Architectural Model as Machine

A New View of Models from Antiquity to the Present Day

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Architectural Press is an imprint of Elsevier

Architectural Press
An imprint of Elsevier
Linacre House, Jordan Hill, Oxford OX2 8DP
30 Corporate Drive, Burlington, MA 01803

First published 2004

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloguing in Publication Data
A catalogue record for this book is available from the Library of Congress

ISBN 0 7506 5634 4

Typeset by Newgen Imaging Systems (P) Ltd., Chennai, India
Printed and bound in Great Britain

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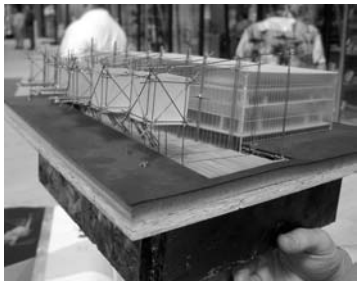
CHAPTER 4

Machine as scale model machine

4.1 *Pygmalion and Galatea*

In the preceding chapters, this study has pointed to the historically important connection between measuring and the scale model machine. As previously pointed out, each measurement of an unknown involves a comparison with a carefully conserved known. Humans define a measurement of an unknown by comparing it directly with a known device, which has been previously developed to agree with reference measurement standards. These reference standards are calibrated from

4.2 *An undergraduate student model built by Sam Bawden*



4.3 *An undergraduate student model built by Josh Green*

time to time by comparing them with a higher level, generally agreed upon, concept of the ideal. In other words, the architectural scale model as *maquette* can be compared to another already completed building or group of buildings, or it may be compared to the accepted conventions of its society. Sometimes, when compared to a scale model, the accepted conventions are proved to be unsatisfactory and may be changed. The architectural scale model can be an important participant in these changes (Figures 4.2 and 4.3).

Historically, the architectural scale model was employed as a thinking machine, that is an idea used for the understandable measuring and testing of the prevailing reference standard's concepts of invisible things. The architect's intention was to create definition through representations which were developed in accordance with the reference standard's view of divine will. Such definitions were formulated by using the architectural scale model machine developed to help define future buildings. These buildings referred to the prevailing manners, morals and habits of an already reasonably well-defined set of standards, whose purpose was to explain the divine. Shifts in these reference standards were also reflected in the thinking mechanism of the scale model. Although varying amounts of freedom of interpretation existed historically for architects, the main emphasis remained representing the message of the divine within the prevailing reference standards.

Today the architectural scale model remains a significant method of defining invisible things. The search for truth remains a constant part of human nature. However, since the Renaissance, there have been fundamental changes in the relationship between the scale model machine and the prevailing reference standards. This chapter will discuss these changes and how they developed.

I

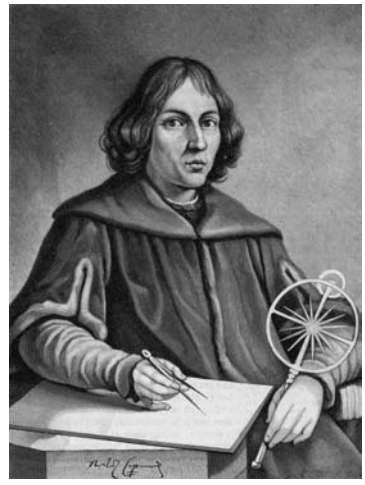
After the fall of the Roman Empire, the representations created through the scale model machine typically operated within a well-defined reference standard. What were perceived to be as the truest definitions of God's laws were carefully conserved by the educated hierarchy of the Christian church. During the Middle Ages, the scale model machine was developed with the expectation that it would agree with the previous reference standard. However, reference standards, as carefully conserved

by the church, appeared more and more to require recalibrating in light of changing manners. It was during the period of the Renaissance that a general loosening of the rigid control of the church allowed this recalibration to occur. This change was the most significant development in representation to occur during the Renaissance.

Astronomy was one of the areas most crucial to this shift. The prevailing scale model of the universe prior to the Renaissance was developed by the 2nd century Greek Astronomer, Ptolemy (Figure 4.4). This scale model, also accepted by Aristotle, was a geocentric universe with the Earth at the center, around which the sun and planets revolved. The geocentric universe was compatible with existing church doctrine, which held that God created the Earth as the center of the universe. With the support of the church this view prevailed for 14 centuries.

