. Thus, before proceeding further, I am going to define the necessary concepts for evaluating the ideas in this paper by independent reviewers objectively, and with possibilities to test and refute all of the ideas discussed.

The first crucial definition explains the concept of work. Dr. Elliott Jaques defines work as the “exercise of judgment and discretion in making decisions in carrying out goal

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<sup>13</sup> Jaques, Elliot & Cason, Kathryn (1994). Human Capability. Rockville, MD: Cason Hall.

directed activities.”<sup>14</sup> This precise wording is directly related to the time of intention – work is everything we do to achieve our goals set some time into the present future – achieve what by when, and it is no different in the employment-related activities (please see any of Elliott Jaques’ works for a complete set of definitions)! Organization is defined as a “system with an identifiable structure of related roles,”<sup>15</sup> which may be divided into bureaucracies and associations. An association is a member-based institution, either voluntary, such as church, or community, or stockholder member, or non-voluntary, such as a country (citizens, elected officials) – no one can be fired or laid off from such an organization. The other type of the organization is bureaucracy, which is organized by an association(s) to work on its behalf (notice that work is clearly defined, such as achieving set objectives!) with a reporting structure – for example a company with hired employees: stockholders constitute an association, which elects board members to organize a corporate bureaucracy to continue and proceed with business activities (the board hires a CEO, etc.). For example, university faculty members without tenure are employees of the university, while the faculty professors with tenure have become members of the institution. Similar analysis applies to law firm partners – they are members of the firm, while the non-partner attorney is an employee.

Having defined all concepts clearly and without ambiguities, it is possible to set on a course of conducting studies and comparing research and theories of similar phenomena to advance the state of the current thought.

#### 2.4. Measuring in Social Sciences

Despite a general understanding of measurements and measuring, it is integral to revisit the measurements theory and understand measuring in the social sciences. It is crucial to understand and elaborate what a measure is, what types of measures there are, and what the differences among different types of measures exist to ensure reliable, accurate and meaningful depiction of reality measured. Sarle (1995) argues that proper use of various measuring and statistical techniques and methods is necessary for a “responsible real-world data analysis.”<sup>16</sup> He distinguishes between measures and actual attributes measured – the idea is that the measures should accurately depict a real-world phenomenon. The example the author provides is measuring lengths of sticks with a ruler – if one stick is 10 cm, and the other is 20 cm, then the second stick must be twice longer than the first – thus, we have drawn an accurate conclusion about the sticks’ lengths. Sarle defines measurement as “assigning numbers or other symbols to the things in such a way that relationships of the numbers or symbols reflect relationships of the attribute being measured.”

There are various types of measurements that are known – the types vary by their degree of accurate reflection of the real world phenomenon. These types are: nominal, ordinal, interval log-interval, and ratio numbers. Despite most researchers know and use statistical measures mentioned above, for the purpose of this study and to extenuate the

<sup>14</sup> Jaques, Elliott. "A Theory of Life: An Essay on the Nature of Living Organisms, Their Intentional Goal-Directed Behavior, and Their Communication and Social Collaboration." 2000.

<sup>15</sup> Jaques, Elliott. "Requisite Organization." Arlington, VA: Cason Hall & Co, 1996.

<sup>16</sup> Sarle, Warren S. (1995). Measurement theory: Frequently asked questions. Disseminations of the International Statistical Applications Institute, 4, 61-66.

discovery of a new measure in social sciences, it is necessary to define and explain the differences between the measures.

Nominal measures are less useful – they are just an enumeration and have nothing more than symbolic values. Ordinal type is also not very useful<sup>17</sup> – the ordinal measures show whether one property is less or more than the other, and depict the following relationship, that if things X and Y with attributes a(X) and a(Y) are assigned numbers n(X) and n(Y), in such a way that  $n(X) > n(Y)$ , then  $a(X) > a(Y)$ .<sup>18</sup> Interval measures become more useful than ordinal, though even interval measures may still be inadequate for a precise scientific research – the main property of the interval-level variables is that the differences between numbers reflect similar differences between the attributes. Log-interval measures are such that the ratios between numbers reflect ratios between attributes.

