The realisation of our perceptions of the world in the forms of space and time is the only aim of our pictorial and plastic art. […] We affirm in these arts a new element, the ***kinetic rhythms*** *as the basic forms of our perception of real time.*
Naum Gabo [1]

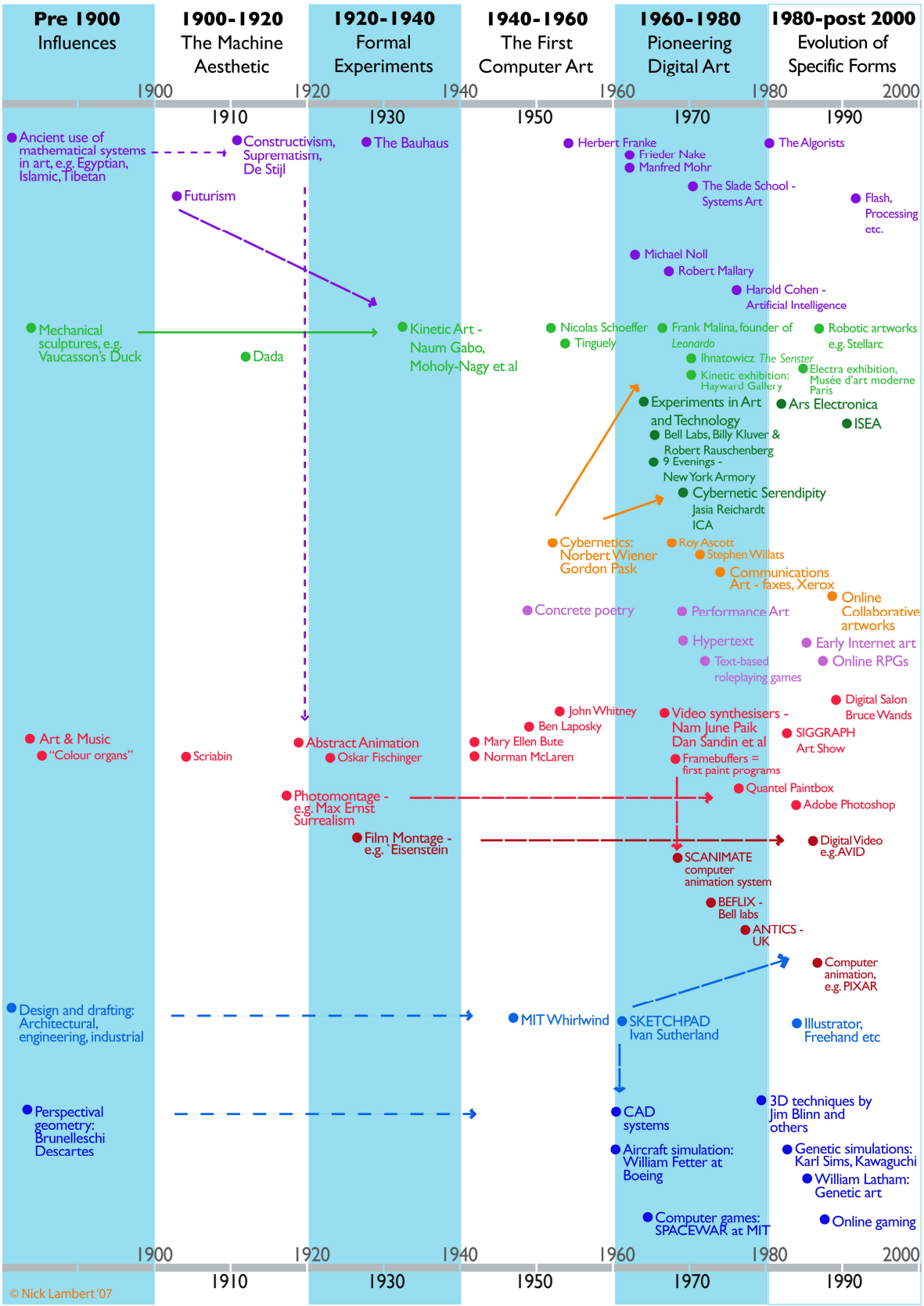
At no single moment is it possible to see the entire work since its repertoire of possibilities unfolds before the spectator.
Jasia Reichardt [2]

For more than a hundred years a certain type of artist has worked to overcome what they see as the limitations of traditional sculpture – that is its intrinsically static quality. Artworks that can move have the great advantage of establishing an immediate and dynamic relationship between the work and the spectator. Sculpture can be set into motion, such as an Alexander Calder mobile moving with a passing breeze or driven by motors as with a Tinguely machine. Integral to this relationship is the concept of time, thus making it a doubly seductive encounter for the viewer. The result is a conception of reality as a process of becoming and not as an absolute and unchanging system. The artist Davide Boriani has written of the relationship between the inherent development and variation of the kinetic work and the processes of perception. As the audience we are confronted by an artwork whose appearance constantly alters and thus constantly challenges our perceptions, activating them anew.[3]

