NBER WORKING PAPER SERIES

THE GREATEST ARCHITECTS OF THE TWENTIETH CENTURY: GOALS, METHODS, AND LIFE CYCLES

David Galenson

Working Paper 14182
http://www.nber.org/papers/w14182

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
July 2008

The Greatest Architects of the Twentieth Century: Goals, Methods, and Life Cycles
David Galenson
NBER Working Paper No. 14182
July 2008
JEL No. J01

ABSTRACT

A survey of textbooks reveals that Le Corbusier was the greatest architect of the twentieth century, followed by Frank Lloyd Wright and Ludwig Mies van der Rohe. The same evidence shows that the greatest architects alive today are Frank Gehry and Renzo Piano. Scholars have long been aware of the differing approaches of architects who have embraced geometry and those who have been inspired by nature, but they have never compared the life cycles of these two groups. The present study demonstrates that, as in other arts, conceptual architects have made their greatest innovations early in their careers, whereas experimental architects have done their most important work late in their lives. Remarkably, the experimentalists Le Corbusier and Frank Gehry designed their greatest buildings after the age of 60, and Frank Lloyd Wright designed his after 70.

David Galenson
Department of Economics
University of Chicago
1126 East 59th Street
Chicago, IL 60637
and NBER
galenson@uchicago.edu

Introduction

> Throughout history there persist two distinct trends – the one toward the rational and the geometrical, the other toward the irrational and the organic: two different ways of dealing with or mastering the environment. These contrasting approaches to the problem have been evident in all cultures … They are constantly recurrent ways of approach; one cannot be considered superior to the other.
>
> Sigfried Giedion[1]

A central fault line in modern architecture, long ago recognized by the critic Sigfried Giedion among others, divides the architects who have embraced geometry and modern technology from those who have found their inspiration in nature and the organic. This division resembles one I have investigated for modern painters, poets, sculptors, novelists, and movie directors. In each of these arts, many important practitioners have based their work on ideas, while others have privileged observation: *conceptual* artists directly present their ideas, whereas *experimental* artists work by trial and error toward representations of their perceptions. And remarkably, in each case there has been a powerful tendency for conceptual artists to arrive at their greatest contributions precipitously, early in their careers, whereas their experimental counterparts mature gradually, and are greatest late in their lives.[2] The present study will extend this analysis to architecture, by considering whether the life cycles of the greatest modern architects have been systematically related to their goals and methods.

Finders and Seekers

> The nature of an object is determined by what it does. Before a container, a chair, or a house can function properly its nature must first be studied, for it must perfectly serve its purpose.
>
> Walter Gropius[3]

> A building should appear to grow easily from its site and be shaped to harmonize with its surroundings.
>
> Frank Lloyd Wright[4]

The key contrast is between those architects whose designs originate in an idea – a theory, or general principle – and those architects who begin with visual appearances. Closely related to this is the significance of place: visual, experimental architects typically begin by seeing the site, then tailor their designs to the setting, whereas conceptual architects are more likely to create what they consider universal designs, without reference to specific attributes of location. Experimental architects typically consider a building's appearance to be an important independent characteristic, while conceptual architects often consider appearance a consequence of utility – "form follows function."

Many experimental architects change their designs during the process of construction, in contrast to their conceptual counterparts, for whom construction simply consists of carrying out their plans. The experimentalists' changes in progress result from their desire to achieve visual goals that the architect is unable to anticipate completely in advance. These goals also produce a distinctive attitude toward collaboration. Architecture is necessarily a collaborative activity: few architects construct their own buildings, so they rely on many others – contractors, engineers, craftsmen – to carry out their projects. Yet because of the importance they attach to aesthetic qualities, experimental architects are more likely to insist on having full control over all decisions concerning the design and construction of their buildings, in contrast to conceptual architects, many of whom believe in a genuine division of labor, in which projects are not only built but designed by a team of specialists, each of whom has control over a different aspect of the work.

In general, experimental artists build their skills and judgment gradually over time, and make their greatest innovations late in their lives. In contrast, conceptual artists' innovations are the product of new ideas, and the most radical new ideas are usually produced early in careers,

before the artist has developed fixed habits of thought. This study will test these relationships for architects, by considering whether experimental architects typically produce their greatest works later in their lives than their conceptual counterparts.

Rankings

> Le Corbusier, Mies van der Rohe, and Wright will ultimately appear more important than their contemporaries because they were greater as artists.
>
> Peter Blake[5]

This study will analyze the achievements of the greatest architects of the twentieth century. These architects can be identified by the same method previously used for painters.[6] Specifically, the opinions of experts can effectively be surveyed by using all available textbooks that treat the history of architecture in the past century. These textbooks include illustrations of the work of important architects. Counting these illustrations serves to indicate which architects are generally considered most important.

I began the selection of the architects to be studied by identifying all those architects whose work was illustrated a total of ten or more times in five leading textbooks of art and architecture history.[7] This yielded 13 architects. I then tabulated all the illustrations of these 13 architects' work in all available textbooks, published within the past 10 years, that surveyed the history of architecture in the entire twentieth century.[8] I included in the final sample for this study the eight architects whose work was most often illustrated in the 22 books surveyed. They are listed in Table 1.

The evidence of the textbooks indicates that historians of art and architecture collectively consider Le Corbusier to have been the greatest architect of the twentieth century, followed closely by Frank Lloyd Wright. Mies van der Rohe completes the trio of architects who are clearly considered to have dominated the century, followed by such other major figures of past

generations as Alvar Aalto, Walter Gropius, and Louis Kahn. Two living architects, Frank Gehry and Renzo Piano, are included among the highest-ranking eight architects of the century. The positions of Gehry and Piano are perhaps most susceptible to change in future, but this survey of a substantial body of evidence makes it clear that the ranking of Table 1 includes all of the architects currently deemed by scholars to have made the very greatest overall contributions to their art in the twentieth century.

The evidence taken from the textbooks can also be used to identify what scholars consider the most important specific embodiments of these architects' contributions. For each of the eight sample members, Table 2 lists the two buildings that were most frequently illustrated in the textbooks. This tabulation will be used to determine when in their careers these great architects arrived at their major innovations. The following sections of this paper will consider each of these eight architects in turn, ordered chronologically by date of birth. For each, the discussion will consider the nature of the architect's goals, his working methods, and the nature and timing of his most important contributions.

Wright

> Nothing is more difficult to achieve than the integral simplicity of organic nature.
>
> Frank Lloyd Wright[9]

Early in his professional life, Frank Lloyd Wright developed the concept of organic architecture, and this remained the foundation for his art throughout his remarkable career of more than seven decades. Organic architecture was based both on inspiration from nature – buildings should be simple, individual in character, and in harmony with their surroundings – and on the aesthetic of nature – materials should retain their original appearance, and the buildings they created should have the colors and the honesty of nature.[10] Wright emphatically

rejected the idea that modern architecture should adopt the aesthetic of the machine: “Why should architecture or objects of art in the machine age, just because they are made by machines, have to resemble machinery?” He equally did not believe that form should necessarily follow function: “Nor is there good reason why forms stripped clean of all considerations but function and utility should be admirable beyond that standpoint. They may be abominable from the human standpoint.”[11]

Wright’s priority of making his buildings harmonize with their surroundings made it extremely important for him to know their sites well. So for example he travelled from his home in Wisconsin to the site of Fallingwater, near Pittsburgh, at least three times during the year that elapsed between his acceptance of the commission and his presentation of his first drawings to the client.[12] The same priority prompted him, whenever possible, to use local materials in constructing his buildings, and to leave them in their natural state to the greatest extent possible. Thus for example the flat beige stones that made up Fallingwater’s tapestry walls, and visually echoed the house’s wide balconies, were taken from a sandstone quarry just a few hundred feet from the house, and the stones’ rough surfaces were preserved by prying, rather than cutting them, out of the earth.[13]