Ratio measures are most interesting and in-demand in every scientific field. Ratio scale numbers depict accurately the differences and ratios between the attributes and have a concept of zero, such as zero means nothing. For example, a stick, which length is zero centimeters equals to the length of zero meters, and is nothing – it doesn't exist! This is important to note because in interval-level numbers, zero does not mean that the property does not exist.

The following diagram demonstrates the usefulness (or preciseness) of measures' types:

**Figure 6. Preciseness of Measures.**



At the present time, it has become acceptable in social sciences to manipulate and calculate numbers to analyze information using ordinal-level numbers, and various statistical techniques have been developed to make the analysis depicting reality as close and accurate as possible. The main reasons for using the ordinal-level measures have been the lack of measuring instruments to observe ratio-type data, until the recent past. Dr. Elliott Jaques found a scientific way to collect ratio-scale data within the social sciences, which is a phantom leap forward towards social sciences catching up with natural sciences in data analyses and mathematical propositions.

The new instrument to obtain ratio-scale data within organizational science is called time-span, which measures the level of work in a role by identifying the longest task or project within the role assigned by the manager to a subordinate, for which the subordinate has discretion and authority to complete the assignment. Dr. Elliott Jaques defines time-span as the “targeted completion time of the longest task or sequence in the role,”<sup>19</sup> and it is quite easy to measure. To measure a role, a researcher has to interview the manager and learn what is the actual longest assignment s/he assigned to the subordinate. Having measured over eighty organizational roles, the author learned it takes about five minutes to interview the manager – please see “Time-Span Handbook”<sup>20</sup> by

<sup>17</sup> It is the author's opinion that ordinal scale measures are not very useful as they are imprecise depicting a real-world relationship.

<sup>18</sup> Sarle, Warren S., *Ibid.*

<sup>19</sup> Jaques, Elliott. "A Theory of Life: An Essay on the Nature of Living Organisms, Their Intentional Goal-Directed Behavior, and Their Communication and Social Collaboration." 2000.

<sup>20</sup> Jaques, Elliott (1964). Time-Span Handbook. Rockville, MD: Cason Hall.

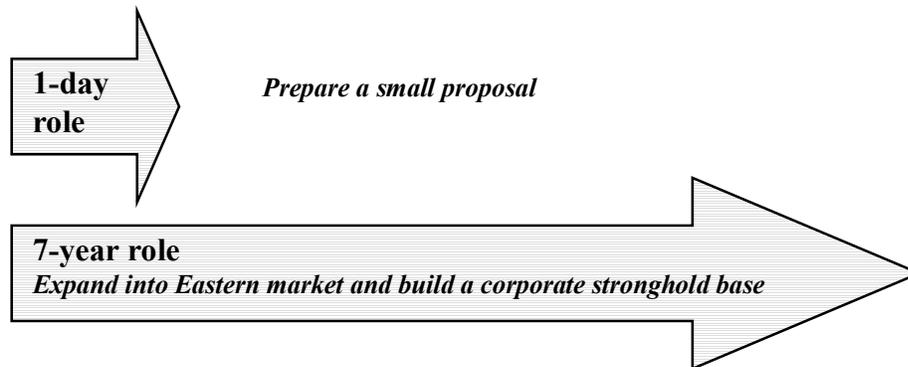
Elliott Jaques for an exact guide how to go about using the time-span instrument, and its comprehensive description and examples of various types of roles, such as accounting, machinist, technologist, and many others.

