

THE ASSISTIVE RESEARCH AND IDEATION ENGINE: THE APPLICATION OF
EFFECTIVE COMMUNICATION DESIGN TO ENHANCE THE
PROCESS OF ONLINE RESEARCH

by

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DEDICATION

To my ancestors for my corporeal existence
To my parents for my creative prowess
To the canvas around me
To all things that inspire me to inquire, dream, and create

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ABSTRACT

This Thesis focuses on the conception and wireframing of an Assistive Research and Ideation Engine (ARIE). The ARIE is an online platform that will facilitate a more effective research process by enhancing the ability of the individual to seek, collect, and evaluate information in an effort to resolve inquiry and develop ideas. Expanding the traditional perception of research beyond industry and academic function allows for a broad demographic to conduct research. The use of the Internet as a source of inspiration and knowledge has been widely implemented in many online applications, however no existing online platform holistically supports the act of research and development of ideas—as defined in this paper. Search engines, like Google, are the current standard in conducting research online. However, the Google search engine has also been shown to over-filter query results, narrowing the exposure to content (Pariser, 2011). While the combined use of separate online search engines, note-taking, and storage platforms provide support in seeking, collecting, and evaluating online content, these platforms are not specifically designed to facilitate the research process. Moreover, performing persistent and targeted online research via a search engine poses many challenges. By designing a new online platform that manages and facilitates research functions, the individual can increase gained knowledge, Ideation effectiveness, and inquiry conclusions. A representative wireframe of an interface design will illustrate the potential viability of the ARIE.

I. INTRODUCTION

From early education until college, students are expected to investigate and collect information in order to formulate new ideas; this process is also called *Ideation*. Ideation is not bound to academics, but is an expectation that progresses into adulthood. Whether it is a project of personal interest or task for professional work, effective research is necessary to gain the most out of each inquiry. To aid in Ideation, individuals use online platforms to gain knowledge and stimulate creative thinking. However, current assessments of critical and creative skills of individuals within the workplace are declining as expectations are rising (Burger & Starbird, 2012; Adobe, 2012). The ramifications of poor Ideation are not just distinct to the individual, but affect the greater good of society. Enabling more effective research and Ideation has benefits in education, innovation, industry, and field research (Howard-Jones, 2012; Sanders, 2005; Scott, 2013; Adams, 2005).

Many factors influence the ability of the individual to maximize their Ideation. While much of the ability is intrinsic and distinct to each individual (Isaken, 2010, as cited in Isaken & Aerts), all individuals can think creatively and be influenced by extrinsic motivators to foster better Ideation (Howard-Jones, 2012; Adams, 2005, p. 8). The challenge is to create a beneficial type of extrinsic stimulation that enhances the generation of unique conclusions; the lack of proper extrinsic motivation can restrict outcomes. Each individual operates within their own range of understanding and learned knowledge, which is a product of their previous experiences (Paul & Elder, 2008, p.8). Consequently, the act of seeking information is restricted by the perimeter of the individual's own capacity, limiting the ability to make increasingly unique connections.

Ideation exercises, like mind mapping, still only spur the same capacity; mind mapping allows the individual to quickly explore and visualize an idea by building off of a central word through a series of radiating sub-branches containing associative words related to the central word or idea (Buzan & Buzan, 1993). These Ideation exercises force the individual's learned knowledge onto new reasoning, resulting in underdeveloped, inadequate, or conventional outcomes (Paul & Elder, 2008, p.8). To counter this effect, the individual's knowledge capacity must be expanded to a wider selection of information in order to create more diverse connections. Increasing diverse connections between various types of content can subsequently increase the chances of more unique solutions (Howard-Jones, 2008).

To optimize Ideation, a unique harmony between the individual, information, and environment should be established. Additionally, increasing the creative atmosphere of an environment can facilitate the creation of unique Ideation outcomes (DiLiello & Houghton, 2008; Kelley & Kelley, 2013).

Creative environments that enhance Ideation can take many forms. The extrinsic stimuli of physical environments have been known to positively enhance Ideation and can excite the senses. For example, ambient noise within a coffee shop has been shown to stimulate Ideation (Mehta, Zhu, Cheema, 2012). Additionally, digital environments have experimented with different ways to enhance Ideation. Pinterest is an online platform that allows individuals to increase diverse connections by spurring unique investigation into unfamiliar information. Pinterest has redesigned the normally overwhelming processes of seeking and gathering information, and transformed them into efficient and enjoyable tasks for individuals, as shown in Figure 1. The structured and consistent layout of visual

content provides an effective environment to efficiently explore. The success of improving the way online content is displayed and reviewed in an online digital environment is supported by the 70 million individuals who currently use Pinterest (Smith, 2013). Exposure to a wide variety of information in an engaging way may hold the key to enhancing Ideation. The success of the individual's experience with digital environments, or *user experience* (UE), is contingent on the visual design, also known as *user interface design* (UID), and platform functionality, also known as *user experience design* (UXD). Through the effective use of UID and UXD, Pinterest has created a creative and effective UE that allows individuals to enhance their Ideation.

The designed digital environment of Pinterest also allows individuals the comfort of working within a cohesive and neutral interface. As the individual continually reviews large quantities of content, the UID and UXD are simple, enhancing the ability to quickly move through data without becoming overwhelmed. The alternative is viewing each piece of content in its own respective, unique digital environment.

While new online environments are showing potential in the way that they expose individuals to vast amounts of content, search engines are hindering the research and Ideation process. Search engines are computational online platforms that allow individuals to input a search query yielding results from various sources on the Internet, as shown in Figure 2. Individuals can then navigate through the information to find applicable content. While search engines provide a robust informational resource, they are not designed to engage individuals with ongoing research. Additionally, over filtration and content biases have imposed prejudices on the display of information (Pariser, 2011; Kaufman, 2013, para. 4). By default, individuals are conditioned to

navigate down accessible and logical informational connections, causing the generation of underdeveloped and conventional ideas. Moreover, search engines provide information in response to the individual's query request. If individuals are working within the limitations of their own current knowledge, as stated earlier, the design of search engines can only react within the bounds of the individual's ability to explore new information (Paul & Elder, 2008, p.8). As the dominant online platform to find information on the Internet, search engines are effectively limiting the process of research and Ideation by forcing society to become very familiar with a relatively small amount of information (Pariser, 2011), thus leading to analogous thinking.

While separate online tools for seeking, collecting, and evaluating online content exist, individuals attempting to optimize Ideation are required to stitch these separate online platforms together. Currently there is not an existing online platform designed to maximize the research and Ideation potential of the individual, as well as support ongoing and targeted research. A new type of online platform, called the Assistive Research and Ideation Engine (ARIE), needs to be created to assist individuals in the process of research and Ideation. Enhancement of information seeking methods within the ARIE will expose individuals to different types of information than experienced with existing search engines. Furthermore, by allowing the ARIE to continually source information based on the individual's actions, the display of new content will be shaped to showcase a broader range of applicable information. In addition, by enabling the ability to actively search and save found content within the ARIE, the individual can continually evaluate their findings without needing to stitch separate online platforms together. By designing the ARIE to support and enhance research, Ideation will be elevated into a new range of

possibilities.

This Thesis focuses on the conception and wireframing of the ARIE, an online platform that will expand the traditional perception of research beyond industry and academic function, affording a broad demographic of individuals the ability to conduct research in an effort to gain knowledge and increase Ideation. The individual will begin their session with the ARIE by inputting a search query. The ARIE will then respond with qualifying information—similar to a typical search engine. However, this is where the similarity to a typical search engine ends. As the individual begins to explore the returned qualifying information, the individual’s searching behavior, content searched, and interaction with the content will be collected. This data will then be used to deliver a more sculpted set of search results to the individual. Each piece of new search information will be shaped by the previous actions of the individual. While this may seem similar to the over filtering method of search engines, the ARIE will be instructed by both the programming and the individual to allow for more flexibility in retrieving content. This paired with the ARIE’s unique UID and UXD, will provide an effective UE to enhance the research and Ideation process. The objective of this Thesis is to improve the UE of research and enhance Ideation outcomes through the creation of the ARIE.