Wright was a firm believer in the value of making improvements to his buildings throughout the process of construction. For him working drawings were merely a point of departure: “The original plan not as an idea but as a piece of paper may be thrown away as the work proceeds. Probably most of those for the most wonderful buildings in the world were because the concept grows and matures during realization, if the master mind is continually with the work in order that the original plan may be fulfilled.”[14] Many builders were annoyed by the delays caused by Wright’s changes, and many clients were even more dismayed by the cost

overruns they occasioned, but Wright was never fazed, because as his biographer Brendan Gill observed, for Wright "no design could be called complete until the building itself was complete; to him the process of construction was a process of refinement as well." Wright grew experienced in justifying his changes to irate clients, in one case explaining that "You see the building grows as it is built and is none too easy, therefore, to keep up with always." Gill marveled: "Who but Wright would have dared to use the occurrence of second thoughts (and third and fourth and fifth thoughts) as a reason for failing to fulfill his professional obligations as an architect?" Yet Wright's results were such that his expensive revisions usually alienated his clients only temporarily, for "they contrived to forgive him as, with the passing of time, irritated incredulity was transmuted into admiration."[15]

Wright's vision of organic architecture was highly personal, so it is hardly surprising that he warned against the dangers of divided control: "No system will be adequate to modern conditions that does not give to the architect complete control of his design and assure control to him until final completion of the building." Anything less risked artistic failure: "I believe that only when one individual forms the concept of the various projects and also determines the character of every detail in the sum total, even to the size and shape of the pieces of glass in the windows, the arrangement and profile of the most insignificant of the architectural members, will unity be secured which is the soul of the individual work of art."[16]

Wright experimented continually throughout his long career, and his style evolved gradually. One survey of his work concluded that "When we look at the totality of his oeuvre, we see in his form language a remarkable coherence, continuity, and recurrence of motifs."[17] The scholar Neil Levine pointed to one specific element of Wright's artistic growth over time, as he noted that Fallingwater, which Wright designed after the age of 70, "derives its unique

immediacy of impact and oneness with the landscape from the overriding force of the diagonal axis." Wright had begun experimenting with the diagonal axis more than 30 years earlier, and had become increasingly reliant on it over time, until during the early 1920s "it became the norm rather than the exception in his work." Wright's organization of Fallingwater consequently drew on decades of experience with the device, with the result that Levine concluded that "The diagonality of the plan of Fallingwater is extremely subtle."[18] Wright himself had no doubt about the artistic value of experience for organic architecture: "As understanding and appreciation of life matures and deepens, this work shall prophesy and idealize the character of the individual it is fashioned to serve more intimately."[19]

Gropius

> In the progress of our advance from the vagaries of mere architectural caprice to the dictates of structural logic, we have learned to seek concrete expression of the life of our epoch in clear and crisply simplified forms.
>
> Walter Gropius[20]

Throughout his career, Walter Gropius advocated the creation of a rational, ahistorical architecture appropriate to a modern, technological age. In 1923, for example, he observed that recent architecture had become "sentimental, aesthetic, and decorative," and declared that it was a goal of the Bauhaus, of which he was director, "to create a clear, organic architecture, whose inner logic will be radiant and naked, unencumbered by lying facades and trickeries; we want an architecture adapted to our world of machines, radios and fast motor cars, an architecture whose function is clearly recognizable in the relation of its forms."[21] His contributions to both the theory and practice of architecture reflect a consistently systematic, conceptual approach.

After working as an assistant to the architect Peter Behrens for two years, Gropius established his own office in 1910. The following year, in his first important commission, he

designed the facade of a factory for a shoe last company. Instead of the traditional brick facade, Gropius created a startling innovation, a facade made entirely of glass windows separated only by thin steel strips. By eliminating weight-bearing exterior walls, Gropius introduced the modern glass curtain wall, which eliminated the visual separation between indoors and outdoors. At the age of 28, barely more than one year into his career as an independent architect, Gropius had made a revolutionary contribution, that would become a standard part of the vocabulary of twentieth-century architecture. He underscored his innovation three years later with an entirely glass-sheathed model factory at the 1914 Werkbund exhibition in Cologne. Peter Blake later remarked that these two buildings "represented so radical, so complete a break with the past that their construction must have had the effect of a violent explosion in the world of architecture."[22] The innovations of Gropius' buildings were fully embodied in their plans, and he typically delegated responsibility for the actual execution of construction to assistants.[23]

Gropius consistently favored what he called *rationalization* – "liberation of architecture from a welter of ornament, the emphasis on its structural functions, and the concentration on concise and economical solutions." He predicted that style would disappear altogether: "A breach has been made with the past, which allows us to envisage a new aspect of architecture corresponding to the technical civilization of the age we live in; the morphology of dead styles has been destroyed." He believed it would soon become possible "to rationalize buildings and mass-produce them in factories by resolving their structure into a number of component parts. Like boxes of toy bricks, these will be assembled in various formal compositions." The architect as artist was to be replaced by a team: "The art of building is contingent on the coordinated team-work of a band of active collaborators whose orchestral cooperation symbolizes the cooperative organism we call society." Theoretical training was essential for aspiring architects: "since

theory represents the impersonal cumulative experience of successive generations it offers a solid foundation on which a resolute band of fellow-workers can rear a higher embodiment of creative unity than the individual artist." In a direct contradiction of Wright's assertion of the need for control by the individual, Gropius declared that "A building designed by one man and carried out for him by a number of purely executant associates cannot hope to achieve more than superficial unity."[24] Teamwork would fundamentally transform the role of the architect: "The nature of teamwork will lead the students to good 'anonymous' architecture rather than to flashy 'stunt' design."[25]

Gropius' greatest innovation in architectural practice, which was based on a change in the material and function of walls, was based on a new idea, and in this it was consistent with his theoretical conception of the necessary changes in the method of creation of architecture, with the replacement of the individual by a team, and elimination of traditional distinctions between artists and craftsmen. Gropius was well aware of his philosophical difference from Wright: "he is very strongly an individualist, whereas I am very much in favor of teamwork."[26] A biographer noted that Gropius' beliefs set him at an opposite pole not only from Wright, but also from Mies and Le Corbusier: "Not one of them could accept Gropius' 'impersonal instrument' theory of architecture … Not one of these men could have worked with collaborators, as Gropius does, because their concept of creativity is so private."[27]

Mies van der Rohe

> We should attempt to bring nature, houses, and human beings together in a higher unity.
>
> Ludwig Mies van der Rohe[28]

In comparing Mies van der Rohe to Le Corbusier, the architect Philip Johnson observed that Le Corbusier was the more flamboyant, "but Mies may be the strongest, as he is surely the

purest. And his answer to the pyrotechnicians is classic: 'I don't want to be interesting. I want to be good.'"[29] A series of analysts have attested to Mies' overriding concern with the appearance of his buildings. Mies' biographer, Franz Schulze, concluded that "Throughout his life he would always be prepared to qualify his fundamental commitment to rationality, his admiration for technology, his abiding faith in philosophy, with a simple yet powerful passion for materials."[30] The architect Myron Goldsmith, who was a student and later a colleague of Mies, recalled that Mies "liked the simple ideas, the simple forms, but in working them out, they would sometimes get elaborate in the details … Above all, the aesthetic aspects were always uppermost in his mind."[31]