[1] Naum Gabo, 'The Realist Manifesto', published Moscow 5 August 1920, in *Theories of Modern Art*, ed. by H B Chipp (Berkeley, C.A.: University of California Press, 1968), pp. 325-329.
[2] Jasia Reichardt, 'Twenty years of symbiosis between art and science', *Impact of Science on Society*, XXIV, no. 1 (1974) 41-51.
[3] http://www.davideboriani.com/

Superficie magnetic, circa early 1960s by Davide Boriani. Tiny metal filaments encased in a clear disc, a hidden magnet rotates behind that moves the grey filaments around creating intriguing and constantly-changing patterns.

Within the wide range of what might be considered kinetic art there are connections with many of the major art movements of the 20th Century – too numerous to do justice to here but including photography, Dada, holography, video, performance art, land art, electronic and digital art, computer graphics and animation. Some of the relationships between these and overlapping connections are indicated in the diagram reproduced on the next page.



Digital Art History diagram by Dr Nick Lambert

Kinetic art derives from the European avant-garde, from a fascination with modern science and technology alongside the Constructivist interest in exploiting the particular material properties of the object and its spatial presence. "Kinetic" was a term used by Naum Gabo in his *Manifesto of Realism* (1920). Gabo believed that art of the last twenty years had fallen into 'an impasse' which, 'must be broken'. His contemporary László Moholy-Nagy wrote in *Vision of Motion* (1922) that artists must replace the static principles of classical art with dynamic principles from life. To both artists kinetic signified the same thing - the integration of real movement, involving time, with the plastic arts. For them the element of time was of central importance - entrapped within the kinetic work of art either because the composition itself moves, or the spectator must move to grasp its significance. Gabo experimented with new visual forms based on scientific discussions of space and time, and kinetic artists viewed movement itself as a new medium. From the Futurist principle of dynamism as an expressive means and the emphasis on process rather than objects, through Dada's exhortation "Art is dead. Long live the machine art of Tatlin", to Marcel Duchamp's *Bicycle Wheel* readymade, sculpture became dynamic – moving through time and space. Thus the advent of kinetic art represents a fundamental shift in art history - art as a process of transformation, involving the viewer, which cannot be understood without the concept of duration.

A visionary multimedia artwork that helped inaugurate the artistic dialogue between machines, light, shadow and motion was Moholy-Nagy's *Light Space Modulator* demonstrated in 1930 in Paris. Powered by electricity, it was driven by a motor and equipped with 128 electric bulbs in different colours. When in operation it creates a variety of forms and casts a variety of shapes and shadows on the walls and ground around it. Although he only made one kinetic sculpture Moholy-Nagy also created experimental photo-grams and at the Bauhaus worked with light, film and typography, all potential elements of kinetic art and his work proved influential upon subsequent generations.

László Moholy-Nagy *Light Prop for an Electric Stage (Light-Space Modulator)* (1930)
Harvard Art Museums, Busch-Reisinger Museum, Gift of Sibyl Moholy-Nagy, BR56.5
Photo: Junius Beebe © President and Fellows of Harvard College

Slightly preceding this was Gabo's *Kinetic Construction (Standing Wave)* of 1919-20, made to demonstrate the principles of kinetic arts to his students. Consisting of a rod of oscillating metal, when motorised, an optical illusion of a wave is created. Again, although Gabo failed to create any more kinetic sculptures (on the grounds that available motors were too crude to achieve his aims), this work and his writings served as a potent source of inspiration for artists.

Naum Gabo *Kinetic Construction (Standing Wave)* (1919-20, replica of 1985)
The works of Naum Gabo © Nina Williams. Photo © Tate London 2010

By the mid-20th Century kinetic art had expanded its repertoire. In particular the advent of digital technology made it possible to program art works to move or respond according to pre-determined sets of instructions, with the result that increased interactivity became possible. The concept of interactivity was inspired by examples from the new science of cybernetics. The modern concept of cybernetics was given form by the MIT mathematician Norbert Wiener in his book *Cybernetics, or Control and Communication in the Animal and the Machine* (1948). According to Weiner, at a basic level, cybernetics refers to 'the set of problems centred about communication, control and statistical mechanics, whether in the machine or in living tissue'. Wiener's concept was that the behaviour of all organisms, machines and other physical systems is controlled by their communication structures both within themselves and with their environment. The result of Wiener's book was that the notion of feedback penetrated almost every aspect of technical culture and was to open exciting possibilities for art.