Thesis Organization

This Thesis is organized into five chapters. Chapter one, Preliminary Research, discusses (a) the creation of the individual’s UE through effective communication design; (b) increasing creative potential to maximize Ideation outcomes; (c) the enhancement of Ideation outcomes through the facilitation of order and disorder; (d) the broadening of the term *research*; (e) the impact that an improved research process can have on Ideation

outcomes; (f) the current deficiencies of search engines and their impact on online research; (g) the benefit online aggregators can provide to research; (h) the UID and UXD characteristics necessary for an effective high content online platforms. Chapter two, Statement of the Problem, will provide insight into why the ARIE should be created and the benefits it could provide to the research process. Chapter three, Observations, discusses issues related to the use of current online researching platforms. Chapter four, Methods, will provide information about the development of the UID and UXD for the ARIE. Chapter five, Conclusions, discusses the limitations and implications of this Thesis research, future research and implementation of the ARIE.

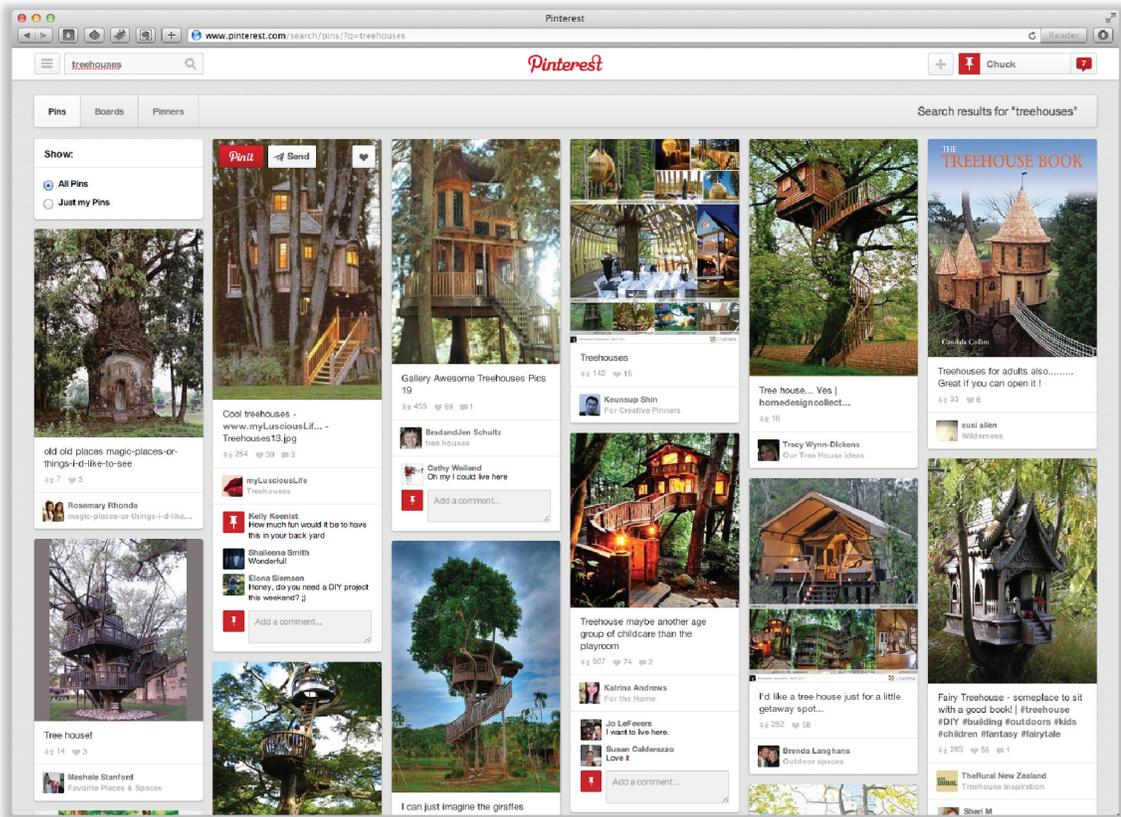


Figure 1. The Interface Design Layout of Pinterest. This depicts the typical layout of Pinterest, an online platform, when displaying search results.

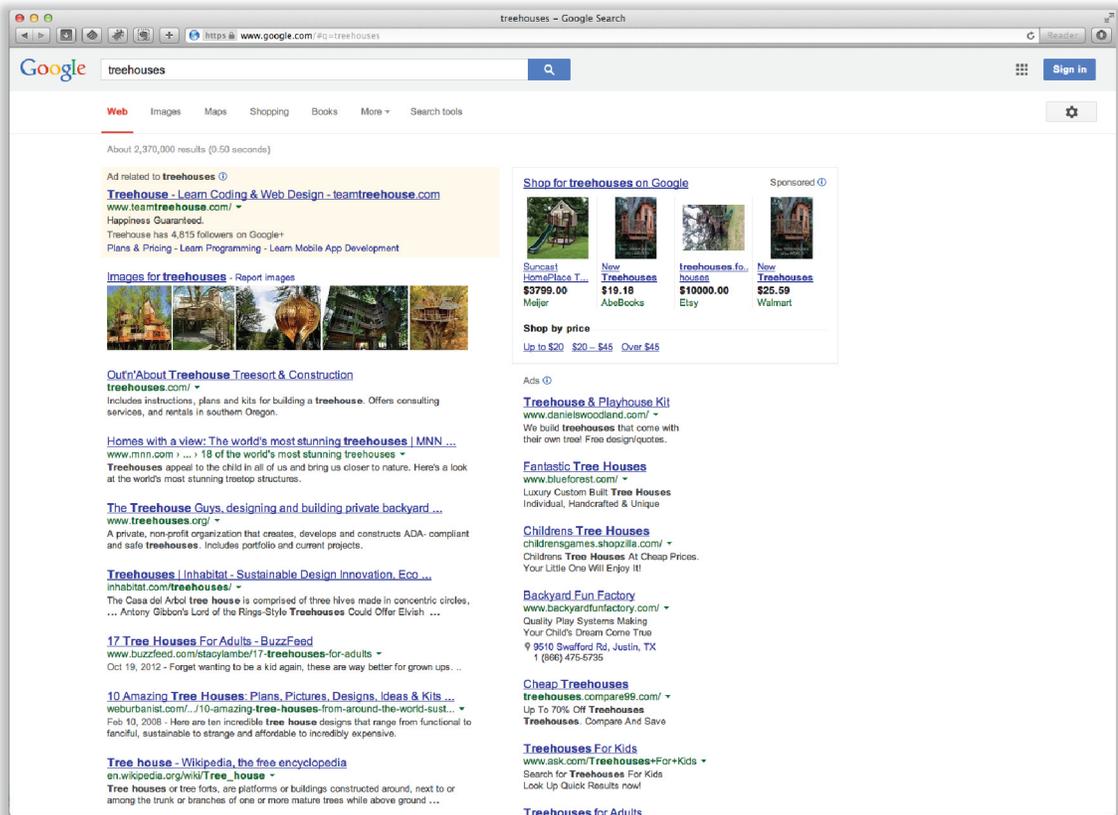


Figure 2. The Interface Design Layout of Google’s Search Engine. This depicts a typical layout of Google’s search engine when displaying search results. Google, is one of many search engines, but is the most widely used search engine.