The minimalist, industrialized appearance of Mies' buildings led many to assume that they were planned systematically and mechanically. So for example a hostile critic described the Farnsworth House in Plano, Illinois, as "nothing but a glass cage on stilts."[32] In fact, however, the scholar David Spaeth explained that the house was not based on theory: "No formula or mathematical relationship forms the basis for the proportions; they were as much a response to the materials and the methods of fabrication and assembly as they are the result of what was satisfying to the eye and pleasing to the intellect."[33] Mies' visual approach to design led him to depend heavily on the use of elaborate three-dimensional models of his projects, at a time when this was unusual for architects.[34] Edward Duckett, who constructed many of these models, recalled "I don't think he'd have ever made up his mind about the Farnsworth House unless we'd made a model of it."[35]

Mies' use of models could go beyond his concern for the appearance of his building to his desire for the integration of the building into its environment. In 1954, when Mies was planning the Seagram Building, which would prove to be one of his most important works, his

client reported that he not only had models of several different possible designs for the skyscraper, but "he has a cardboard model of Park Avenue between 46th and 57th streets with all the buildings on the Avenue and some going in the blocks and then he has a number of towers for different solutions that he places in the empty place of the old 375 [the Park Avenue address] and this model is up on a high table so that when sitting in a chair his eye is just level with the table top which equals the street – and for hours on end he peers down Park Avenue trying out the different towers."[36]

Mies worked by trial and error. An architect who worked with him remarked that he never settled on a solution quickly: "He constantly said 'if you have six solutions, put them all down, if you have ten, put them down. Whatever you think is possible, try it.'" Another colleague added that Mies "tried some weird things. He was never hesitant to try some idea that just was bizarre. He had the judgment to know that it was wrong, but until he saw it, he had no compunction about approaching it and thinking about it."[37]

A celebrated instance in which Mies made a significant alteration to a design for aesthetic reasons involved his famous apartment buildings at 860-880 Lake Shore Drive in Chicago. In order to relieve the monotony of the otherwise smooth facades of these two 26-story towers, Mies had I-beams welded onto the building's columns and mullions (the steel strips that separate the windows). The projecting I-beams added visual interest: they created changing patterns of shadow, and also made the appearance of the facades change as a viewer moved around the buildings. When Mies was asked why he had added the I-beams, he explained that they stiffened the buildings' frames, but that the real reason was that without them "it did not look right."[38] Mies' aesthetic gesture was duly criticized by some architects who believed in the conceptual principle that form should be determined exclusively by function.[39]

Mies' architecture appeared formulaic, and it was so widely influential in part because it was assumed to be based entirely on ideas, which could be readily communicated.[40] In fact, however, a number of commentators have observed that work based on Mies' designs tended to be of inferior quality, because imitators failed to understand the aesthetic subtlety of Mies' originals. Martin Filler, for example, called this the "paradox of Miesianism: though its originator believed he had established universal models that made it possible for all architects to design clear, functional, economical structures after his example, this architecture was in fact so dependent on highly personal factors – his innate sense of proportion, his obsessive interest in detail, and his keen instinct for dramatic contrast in settings ranging from the bucolically rural to the densely urban – that his principles remained woefully incomplete in the hands of his less-attentive followers, to say nothing of his crass counterfeiters."[41] Mies made significant contributions over a period of four decades, and his style evolved throughout this extended time. Giedion described his career as unified by "a continuous pressure for the conquest of pure form."[42]

Le Corbusier

> Creation is a patient search.
>
> Le Corbusier[43]

When the 36-year-old Le Corbusier published *Toward an Architecture* in 1923, with its bold declaration that "A house is a machine for living in," the book quickly came to be regarded as a radical functionalist manifesto for the new machine age. This view was supported by the book's abundant photographs of elegant modern ocean liners, airplanes, and automobiles, and such assertions as "The creations of machine technology are organisms tending toward purity."[44] Five years later, the pristine whiteness and geometric simplicity of the Villa Savoye, which Frank Lloyd Wright contemptuously dismissed as a "box on stilts," appeared to confirm Le

Corbusier's identity as a reductionist worshiper at the shrine of modern industrial functionalism.[45]

From the beginning, however, there was a greater subtlety to Le Corbusier's vision of architecture that was often overlooked.[46] Thus for example in *Toward an Architecture*, he criticized some young architects for claiming that utility was a sufficient condition for beauty, he declared that "Architecture goes beyond utilitarian things," and he stated his belief that "There is no art without emotion."[47] Peter Blake explained that even early in his career Le Corbusier was never a functionalist: "by and large, Corbu has been less concerned with the technology of architecture than with its art. The confusion about Corbu's true objectives stems from the single, simple fact that he found his major sources of *aesthetic* inspiration in the *technology* of our time."[48] Vincent Scully agreed: "Le Corbusier's view was from first to last different from that of his [Bauhaus] colleagues. It was always visual, never emotionally reductive, as theirs often was. For him, architecture was 'a play of forms under the light,' an art to 'touch my heart.'"[49]

Le Corbusier's art changed considerably between the late '20s and the early '40s. Blake commented that "from the late twenties on, there were unmistakable signs of a loosening-up process, a growing interest in nature as a source of inspiration," while Charles Jencks described this as a "shift from the white machine aesthetic toward a hybrid, rough mode that combines crude hand-built masonry and factory-built systems."[50] At the inauguration of his celebrated Unité d'habitation apartment building in Marseille in 1953, Le Corbusier justified the raw concrete surfaces of what many called his late "Brutalist" style in anthropomorphic terms: "concrete shows … the joints of the planks, the fibers and knots of the wood … [I]n men and women do you not see the wrinkles and the birthmarks, the crooked noses, the innumerable peculiarities? … Faults are human; they are ourselves, our daily lives."[51]

In 1950, at the age of 63, the irreligious Le Corbusier agreed to design what would generally come to be considered his greatest building – indeed the building that was illustrated more often in the textbooks surveyed for this study than any other work by the greatest architects of the twentieth century – a Catholic church in the small village of Ronchamp. When he was first approached for the project he declined, saying he had no time for a "dead institution." Yet when Le Corbusier visited Ronchamp, the priest who accompanied him recalled that the architect was "seduced by the site," high on the top of a hill, with uninterrupted views of nature in all directions, and that he immediately began drawing.[52] Le Corbusier's notes from that first visit confirm the importance of the site: "Ronchamp? Contact with a site, situation in a place, eloquence of the place."[53] This was an example of Le Corbusier's usual practice, for his normal procedure upon accepting any new commission was immediately to visit and study the site, then to let a design develop gradually in his mind in response to the setting, often with the help of models.[54]

Le Corbusier arrived at the bold forms of the Ronchamp chapel visually: he claimed that the most celebrated element, the bulging, curving roof, was suggested to him by the shape of a crab shell he had found on a beach three years earlier.[55] The flamboyant design annoyed many critics – Nikolaus Pevsner described Ronchamp as the "manifesto of a new irrationalism" – but it inspired many younger architects, who felt it gave them a new freedom to use unorthodox forms for their own purposes of expression.[56] Scully recognized that at Ronchamp, Le Corbusier had devised "such eccentric and active shapes as architects had hardly imagined before." Scully compared the gestural forms of the chapel to the paintings the Abstract Expressionists were making during the same decade: "Like such painting, Le Corbusier's buildings are experienced in primarily physical, empathetic terms, and whatever associations they may suggest remain

shifting and cloudy." Scully also understood that Le Corbusier shared a fundamentally experimental orientation with the Abstract Expressionists: "His loyalty, unswervingly given, was to his own vision, his primal search."[57]