4.4 *Ptolemy's Universe, illustrated*

Nicholas Copernicus (Figure 4.5) created a scale model machine that threatened to recalibrate the prevailing reference standard that had been carefully conserved by the church. When he published his book *On the Revolution of the Heavenly Orbs*, he argued that simplicity and symmetry would be better served by putting the sun, not the Earth, at the center of the cosmos. Many serious questions were raised about Copernicus's ideas and his work threatened to overthrow the scale model machine defined by Ptolemy, Aristotle and the church.



4.5 *Portrait of Nicolaus Copernicus*

The reaction of the church, the conserver of the existing reference standard, was extreme. Those who supported Copernicus's new scale model were excommunicated from the church. In the early 1600s Bruno (Figure 4.6), Vanini and Fontainier were all burned at the stake as atheists for supporting this new position. Finally, the Italian astronomer Galileo boldly undertook to prove that the Copernican scale model worked. Through his newly developed telescope, Galileo was able to observe the satellites of Jupiter, Saturn's rings, and the moon's surface. Galileo vigorously and actively attempted to publish his findings, which supported the Copernican scale model of heliocentricity.[1] Though he was summoned before the Inquisition and severely punished, in the end Galileo's support of the Copernican model forced a rather minor recalibration, but not the destruction, of the existing reference standard as conserved by the church.

Though the methods used by Copernicus and Galileo differed from those used by architects of the time, certain

4.6 *Statue of Bruno*

similarities existed. For both, there was a commonly accepted reference standard, defined by a specific group, that employed an understandable measure of the invisible. The architectural scale model machine could also be used to support or develop new calibrations of the reference standard through the use of representations. It should be noted that those who control the reference standards are not always enthusiastic about outsiders playing with even minor recalibrations of their carefully controlled order systems. One can start to understand the uproar that Adolf Loos caused with his Steiner House of 1910. The reader can also guess at the outcome if Michelangelo had presented his models to a 12th century building guild.

II

A basic tenet of the humanistic approach was that it regarded the rational individual as having the highest value. This valuing of rationality developed into rationalism: the view that reason rather than sense is the foundation of certainty in knowledge.[2] Rationalism contrasts reason with revelation as in religion, or with emotion and feeling as in ethics.[3] Mathematics became more and more the scale model machine of choice during this period. Leonardo de Vinci wrote, 'There is no certainty in science where one of the mathematic sciences cannot be applied.'[4] He, however, also told of receiving inspiration from clouds, stains on rocks and his religion, for he did not believe these positions to be incompatible. Still, geometry, physics and calculus all had a major effect on his architectural scale model machine during this period.

In Chapter 3, it was discussed that the scale model machine was an important part of defining and calibrating the reference standard. As mathematics became the scale model of choice so also was the reference standard increasingly seen as a mathematical mechanism. For Renaissance thought, the rational next step was to begin to view invisible things as part of a giant mathematical mechanism. However, mathematical methods deal mainly with quantitative and not qualitative phenomena, and the architectural scale model machine deals with both. This situation caused an interesting division in the architectural model machine, since mathematics attempts to measure precisely, and humans are imprecise and require a certain amount of play within their measurements.

III

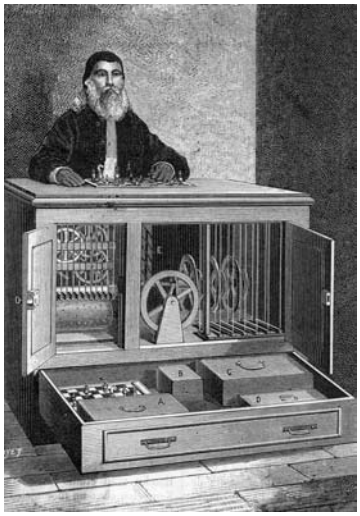
René Descartes believed in the superiority of the mathematical scale model as a means for measuring. He wrote, 'Of all who have sought for the truth in the sciences, it has been the mathematicians alone who have been able to succeed in producing reasons which are evident and certain.'[5] He believed that no situation in human life, no problem facing mankind could not be solved by applying the infallible, all-encompassing laws of mathematics. Descartes' scale model of the universe was called *mechanism*. In this scale model the whole universe is seen as a giant mechanism moving in a mathematically measurable clockwork system. Within this reference standard all living bodies are seen as machines, forms of automata, mechanically responding to stimulation.[6]