II. PRELIMINARY RESEARCH

Designing Outcomes

“[By] choosing not to think about how design influences behavior is still a decision about influencing behavior: everything that is designed affects how we act, whether it is intended to do so or not.” (Lockton, Cain, Harrison, Guidice, Nicholson, Jennings, 2011, p. 3)

The communication design (CD) discipline has evolved from a purely functional or aesthetic application to the creation of products and information. The evolution of markets, new technology, and design education as a whole has motivated communication designers to further examine the interaction between individuals and the designed elements within our world. Cary (2013) commented that, “If design traditionally is not [centered around the individual], who or what is it centered around?” (para. 4). Although it is true that CD emerged as a function to better serve individuals, designers now aspire to orchestrate the entire UE the individual has with CD. A fundamental motivation within this approach is to elicit a specific response or behavior by the individual; designers are now engineering outcomes. The desired outcomes are created through the application of strategic design elements to initiate reciprocative actions by the individual. In the context of CD, the combination of effective UID and UXD in an online platform facilitates a positive UE. As the CD discipline continues to focus on the human element, motivations push beyond designing for the individual and into designing for the individual’s desired interaction. In a 2012 TED talk, Timothy Presterro suggested that while design motivations can lead to inspirational outcomes—like a concept car design—solutions can also focus on better individual-centered outcomes that actually enable change, not just inspire it. Desired outcomes should not be expected to transpire; outcomes must be facilitated by design. Correspondingly, Young (2008) stated that, “for an experience to be

considered successful, people have to be able to use it and want to use it” (p.26). A recent study conducted by Opower, an energy consultancy firm, provides evidence of a successfully designed outcome. Opower found that by designing smiley face icons to distinguish between good and poor energy conservation in relation to their neighbors, the icons caused homeowners to change their energy habits. Through the use of subtle psychological CD cues, individuals felt the need to establish a usage equilibrium with their neighbors, either out of concern or guilt (Alcott, 2011). It is also important to point out that the designed experience changed the individuals’ perspectives, causing an adjustment to the existing viewpoint on the issue, resulting in a modified conclusion to be conceived as well as an adjusted behavior. The success of this specific outcome is a direct result of effective CD used to initiate a change in the individual’s perception of a familiar topic. This example is significant because it showcases the effect CD can have on provoking and influencing the individual’s behavior and modification of established knowledge.

Outcomes can be sculpted through a better understanding of the individual’s behavior and what drives emotional motivators. According to Desmet (2012), “all designed technology, products, services, and systems evoke emotions, and not considering these emotions in the design process is a missed opportunity at best” (para. 3). Additionally, as shown in the Opower example, CD can be used to increase engagement to information.

The use of CD to stimulate and modify cognitive processes has many applications. By increasing the engagement to information, more effective Ideation can be achieved, increasing the potential for unique outcomes.

Increasing Creative Potential to Maximize Ideation Outcomes

Creativity is elusive, yet found in everyone. Sanders (2001) stated that, “All [individuals] are naturally creative (p.4). [They] will fill in what is unseen and they will fill in what is unsaid based on their own experience and imagination (McCloud, 1994, as cited in Sanders, 2001). [They] project their needs onto ambiguous stimuli because they are driven to make meaning” (Sanders, 2001, p.4). Creativity is both original and appropriate (Hayes, 2004, as cited in Howard-Jones, 2012), and its role can be applied to all aspects of our life (Runco & Richards, 1997, as cited in Runco, 2004, p.4). According to Kelley and Kelley (2013),

Creativity is much broader and more universal than what people typically consider the ‘artistic’ fields. We think of creativity as using your imagination to create something new in the world. Creativity comes into place where you have the opportunity to generate new ideas, solutions, or approaches. And we believe everyone should have access to this resource. (p. 3)

An individual’s skill and ability to produce beneficial outcomes through the use of their creative capacity is referred to as *creative potential* (Kelley & Kelley, 2013). Lack of creative stimulation can restrict an individual’s ability to maximize their creative potential to produce beneficial Ideation outcomes; creative potential can be increased in all individuals (DiLiello & Houghton, 2008; Kelley & Kelley, 2013). All individuals can think, inquire, seek answers, and form conclusions. In the context of research, these processes can be poorly fostered, lacking the creative influence that allows for more effective Ideation.

Creative potential has a dramatic effect on the individual’s ability to process and

function within society (Kelley & Kelley, 2013). An increased focus on developing and managing creative potential within individuals has been shown in almost every field and industry today (Lee & Rodríguez-Pose, 2013; Isaken & Aerts, 2011, cited Gilson, 2008; Zhou & Shalley, 2008; Kelley & Kelley, 2013). Maximizing the creative potential increases the ability to produce more creative outcomes; “The flexibility of creative [individuals] is what gives them the capacity to cope with the advances, opportunities, technologies, and changes that are a part of our current day-to-day lives” (Runco, 2004, p. 2). Runco stated that, “Creativity [...] underlies problem solving and problem finding; it plays a role in reactions (e.g., adaptations and solutions) but it is also often proactive (Runco, 2005, p. 2, 3). Although all individuals are innately creative, unlocking and amplifying their distinct creative potential is a challenging task—an undertaking with boundless benefits (DiLiello & Houghton, 2008; Kelley & Kelley, 2013). According to Burger and Starbird (2012), “doing anything better requires effective thinking—this is, coming up with more imaginative ideas, facing complicated problems, finding new ways to solve them, becoming aware of hidden possibilities, and then taking action” (p. vii). Burger and Starbird also asserted that great ideas do not just appear they are strategically produced (2012). The need for enhanced creative potential has resulted in many theories and methods aimed at trying to better each individual’s capacity for Ideation. While research has shown that creative potential is constrained to each distinct individual (Isaken, 2010, as cited in Isaken & Aerts), and there is no magical formula to activate creativity (Flaherty, 2004, as cited in Uzzi & Spiro, 2005), extrinsic influences have a profound effect on creative outcomes (Howard-Jones, 2012; Adams, 2005, p. 8). The objective for the inclusion of this research in this Thesis is not to scrutinize the vast array

of theories on creativity, but to provide evidence that extrinsic motivators can increase creative potential in the effort to enhance the Ideation process.

Throughout the process of cogitation, from the individual's initial inquiry to their final outcomes, many factors influence Ideation. As individuals practice thinking in order to resolve inquiry, thoughts will move through an infinite number of pathways—each pathway eventually leading to other intersections that will need to be navigated. Lack of stimulation can impair the course that thinking takes, limiting the ability to make new connections. When trying to conceive an idea, the more familiar the individual is with the subject, the harder it is to move beyond linear exploration (Uzzi & Spiro, 2005). Additionally, familiarity with their surrounding context restricts the fluidity of generating ideas. By increasing the amount of serendipitous exposure to new material, via increased accessibility to material, fluidity of connections between disparate thoughts can be achieved. Moreover, enhancing the ability of the individual to see connection opportunities will allow for the production of new thoughts (Becker 1982; Lawrence 1900; Garebian 1995, as cited in Uzzi & Spiro, 2005). Howard-Jones's (2008) findings support this by stating that, “consciously visualizing an issue/topic within a range of different contexts can help boost [Ideation] by encouraging new associations” (p.14). Incorporation of disparate information has been shown to increase creative thinking that ultimately gives way to creative outcomes (Howard-Jones, 2008, p. 19).