Aalto

> Nature, not the machine, is the most important model for architecture.
>
> Alvar Aalto[58]

In the early 1950s, Giedion described Alvar Aalto as the leading successor to Frank Lloyd Wright in developing an organic architecture in opposition to the mechanical functionalism of Gropius and others. He praised the "moral force" of Aalto's "one supreme concern: to reestablish a union between life and architecture."[59] Aalto believed strongly in subordinating technology to human concerns: "We have dreamed of being master of the machine, not its slaves."[60] In his view, the architect's true goal was "to make the little man a little happier by offering him a setting which suits him exactly, and does not make him a slave to standardization. In other words, I am advocating unbridled individualism."[61]

Aalto did not believe in general principles or theoretical programs, for to him "Each task is different and the solutions can therefore not be made general."[62] Architects should build, not write: "The Creator created paper for drawing architecture on. Everything else is, at least for my part, to misuse paper."[63] Martin Filler noted that Aalto was flexible in his approach to design "because he was never constrained by purely ideological issues."[64] Aalto believed that architecture could be made more methodical, "but the substance of it can never be solely analytical. Always there will be more of instinct and art in architectural research."[65] His own approach to complex design problems was to rely on intuition and the subconscious: "I simply draw by instinct, not architectural syntheses, but what are sometimes quite childlike

compositions, and in this way, on an abstract basis, the main idea gradually takes shape."[66] The personal nature of Aalto's vision made him leery of collaborative approaches: "Teamwork to me is an ominous word." He compared the form of collaboration he used in his office to "an orchestra where each instrument should play correctly under the leadership of the conductor."[67]

Aalto's inspiration came from nature, particularly the landscape of his native Finland. When a journalist asked him what a city should be like, he replied "You should not be able to go from home to work without passing through a forest."[68] Giedion described the graceful forms of Aalto's designs as a product of "the curved contours of Finnish lakes," and observed that in the Villa Mairea, Aalto's most celebrated building, "the forest seems to enter the house and find its concomitant echo in the slender wooden poles employed there."[69] The architect Robert Venturi recalled that "When I was growing up in architecture in the 1940s and 1950s Aalto's architecture was largely appreciated for its human quality, as it was called, derived from free plans which accommodated exceptions within the original order, and from the use of natural wood and brick, traditional materials introduced within the simple forms."[70] A critic told of an occasion when Aalto was asked about architecture, and "began to talk about the Finnish countryside and salmon fishing. For the first time we felt that architecture is *life* and that creation arises from contact with reality … Reality … is largely *local*, tied to place, and it is the task of the architect to make people to see the special character of the place and its properties."[71]

Aalto believed in gradual change, as he considered all art to be "a continuous process of refining and reworking matter – not for its own sake, but for human demands."[72] His own discipline was the most incremental: "Architecture demands even more of this time than other creative work. As a small example from my own experience, I can mention that what appears to be nothing but playing with forms may be unexpectedly, much later, lead to the emergence of an

actual architectural form."[73] In true experimental fashion, he proposed that large urban projects should not be planned only on paper, but should be allowed to grow out of small trial works: "When we plan a larger building cluster for a certain area, a neutral area that could serve as an experimental area can be separated from this overall area. There we could immediately begin to build – naturally, not a large number of buildings – while working on the totality that still exists only on paper. In this manner we would become familiar with the elements of which a community consists."[74]

Kahn

> When you're making something you must consult nature.
>
> Louis Kahn[75]

Louis Kahn defined architecture as "the thoughtful making of spaces."[76] The key term in this was "thoughtful," for Kahn valued questions above answers, and processes above products.[77] Kahn's architecture grew out of deep reflection and belief: "it is not what you want, it is what you sense is the order of things which tells you what to design … It cannot be something that is imposed on you – you believe in it."[78]

Kahn wanted buildings to speak for themselves. This meant not only that they should make their intended purposes clear, but that they should openly exhibit their functions, reflect the process of their construction, show the true nature of their materials, and use those materials in ways that showed them to best advantage. Kahn took to heart his observation that "everything that nature makes it records in what it makes how it was made."[79] He believed buildings should do the same, and that one implication of this was that the architect should "derive from the very nature of things – from his realizations – what a thing wants to be."[80] As an illustration of this process, he described considering the nature of brick: "You say to brick 'What do you want, brick?' And brick says to you, 'I like an arch.' And you say to brick, 'Look, I want one too, but

arches are expensive and I can use a concrete lintel over you, over an opening.' And then you say, 'What do you think of that, brick?' Brick says, 'I like an arch.'" For Kahn it was a moral imperative for the architect to honor the materials he used, and this could be done only by glorifying the material, "instead of just shortchanging it or giving it an inferior job to do, where it loses its character."[81]

Kahn did not trust collaboration, for he believed firmly that "an act of architecture" – which was not merely making a building, but "making a space what it wants to be" – could not be done by more than one person. The process of creating a meaningful artistic form was individual: "I think, that if an artist is an artist he has to guard very, very religiously his personal work. He cannot share his work with another."[82]

The scholar Robert Twombly concluded that "The point about Kahn is his search." That Kahn was a seeker was more apparent than the nature of his goal, as Twombly remarked that "What he was searching for is difficult to say," but Kahn was always looking for something beyond what he had found.[83] This was reflected not only in the fact that Kahn worked very slowly, often spending years even on projects that were unlikely ever to be constructed, but as Twombly observed, "more important is this: Built or not, Kahn designs were rethought, reworked, and reconceived, in short, agonized over."[84] Kahn took for granted that he could make changes even when buildings were under construction, as he explained to the director of the Kimbell Art Museum that "the building gives you answers as it grows and becomes itself."[85] Like most great experimental artists, however, Kahn's search went beyond individual projects. Thus Twombly recognized that "he understood that the pleasure and meaning of life was in the search."[86] Eternally optimistic, in a speech to architecture students the year before he died, Kahn declared that "Of all things, I honor beginnings."[87]

Even in a profession known for extended apprenticeships and delayed opportunities to receive commissions for important projects, Kahn was a notable late bloomer. In 1962, Vincent Scully observed that "Ten years ago Louis I. Kahn, then over fifty, had built almost nothing and was known to few people other than his associates in Philadelphia and his students at Yale. None of them would at that time have called him great, although his students generally felt, with some uneasiness, that he should have been, even might have been, so. But within ten years the 'might-have-been' has turned to 'is,' and Kahn's achievement of a single decade now places him unquestionably first in professional importance among living American architects."[88]

Gehry

> It's modern life, the real experience of living in this world, that's fueled my work.
>
> Frank Gehry[89]

Frank Gehry's motivations for his architecture are visual. One of his longstanding concerns has been to capture "a sense of movement."[90] One of his first attempts at this was in designing a guest house for the art collector Norton Simon in 1976: "I decided to make a trellis that looked like a pile of wood that had been laid on the roof, caught up in the wind blowing off the ocean, as if the wind had caught it and flung it into mid-air. The trellis would have captured this movement, and every time you looked at it, it would look different." The problem was that Gehry didn't know how to achieve this: "I knew how to draw it, but I didn't know how to build it." He decided to work iteratively: "I would do a layer at a time. I did a drawing of the first layer of pieces of wood, and we built that. And then I went out and stared at it and afterward I made a drawing of the next layer of pieces of wood, and we built that." After three layers were built in this way, Simon called a halt: "He wouldn't stand for it, it offended him that he was paying for this experiment and he didn't know where it was going to go, he didn't know if it was going to

pay off. He said to me ‘There have been many great artists over time who have not been able to finish their masterpieces. I’m going to add you to the list.’ And so we stopped.”[91]

