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The design process is very rarely linear or straightforward. Ideally, it is an adaptive, cyclical, and reflective process that balances experimentation with refinement, subject entirely to the desired outcome each time. Interestingly, as new tools and processes emerge, these creative processes evolve alongside them. My fascination with this ever-changing nature within design has led me to explore three carefully chosen, interconnected keywords: **Iteration**, **Ideation**, and **CAD**. Through this investigation, I utilise the knowledge gained to arrive at a definitive question that will form the basis of my independent inquiry.

Iteration

In the design context, to iterate is to repeat “a set of design and development operations, with each repetition building on the last, until the desired result is achieved” (Lidwell, 2015, p165). Iteration is a crucial component of the design process, most commonly seen in the form of redrawing designs as rough draft sketches and mockups, or testing and prototyping models and monitoring results and potential improvements. While arduous to some, iteration in design reinforces what might have previously been mere supposition, encouraging exploration and experimentation whilst allowing the designer to “refine the design, add detail, and finally result in a polished product” (Holtzblatt and Beyer, 2015, p57).



Fig. 1 - The Double Diamond design methodology

Iterations' inclusion in the Design Council's widely respected Double Diamond model (Fig. 1) further reinforces not only its importance in the design process but also its interconnection with all of its parts. The Double Diamond embraces iteration as a fundamental strategy, in harmony with ideation, a subject to discuss further on.

From my research, a question arose: Is iteration only put to use in the later stages of the design process? Though it is particularly critical, Iteration is not exclusive to the latter; *Develop* and *Deliver* half of the Double Diamond. In truth, it underpins the entire process - “The Creative Process contains multiple cycles of iteration” (IDEO, 2025). During *Discover*, ideas are explored and revisited as new insights surface; in *Define*, problem framing often requires multiple

revisions before reaching clarity. By incorporating the mindset of iteration into each layer of the design process, we might “spot errors early, avoid risk and build confidence” (Design Council, 2024).

Through my research, I found there is a frequently overlooked beauty in the iterative process; there are no real failures. Each iteration should serve as “lessons learned to apply to the next iteration” (Lidwell, 2015, p165), and as long as your next design learns from the last, you are continually moving towards your goal. One such example of consistent improvement through iteration is the development of James Dyson’s dual cyclonic vacuum cleaner design, which famously underwent 5,127 different iterations as various prototypes over 5 years before its final design was presented (Dyson, 2025). The goal of iterative design is not merely to function as the linear path of trial and error; rather, it encourages lateral thinking and multiple methods of design thinking, be it through 5 or 5,000 iterations of a single idea. Only through this often meticulous approach can we refine a design to a point “at which beauty and high utility” are “interconnected”, and we are given a successful and carefully crafted outcome (Papanek, 1984, p57).

We see iteration primarily in the problem-solving and troubleshooting aspects of design, but can it not also hold importance within artistic practices? By recording, categorising and developing each idea, a timeline is formed, with each part having contributed to a final result. The amassed archive of development becomes a narrative of an artist’s progress. In many ways, it brings Gestalt theory’s notion of holistic perception to mind; the final design is not simply the product of one, singular good idea, but the culmination of countless imperfect ones, each holding their quiet significance and forming something greater, “something more than the sum of the elements” (Wageman 2015, p5).



Fig 2. - Iterations from Stephen Berry's "Cambrils" collection

Every step, regardless of how rough or incomplete, plays a role in shaping the outcome, and in doing so, the process itself becomes a reflection of the final piece. One such example of this methodology at work is the “*Cambrils*” series of artworks, painted by Stephen Berry (Fig. 2). Each painting is another iteration of the last, in the process of which he altered composition, colours, aspect and even painting technique. Despite describing the process as “frustrating”, he

praises the merits of iteration in his work, stating that “Only after I’ve painted it a time or two can I readily anticipate what I’m going to be doing next” (Berry, 2014).

Ideation

Ideation, put simply, is the process of “Idea generation”; it is an integral part of any design process, without it there would be no basis “for much of new product development and business growth” (Cash and Štorga, 2015). It is for this reason that it too appears in the double diamond model, and similarly to iteration, underpins most key stages of the design process. Papanek describes it as the process of eliminating “Blocks” - gaps in our knowledge, emotion and perception that can “effectively stop problem-solving” (Papanek, 1984, p155).