Although exposure to broad spectrums of information can increase the probability of unique Ideation outcomes, the individual's intrinsic motivations can greatly restrict this process. Howard-Jones (2008) stated that, “Given stimuli can be more effective than selected stimuli, since [...] we tend to choose elements that are easily and obviously

related” (p. 19). Consequently, the explorative abilities of each individual are restricted by their own learned knowledge. According to Runco (2004), “Declarative and factual knowledge may supply the individual with options when he or she is solving problems, but at the same time can inhibit creative thinking if the individual looks only to established knowledge” (p. 12). Runco also stated that, “Experts are often inflexible, and thus overlook original options, precisely because they rely so heavily on established knowledge” (Hayes 1978; Simon & Chase, 1973; as cited in Runco, 2004, p. 12). Logical reasoning restricts the potential directions for new exploration based off the individual’s own understanding of the topic. This questions the individual’s competency in stimulating their own thoughts. If a large component of Ideation lies in the competency of the individual to blend existing knowledge in original outcomes (Adams, 2005, p. 8), “then it is conceivable that creative performance [potential] may be increased by any technique that might serve to break the stranglehold of conventional expectations and simply increase the number of randomly generated variations” (p. 8). Moreover, any effort to increase the current knowledge of the individual will enable more effective Ideation. The aid of external influences can expose new pathways of exploration and push beyond the limitations of the individual, thus increasing their creative potential.

Collaborative experiences have been widely successful in provoking exploration to new pathways of thought. Collaboration synthesizes the unique gained knowledge of each individual, cultivating a unique line of thinking based on vastly different views on the same subject material, resulting in a heightened creative potential of each individual (Johansson, 2004, p. 105, as cited in Adams, 2005, p. 6). During Ideation, ideas bounce back and forth, building a uniquely synthesized scaffold of thought. However, Ideation is

still limited to the combined learned knowledge and quality of creative thinking within a collaborative group. While all findings point to interpersonal collaboration to expand the capacity of knowledge, the exploration of computational collaboration—the collaboration between the individual and computer interface—to enhance Ideation has not been discussed in length. The computer interface taps into the largest source of collected knowledge, the Internet. Considering the major benefit of collaboration is to increase different and combined knowledge bases (Jeong & Chi, 2006), collaborating with the Internet as a knowledge base could surpass interpersonal collaboration as a means to optimize Ideation.

Environmental factors also play a role in the individual's ability to think creatively (Howard-Jones, 2012, p.6). However, not all environments are designed to fulfill this objective. Adams (2005) asserted that environments that encourage the individual to generate new variations and new combinations of ideas can enhance the creative mind. Howard-Jones (2012) stated that, "A relaxed and uncritical environment appears most helpful for generative thinking" (Forgays and Forgays, 1992, as cited in Howard-Jones, 2012, p.12). The environment must also be stimulating but not distracting and "allow easy access to resources (Runco, 2004, p. 7). This information showcases the need for controlled extrinsic stimulation and a proper environment to stimulate and foster Ideation. Like all organic life, effective Ideation requires a sustained amount of quality nutrients and the right environment for proper growth and continuous stimulation for maturation.

The facilitation of creative thinking and Ideation should not be expected to occur in a digital or physical environment where the integrity of Ideation is paramount. The

environment should be designed to effectively achieve the desired outcome. It can be deduced that without proper nurturing, ideas will not reach their full potential and without stimulation to enhance creativity, ideas will become analogous; the facilitation of ideas is essential. The focus of this research is to better understand the complexities that produce heightened levels of Ideation in order to design a better environment that facilitates an improved research experience.

Enhancing Creative Outcomes with Order and Disorder

The design of an environment impacts creative processes and Ideation outcomes. Any environment, physical or digital, benefits from the implementation of strategic design to elicit the individual's responses. To spur creativity, environments should have a balance of both order and disorder (S. Johnson, 2010, p. 99–128). This unique tension can facilitate chance encounters—serendipity—to occur while also stimulating the individual's behavior. The environment's design can also support fluctuations in balance between order and disorder (Avital, 2010, S. Johnson, 2010, 99–210). This dynamic ability can stimulate creative energy, subsequently promoting unique outcomes and enhancing Ideation.

Disorder in any environment is usually an undesirable characteristic. Vinh stated that, “[designers] create order out of disorder” (Vinh, 2011, p. 1). However, the abetment of both order and disorder can promote serendipity in the process of yielding creative results (S. Johnson, 2010, p. 99–128). As much as individuals seek to eliminate the possibility of unsolicited outcomes, the introduction of variance can stimulate creativity and unique Ideation. In this context, disorder is not observed as a loss of control, but the designed capability of chance encounters in an effort to amplify serendipity.

Disorder in Physical Environments

No singular space is as famous for facilitating order and disorder within a defined physical environment as MIT's Building 20. Although the building is known for producing innovative ideas, the space was not designed with this intention. Observation of extrinsic factors that influenced a heightened creative potential with the building's environment can also inform the design of new environments, physical and digital, where an increased creative potential is desired.

The large, temporary, and inexpensively constructed building was designed for laboratory use before World War II. Shortly after its construction, it was deemed a failure; attributed to the hasty design and construction process. However, its transient requirement was extended to sustain the continual overflow of many different academic disciplines. The quality of the construction made for ease in tearing down walls and repurposing spaces per the occupants' discretion. More importantly, the confined conditions forced different disciplines to interact. The flexibility of the physical environment, mixed with a diverse wealth of knowledge, aided in the production of creative thought (Lehrer, 2012). The creative potential of Building 20 is supported by Johansson's research of the Medici Effect, in which Adams (2005) stated,

Creative outcomes result when people are able to break down the associative barriers that exist between disciplines or areas of knowledge. When this breakdown occurs, individuals can enter what Johansson terms "the Intersection" between fields, where the number of new combinations of ideas is staggeringly high. (p. 9)

Adams also asserted that continual thinking within "the Intersection" produces a

remarkable yield by individuals (p. 9). Steve Jobs saw potential within the formula of the Building 20 physical environment and applied it to the Pixar headquarters in California; designing the space to facilitate chance encounters and stimulate creativity (Lehrer, 2012). Why was the environment of Building 20, and subsequently the Pixar Headquarters, important in the encouragement of creativity? In Steven Johnson's book, *Where Do Good Ideas Come From*, he proposes that for great ideas to occur, a balance of both order and disorder must be present (S. Johnson, 2010). Johnson also noted that "Christopher Langton observed [...] that innovative systems have a tendency to gravitate toward the 'edge of chaos': the fertile zone between too much order and too much anarchy" (p.52).

Although Building 20 was not designed specifically to stimulate innovative thinking, this scenario identifies environmental influences that can inform the design of new environments. These influences include (a) the observation of creative motivators exhibited in a unique environment can be designed into new environments to produce similar outcomes; (b) facilitating a balance between order and disorder promotes serendipity, thus enhancing the probability for creative outcomes; (c) exposing individuals to a diverse collection of information amplifies creative outcomes; (d) sustained interpersonal interactions within a diverse informational environment promotes the probability of serendipitous connections between information.

Facilitating a balance between order and disorder can create a highly dynamic and creative environment that promotes nonlinear thinking, yielding more creative outcomes. While focusing on linear thought—the order—Ideation processes must be supplemented with exposure to dissimilar thinking—the disorder. The exposure to disorder, or

nonlinear connections, increases the likelihood for unique solutions to emerge, thus enhancing Ideation.