By the 1950s a number of European sculptors were well advanced in the development of art making according to kinetic and cybernetic principles. Nicholas Schöffer was a pioneer of interactive sound-equipped and cybernetic works, collaborating with engineers from Philips Electronics of the Netherlands. Schöffer specialised in computer-controlled lumino-dynamic constructions using built-in photo-electric cells and microphones. These works reacted to variations in the fields of colour, light and sound intensity and some of his 'cybernetic towers' reached vast environmental proportions.

Jean Tinguely used found objects and recycled machine parts to create kinetic works from the early 1950s in Paris. His deliberately messy and noisy artworks express the disquieting aspects of our mechanical age and along with Gustav Metzger he theorised about the possibility of 'auto-destructive art'. Works such as *Study No2 for an End of the World* (1962) demonstrate a simultaneous fascination and repulsion with machines and question their impact on humanity. Tinguely's ideas spread when he exhibited at London's Institute of Contemporary Art (ICA) in 1959 and to New York in 1960, when he worked with Billy Klüver at the Museum of Modern Art. Tinguely and Schöffer exhibited together at the Jewish Museum in New York in 1965 and then featured in *Cybernetic Serendipity* (1968) at the ICA, thus impacting on the art and technology movement in Britain and inspiring a number of pioneers here including Edward Ihnatowicz.

The great interest in cybernetics and art in Britain culminated in what is now seen as a seminal exhibition, *Cybernetic Serendipity*, curated by Jasia Reichardt. This was an enormously influential and inspiring exhibition for the generations of artists who witnessed it as well as introducing to a wider audience the possibilities afforded by the conjunction of art and technology. Among the kinetic works on view were humorous robots by Bruce

Lacey and Gordon Pask's reactive, educable, role-playing piece the *Colloquy of Mobiles,* together with many other works utilising sound, light, movement and digital technologies.

Edward Ihnatowicz *SAM (Sound Activated Mobile)* (exhibited 1968)
Copyright estate of the artist

Arguably the major pioneer of early British cybernetic arts was the Polish émigré Edward Ihnatowicz. His sculpture *SAM (Sound Activated Mobile)* was exhibited at *Cybernetic Serendipity* and judging from surviving film footage, appeared to be a huge hit with audiences. For him the crucial component of kinetic art was the aspect of spectator or audience participation. Ihnatowicz wanted to move beyond the functionless machines of Tinguely. *SAM* was interactive in the sense that it moved directly and recognisably in response to what was going on around it - the viewer determined what motion it made. A self-taught engineer he was able to custom-build components to his specifications.

Gustav Metzger's 'biggest project ever proposed', *Five Screens with Computer,* envisaged as a huge computer-controlled interactive kinetic work of public art, although too late to be included in *Cybernetic Serendipity*, did appear in the accompanying book with an illustration. [4]

[4] See *Cybernetic Serendipity: the computer and the arts*, ed. by Jasia Reichardt (New York, N.Y. : Frederick A. Praeger, 1969). In 1969 a model was publicly exhibited at *Event One*, an inter-disciplinary Computer Arts Society exhibition at the Royal College of Art. This model is now in the collection of Generali Foundation, Vienna.

A couple of years later Ihnatowicz's *Senster* (1971-74) became the largest single commission of computer-driven art in Britain during this period. The *Senster* went further than *SAM* in that it responded to the viewer's movements as well as sounds. Commissioned by Philips for their popular science centre the Evoluon in Eindhoven, it inhabited a difficult space - partly to showcase the Philips computer, partly as artistic spectacle. This relationship ultimately proved too challenging to correlate and the *Senster* was dismantled after three years. Drawing on cybernetic notions of feedback and due to skilful programming by the artist, Ihnatowicz's kinetic works gave viewers the appearance of being truly intelligent.

Edward Ihnatowicz *Senster* (exhibited at Evoluon, 1971-74)
Copyright estate of the artist

By now kinetic art had penetrated the consciousness of art in Britain. Frank Popper's book *Origins and Development of Kinetic Art*, (London: Studio Vista) was translated by Stephen Bann and published in Britain in 1968 (Bann having previously published a collection of essays about kinetic art in 1966). Other early British commentators and historians of the kinetic include Michael Compton (1967), Reichardt (1966, 68 & 71), Guy Brett (1968), Jean Clay (1969) and J Tovey (1971). *Studio International*, the leading art journal of the day, regularly featured kinetic and multimedia work.