While Papanek’s view on the process is one of eliminating obstacles, a majority of creatives and makers are familiar with ideation in its most basic and well-known form: the momentary “spark of genius”, the hunt for a “blinding flash of revelation” (Papanek, 1984, p152). Koestler best describes it as “the Eureka act”, in reference to the exclamation made in the story of Archimedes’ discovery of measuring the volume of a crown using water, after dropping it in his bath. During the “Eureka act”, we see “the sudden shaking together of two previously unconnected matrices” (Koestler, 1964, p212), and in Archimedes’ case, these were the crown and the water. While the crown was the subject of his focus, the water in the bath was only apparent to him at a subconscious level. The “Eureka” moment was a direct result of the “collision” of these two previously disconnected ideas, unveiling a solution now made obvious despite each element previously being on “different levels of consciousness” (Koestler, 1949, p252).

Koestler’s explanation led me to question, how does the designer initiate the “collision” of ideation? Referring back to Papanek’s highly methodical approach, eliminating all subconscious blocks or gaps in knowledge often best sets the conditions that allow ideation to occur. Collaborative techniques such as brainstorming, devised by IDEO, are often employed to this end, aiming to utilise the knowledge and expertise of a team of designers as one ideating unit. In the case of brainstorming, each team member is tasked with generating as many ideas as possible, no matter how daft or outlandish, and in turn, each idea is reviewed as a group and measured against the project specification (IDEO, 2025). Ideation techniques such as brainstorming, mindmapping, bisociation, synectics each allow designers to function as effective, thinking units, and it is such a capability that makes it “no accident that designers can now be found in the boardrooms of some of the world’s most progressive companies” (Brown, 2009, p17).

Something that came to my attention, however, is how the notion of collaborative ideation sessions aligns closely with John Huizinga’s concept of “play”. Huizinga argues that play is essential for creativity and culture, that it is “in fact freedom” (Huizinga, 1949). Similarly, when designers ideate, tinker, remix, exaggerate, and misapply ideas, they access cognitive and emotional states conducive to making new, novel connections. Through playful engagement

within ideation, designers can step “into a temporary sphere of activity with a disposition all of its own” (Huizinga, 1949), where familiar ideas become strange again, and new ones are born.



Fig 3. - Working pneumatic Mustang V8 engine scale model

One of the clearest embodiments of ideation through play is found in LEGO. To many, designer or not, LEGO transcends age and discipline. LEGO is used in design thinking workshops, architectural modelling, and even engineering prototyping, with a working pneumatic V8 engine made entirely of LEGO serving as one such example (seen in Fig. 3). With LEGO, for many, the process of building, testing, and rebuilding becomes a form of ideation so fluid and tactile that it barely feels like design work at all - LEGO allows for ideation in its purest, most accessible form. LEGO's design has such innate and intuitive “affordances” - design cues so abundantly clear its purpose is immediate and apparent (Norman, 2013, p27) that ideation flows naturally and new constructs and ideas are immediately tangible to build. This simplicity encourages a playful, low-risk environment where ideas can be built, tested, and rebuilt fluidly, appealing to children and adults alike.

CAD

Computer-aided design or CAD is a category of design processes and methods performed entirely, or partially in a virtual space, commonly used in the “design, analysis, manufacture, and assembly” of a majority of modern-day products, particularly when concerning mass production (Bi and Wang, 2020, p7). The advent of CAD in 1957 when Patrick Hanratty developed the first numerical control system, led to the creation of the first 2D sketch design software, “SKETCHPAD”, in 1960 and then “NURBS”, the first 3D design software, in 1970 (Airedale Springs, 2015). Today, there are a myriad of assorted design software and systems available to designers and manufacturers as a result of technological growth, resulting in 2D, 3D, and parametric design methods becoming commonplace in the workplace.