Disorder in Digital Environments

Digital environments are typically known for establishing order and efficiency, but designing them to produce disorder can yield unexpected, yet beneficial results (Avital, 2010). Within the last decade, the field of architecture has been reinvigorated by enhancements in computational technology. Known as *generative design*, new capabilities in software programming have now enabled architects to setup variable parameters for different aspects of the architectural design that can generate an infinite number of outcomes (Theodoropoulou, 2007). Based on the variables within each programmed scenario and the context of the design focus, the generated design information can be increasingly unconventional or only set to output slight aesthetic variations. According to Avital (2010),

Generative design refers to the design considerations in developing systems or platforms that support and enhance generative capacity—that is the considerations in designing systems that are conducive to [the individual’s] ability to produce new configurations and possibilities, to reframe the way [individuals] see and understand the world, and to challenge the normative status quo. (p. 1)

Avital also stated that, “[The individual’s] generative capacity is a key source of innovation, and by definition, generative design aims to encapsulate the design directives of systems that enhance and complement that capability (p.1). Constructed for the 2008 Olympics, the Beijing National Stadium and the Beijing National Aquatics Centre, better known as the “Bird’s Nest” and the “Water Cube,” are examples of the creative power

behind generative computing. “Contrary to the common 'parametric design' in which a design target is predefined and can be parameterized, generative design is focused on the generation or discovery of new design alternatives in the form of disparate sets of evolving configurations (p.1). Traditionally, architects designed all aspects of a structure in a controlled and ordered manner. But today, new computing processes allow software to concoct unique aesthetics that can then be woven into the final architectural design. The results have produced undiscovered visual solutions, allowing new creative outcomes in architecture (Theodoropoulou, 2007). The use of generative processing to facilitate varietal output incorporates control, but also allows flexibility, thus allowing the ability of architects to regulate the balance of order and disorder. Generative processing provides evidence that digital environments can be designed to facilitate order and disorder, while also aiding in the ability to produce more creative outcomes. Similar computational programming can be implemented within the functionality of the ARIE. This is supported by, Andre et al. (2009) who gives credence to the ability of an online platform to aid in Ideation,

Computers can foster serendipity by surfacing interesting connections, by providing mechanisms to enhance the expertise of the would-be discoverer to be better attuned to recognizing such connections, and by supporting means for enabling either the growth of the idea or the sharing of it so it can be developed by those more keenly interested in the connection. (p. 6)

The online platform Pinterest has also embraced order and disorder to create a more dynamic digital environment. Pinterest allows individuals to post and collect images they find interesting. Individuals organize their collected images by “pinning”

them to unique repositories—or “boards.” Each board is created to establish a different category of interest. As individuals begin to search through the innumerable selections of images that relate to their interests, they can select an image to “pin” to one of their “boards.” This then allows the individual to view related images to the selected image. While searching, other individuals’ boards can be viewed and followed. By clicking on other boards and moving through the “pinned” images of other individuals, the probability of chance encounters exponentially increases. As more boards are followed, the flow of imagery on each individual’s Pinterest feed becomes more diverse. The type of imagery shown in the Pinterest feed is reliant on the types of images added to the boards each individual is following, allowing for a diverse exposure to imagery that the individual may have never encountered. By building more boards and following more individuals, the ability to glean over diverse varieties of imagery continues to increase.

Although Pinterest relies on the connectivity of individuals, as they share and collect imagery, a similar experience can be created between the individual and the ARIE. The ARIE would respond to the actions of the individual and the individual’s generated data, engaging the individual in different ways. The ARIE would also provide new data as the individual curates the information, aiding further in Ideation. The ARIE can be designed to allow for variances in order and disorder to increase serendipitous findings. In the task of reviewing content to gain insight, the implementation of order and disorder is two fold, (a) as the individual explores information by their own volition—the order—the reciprocated information displayed to the individual can vary—the disorder. The reciprocated information displayed to the individual within the ARIE can be similar to current topic under investigation—the order—and also be variably dissimilar from

current inquiry—the disorder.

The Individual in the Environment

Chance exposure can have a profound effect on outcomes. Penicillin, considered one of the defining medicinal discoveries of the twentieth century, was found by chance. “Alexander Fleming failed to disinfect cultures of bacteria, [...] upon his return he found them contaminated with *Penicillium* moulds which had killed the bacteria” (Andre, Schraefel, Teevan, & Dumais, 2009, p. 1). While this “chance” discovery gave way to a groundbreaking change in the treatment of a wide range of diseases, it was Fleming that found purpose in what could have been viewed as a mistake. Andre, et al. (2009) identify that while serendipitous findings can provide new links to creative solutions, it is up to each individual to see potential in the serendipitous findings (p. 1). To enhance Ideation, the ARIE should maximize the individual’s ability to make new connections between disparate information.

It should also be pointed out that no extrinsic motivation can enhance the individual more than the individual’s own personal interest in the information (Adams, 2005, p. 10). Despite this observation, the initiation of research does exhibit some level of connection to the topic. A core objective for the ARIE is for the UID and UXD to engage the individual and spur further interest. Additionally, the increased engagement would perpetuate positive reactions by the confidence gained in use of the ARIE. The satisfaction of using the ARIE can sustain increased motivation to gain information—increasing the longevity of exploration.

Application of Findings in a New Environment

As the research in this section suggests, designing order and disorder into the

informational flow of the ARIE is paramount to the success of facilitating Ideation. Serendipitous findings have been shown to dramatically enhance the probability of unique connections of disparate information (S. Johnson, 2010, p. 99–128). However, the individual may lack the proper foresight to make more varied connections, exhibiting the need of the system to aid in connection building. To maximize the potential of the ARIE to become a beneficial aid, the following factors will be applied:

- Exposure to a diverse selection of information; this includes content that is both similar to the current exploration direction and variably dissimilar from the current direction. This then increases the probability of serendipitous findings.
- Assist the individual in making connections between disparate information.
- Engage the individual to continually reflect on and engage with the information.
- Reactive and proactive abilities of the ARIE are essential, allowing the individual to search freely, while also influencing the search direction.

It is important to observe the motivators elicited in physical environments in order to embed similar influences within digital environments. As much as digital environments have introduced a new set of unique extrinsic influences, the environmental factors that provoke the individual's engagement in the physical world cannot be dismissed. The combination of proven digital and physical design motivators should be considered for any new digital environment, especially an online platform poised to enhance the process of research by implementing effective UID and UXD to create an improved UE.

Broadening the Meaning of Research

Research is generally perceived as a complex and laborious process conducted for

academic need or strategic industry endeavor. Under these stigmas, research has a perceived esoteric initiative. While some research contexts can affirm these perceptions, research does not always have to adhere to these parameters. As much as research can be extremely rigid, laymen can also practice it to aid in Ideation. The aim of expanding the scope and definition of research is not to rule out the importance of traditional research but to provide a more expansive view of “research,” while also adding further value. In 1942, Shairer (1942) wrote, “[research] extends the boundaries and horizons of human knowledge and experience,” and that, “each new discovery seems to make research only more endless. Vast new areas are continuously being opened for development and practical use, and there is no apparent limit to the potential resources yet to be uncovered” (p. 328). These seventy-year old explanative and idealistic viewpoints remove the act of research from perceived contexts and allow for open interpretation to its function—to explore and gain knowledge, enhancing Ideation.

To further understand the act of research, an explanation of traditional research methods is necessary. At a high level, research generally falls into two general methods: basic research and applied research (Roll-Hansen, 2009). Basic research is theoretical or experimental in nature. In practice, it is used to advance knowledge about a proposed self-initiated theory, with the expectation that gaining understanding is the ultimate outcome of the process. Applied research is reactionary, initiated by an external influence to investigate specific issues and attempts to gain further insight about the issue or discover applicable solutions. While both structures are very different in terms of theory and execution, they adhere to similarly strict standards of testing, information documentation, and production of conclusive evidence. While each offers unique

advantages and could be applied to any discipline, basic research is concentrated in fields, not industry, while applied research is widely practiced in the context of industry (Adams & Clemmons, 2006). The rigid standardization within traditional research is meant to eliminate biases towards data and form conclusions that showcase only empirical findings. The application of these methods is partially due to a project's need for objective outcomes. Even though traditional research methods are highly effective and necessary to their respective applications, not all inquiries require such rigid processes. Moreover, research outside of the formal structure makes the value of findings no less important to the individual or less important to Ideation. To increase value, the definition of "research" must be expanded in terms of application, practice, and qualitative outcomes.