Time-span is a ratio-scale measure of the time of intention, with the absolute concept of zero. If the role's time-span is zero, that means that the role does not exist. If role A is measured at 6 months, and role B is measured at 1 year, then  $t(A) = \frac{1}{2} t(B)$  (t stands for time-span) – this means that role B is twice bigger than role A. Thus, all roles within a bureaucracy can be measured with time-span, and thus, analyzed in a new light. For example, a Canadian firm, Capelle Associates Inc. has based its management consulting business primarily upon the theory and measures that Dr. Elliott Jaques has developed, and they are quite successful with research papers confirming the findings measuring organizational productivity and performance; their research papers are available at their corporate web site at [www.capelleassociates.com](http://www.capelleassociates.com).

The time-span instrument is the first one in its kind in social sciences that allows measuring and comparing precisely levels or roles within various types of organizations, industries, and countries – it is universal. A project manager's role in company A, country X measured at 3 years is accurately comparable to the database designer's role in company B of country Y should time-span of this role be found to be 3 years as well.

In another example of divergent roles, it may take a day to prepare a small proposal – thus, the targeted completion time of this task is one day, and should this be the longest task in the role, it is a one-day role. In another role it may take seven years for the following task: expand into the Eastern market, build and create an Eastern-European home for the corporate products, and possibly merge and acquire emerging and competing companies with comparable products and potential – thus, the targeted completion time of this task is seven years, and should this be the longest task in the role, we will have measured the role at a seven years time-span. The following figure depicts the measurement through the target completion time:

Figure 7. Role Differences.<sup>21</sup>



<sup>21</sup> For example, in a multiple-task role, the level of work would be defined by the time-span of this role, which would be the longest phase of a project or entire project for which the person may make decisions to lead it to a conclusion – for example, install and configure a corporate firewall within the next four weeks – if four weeks were the longest assignment in this role, then the time-span of this role would be four weeks (the time of intention). At the same time, each person has an in-born capability to work into the present future on the axis of intention, which Jaques measures with the maximum distance the individual can cope with, or time-horizon.

Furthermore, it is possible to evaluate a person’s potential capability via the instrument called time-horizon, which is defined as a “method of quantifying an individual’s potential capability, in terms of the longest time-span s/he could handle.”<sup>22</sup> Dr. Jaques’ book on human capability describes methods of determining an individual’s potential<sup>23</sup>, though, there is no a discovered instrument to obtain a ratio-scale number yet, though it is possible to evaluate the potential cognitive stratum, and thus, estimate a potential time-horizon, as it will be within the bounds of the stratum. For example, a person at a certain age measured at stratum 3 would have a potential time-horizon between 1 year and 2 years (see chart 5 above).

There are other instruments that are still being discovered, in addition to time-horizon, such as complexity. Presently there is no way to measure complexity with ratio-scale numbers, and instead, there are various methods available to estimate complexity, such as, function-point analysis in information systems. Dr. Elliott Jaques thinks of complexity as number and rate of variables manipulated over time, but there is no ratio-scale instrument to measure the complexity of the task precisely at the present time.

Despite the lack of instruments, the discovery of time-span, and having come closer to measuring time-horizon and eventually task’s complexity creates a new paradigm in social sciences that allows a real possibility to collect ratio-scale data for testing theories and hypotheses scientifically to create a new promising and possible future for mankind through a different organizational design, revised social sciences, and within it, many fields, including information systems technology.

**3. RECOMMENDATIONS**

**3.1. Team Building**

According to the theoretical propositions above, which are described at length and details in the Requisite Organization theory (ROT) in Jaques’ writings, the author has concluded that team building is a scientific endeavor, easily resolvable and testable. Such as, a work team within a bureaucracy is created to achieve a certain purpose by a certain deadline within a specified budget. In normal times (normal non-emergency projects, excluding war, extreme hardship, survival of the company and so on), according to the ROT, the project’s time-span would determine what type of people should constitute a team, and what type of manager should the team members report to. If the entire team is assembled to carry on the entire project, while the manager is juggling several projects (including this one) to complete a larger project, then mathematically, the above propositions should be described as follows:

*Theorem 1: Project of [t(prj)] of stratum n should consist of team members of p = n, and manager of p = n + 1, where*

Time-span of the Project:	t(prj)
Time-horizon of the Individual/Potential:	p
Stratum:	n

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<sup>22</sup> Jaques, Elliott. "A Theory of Life: An Essay on the Nature of Living Organisms, Their Intentional Goal-Directed Behavior, and Their Communication and Social Collaboration." 2000.  
<sup>23</sup> Jaques, Elliot & Cason, Kathryn (1994). Human Capability. Rockville, MD: Cason Hall.