But what does CAD mean for design? What is it to the designer? From my research, CAD appears to be the most recent evolution of a tool at the modern designer's disposal. It is in

today's design practices what the stone tools of yesterday were to the prehistoric "axemakers", and similarly opens doors to an entirely new scope of design, just as the stone axe once transformed the capabilities of early humans (Burke and Ornstein, 1977, p.17). CAD has radically reshaped the design world and allowed for much more complex designs to be manufactured on a large scale due to its ease of translation to mass manufacturing processes and rapid prototyping methods (i.e CNC milling machines and 3D printers).

Our tools do more than allow for creative expression, they also shape the very nature of what is expressed. This is perhaps where CAD majorly differs from all previous tools throughout history. McLuhan famously asserted, "the medium is the message" (McLuhan, 1964, p1), a statement particularly true when discussing a designer's method of creation. CAD is not simply a platform for translating ideas into technical drawings and renders; its use can fundamentally influence those ideas, guiding the designer's decisions through its structure, interface, and restrictions in capability. Additionally, we can receive no real tactile or ergonomic feedback from CAD, as a result of which the designer's materials are no longer capable of "continually talking back to him" (Schön, 1991).

Some might argue that this lack of physical connection, alongside the difference in design interaction severs the "joy of the maker" (Morris, 2019) that many designers live for, particularly those that take pride in traditional handcraft or illustrative methods. While CAD does have innate weaknesses, we must not overlook its capacity to allow designers to strive for new levels of precision, clarity, and functional beauty, within their designs.



Fig. 4. - Joris Laarman's "Bone chair", created via generative design

One such example of CAD's capability to enable designers to explore new areas of aesthetics and shape is Joris Laarman's "Bone chair". Despite its entire conception being performed digitally, the design of the "Bone chair" takes inspiration from nature, literally mimicking bone structure within its design and taking "the underlying principles to generate shapes just like an evolutionary process" (Laarman, 2019). This was accomplished via an algorithm that stripped away all unnecessary material from a virtual 3D model, reinforcing only the points under

significant strain when a user is sitting on the chair, before creating a mould and casting the chair as a singular piece (Laarman, 2019). This simulated process of generative design is only possible through CAD, and ironically recreates a natural structure far more accurately and precisely than any other means. This process not only creates shapes and structures that are both organic and futuristic, it also refines material consumption to exactly what is needed, aligning with Dieter Rams' views on good design being "as little as possible", and are simply "less but better" (Rams according to The Design Museum, 2017).

Conclusion

To summarise, the words I have chosen each reflect aspects of design means in the modern era. As illustrated in the double diamond model (fig 1) iteration and ideation are two long established facts of life to a designer, they are essential to the process and coincide with one another within each step. The issue begins when the steps themselves begin to change; new tools are discovered that may streamline, or entirely alter the fundamental way in which ideas are conceived and reiterated.

CAD is only one such example of this and is a component in an entire fleet of new technologies. Additive manufacturing processes (such as FDM 3D printers) are drastically altering the ways in which the iterative process is accomplished, allowing new iterations of CAD 3D models to be instantly created 1:1 or at scale in a variety of materials. While not without flaw or constraints, having accurate conceptual block models immediately at hand not only streamlines the iterative process, but makes ideation far easier, allowing teams of designers to visualise and interact with early designs in completely different ways. It allows designers to "Fail fast" and "Fail early", spotting potential problems sooner rather than later (Lidwell, 2015, p165).

However, CAD's digital format lends heavily to purely digital workspaces, potentially remote work, rather than the traditional sketching studios filled with desks dedicated to drawing, filled with discussion, interaction and peer feedback. Ideation encourages discussion and interaction, a level of fun and "play" as previously discussed, and while iteration is highly suited to CAD's streamlined nature and interface, ideation often needs a good collaborative setting, as "Developing connections and building relationships is as important as creating ideas" (Design Council, 2025).

While CAD and CAM (Computer-aided manufacture) processes lend heavily to the creation process themselves, it does seem as if their integration requires a delicate balance. We are now delicately teetering loss in human interaction and involvement in the design process, or as Frayling describes it simply as "the pleasure in making" against the sheer precision and adaptability that modern technology offers (Frayling, 2016, 6:30). It was the discovery of this impasse that led me to the following question; **How is the growing use of computer-aided design and manufacturing affecting the designer's role in modern product design?** This question will be the central focus of my independent inquiry, and from my research I aim to better understand what it means to be a designer in the virtual era of design.

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