To push beyond the confines of traditional practices, research must be considered in a broader sense. At its core, research is initiated by a critical inquiry in which focused exposure to information is sourced in an attempt to gain knowledge, stimulate thought, and/or develop conclusions. Additionally, research does not always need to be a means to an objective end, but can also nurture creative thinking. For example, Sanders (2005) discusses the added value research brings to product design, especially when designers conduct research earlier in the development process. Correspondingly, the qualification of sourced information can be varied (i.e. not limited to scholarly sources) as long as the sources are related to the research topic and the information gained satisfies the goals of the individual. In 2010, Microsoft, the creator of the search engine Bing, published an educational reference document to inform teachers and students on how to conduct better research online. Bing stated that, "The goal of information repositories, digital or

otherwise, is to support research, by providing access to the information necessary to foster the development of critical thinking” (Microsoft, 2010, p. 4). Microsoft elaborates by stating:

Critical thinking is more than a buzz phrase; it’s the ultimate goal of all education. In *How We Think* (1910), John Dewey defines critical thinking as “reflective thought” rather than routine thought; it’s the process of “active, persistent, and careful consideration” of the credibility and conclusions of supposed knowledge or information. That’s basically what we mean by research. (p. 4)

This alternative perspective is important because it removes stigmatic associations and allows for flexibility in utilization of the term “research.” This perspective also gives the act extended value. Under this premise (a) any topic is worthy of research; (b) any individual is capable of conducting research; (c) any research contributes value to the individual; (d) outside the requirement of formal settings, research can be conducted via various methods.

Redefining and broadening the definition of research, allows endless applications. Research as a process is applied by more than just professionals and field researchers; it is practiced widely any individual seeking knowledge. In creative industries, such as CD, research can be conducted purely as a source of inspirational stimulation. Published twenty-two years ago before the explosion of online interaction, Wilson (1991) encouraged artists to not just use technology to help create artistic product, because this exclusivity “does not successfully penetrate to the core of research developments.” Wilson warns that the artistic community must find new ways to reflect on knowledge and should not “fail to get involved with the vigor, intensity and depth of the researchers

who are generating the products and ideas.” Artistic movement can be generated by “sources cultivated for information and inspiration” (para. 5–7). Although the interaction between technology and artists has progressed considerably from when those statements were published, the intentions still resonate and are applicable to the ARIE.

Quality research has the ability to enhance Ideation, regardless of the context or creator. Scott (2013) agrees that the rigidity of traditions needs to be expanded, stating that, “Ideas must be set free. Academic freedom is at risk in an over-managed research environment [...]. But so too is scientific promise. Alongside the established researchers we need the iconoclasts, the marginal, maybe even the mad” (para. 10). Scott further acknowledges the value in the expansion of stating that, “there are other types of knowledge apart from ‘hard’, theory-led, experimentally driven, evidence-based science. There are lots of ways of describing them—tacit, customary, applied” (para. 12). Scott’s writings give value to all levels and perspectives on knowledge production and critical thinking. In the book *The New Production of Knowledge*, Scott co-authored, he expressed that knowledge goes beyond the confines of academic disciplines and that anyone that has studied creativity or innovation recognizes this form of knowledge. This knowledge can be observed as “highly reflexive, socially embedded, embodied in practice, problem-oriented and, crucially for the present discussion, ‘published’ in countless forms” (para. 12). Nested within the statements above is the sentiment that there is value in the utilization of research—as a means to gain knowledge—across endless genres of thought, and that any individual can inquire and explore solutions. The goal in broadening the definition of research is not to discount the need for empirical evidence, but to lend value to all types of researchers, professional and laymen, and their research goals and

outcomes. The clarification of research supports the stance that professionals, academics, and laymen are currently conducting research—as defined in this section—and that the ARIE can be a viable resource.

The Effect of Research on Ideation

“The root of success in everything from academics to business to leadership to personal relationships and everything else, is thinking—whether it’s thinking disguised as intuition or as good values or as decision making or problem solving or creativity, it’s all thinking.” (Burger & Starbird, 2012, p. vii)

By way of using research as a method to cultivate ideas, three components promote Ideation; these include (a) exposure to targeted and varied sources of information or external influence; (b) the individual’s ability to retain exposed artifacts; (c) the individual’s ability to continually evaluate acquired information.

The first component that promotes Ideation requires that the individual’s research be focused while also being influenced by a wide variety of information. In order to maximize the individual’s creative potential a balance must be struck between depth and breadth of knowledge (Johansson, 2006, p. 104). As linear progression continues, varying nonlinear influences can enrich the thinking and exploration process. Johansson (2006) suggests that seeking collaboration that blends skill sets achieves the right range of knowledge (p. 105). Interpersonal collaboration is generally the most likely contributor, but online platforms can also act as a collaborator. The inventiveness of a solution “rests on the ability to combine previously disparate elements in a new way, which implies a need for a broader focus and variety interests” (Adams, 2005, p. 5). Ideation without thorough exposure can lead to underdeveloped, inadequate, or conventional outcomes.

The second component that promotes Ideation requires the ability by the individual to capture gathered information. Having the ability to store, manage, and

quickly recover information not only prevents the loss of thoughts, but keeps the Ideation circulating. The *commonplace book*, a type of journal that acts as a repository for internal thoughts, interesting findings, and posed inquiries, has been widely used within research fields, as shown in Figures 1 & 2.

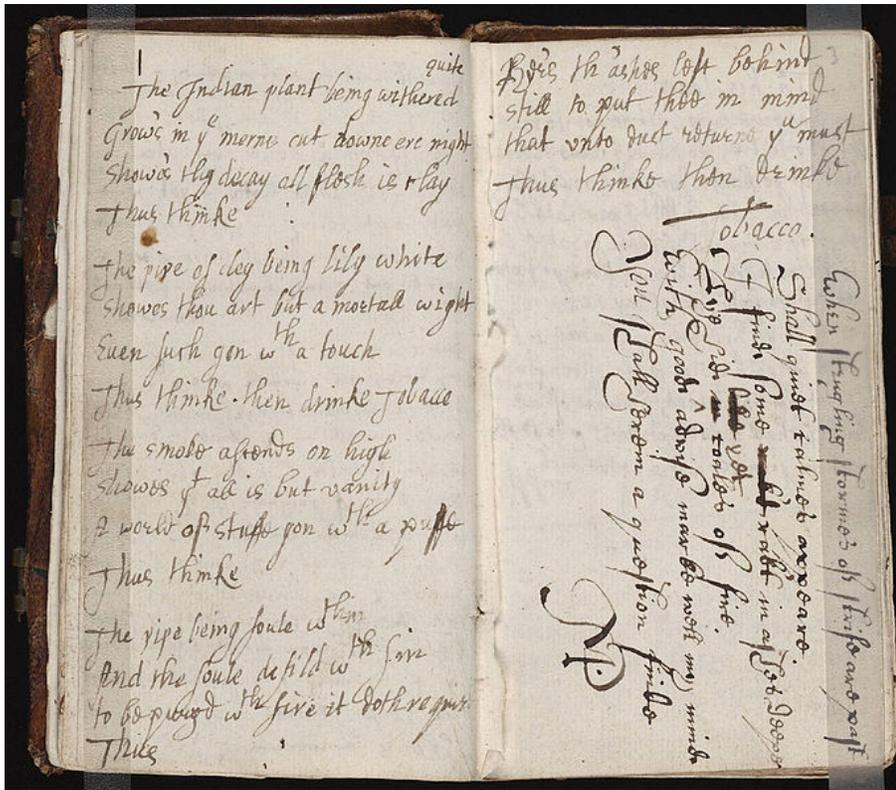


Figure 3. An Example of a 17th Century Commonplace Book. This depicts an example of a commonplace book as it was used during the 17th century.



Figure 4. An Example of a Modern Day Commonplace Book. This depicts an example of a modern day commonplace book. Today, the term *commonplace book* is more commonly referred to as a *journal* or *notebook*.