For Descartes even the human body, the key measure for architecture, could be considered a machine, differing from those of animals only because of a God-given rational soul. According to a story about Descartes, he constructed a mechanical woman, Francine, on mathematical principles. While on a sea voyage, a curious fellow traveler opened his luggage and discovered Francine. When Francine was brought to the captain he ordered her thrown overboard as a product of black magic.[7]

There is a well-documented history of machine people and machine animals. Daedalus is said to have created statues so lifelike that they had to be chained down to keep them from walking away. Another example is the myth of Pygmalion's beautiful statue, which was given the breath of life by the goddess Aphrodite. The technology of automata was of great interest to the Arabs, who transmitted the tradition from antiquity to the Middle Ages. These automata were shown as marvels at courts and medieval fairs throughout Europe. The French artists Bracelli and Petitot are known for their engravings of machine trades people during the 16th and 17th centuries.

Some of the most important examples of automata were created by Jacques Vaucanson in France and Pierre Jacquet-Droz in Switzerland. Vaucanson's famous mechanical duck was presented in 1738 to the Academie Royale des Science, along with a mechanical flute player and drummer. The artificial duck was described as being made of gilded copper and possessing the ability to drink, eat, quack, splash about in the water, and digest food like a living duck.[8] In 1770 Jacquet-Droz presented an automatum of a young boy who, it was claimed,

4.7 *Drawing Automayon by Jacquet-Droz*



4.8 *Automated chess player or robot*

could actually write. It was said that when the mechanism was started, the boy dipped his pen in the inkwell, shook it twice, placed his hand at the top of the page, paused and slowly and carefully began to write (Figure 4.7).[9]

The representation of machines as people exerted a fascination not only as a marvel but also because the automata posed an important question about the differences between humans and machines that appear human. There must have been a certain feeling of sacrilege in the idea that these were humans created by humans and thus without souls.[10] The soul has been described as the emotional side of human nature and can even serve to represent the principles of thought and action in human beings.[11] The soul is generally defined as the principle of life, feeling, and thought in humans and is regarded as a distinct spiritual entity separate from the body. The soul is a form of spirit. The word spirit comes from the Latin *spiritus* or breath, literally meaning breath of life, usually given by a deity. When a human receives inspiration it literally means to breathe in the spirit. To be inspired can mean to be guided or controlled by divine influence.[12] Therefore, machines, which do not have souls, could be seen as lacking the ability to be inspired (Figure 4.8).

For Descartes the division between the concept of a mechanical body and the human mind created a dualism. Dualism assumes that a person's mind and body are irreducibly different entities. To the rationalists the human body could be precisely measured, while measuring the abstraction of the soul is elusive.

The reader should recall the automata statues of Daedalus. These mechanisms were considered so life-like that they were chained down to keep them from walking away. However, though these machines appeared real, there were those who considered his machines to be possible illusions of the truth.

IV

One important institution influenced by rationalism was the academy. Academies were originally organized not only to educate future artists, architects, and scientists, as well as those in other disciplines, but they also provided a place for their members to exhibit work. Because of the declining financial support of individual patrons, these academy-controlled exhibitions

developed into the most significant market for creative work. It soon became apparent that the state was the only institution able to support the academies.

French academies, founded and supported by the state, were originally developed to educate the public.[13] However, with the appointment of Jean Baptiste Colbert (1619–1693) as director, they began to function as an authoritarian arm of the state. Colbert was a statesman and not a member of an academy; he served as the finance minister and first controller general of France. During this period, France was in a deep financial depression that caused political hostility and economic dislocation. As part of his attempt to extend his political authority, and also as a means to parry opposition from intellectuals, Colbert positioned himself as head of a vast network of cultural patronage controlled through the academies. From this position he was able to place a significant number of French intellectuals and artists on the royal payroll.