According to the theory, the derived theorem above should help create a team in which every member is capable of adding value to the entire project and has the necessary capability to cope with the complexity of the project. The manager should have the capability one stratum higher than the project's time-span to coordinate projects of complexity of stratum  $n$  to complete a larger project of complexity  $(n + 1)$ , of which the projects of complexity  $n$  are part of.

If, on the other hand, the project is handed to a manager, who is authorized to assign the parts of the projects to his/her subordinates and assemble the team of subordinates to delegate parts of the project to, then mathematically, the above propositions should be described as follows:

*Theorem 2: [t(prj)] of stratum  $n$  should consist of team members of  $p = n - 1$ , and manager of  $p = n$*

Theorem 1 should apply in partnerships, associations, college study groups and other types of organizations which are not bureaucratic managerial hierarchies because each member should have the capability to determine and add value to the entire endeavor, and should be able to work at the complexity required to complete the project successfully. Theorem 2 applies to a managerial bureaucracy, in which a manager is assigned a project by his/her manager (manager once removed), and the manager should delegate pieces of the project to his/her subordinates accordingly, and make decisions for the course and endeavor of the entire assignment.

### 3.2. Software Development

Developing software may be a complex or not a complex endeavor, requiring skills and knowledge of various tools, programming languages, algorithms, and experience. Under normal circumstances (abnormal circumstances are discussed later in the paper), developing good software applications does not differ from building successful teams – the main idea is to put the right people on the project.

For example, let's assume that project's estimated length is three years. Under normal circumstances, it is likely that the complexity of this endeavor corresponds to the complexity of the task's stratum as follows (derived from theorem 2):

*Theorem 3: A person of  $p = n$  should manage the software development project of [t(prj)] of stratum  $n$ , with reporting subordinates (software programmers) of  $p = n - 1$*

Thus, the manager who is in-charge of the project should have time-horizon at least matching the complexity of the project, with subordinates with time-horizons of one stratum lower.

The theorem above is incomplete because the concept of complexity (or simplicity) has not been defined, well understood or operationalized so that it could be accurately measured with ratio-scale data. It is assumed that during normal times, a reasonable estimation of a project's length corresponds to its complexity, which will default in abnormal times, like war, extreme pressure, and other not normal circumstances, which are discussed later in the paper.

Function-Point Analysis, an empirical method of estimating software complexity is not a precise way of measuring the complexity of a software development task – it is an estimation to approximate how long the project might take and how much it might cost based on the number of variables participating in the endeavor. Not having a precise measuring instrument to measure complexity, function-point analysis allows a rough estimate, and suggests that a more ‘complex’ project should take longer to implement (the one which receives more function-points), and thus, provides some support for the propositions above. Pressman (1997) writes “FP has no direct physical meaning – it’s just a number.”

### **3.3. Database Development**

Database development is no different from software development – database development may also be of various levels of complexity. The key to success is assembling a team of right people for the entire project or part of the project, with the project manager in-charge whose capability matches the complexity stratum of the project. Function-point analysis is also used in database development to estimate roughly the size of the project, and under normal circumstances, the formula developed for the previous paragraph corresponds to database development as well, as database applications are a type of software applications with specialized requirements.