The notebook allowed for “tension between order and chaos, between the design for methodical arrangement, and the desire for surprising new links of associations” and “each rereading of the commonplace book becomes a new kind of revelation” (S. Johnson, 2010, p. 85). Information and thoughts remained on the surface, circulating ideas that can yield unexpected and profound results; and more importantly as S. Johnson points out, it “facilitates reflexive thought” (p. 85). Reflexive thought is an important aspect of Ideation, as defined in the third component. One of the most recognized for keeping a commonplace book was John Locke, an English philosopher in the seventeenth century. During his time, Locke’s research and writings were radical, adding profound discourse in religion, politics, philosophy, epistemology, and education (Internet Encyclopedia of Philosophy, 2001). While at Oxford in 1652, Locke continued to develop a system in which his notes were kept. His successful use of the system gained

interest by the public that resulted in a published book for use by all (S. Johnson, 2010, p. 84-55). As discussed earlier, enabling order and disorder to coexist, heightens Ideation. S. Johnson supports the need for order and disorder by stating that, “[The commonplace book] provided just enough order to retrieve and review information when needed, while concurrently allowing the main body of the commonplace book to have its own unruly, unplanned, meanderings” (p. 87).

Ongoing research can continually initiate the Ideation, but without a place to document thoughts the ability to progress through ideas would be restricted. The act of research encompasses sourcing and documenting information. Providing a space where ideas can be stored and subsequently reviewed, gives the information time to cultivate. Good ideas do not present themselves in the moment but are the product of slow hunches that germinate over time (S. Johnson, 2010, p. 67-97). S. Johnson’s (2010) findings also conclude that the commonplace book helps to keep ideas in rotation. This physical container allows ideas to continually be processed “off stage”—in the mind, blending ideas in a unique tumbling creating a unique synthesis of thoughts (p.84). The same experience exhibited by physical containers of information can also be simulated in the ARIE.

The third component that promotes Ideation requires the ability by the individual to continually evaluate acquired information during the research process. The commonplace book also satisfies this component, by enabling the ability to continually review information. The process of documenting and reviewing within the commonplace book can also be viewed as a form of note-taking. Bauer’s (2008) research shows that, “both the process of note-taking and reviewing notes promote learning” (p. 3). The act of

reviewing acquired information and notated thoughts perpetuates cogitation, which should then be notated, inciting the continual process of Ideation and review. Thoughts not notated were less likely to be reinserted back into subsequent Ideation activities, where notes that were recorded had a higher probability of recirculation (p. 19). This is supported by Bauer's observation that the process of reviewing logged information within a centralized container heightens the probability of "bridging inferences" (p.15). Additionally, Bauer asserted that note-taking allows the individual to further engage with information by allowing reinterpretation of observations in a unique and relatable way (p. 16). This note-taking byproduct could be extremely beneficial to the ARIE by continually evaluating the individual's actions to curate additional information for review. Bauer also suggests that the characteristics that make physical note-taking successful can be applied to note-taking with an online platform, where the effectiveness of taking notes, reviewing notes, and learning can be increased.

Purely through exposure to information, Ideation is facilitated through the (a) exposure to targeted and varied sources of information or external influence; (b) the individual's ability to retain exposed artifacts; (c) the individual's ability to continually evaluate acquire information. By exploring information, experiences are mentally catalogued, leading to serendipitous connections within mental repositories—taking place both consciously and subconsciously. This process can be understood by examining another similar process known as bricolage. Bricolage is "the process of theoretical tinkering by which individuals and cultures use objects around them to assimilate ideas" (Repenning & Loannidou, 1997, p. 3). S. Johnson (2010) points out that combining known mechanical processes and physical objects in a completely new way led to the

creation of the Gutenberg Press. As pointed out in this example, bricolage is most often associated with reengineering the physical world in order to generate new ideas. However, Levi-Strauss (1962) suggests the act of bricolage cannot be constrained to a set discipline, but that each project is unique and what each individual collects and uses gives way to the possible combination of solutions. Moreover, Levi-Strauss expands on this by describing a type of “intellectual bricolage” used by authors to write creatively (p. 11). Additionally, Kincheloe (2005) expands on bricolage by stating that, “All observations of the world are shaped either consciously or unconsciously by social theory—such theory provides the framework that highlights or erases what might be observed” (p. 324). Although bricolage is sometimes interchangeable with creativity, and vice versa, bricolage is one of many methods to enhance creativity and should not be used in the place of creativity (Le Loarne, 2005).

The research components outlined in this section are also fundamental components of the ARIE. The primary functions of the ARIE will build on proven components of research that enhance Ideation. The process of bricolage is important because the ARIE can also be designed to provide opportunities for the blending of ideas.

The Effect of Search Engines on Research

Currently, the Internet is the largest resource of information. As universal as it has come to be, the process of how information is sourced and then displayed on the individual’s screen is a mystery for many. Individuals command actions and information is quickly compiled from an innumerable amount of online data repositories and filtered to a browser window. However, when search engines are used as a research tool, they are crippling the integrity of the research process (Goodwin, 2011; Jensen, 2011; Pariser,

2011). In 2010, Microsoft, creator of the search engine Bing, published a teaching guide to assist students and teachers on how to use search engines to conduct better research. In summary of the teaching guide's objectives Microsoft (2013) writes that, "the challenge remains for [individuals] to find, evaluate, and apply the information they discover in the classroom and beyond" (para. 1). Additionally, Microsoft (2010) stated that, "As [individuals'] ability to gather and store information evolves, however, [their] skills in finding and analyzing information must also evolve" (p. 4). Three conclusions can be inferred from these statements: Microsoft is explicitly referring to the process of researching online, Microsoft has observed the need to better facilitate online research, and by deeming the process a "challenge," the current state of researching online is observed as problematic for individuals.

Unfortunately, search engines have been the cause of many challenges regarding research and Ideation. Rigid computational processes and streamlined functionalities of search engines have narrowed the exploratory nature of creativity which then hinders Ideation. As a large majority of individuals use these platforms for supplemental information to advance their respective projects, the methodology search engines employ to source information for the individual has been observed as deficient. A recent study cited that 94 percent of United States' educators claim that their students think "researching" means using a search engine, like Google (McGee, 2012). In a separate study of five universities in Illinois, it was found that students lacked the fundamental understanding of how to properly tailor a search request. Instead, students felt anxious and sometimes settled for fewer sources due to the overwhelming mass of information (Goodwin, 2011). Google's search engine is one of the most ubiquitous online resource

platforms today (Comscore, 2013), but few realize the search engine's process of compiling results for each request is based on proprietary biases towards certain data. Search engines are designed to assess large amounts of data from the Internet and showcase refined findings to individuals. Although search engines increase the efficacy of information accessibility, they can cause debilitating effects to research and development because the display of information is both calculated and predictive, based on proprietary developed sets of algorithms. A 2010 survey of 1,000 college students revealed that the search results presented first were trusted to be best sources as provided by Google (Goodwin, 2011). Additionally, an unrelated survey concluded that 94% of individuals clicked on the first page of search results while 6% continued on to the second page (Jensen, 2011). If the lot of retrieved information is filtered before the individual can survey a set of impartial results, the results yielded will, by definition, affect Ideation based on actions predetermined by search engine platforms. Although search engines have impaired research, online platforms can aid the process of exposure to influential research information, but only if they are designed for this purpose.

Although it is necessary for a search engine to focus on a topic, advanced filtering has hindered serendipity within the process of searching, guiding the individual to a preferred set of query results, based on the rankings and correlation distances. Pariser (2011) describes that through ongoing use of online platforms, including search engines, search results begin to cater to the individual's previous behavior, omitting what is deemed less relevant information to the individual. According to Stewart (2013), "Companies like Expedia, Yelp, and, especially, Microsoft [claim] that Google manipulates the [query] results to favor its interests at the expense of competitors"

(para.3). These “interests” seem to assist consumers most, and not researchers looking to source appropriate information. This is supported by the fact that Google’s “organic” searches results accounted for “94% of the links clicked on by consumers” (Kaufman, 2013, para. 4). Kaufman (2013) suggests that, “Organic search will continue to be a strategic channel for ecommerce” (para. 4). It is conceivable that if a large majority of individuals were consumers, the UE would support their actions. Although the need for unique curation for each individual can have many benefits, search engines impose unwarranted biases on the display of information restricting serendipitous findings and exposure to a wider variety of information that could enhance Ideation.