Gehry wanted even his finished works to appear unfinished: “I prefer the sketch quality, the tentativeness, the messiness if you will, the appearance of in-progress rather than the presumption of total resolution and finality.”[92] He compared his aesthetic to that of three great experimental painters, whose finished works famously bear the signs of their own making: “I was interested in the unfinished – or the quality that you find in paintings by Jackson Pollock, for instance, or de Kooning, or Cézanne, that look like the paint was just applied.”[93] Like the Abstract Expressionists, Gehry often begins his designs without a specific goal: “I start drawing sometimes not knowing exactly where it is going … Sometimes it seems directionless, not going anywhere for sure. It’s like feeling your way along in the dark, anticipating that something will come out usually … Sometimes I say ‘boy, here it is, here it is, it’s coming.’ I understand it. I get all excited and from there I’ll move to the models.”[94] A critic observed that this process allowed Gehry to work without preconceptions: “He can put theory aside in order to raid his unconscious, like a refrigerator at night, for the hunches, whims and contradictions that make his best work inimitable.”[95]

The dramatic design of Gehry’s most celebrated building, which placed second overall in total illustrations among all individual works in this study, emerged from a process of trial and error, driven by Gehry’s visual inspection and intuition. James Russell summarized the process by which Gehry designed the Guggenheim Museum at Bilbao: “In dozens of drawings and in models, some of which were assembled from the crudest cardboard and crumpled paper, he and colleagues studied the design, tore it apart, and refined it in an iterative process that relied almost entirely on the architect’s intuition.”[96] Gehry’s design for the Guggenheim was created with the

assistance of a computer program developed for the French aerospace industry. Yet rather than designing directly in the computer, which Gehry feared would restrict his architecture to simple and symmetric geometric forms, the computer was used to translate handmade designs into forms and materials for construction: the computer thus did not dictate or constrain the design, but preserved the nuances and subtleties that had been drawn and modeled with traditional media.[97] The complex curves of the Guggenheim were made feasible by the computer: an assistant to Gehry remarked that "Bilbao could have been drawn with a pencil and straight-edge, but it would take us decades."[98]

Like Kahn, Gehry came to prominence late. He first gained significant attention within his profession with the renovation of his own house when he was nearly 50, and his public reputation and fame rest heavily on the Guggenheim at Bilbao, which he designed at 64. Martin Filler observed that "in 1976, when America's Bicentennial prompted countless predictions, no one would have bet that Gehry, pushing fifty and with no major public buildings to his credit, would become the country's, let alone the world's, dominant architectural figure by the new millennium."[99] In characteristically experimental fashion, Gehry considers his work as an evolution, not only in the production of individual projects, but also from one project to the next: "at some point I stop, because that's it. I don't come to a conclusion, but I think there's a certain reality of pressures to get the thing done that I accept. It's maturity, or whatever you want to call it, to say, stop, go, finish. I've got other ideas now, and the door is open for the next move, but it's not going to happen on this building, it's going to happen on the next one."[100]

Piano

> Architecture is science.
>
> Renzo Piano[101]

Renzo Piano achieved instant fame in 1971, at the age of 34, when he and his 38-year-old partner Richard Rogers won out over 680 other entrants in an international competition to design a new Parisian cultural center. The building, which was to house not only the French national museum of modern art, but also a public lending library, a center for visual research, a bookstore, several cinemas, and two restaurants, was to be located in central Paris, in the historic Marais district.

Originally designated as the Plateau Beaubourg, but subsequently named after the French president who initiated the project, the Centre Georges Pompidou opened in 1977, and quickly became both one of Paris' most popular tourist destinations and the city's most controversial building. The authorized catalogue of Piano's work explained that the most basic intention of the center's design "was to define a new relationship with culture. No longer elitist, culture was to come off its pedestal and enter the mainstream of life."[102] Piano himself recalled that "constructing a building for culture at the beginning of the seventies was an incredibly confused undertaking: the only thing to be done was to aim at convertibility."[103] Peter Buchanan described the Pompidou as "the ultimate expression, even caricature, of the Modernist ideal of the building-as-machine and the more recent notion of building-as-kit-of-parts."[104] The latter theory held that buildings should be like machines in that, for ease of production and later maintenance and alterations, they should be made from standardized parts. Large interior spaces would allow temporary subdivision for specific purposes; services, including the movement of people, should be placed on the exterior of the building, where they would not interfere with the flexibility of the open interior spaces. Piano enthusiastically embraced the machine conception, and the implied functionalist aesthetic: "Having conceived the Beaubourg as an authentic machine, it became logical that those huge 'fingers' that carry cold-hot-cold air into the building became

important and visible elements of this building … The concept was that this microcosm, in order to remain really accessible, had to expel to its exterior, in a kind of centrifugal movement, all the fixed elements of the structure." Nor did Piano object to the description of the Pompidou as a factory: "this notion of the Beauborg as a machine or factory has always filled me with joy."[105] Buchanan has described the Pompidou as "a monument to the ideas of function and flexibility."[106]

The Pompidou has often been criticized as ugly and out of place in its neighborhood. Martin Filler, for example, recently wrote that "its preposterous imagery of an oil refinery in the heart of the otherwise gracefully preserved Marais remains as offensive as ever." Filler also described the building as "pseudoprogressive" – "essentially a giant shoebox enmeshed in miles of mostly useless painted metal ducts, pipework, and scaffolding."[107] Interestingly, instead of defending his work against charges like these, Piano has explained that the design was intentionally provocative, not only aesthetically but even technically: "Beaubourg is a double provocation: a challenge to academicism, but also a parody of the technological imagery of our time. To see it as high-tech is a misunderstanding. The Centre Pompidou is a 'celibate machine,' in which the flaunting of brightly colored metal and transparent tubing serves an urban, symbolic, and expressive function, not a technical one."[108] Young conceptual artists often create innovations that mock earlier art even as they quote from it: thus for example Peter Wollen wrote that Jean-Luc Godard's films "showed a contradictory reverence for the art of the past and a delinquent refusal to obey any of its rules."[109] The Pompidou appears to have been a classic case of this, for the flexibility of its interior spaces, gained by placing its services on the building's exterior, provided a textbook demonstration of a longstanding goal of modern functionalist architecture even as the conspicuous placement and decoration of those services parodied

functionalism. Piano similarly expressed the irreverent attitude of many young conceptual innovators, as he described the Pompidou as “an act of loutish bravado,” and “a huge joke, a kind of face pulled at the cultural establishment.”[110]

During the past century, a number of conceptual artists have rejected the belief that an artist should have a single trademark aesthetic, and Piano shares this attitude, referring to colleagues as trapped in a “golden cage of style.”[111] He also demonstrates a conceptual attitude toward collaboration. Peter Buchanan has explained that Piano’s enterprise, formally titled Renzo Piano Building Workshop, is based on collaboration not sequentially but simultaneously, aiming for a “synergistically creative process in which consultants contribute right from the beginning and all the way through the design process as integral members of the team. In retrospect it is impossible to disentangle who contributed what to the design.”[112] Piano magnanimously acknowledges that “it is the team that merits the success of what we are doing,” and Buchanan argues that Piano’s lack of direct involvement in the development of his ideas allows him to judge his studio’s projects more objectively: “he tends to stand back and let others work up the design while he watches and guides. This detachment allows him to see more clearly and intervene more easily to redirect a design in which he has not become entangled in his own graphic knots, tics or seductions.”[113]

Continuity and Discontinuity

> Stylistically, Gropius leapt into maturity at an early age and with scarcely any fumbling.
>
> James Marston Fitch[114]

> Le Corbusier has grown so greatly in his powers and in his outlook that the period between 1938 and 1953 cannot be passed over in silence.
>
> Sigfried Giedion[115]

The analysis of the preceding sections has established that six of the eight sample members were experimental innovators, and two were conceptual. The question to be considered in this section is whether this resulted in differences in their behavior that can be measured systematically.