### **3.4. Designing and Implementing Telecommunications**

Building, upgrading, and designing telecommunications infrastructure are the processes that are in essence no different than designing software or databases, just requiring a slightly different set of skills and knowledge, but on the abstract level these endeavors are the same – they require to complete a project within a certain deadline, and manage all technology pieces to put them together to complete the development’s goal. Theorem 2 and 3 formulas should apply within managerial bureaucracies – the length of the project should constitute the magnitude of the person who should manage the project.

### **3.5. Creating Innovations**

Creating something new – developing a brand new product for the market, designing and implementing a new technology, is a high-capability endeavor, requiring efforts of people of highest capability. It is arguable that any new project is an innovation because the specific requirements have never existed before – it is unique, requiring the people working on it make unique decisions (Jaques, lectures). On the other hand, similar endeavors have happened in the past – they may have differed in some ways, but in general there is some experience how to proceed. In managerial bureaucracies, theorem 2 depicts who should constitute a team or a person responsible for the task of a certain estimated complexity.

Let’s assume that it is indeed possible to measure the complexity ( $c$ ) of any endeavor similar to the discontinuous strata Jaques has pointed out, and let’s assume that when  $c = 0$ , the project does not exist. Therefore, to achieve the complexity of level 1 would at the minimum require a person whose time-horizon is at least at level 1. Thus, the complexity of the highest technological innovation would require a person of the potential capability at least comparable with the complexity of the project.

According to the hypothesis above, it is evident that greater innovations may be achieved only by highest-capability people, and complex innovations may take a long time, and likely resources, at the minimum to support the developers. The issue is that there is no discovered instrument to identify various complexity levels at the ratio-scale level.

The author's hypothesis is to identify all steps and their sequences: determine the steps necessary, their relations (or, and, sequence or parallel), and then determine the order of the steps. This is also not a precise method because it requires interpretation of the order of the step (step's stratum) and step by itself is not well defined – something to get done within a specific time as the smallest unit of assignment in the project.

Thus, estimating, it is possible to evaluate the magnitude of the required innovation – the goal is clear and unambiguous – to develop or create something by a certain date, and it is manageable to estimate the order of a specific innovation, thus, needing a person of at least matching capability, interest and commitment to the idea, and allowing the necessary time and resources.

### 3.6. Exceptions: Abnormal Circumstances

There are exceptions to normal course of life – such as war, extreme competition for survival of the organization, or some other emergency – situations Jaques describes as compressed time (lectures), which mean that the project that normally should take a certain time, gets completed a lot sooner by people of higher capability than required by the project's complexity level, because they can perform a lower-complexity task faster. Thus, in extraordinary circumstances, it is necessary to engage people of the highest capability available to complete a task, as follows:

*Theorem 4: A person of  $p = n + m$  should manage the project of  $[t(prj)]$  of stratum  $n$ , with reporting subordinates of minimum  $p = n$  or  $n + m - 1$ , where  $m > 0$  (stratum).*

For example, in an emergency, a three-year project, normally requiring a person with potential capability at stratum 4, may get completed in two-years by a person working at stratum 5 or higher.

## 4. CONCLUSION

Understanding the basic constructs of the problem of universals in management studies, such as potential capability of the person estimated through time-horizon, and the level of working role in a managerial bureaucracy through time-span of the role, and estimates of complexity could help match people with technology projects better. Projects of different complexity would require people of matching capability – understanding both could help fit people better. Such as, a lengthier project (with a higher number of function points) may hint to assign people of a higher and corresponding time-horizon than a smaller project – to which is best to assign people with a lower, and also corresponding time-horizon, and so on. Teams should be assembled with understanding of the capabilities of people to achieve success.

## 5. RECOMMENDATIONS FOR FUTURE STUDIES

The theoretical theorems discussed in this paper need to be tested empirically. In addition, there is a need to develop a measuring instrument to measure the complexity of the project accurately, and match complexity levels with the ability of people at different time-horizons to work at the abstract complexity levels to solve the problem of universals within their scope of the assignment, according to their current potential capabilities.

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