Colbert also adhered to the rationalistic view that creative matters could be universally subjected to reason. This view produced a narrow set of creative rules covering all the fields controlled by the academies. These rules called for art that was generally neoclassical, a style considered politically nonthreatening. Through such methods Colbert, the politician, was able to gain control over creative fields, thus defusing intellectual opposition to the state. An artist who did not create within the rules of the academy found little work (Figure 4.9). Colbert's successful approach to controlling intellectual opposition led to the development of numerous other academies throughout Europe and in America. These were usually state-controlled and similar in approach to the French academies; by 1790 there were more than 100 such institutions.[14]

Academies were designed to regulate and govern the message of the model machine for the state, which was the new conserver of the reference standard. When Galileo presented his scale model, the church, a similarly powerful conserver of the reference standard, was eventually forced to reconsider its carefully conserved views. With the rise of Cartesianism, the previously accepted reference standard used to explain invisible things was questioned. The church could not precisely measure its more metaphysically based view of the truth; subsequently it lost its complete control over the reference standard. Through the academy, the state attempted to politically control interpretations of the scale model machine, as the church had

4.9 *Students in front of the École des Beaux Arts, Paris, France*

done earlier. However, the academy offered a rational reference standard with a more scientific view concerning invisible things. The French aristocracy must have begun to question this new direction after the machinery of the guillotine went to work.

Although the fall of the aristocracy allowed a different political group to conserve the reference standard, the new scientific view remained. According to this view, advances in science and invention were necessarily good for mankind. In 1756 Voltaire wrote, 'Reason and industry will progress more and more, that useful arts will be improved, that evils which have afflicted men and prejudices which are not their least scourge, will gradually disappear among all who govern nations.'[15] Those who accepted this prevalent rationalistic view believed in progress and were consequently convinced of humankind's perfectibility.

Not all of Voltaire's contemporaries remained enthusiasts of the new rational reference standards. For example, it was a short 60 years after Voltaire's statement that Mary Shelly created Frankenstein's monster. In this story the rational scientist discovers the secrets of life and attempts to create a man. Instead, he produces a hideous monster who destroys all who are close to him. In the end, after a global chase, they both perish. One might interpret this story as describing, through

analogy, the failure of science to completely define the measure of man.

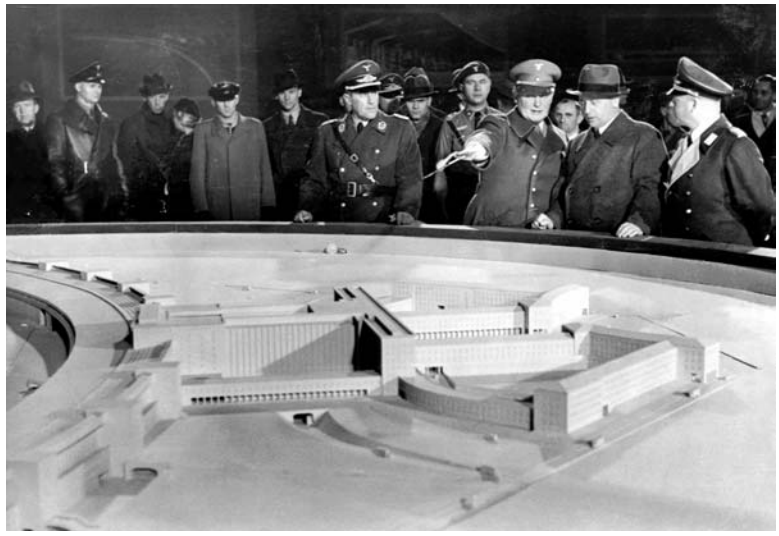
Between Voltaire and Frankenstein, the world saw the bloody French and American revolutions which produced radical and rationally based social and economic changes. After the French Revolution, hopes for a better life were frustrated by new tyrannies. The Industrial Revolution brought about an extensive mechanization of production systems. Workers were thrown out of work by machines, child labor became the norm, and miserable slums soon surrounded the new factories. New political problems required new political systems, or new calibrations to the reference standard.

V

The academies survived this turmoil and served as an arm of the new rationally oriented political groups. Changing the political organization in control of the reference standard typically led to new calibrations, which in turn affected the architectural scale model machine. The political groups that control the policies of the reference standards can be called governments. In one usage, the word 'government' applies to the institutions and processes by which groups and states are regulated. In another, a governor is a control device on a machine by which the output of that machine is controlled in accordance with a desired standard. Governors prevent machines from spinning out of control. However, an over-governed machine may become sluggish and run inefficiently (Figure 4.10).