As noted earlier, a key difference between the two types of innovator is in their life cycles: experimental artists typically improve over long periods, and make their greatest contributions later in their careers than their conceptual counterparts, who arrive at their major contributions at early ages. Table 3 shows the ages at which the sample members designed the buildings listed in Table 2.

The median age at which the experimental architects designed the buildings listed in Table 3 was 62, fully 24 years greater than the corresponding median age of 38 for the conceptual architects. This differential is virtually the same – 62.5 for the experimental architects, and again 38 for the conceptual ones – if the analysis is restricted to each architect's single greatest building. Only one building in Table 3 was designed by an architect under the age of 30 – the Fagus Factory, by the conceptual Gropius. Two of the three buildings designed by architects before the age of 40 were the work of conceptual innovators. In contrast, fully seven of the buildings listed in Table 3 were designed by architects who had passed the age of 60, and all seven of these were the work of experimental innovators. A striking fact is that five of the six experimental architects have at least one entry in Table 3 for a building they designed after 60. The greatest conceptual architect considered here, Gropius, had designed both of his greatest buildings by the time he was 42, whereas the three great experimental architects to whom he is often compared all continued making their greatest work more than two decades further into their lives – Le Corbusier to age 63, Wright to 76, and Mies to 68. Although limited in quantity, the

evidence of Table 3 clearly demonstrates that the experimental architects considered by the study typically did their greatest work later in their lives than their conceptual counterparts.

Another significant difference between the two types of innovator is a consequence of the contrast between the gradual improvement of the experimentalists and the precipitous formulation of new approaches by the conceptualists. Thus conceptual innovators often produce individual works that fully and completely embody their innovations, whereas experimental innovators tend to make larger bodies of work in which their innovations appear piecemeal and incrementally.[116] The data set produced for this study yields evidence that bears on this difference, as Table 4 shows the mean number of reproductions per building illustrated for each architect that appear in the textbooks surveyed for this study. If an architect makes a small number of designs that clearly and fully introduce his innovations, these and only these will tend to appear in all the books, and the mean number of illustrations per building for that architect in the textbooks will be high. In contrast, if an architect makes many works that differ only slightly from each other, it will be less apparent which of his works best demonstrate his achievement, scholars will disagree more over which works to illustrate, and the mean number of illustrations per building in the textbooks for that architect will be low.

Table 4 shows that the two conceptual architects both have higher mean numbers of illustrations per building illustrated than their experimental counterparts. Thus for example Gropius' total of 84 illustrations in the textbooks was distributed among just 11 projects, yielding a mean of 7.6 illustrations per building. In contrast, Le Corbusier's total of 212 illustrations was distributed among a remarkable 45 projects, for a mean of 4.7 illustrations per building. Thus Le Corbusier had 2.5 times as many total illustrations of his work as Gropius, but these represented more than four times as many different buildings than did the illustrations of Gropius' work. The

evidence of Table 4 is thus clearly consistent with the implication that the contributions of the two conceptual architects were more clearly represented by a smaller number of works than the innovations of the six experimental architects.

The quantitative evidence points to clear differences between experimental and conceptual architects that parallel the findings for practitioners of other arts. Simply put, the conceptual architects studied here arrived at their major innovations earlier in their lives than their experimental counterparts: great conceptual architects are young geniuses, great experimental architects are old masters. And the conceptual architects embodied their innovations in smaller numbers of works than their experimental counterparts: architecture's young geniuses mature suddenly, and present their innovations fully formed, while its old masters mature gradually over time, and arrive at their contributions incrementally.

Conclusion

> One can be a poet at twenty, a virtuoso at fifteen; but architects and urban planners are late bloomers.
>
> Le Corbusier[117]

Not all architects are late bloomers. Walter Gropius, for example, who was among the greatest architects of the twentieth century, could justifiably declare that "I had already found my ground in architecture before the First World War," for the Fagus Factory, which he designed in 1911 at the age of 28, is considered among his very most important achievements.[118] Le Corbusier was right, however, about himself and his greatest peers, including Frank Lloyd Wright and Mies van der Rohe, for they were all late bloomers, who made great work after the age of 60. It is likely that Le Corbusier knew why this was true. His art, like that of Wright and Mies, aimed at creating beautiful buildings that would inspire those who used them, and he knew

that his appreciation of beauty in architecture, and his understanding of how to achieve it, had grown over time.

Sigfried Giedion concluded his influential overview of the evolution of architectural form by stressing that it was not sufficient to study architecture in isolation, for true understanding required a deeper analysis of creativity throughout human activities: “We cannot grasp the constitution of this growth without knowing what *methods of approach* underlie explorations in the different realms of thought and feeling.” The present study constitutes one more step toward the comparative study of methods in the different realms that Giedion called for.[119] This study has shown that modern architecture, like the other major arts, has been divided between what Giedion called the rational and geometric, and what he termed the irrational and organic. Some great modern architects have systematically based their work on the application of general principles, whereas others have worked visually to create buildings that looked right to them. In architecture, as in the other arts, scholars have been aware of each important practitioner’s approach, but as in the other arts they have failed to appreciate the implications of the difference between the two types of innovator. Recognizing the consistency of the difference between conceptual and experimental architects not only explains a major source of creative tension in the development of this art, but brings us closer to understanding the common elements of human creativity in all its domains.

Footnotes

1. Sigfried Giedion, *Space, Time and Architecture*, third ed. (Cambridge: Harvard University Press, 1954), p. 412.

2. David Galenson, *Old Masters and Young Geniuses* (Princeton: Princeton University Press, 2006).

3. Leland Roth, *Understanding Architecture*, second ed. (Boulder, CO: Westview Press, 2007), p. 524.

4. Frank Lloyd Wright, *Frank Lloyd Wright on Architecture* (New York: Duell, Sloan and Pearce, 1941), p. 34.

5. Peter Blake, *Le Corbusier* (Baltimore: Penguin Books, 1960), p. 11.

6. E.g. David Galenson, "Quantifying Artistic Success: Ranking French Painters – and Paintings – from Impressionism to Cubism," *Historical Methods*, Vol. 35, No 1. (2002), pp. 5-20.

7. These books are listed in the appendix.

8. See the appendix for a listing. All illustrations were counted, including photographs, building plans, and drawings or sketches.

9. Wright, *Frank Lloyd Wright on Architecture*, p. 58.

10. Terence Riley, ed., *Frank Lloyd Wright, Architect* (New York: Museum of Modern Art, 1994), pp. 32-33.

11. Wright, *Frank Lloyd Wright on Architecture*, p. 141.

12. Franklin Toker, *Fallingwater Rising* (New York: Alfred A. Knopf, 2003), pp. 139-140.

13. Toker, *Fallingwater Rising*, pp. 203-04; Riley, *Frank Lloyd Wright*, p. 100.

14. Wright, *Flank Lloyd Wright on Architecture*, p. 108.

15. Brendan Gill, *Many Masks* (New York: G.P. Putnam's Sons, 1987), pp. 189, 367.

16. Wright, *Frank Lloyd Wright on Architecture*, pp. 139, 24.

17. Riley, *Frank Lloyd Wright*, p. 32.

18. Neil Levine, "Frank Lloyd Wright's Diagonal Planning Revisited," in Robert McCarter, ed., *On and By Frank Lloyd Wright* (London: Phaidon Press, 2005), pp. 236-253.