The extensive *Kinetics* exhibition took place at the Hayward Gallery in 1970. This wide-ranging show concentrated on mechanical movement and exhibited a large number of works by pioneers Tinguely, Schöffer, Nam June Paik, Frank Malina, Liliane Lijn and Dante Leonelli, among others. In the catalogue Jonathan Benthall wrote: 'There is little doubt that cybernetics and general systems theory have given us a single vocabulary and set of concepts for discussing the most diverse types of system. […] they provide a common interdisciplinary language at the core of which is the idea of transformation.'[5]

[5] *Kinetics* (London: Arts Council of Great Britain, 1970)

The film *Kinetics* (1970) commissioned by the Arts Council of Great Britain and made at the Slade School of Art film department, directed by Lutz Becker, formed a record of the exhibition and stated:

> Kinetic art explores and celebrates man-made and natural dynamics and implies that they are both natural to man. It rejects or seems to reject the Romantic dream of art as something other-worldly, remote from our daily lives. At the same time it comes remarkably close to satisfying for the first time, the ultimate ambition of the Romantics of creating an art that attains the condition of music. [6]

Two years later Thames and Hudson published Benthall's *Science and Technology in Art Today* (1972). This gem of a book details many of the artists from the exhibition and others including Ihnatowicz and the work of the British artist-led Computer Arts Society, among whose members included several working with kinetics. Its comprehensive coverage introduces the latest players in avant-garde art including the Chinese Tsai Wen-ying whose work Benthall believes takes Gabo's vibrating rod concept to the next level and the American Hans Haake whose work is described as 'a move towards *actually* disturbing ecological, social and political equilibria'.[7] This last indicates Benthall's belief in the potential of kinetic art to be a force for critical social commentary, as well as emphasises its strong aesthetic properties.

Throughout this period art schools proved to be a fertile breeding ground for the next generation. In the late 1960s - 1970s a number of leading art schools including Wimbledon, Hornsey, Coventry, Liverpool and Leicester to name just a few, had strong undergraduate presence in kinetics which often included workshops specifically devoted to light and sound techniques. Many digital and computer art pioneers commenced their undergraduate career working in kinetics. A number of these then proceeded to study at the Slade. Such artists include Dominic Boreham, Paul Brown, Nigel Johnson, Stephen Scrivener and Darrell Viner. Scrivener was the first student to do computational work at the Slade in 1972 joining the postgraduate school's pioneering computing curriculum set up by systems artist Malcolm Hughes.

Significantly, the first artist to be awarded the PhD in Britain (1978), Andrew Stonyer, produced multimedia kinetic work. Stonyer's technically-oriented project lent itself to a research degree more readily precisely because it's technical nature (and thus relationship to science) was perceived as having inter-disciplinary elements which could be judged at a high level. Both Stonyer and Scrivener (who was second to be awarded the PhD) paved the

[6] *Kinetics. The record of an exhibition. Hayward Gallery 1970,* Lutz Becker, Slade School of Fine Art, 22 min
[7] Jonathan Benthall, *Science and Technology in Art Today,* (London: Thames & Hudson, 1972), p. 130.

way for subsequent generations of artists, in all media, to contribute at the highest level of research thus raising the status of fine art as a discipline to that on a par with other fields including science. Once again, kinetic artists were at the vanguard not only of artistic practice but also as pioneers in the advancement of the arts.

CONCLUSIONS

So, given these achievements, it might be pertinent to ask why kinetic, robotic, electronic and new media art has had, all too often, a tendency to exist somewhat outside the mainstream art world of dealer-gallery networks, particularly within the UK? This is due to a variety of reasons; perhaps chiefly among them is an historic lack of understanding and financial support in both the public and private sectors. This makes the organisation Kinetica all the more noteworthy. Along with a host of other like-minded organisations such as the Computer Arts Society, CRUMB, FACT Liverpool, onedotzero, Furtherfield and the new MAD Museum (Mechanical Art and Design) in the UK and Ars Electronica, ZKM and SIGGRAPH to name just a few international groups, Kinetica strives to provide a platform and to increase the network of creativity and opportunities for artists and audience development within this arena. The highly positive response to their activities demonstrates the demand and depth of audience for such art. Kinetica is particularly notable for its instigation of the first commercial art fair devoted to media art in 2009, achieving sales that likewise demonstrate there is a market for this work – a fact that more commercial art dealers would do well to heed. This fair continues to grow year on year.

It is true that this type of art can be highly dependent upon support and funding, that it can also incorporate aspects such as performance and installation which resist "collection" in the conventional sense by museums or private collectors. And undoubtedly more work needs to be done in the areas of curatorial education and conservation research. However despite the many challenges of working with this media surely the long history of engagement with new technology will continue as artists look for new means of understanding and interpreting our modern networked world whilst striving to push aesthetic boundaries. The more this art is seen and discussed, the more it will become incorporated into the mainstream contemporary art landscape. Jack Burnham predicted in 1968 that our relationship with art in the Information Age would evolve from a 'one-way' process to a 'two-way' dialogue.[8] By manipulating the very material of our technological age kinetic artists are uniquely placed to facilitate this dialogue.

[8] See Jack Burnham *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century*, (New York: George Braziller; London: Allen Lane/Penguin Press, 1968)