There are varying forms of governors or governments in control of reference standards which are important to consider in the study of the scale model machine. One of the earliest forms of government was a state headed by a king or monarch, who was an absolute ruler. Many compromises were reached between the church and this form of government: for example, the concept of the 'Divine Rights of Kings,' and St Thomas' belief that the state and government were manifestations of God's will. In this case, the reference standards conserved by the hierarchy of the church maintained a great degree of control over kings in the western world.

In totalitarian systems, the government serves as an agency of the state in an attempt to regulate all activities of individual citizens. Typically, in such societies, the message of the architectural scale model machine is tightly restricted



4.10 *Goering with a model of the Berlin airport*

by the state and, thus, those with incorrect interpretations of the rules have disappeared in the night. Totalitarian systems, like the Gothic Christian church, are not interested in new calibrations of the reference standards. Under such systems other reference standards such as organized religions, which could compete with the state, are usually dominated or discouraged.

In constitutional government systems, there is an attempt to limit the absolute control of governmental authority, usually to protect against totalitarianism and to guarantee individual liberties. Under such systems, modest recalibrations are allowed as long as they adhere to the generally accepted framework of society.

Anarchists recommend no form of government. They advocate the abolition of government as the indispensable condition for full liberty. Their tenets hold that there is a basic human instinct for mutual cooperation among individuals, which removes the need for regulation by external rule. Friedrich Engles advocated that both the state and government would 'wither away' once the need for private property was removed. Those maintaining an anarchistic position would not trust any governors placed on the scale model machine (Figure 4.11).

VI

Authors such as Vasari and Wittkower note that the artistic mind is not always a conformist mind. Some artists have

4.11 *Anarchist militia in Barcelona*

always attempted, with varying degrees of success, to recalibrate the prevailing governing reference standard. An example of this situation occurred during the period of Romanticism (late 18th to early 19th century) during which artists and intellectuals attempted to gain additional freedom from the tight controls of the academy. The Romantic Movement was considered anticlassical because it placed an emphasis on imagination and feelings. It stood in opposition to the governing academy's restrictive, rational rules and reverence for Greek and Roman art. The Romantic Movement asserted that artists and architects are by definition creative individuals who are not easily governed. It can be inferred that these individuals dislike tight governance because the scale model machine can become sluggish and lifeless when the conservers of the reference standard become too restrictive.

The term 'Modernism' describes the philosophies and practices of modern architecture: a self-conscious and deliberate break with past reference standards and a search for new forms of expression. Modernism has connections with both Romanticism and Cartesianism. Although there was a conservative side to early 20th century Modernism, the avant-garde played an important role in this movement.[16] There are several key points to consider about the avant-garde. Although this position has its roots in Romanticism, the Modernist avant-garde

was experimental and chiefly interested in directly changing the existing reference standard through scale model machines. The movement explicitly rejected past means of governing the message of the scale model machine. The avant-garde wished to expand the architect's ability to directly influence the reference standards of society.

The Modernist movement, influenced by the avant-garde, continued an expanding interest in the scientific/rational reference standard. This situation created an interesting split in the movement. On one side there was a search for universally applicable scientific laws which could be applied to architecture, resulting in a rational, objective, geometric style. On the other side there was an exaltation of subjectivity, creating a style which was emotionally expressive, subjective, and willful.[17]

The subjective, expressive and personal side of modern architecture was seen in a variety of architectural projects during the late 19th century. The modern subjectivist position combined with the English arts and crafts movement was the basis for Art Nouveau. Most subjective architects, such as Charles Rennie Mackintosh and Antonio Gaudi, have been interested in a departure from the imitation of past governing reference standards. Although these architects have drawn on past architectural measurements, such as the Gothic and neoclassical, they have shown a new freedom in reinterpreting issues, such as function, comfort and scale. These subjectivists maintain a relationship with past concepts of architecture, but they reject the overly restrictive governing of formula historicism represented by the academy. This has created an interesting combination of past knowledge and beliefs with the new Modernist concepts of the invisible.[18]

A main goal of the objective position in modern architecture, by contrast, was to measure and define the object with some form of rational precision. An object is anything that is visible or tangible, which can be perceived intellectually or can be measured with some degree of precision. The object is also the end towards which an effort is directed. The objective position is one that belongs to the object of perception or thought and is not affected by personal feelings or prejudice. An objective is the goal of one's actions. This seemingly would allow an eventual gaining of control over the message of the architectural scale model machine without it being affected by more subjective, imprecise and less controllable forms of measurement.