19. Wright, *Frank Lloyd Wright on Architecture*, p. 45.

20. Walter Gropius, *The New Architecture and the Bauhaus* (Cambridge: MIT Press, 1965), p. 44.

21. Herbert Bayer, Walter Gropius, and Ise Gropius, eds., *Bauhaus, 1919-1928* (Boston: Charles T. Branford Company, 1952), p. 27.

22. Blake, *Le Corbusier*, pp. 30-31.

23. E.g. Winfried Nerdinger, *Walter Gropius* (Berlin: Bauhaus-Archiv, 1985), pp. 30, 70.

24. Gropius, *The New Architecture and the Bauhaus*, p. 79.

25. S. Giedion, *Walter Gropius* (New York: Reinhold Publishing Corporation, 1954), p. 15.

26. Patrick Meehan, ed., *Frank Lloyd Wright Remembered* (Washington, D.C.: Preservation Press, 1991), p. 47.

27. James Marston Fitch, *Walter Gropius* (New York: George Braziller, 1960), p. 25.

28. Phyllis Lambert, ed., *Mies in America* (New York: Harry N. Abrams, 2001), p. 347.

29. Richard Miller, ed., *Four Great Makers of Modern Architecture* (New York: Da Capo Press, 1970), p. 111.

30. Franz Schulze, *Mies van der Rohe* (Chicago: University of Chicago Press, 1985), p. 101.

31. Lambert, *Mies in America*, p. 201.

32. John Zukowsky, ed., *Mies Reconsidered* (Chicago: Art Institute of Chicago, 1986), p. 23.

33. David Spaeth, *Mies van der Rohe* (New York: Rizzoli, 1985), p. 125.

34. Schulze, *Mies van der Rohe*, p. 284.

35. Lambert, *Mies in America*, p. 215.

36. Schulze, *Mies van der Rohe*, p. 273.

37. Lambert, *Mies in America*, pp. 200-201.

38. Lambert, *Mies in America*, p. 362.

39. Carter Wiseman, *Shaping a Nation* (New York: W.W. Norton, 1998), p. 176.

40. E.g. see Arthur Drexler, *Ludwig Mies van der Rohe* (New York: George Braziller, 1960), p. 9.

41. Martin Filler, *Makers of Modern Architecture* (New York: New York Review Books, 2007), p. 51.

42. Giedion, *Space, Time and Architecture*, p. 562.

43. Le Corbusier, *Creation is a Patient Search* (New York: Frederick A. Praeger, 1960).

44. Le Corbusier, *Toward an Architecture* (Los Angeles: Getty Research Institute, 2007), pp. 151, 158.

45. Charles Jencks, *Le Corbusier and the Continual Revolution in Architecture* (New York: Monacelli Press, 2000), p. 173.

46. Blake, *Le Corbusier*, p. 37.

47. Le Corbusier, *Toward on Architecture*, pp. 162, 194, 204.

48. Blake, Le Corbusier, p. 34.

49. Vincent Scully, *Modern Architecture and Other Essays* (Princeton: Princeton University Press, 2003), pp. 237-238.

50. Blake, *Le Corbusier*, p. 108; Jencks, *Le Corbusier and the Continual Revolution in Architecture*, p. 188.

51. Jencks, *Le Corbusier and the Continual Revolution in Architecture*, p. 254.

52. Jencks, *Le Corbusier and the Continual Revolution in Architecture*, p. 263.

53. Alexander Tzonis, ed., *Drawings from the Le Corbusier Archive* (London: Architectural Design, 1986), p. 31.

54. William Curtis, *Le Corbusier* (Oxford: Phaidon Press, 1986), p. 217.

55. Tzonis, *Drawings from the Le Corbusier Archive*, p. 32.

56. Sabine Thiel-Siling, *Icons of Architecture: The 20th Century* (Munich: Prestel, 2005), p. 82.

57. Scully, Modern *Architecture and Other Essays*, pp. 247, 243.

58. Goran Schildt, *Alvar Aalto: The Decisive Years* (New York: Rizzoli, 1986), p. 216.

59. Giedion, Space, *Time and Architecture*, pp. 415, 565.

60. Alavar Aalto, *Sketches* (Cambridge: MIT Press, 1978), p. 128.

61. Goran Schildt, *Alvar Aalto in His Own Words* (New York: Rizzoli, 1997), p. 165.

62. Aalto, *Sketches*, p. 171.

63. Aalto, *Sketches*, p. 160.

64. Filler, *Makers of Modern Architecture*, p. 92-93.

65. Schildt, *Alvar Aalto in His Own Words*, p. 103.

66. Schildt, *Alvar Aalto in His Own Words*, p. 108.

67. Alto, *Sketches*, p. 172.

68. Peter Reed, ed., *Alvar Aalto* (New York: Museum of Modern Art, 1998), p. 47.

69. Giedion, Space, *Time and Architecture*, pp. 587, 592.

70. Reed, *Alvar Aalto*, p. 133.

71. Reed, *Alvar Aalto*, p. 64.

72. Schildt, *Alvar Aalto in His Own Words*, pp. 267-268.

73. Schildt, *Alvar Aalto in His Own Words*, p. 109.

74. Aalto, *Sketches*, p. 167.

75. Louis Kahn, *Essential Texts* (New York: W.W. Norton, 2003), p. 277.

76. Kahn, *Essential Texts*, p. 47.

77. Vincent Scully, *Louis I. Kahn* (New York: George Braziller, 1962), p. 44.

78. Kahn, *Essential Texts*, p. 59.

79. Kahn, *Essential Texts*, p. 198.

80. Kahn, *Essential Texts*, p. 39.

81. Kahn, *Essential Texts*, p. 271.

82. Kahn, *Essential Texts*, pp. 59-60.

83. Kahn, *Essential Texts*, p. 11.

84. Kahn, *Essential Texts*, p. 15.

85. Carter Wiseman, *Louis I. Kahn – Beyond Time and Style* (New York: W.W. Norton, 2007), p. 226.

86. Kahn, *Essential Texts*, p. 19.

87. Kahn, *Essential Texts*, p. 278.

88. Scully, *Louis I. Kahn*, p. 10.

89. J. Fiona Ragheb, ed., *Frank Gehry, Architect* (New York: Guggenheim Museum, 2001), p. 289.

90. Ragheb, *Frank Gehry*, p. 289.

91. Kurt W. Forster, *Frank O. Gehry* (New York: Distributed Art Publishers, 1999), pp. 31-33.

92. Ragheb, *Frank Gehry*, p. 308.

93. Ragheb, *Frank Gehry*, p. 311. On these three painters, see David Galenson, *Painting Outside the Lines* (Cambridge: Harvard University Press, 2001), pp. 52-57, 119-124.

94. Coosje van Bruggen, *Frank O. Gehry: Guggenheim Museum Bilbao* (New York: Guggenheim Museum, 1999), p. 103.

95. Ragheb, *Frank Gehry*, p. 316.

96. Theil-Siling, *Icons of Architecture*, p. 182.

97. Ragheb, *Frank Gehry*, pp. 353-363; van Bruggen, *Frank O. Gehry*, pp. 135-138.

98. van Bruggen, *Frank O. Gehry*, p. 138.

99. Filler, *Makers of Modern Architecture*, p. 170.

100. van Bruggen, *Frank O. Gehry*, p. 130.