In architecture, objectivism can best be seen in public buildings showing a strong sense of function. Railway stations, exhibition halls, factories and other such buildings have typically, but not always, been the work of engineers who were generally more prone to be interested in a scientific approach. The Crystal Palace in London, the Biblioteque Ste. Genevieve and the Eiffel Tower in Paris are early prime examples of this new structural style.

Many historians point to the Steiner House in Vienna (1910), by Adolf Loos, and the A.E.G. Turbine Factory (1909), by Peter Behrens, as the beginnings of a rationally based modern architecture. These buildings were of a severely functional nature in agreement with the principles of the De Stijl architects. The architect J.J. Oud wrote about the approach, 'Subordination of the utilitarian to the idealistic would be detrimental to . . . cultural and general values and would only hamper the striving for style.'[19] The Bauhaus also took an objective approach and tried to combine architecture with industrial techniques and modern programmatic needs reflecting a generally optimistic point of view towards machines. Members of the Bauhaus such as Gropius, Breuer, Mies van der Rohe, Moholy-Nagy, Kandinsky, and Klee almost all emigrated to the United States when Hitler's totalitarian government came to power.

The period between the two world wars was known as the 'Machine Age'. The United States, always fascinated by machinery, led the world in numbers of automobiles, electricity consumed and steel production. Consequently, there was a general feeling of optimism and confidence about the future in the United States. The United States' infrastructure, politically, physically, and demographically (in relation to that of other societies) was basically untouched by the Second World War. This assisted in technologically placing American society in an overwhelmingly prominent position in the world.

In Walt Disney's 1941 animated masterpiece *Fantasia*, appears the 2000-year-old story of the sorcerer's apprentice. When the learned sorcerer momentarily departs, the curious apprentice attempts to conjure up powerful forces he cannot necessarily control. These forces soon spin out of control, nearly drowning the hapless apprentice before the sorcerer returns and set things straight.

Humans must have felt a similar loss of control over their machines during and after the Second World War (Figure 4.12).

4.12 *Close-up of military tank*

Certainly the governing machinery of Fascism and Stalinism, resulting in millions of human deaths, could be seen as almost uncontrollable. The atomic bombs dropped on Hiroshima and Nagasaki were a major shock to the world, and it appeared to many that humanity had called up forces which could destroy the world. Even more disturbing was the concept that technology could be seen as evolving uncontrollably on its own, independent of human will. Would a god-like sorcerer return to set things straight?

The post-war condition philosophically cast great suspicion on the ability of earlier reference standards to effectively govern the scale model machine. Governments had failed, machines threatened human existence and the much-revered measurements of science had, all too often, gone awry. People in general seem to have lost trust and confidence in their capability to control their machines; to have lost faith in the capacity of reference standards to serve as a reliable governing framework for understandably scaling the model machines.

VII

4.13 *Marcel Duchamp playing chess and smoking pipe*

The following analogous stories explain the current situation of the scale model machine. Such analogies can offer a broader understanding of the subject. The first concerns the work of Marcel Duchamp (Figure 4.13).

During the horrors of World War I, refugee artists formed the Dada movement in Zurich. The Dadaist movement was out to shock, adopting the motto of the anarchist thinker Bukunin, 'Destruction is also creation.'[20] The key founder of this movement was Marcel Duchamp, who was well known for his aesthetic study of machines. His irreverence for conventional aesthetic reference standards led him to devise a series of machine-like 'ready-mades,' causing a revolution in art. He was interested in destroying past notions about how machines were perceived. In this role, Duchamp served as an artist and an anti-artist, both destroying and constructing. Though much of his work was produced prior to the Second World War, it was not until 1960 that this work emerged from relative obscurity.

According to Duchamp, 'The artist is a "mediumistic being" who does not really know what he is doing or why he is doing it. It is the spectator who through a kind of "inner

osmosis", deciphering and interpreting the works' inner qualifications, relates them to the external world, and thus completes the creative process.'[21] Certainly there are many artists and architects who are uncomfortable being considered only 'mediumistic' beings, because their opinion about the spectator is not always respectful. However, as Duchamp reminds us, 'it is posterity that makes the masterpiece.'[22]

After producing many of his machines Duchamp found himself spending more and more of his time playing chess. In fact, he became so accomplished at the game that during the 1930s he actually represented his country as a member of the French championship chess team. These two interests of Duchamp were not mutually exclusive; he viewed them as quite similar. Duchamp writes that he found many points of resemblance between his art and chess: 'In fact, when you play a game of chess it is as if you were sketching something, or as if you were constructing the mechanism by which you would win or lose. The competition part of the business has no importance, but the game itself is very, very plastic, and it is probably that which attracts me.'[23] Another example may further explain this point.

Jean-Paul Sartre's conversion to Marxism may be similar to Duchamp's interest in playing chess. A key criticism of Sartre's famous existentialist position was that its ethics (a system of morals, customs, or manners) hovered on the edge of nihilism.[24] This position created an extreme situation which Sartre seems to have found impossible to maintain. Could Sartre's lack of a moral reference standard also affect his ability to play with his ideas within a measurable framework? Eventually the mode of the French political situation served as the framework for Sartre's conversion to Marxism. For Sartre, the definitions of the Communist Party served as his reference standard, whose judgment and evaluation of him was the only one that truly mattered.

The horrors of the world wars seem to have deeply shaken both Duchamp's and Sartre's faith in the ability of humanity to effectively govern their mechanisms. They were pointing to perceived imprecisions of human measured ideologies which are forms of reference standards. These ideologies served as governors which were seen as overly restricting the creative fields. In reaction, Duchamp and Sartre moved to more extreme, unorthodox and nontraditional modes of thinking which did not necessarily reflect or trust the current manner.

However, for an architect it can prove difficult to finally test the effectiveness of an architectural scale model machine, without allowing criticism by the current manner. In other words, the proposed building needs to be inhabited to see if it works well in the current environment.

This study proposes that scale model machines are similar to playing pieces of an intricate game. The purpose of this game is to discover the truth. Scale model machines are used to see whether the current rules of the game are well defined. However, occasionally a rule might be found lacking and will be changed through the mutual consent of the players.

James S. Hans, in *Hermeneutics, Play, Deconstruction*, points to the work of Hans-Georg Gadamer on interpretation and art. He writes, 'In short, play is a fundamental example of the process of the work of art for Gadamer because it requires the absorption of the player into the play, a foregoing of an objective or subjective attitude.'[25] The scale model machine can be seen as playing between the attitudes and modestly mediating the measures of humans. Hans continues, 'This [play] requires that the "rules" of the game that the work of art itself establishes – the player begins with his own fore-conceptions, but he must be led by the work itself, must accept the rules of the work itself.'[26] Hans believes that, 'Through the back-and-forth movement within the circle of the play, the rules become established [defined], the participant modifies his own projections accordingly, and he comes to understand the work of art precisely through the series of reversals of his own expectations which the correcting of his fore-projections involves.'[27] Hans points to the work of Gadamer when he notes that this is not free play, as Derrida recommends, but involves giving oneself over to the rules of the thing which one is experiencing. The player must apply the meaning of the experience to his or her own life (Figure 4.14), but the application is determined by the structuring power of the rules that are involved in the production of the play.[28]

4.14 *Play/Young boy building miniature log cabin*

To play as Gadamer recommends, requires an act of faith in accepting a set of rules to serve as a reference standard.[29] According to Kant, faith is the acceptance of regulative principles or ideals that cannot be demonstrated theoretically or empirically but, nevertheless, are needed and used efficiently in scientific, practical, and moral affairs.[30] The architect should not accept this act of faith blindly. As Sartre pointed out, it is a self-deception not to admit that one has

freedom of choice to act in such matters. For Sartre, it is a lack of self-assurance or self-esteem that prevents one from acting on this choice.[31]

Since the Renaissance, the architect has gained greater and greater freedom of choice in recalibrating the existing reference standard or defining new ones. The new freedom offers a foregoing of objective or subjective attitudes, for it includes both. This new freedom has also placed new responsibility on the architect which, in turn, requires greater education and knowledge. In this pursuit, past architects could refer to a broad base of knowledge including such areas of thought as aesthetics, ethics, metaphysics, logic, and epistemology. These areas are similar to those recommended by Vitruvius for educating the architect, since they offered the basis for generally understanding the habits of the human character. This knowledge was considered necessary to successfully represent the boundaries used to measure, calibrate, and test the rituals of life.