101. Pritzker Architecture Prize, *Renzo Piano* (Los Angeles: Jensen and Walker, 1999), not paginated.

102. Peter Buchanan, *Renzo Piano Building Workshop: Complete Works*, Vol. 1 (London: Phaidon Press, 1993), p. 52.

103. Gianpiero Donin, *Renzo Piano* (Rome: Casa del libro editrice, 1982), p. 24.

104. Buchanan, *Renzo Piano Building Workshop*, p. 52.

105. Donin, *Renzo Piano*, p. 24.

106. Buchanan, *Renzo Piano Building Workshop*, p. 52.

107. Filler, *Makers of Modern Architecture*, p. 247.

108. Filler, *Makers of Modern Architecture*, p. 248. "Celibate machine" is a reference to another conceptual artistic provocateur, Marcel Duchamp.

109. Peter Wollen, *Paris Hollywood* (London: Verso, 2002), p. 97.

110. Buchanan, *Renzo Piano Building Workshop*, p. 52; Donin, *Renzo Piano*, p. 27.

111. Buchanan, *Renzo Piano Building Workshop*, p. 11; David Galenson, "And Now for Something Completely Different: The Versatility of Conceptual Innovators," *Historical Methods*, Vol. 40, No. 1 (Winter 2007), pp. 17-27.

112. Buchanan, *Renzo Piano Building Workshop*, p. 35.

113. Donin, *Renzo Piano*, p. 31; Buchanan, *Renzo Piano Building Workshop*, p. 36.

114. Fitch, *Walter Gropius*, p. 18.

115. Giedion, *Space, Time and Architecture*, p. 531.

116. E.g. see David Galenson, "Quantifying Artistic Success: Ranking French Painters and Paintings – from Impressionism to Cubism," *Historical Methods*, Vol. 35, No. 1 (Winter 2002), pp. 12-14.

117. Jacques Guiton, *The Ideas of Le Corbuiser on Architecture and Urban Planning* (New York: George Braziller, 1981), p. 72.

118. Fitch, *Walter Gropius*, p. 18.

119. Giedion, *Space, Time and Architecture*, pp. 158-161.

Table 1: Greatest Architects of the Twentieth Century

Architect	Date of Birth	Date of Death	Country of Birth	N
Le Corbusier (Charles-Edouard Jeanneret)	1887	1965	Switzerland	212
Frank Lloyd Wright	1867	1959	U.S.	198
Ludwig Mies van der Rohe	1886	1969	Germany	149
Alvar Aalto	1898	1976	Finland	85
Walter Gropius	1883	1969	Germany	84
Frank Gehry	1929	--	Canada	78
Louis Kahn	1901	1974	Estonia	69
Renzo Piano	1937	--	Italy	68

Source: This and subsequent tables are based on the data set constructed for this paper. See the text and the appendix for the sources used and the method of construction.

Table 2: Two Most Frequently Illustrated Buildings Designed by Each Sample Member

Architect, building	Location	Date	N
Le Corbusier, Notre Dame du Haut Chapel	Ronchamp	1950	47
Le Corbusier, Villa Savoye	Poissy	1928	37
Wright, Guggenheim Museum	New York	1943	39
Wright, Fallingwater	Bear Run, PA	1936	35
Mies van der Rohe, Weissenhof Seidlung	Stuttgart	1927	26
Mies van der Rohe, German Pavilion (tie)	Barcelona	1929	25
Mies van der Rohe, Seagram Building (tie)	New York	1954	25
Aalto, Villa Mairea	Noormarkku	1938	21
Aalto, Sanatorium	Paimio	1929	14
Gropius, Bauhaus	Dessau	1925	43
Gropius, Fagus Factory	Alfeld-an-der-Leine	1911	26
Gehry, Guggenheim Museum	Bilbao	1993	45
Gehry, Gehry House	Santa Monica	1978	7
Kahn, Parliament Buildings	Dacca	1963	22
Kahn, Kimbell Museum	Fort Worth	1966	15
Piano, Centre Georges Pompidou	Paris	1971	31
Piano, Terminal, Kansai Airport	Osaka	1988	19

Table 3: Ages at Which Sample Members Designed Their Two Most Frequently Illustrated Buildings

Architect, building		Age
Experimental		
Le Corbusier,	Notre Dame du Haut Chapel	63
	Villa Savoye	41
Wright,	Guggenheim Museum	76
	Fallingwater	69
Mies van der Rohe,	Weissenhof Seidlung	41
	German Pavilion	43
	Seagram Building	68
Aalto,	Villa Mairea	40
	Sanatorium	31
Gehry,	Guggenheim Museum	64
	Gehry House	49
Kahn,	Parliament Buildings	62
	Kimbell Museum	65
Conceptual		
Gropius,	Bauhaus	42
	Fagus Factory	28
Piano,	Centre Georges Pompidou	34
	Terminal, Kansai Airport	51

Source: See Table 2.

Table 4: Mean Reproductions Per Building Illustrated, by Architect

Architect	mean
Piano	8.5
Gropius	7.6
Wright	6.6
Mies van der Rohe	6.2
Kahn	5.3
Gehry	5.2
Le Corbusier	4.7
Aalto	4.0

Appendix. The 22 textbooks surveyed for this study are listed here. The five books used for the initial selection of the sample of architects are marked by asterisks.

Adams, Laurie, *Art Across Time*, third ed. (Boston: McGraw Hill, 2007).

Arnason, H.H., *History of Modern Art*, fifth ed. (Upper Saddle River, NJ: Prentice Hall, 2003).

Cruickshank, Dan, ed., *Architecture* (New York: Watson-Guptill Publications, 2000).

*Davies, Penelope, et. al., *Janson's History of Art*, seventh ed. (Upper Saddle River, NJ: Pearson Prentice Hall, 2007).

*Doordan, Dennis, *Twentieth-Century Architecture* (New York: Harry N. Abrams, 2002).

Field, D.M., *The World's Greatest Architecture* (Edison, NJ: Chartwell Books, 2007).

Frampton, Kenneth, *The Evolution of 20th Century Architecture* (New York: Springer Wien, 2007).

Frampton, Kenneth, *Modern Architecture*, fourth ed. (London: Thames and Hudson, 2007).

Glancey, Jonathan, *The Story of Architecture* (London: DK Publishing, 2000).

Honour, Hugh; and John Fleming, *The Visual Arts*, sixth ed. (New York: Harry N. Abrams, 2002).

Howells, Trevor, ed., *The World's Greatest Buildings*, revised ed. (San Francisco: Fog City Press, 2007).

*Hunter, Sam; John Jacobus; and Daniel Wheeler, *Modern Art*, third ed. (New York: Vendome Press, 2004).

Irving, Mark, ed., *1001 Buildings You Must See Before You Die* (New York: Universe Publishing, 2007).

Moffett, Marian; Michael Fazio, and Lawrence Wodehouse, *A World History of Architecture* (Boston: McGraw Hill, 2004).

Norberg-Schulz, Christian, *Principles of Modern Architecture* (London: Andreas Papadakis, 2000).

Richter, Klaus, *Architecture* (Munich: Prestel, 2001).

Roth, Leland, *Understanding Architecture*, second ed. (Boulder, CO: Westview Press, 2007).

*Sutton, Ian, *Western Architecture* (London: Thames and Hudson, 1999).

Thiel-Siling, Sabine, ed., *Icons of Architecture: The 20th Century* (Munich: Prestel, 2005).

Tietz, Jurgen, *The Story of Architecture of the 20th Century* (Cologne: Konemann, 1999).

Trachtenberg, Marvin, and Isabelle Hyman, *Architecture*, second ed. (New York: Harry N. Abrams, 2002).

*Watkin, David, ed., *A History of Western Architecture*, third ed. (New York: Watson-Guptill Publications, 2000).