Recent revelations that the rules of our games (the reference standards) are humanly created, and therefore imperfect, should not come as a surprise. They always have been. These concerns point to humanity's current fears that we are losing faith in our ability to control mechanisms. However, if humankind is not to become victim to a technology spinning out of control, architects remain responsible for choosing, regulating and governing their machines (Figure 4.15). These regulations are difficult to develop without a faith that humanity may eventually define the unknown or invisible things. Architects can no longer realistically believe they can escape from their technology. With a faith in ourselves to make more fully educated choices in selecting the best reference standard, technology may allow humankind an escape from our destiny.

4.15 *Frank Lloyd Wright*

Notes

1. This information concerning Copernicus and Galileo is widely documented, here it serves to explain the concept of paradigm shift.
2. *The Compact Edition of the Oxford English Dictionary*, (Oxford, UK: Oxford University Press, 1985), p. 2421.
3. Lacey, A.R., *A Dictionary of Philosophy*, (London, UK: Routledge and Kegan Paul, Ltd, 1986), p. 200. The word 'reason' comes from the Latin *ratio*, the relation in degrees between two similar things and *reri*, meaning to think or reason. The term 'ratio' is used in a general philosophic sense to refer to the human ability to

discriminate, to identify, and to relate things. Ratios are a form of measurement and, as earlier noted, scale model machines are important in defining and developing measurement.

4. Hulten, K.G. Pontus, *The Machine as Seen at the End of the Mechanical Age*, (New York, NY: The Museum of Modern Art, 1968), p. 8.
5. Ibid., p. 9.
6. Ibid., p. 8.
7. Ibid., p. 9.
8. Ibid., p. 21.
9. Ibid., p. 10.
10. Ibid., p. 18.
11. Oxford, op. cit., p. 2927.
12. Ibid., p. 633.
13. Smith, Alan H., *Encyclopaedia Americana*, (Danbury, CT: Encyclopaedia Americana, 1982), vol. 2, p. 217.
14. Ibid., p. 217.
15. Hulten, op. cit., p. 9.
16. The word 'avant-garde,' a French military term meaning 'vanguard,' has been applied since the 19th century to advanced and experimental movements in architecture and art. During the 20th century the avant-garde produced such artistic movements as Fauvism, Cubism, Dadaism, Surrealism and, in philosophy after the Second World War, Existentialism.
17. Smith, op. cit., p. 217.
18. There is an important connection between 'subject' and 'subjectivism.' One meaning of 'subject' is one who is under the authority, control, or rule of another. The subjective approach results in art which reflects an individual's mind or state of mind. A subjective position exists only within the experiencer's mind and is incapable or external measurement. 'Subjective' can mean having to do with the perceived real nature of something and who or what created that real nature. It is involved with ideas about the seemingly immeasurable human inspiration.
19. Benevolo, Leonard, *History of Modern Architecture*, (Cambridge, MA: The MIT Press, 1977).
20. Schulz, Christian Norberg, *The New Tradition*, *Architectural Design* (New York, NY: St. Martin Press, AD, 1991), p. 94.
21. Bisare, Michael, ed., *Western Art*, (New York, NY: Exeter Books, 1979), p. 176.l
22. Tomkins, Calvin, *The Bride and the Bachelors*, (New York, NY: Viking Press, 1965), pp. 9–10.
23. Tomkins, Calvin, *The World of Marcel Duchamp*, (New York, NY: Time Life Library, Time Inc.).
24. Nihilism is the belief that all traditional values and beliefs are unfounded and that all existence is consequently senseless and

useless. It is a denial of intrinsic meaning and value in life, reflecting a general disillusionment with the ability of humans to justify one moral value over another. Grove, Philip H., *Webster's Third International Dictionary*, (Chicago, IL: Encyclopedia Britannica, Inc., 1971), p. 1528.

25. Hans, James S., Hermeneutics, play and deconstruction *Philosophy Today*, 24, Winter, (Celina, OH: Messenger Press, 1980), p. 306.
26. Ibid.
27. Ibid.
28. Ibid.
29. The Oxford English Dictionary tells us that the word 'faith comes from the Latin *fides* which means 'trust or belief.' It is the acceptance or a system of beliefs thought to be true.
30. Angeles, op. cit., p. 94.
31. Ibid., p. 23.