Another challenge with the use of search engines to conduct research is that they do not natively support the ability to capture and continually reflect on information. As discussed earlier, ongoing review of research findings is essential to the effectiveness of research and the enhancement of Ideation.

This information questions the ability of search engines to properly and holistically support research, as defined in this Thesis. The ARIE addresses the deficiencies that search engines have on research in order to improve the process of online research, while subsequently enhancing Ideation.

The Resourcefulness of Online Aggregators

The exponential growth of the Internet has caused an overwhelming amount of content to be created and uploaded for individuals to access. “While the amount of potentially relevant content constantly grows, the time that [individuals] are able to devote towards consuming content remains the same” (Askalidis & Stoddard, 2013, p. 1). Sorting through the innumerable content channels became an arduous task for

individuals, an undesirable UE, when it should have been enjoyable. Schwartz (2005) explains that there is an ongoing paradox of choice today: While individuals never have had so many options, the volume has created anxiety. Individuals prefer a customized and clear presentation of content (Bain & Company, 2012), which has led to the proliferation of a subset of online platforms called online aggregators. Examples of online aggregators include Pinterest and Twitter. The function of online aggregators is to curate information from a variety of sources within a closed system or the greater Internet in order to showcase the individuals' requested targeted data types within one platform.

Online aggregators have enabled individuals to review information that pertains to their interests while not experiencing the restrictive processing of search engines. In addition, online aggregators have simplified the process of uniting individuals with their preferred content. Vast channels of information are filtered down by way of algorithms to match the individual's query. "The two most common forms of curation are expert-based ([experts determine what information is shown to individuals]), and algorithmic-based (a search algorithm determines [what information is shown to individuals])" (Askalidis & Stoddard, 2012, p. 1). Online aggregators also allow individuals to customize the type of content displayed based on their own personal interests. The success of an online aggregation is not solely based on the UXD, but is also enabled by the UID and the interface's back-end processes. Online aggregators must still rely on an effective UID and UXD approach to create a successful UE and the aggregation function is directly related to the type of content exhibited. Additionally, the presentation of the content must alleviate the individual from being overwhelming by a large volume of content.

Algorithmic-based processing has made it functionally possible for online

aggregators to cater to the needs of the individual. Algorithms are automated sets of computer processes and formulas that the individual's queries are passed through in order to retrieve specific information. There are varying genres of algorithms and each is unique and highly proprietary. Companies sculpt algorithms to better understand the individual, the context, and the content to execute a better UE.

As the use of online aggregators and algorithms push content connectivity to new heights, the effects have been both positive and negative. The news industry has seen a dramatic change via the implementation of online aggregators. While consumption of news has shifted away from television, radio, and newspapers in the US, the demand for news on the Internet has grown (J. Simon, 2012). Additionally, the definition of "news" has expanded beyond traditional newspaper outlets to a vast array of content providers, including magazines, independent news providers, and blogs. Individuals want more "tools that enable [the ability] to select feeds from different sources and customize and personalize their news offer[ings]." The increase in mobile and tablet usage provide new distribution tools that stimulated this demand (p. 43, 50). As a result, third party online news aggregators were designed to satisfy the emerging demand of individuals, enabling them to take a more active and participative role with news content. Online news aggregators have become gate watchers, closely observing the dissemination of news by the gatekeepers of content in order to provide individuals with a better UE (J. Simon, 2012). The success of Feedly, a popular online news aggregator, can be shown in their website traffic report. In 2012 Parse.ly, a web publishing analytics company, reported that "[Feedly] is up to 5 billion page views a month across about 160 million unique readers. Its revenue has grown 500 percent in [2013]" (Harris, 2013, para. 3).

Although online aggregators have improved the way individuals explore content, excessive control over displayed information can restrict content discovery. Many online platforms are designed to capture the individual's habits in order to provide more useful results. According to Pariser (2011), Google tracks 57 cues from the individual, including their geographical location, the brand of computer being used, and the type browser used in order to better tailor the individual's query results (Pariser, 2011). These online platforms have become intelligent content engines, allowing the individual to initiate the interaction, and then steering content distribution decisions based on the individual's actions. As discussed by Pariser (2011) in a TEDTalk, online platforms like Twitter began to filter down his content based on his usage actions, yet he still appreciated reading some random content. Today's online platforms have become so effective at understanding the individual that they are now trying to predict the individual's behavior, creating an extreme bias to content distribution. Pariser (2011) advises that to help fix this problem, online platforms need to be configured to not only expose individuals to desired content, but also content that helps offset individuals' own biases—a balance of content will create better perspective. This theory also supports the premise that order and disorder are necessary to engage individuals and maximize Ideation. While all online aggregators innately possess biases by design, excessive control reduces exposure to extraneous influences that introduce the individual to diverse sets of knowledge and perspective.

Although online platforms, like search engines and Twitter, have limited serendipity by imposing excessive amounts of order, the constant flow of information showcased by online aggregators has exposed individuals to a wide variety of

information enabling the discovery of new content channels and varying types of content—all while staying within the individual’s topic preferences. By making the process of content discovery efficient and enjoyable, aggregators have turned individuals into content explorers, expanding their knowledge.

The same benefits provided by online aggregators can be implemented in the ARIE. But as Pariser (2011) cautions, the system should allow individuals to experience a better distribution of content. As discussed in the section, “Broadening the Meaning of Research,” allowing exposure to a broad spectrum of information within a specific topic increases the probability of more unique connections between content and improves Ideation. In the design of the ARIE, the algorithms will be positioned to allow loosely related information to also be displayed.

Designing High Content Online Platforms

The design of an online platform is just as important as the idea behind it—if not more important. The visual design, also known as *user interface design* (UID), is the first visual connection the individual has with the platform. UID is then paired with the designed platform functionality, also known as *user experience design* (UXD). The combined efforts of the UID and UXD are used to create a successful user experience (UE), which enables individuals to achieve the goals as outlined by each unique platform. In the context of the ARIE, the UID and UXD must facilitate a more efficient and effective researching experience than current online platforms. Based on the findings within this Thesis, a general overview of beneficial UID and UXD guidelines will be outlined to aid in the design development of the ARIE.

Enabling the goals of the individual to be accomplished is a common objective of all online platforms. The individual's ability to function successfully within a new environment has been primed by all previous online experiences (J. Johnson, 2010, p. 1–9; Anderson, McRee, Wilson, 2010, p. 12, 18). In terms of UID and UXD of online platforms, the collective previous experiences of all individuals have exposed preferred design characteristics, resulting in the establishment of proven design conventions (Krug, 2006, p. 34-35). Individuals who use the Internet have been exposed to many design conventions as web design capabilities have expanded over the last decade. A better understanding of the way individuals use and read through web pages has resulted in better design techniques. In Nielsen's (2006) study of how individuals read on the web, eye tracking observations conclude that individuals scan web pages in an "F" pattern, first moving their eyes from left to right along the top of the web page, then moving down on the left side, then from left to right again across the middle of the web page, and finally bringing their eyes to the left side and straight down the left side of the web page. Based on this study, designers can leverage these behavior results to design more effective interfaces. According to Krug (2006), individuals quickly scan through a web page trying to make sense of the interface, focusing on functionality and content that helps them achieve their goals (p. 23). Individuals will quickly evaluate an interface to establish meaning (J. Johnson, 2010, p. 25). These actions have been developed from previous conditioning by content heavy online platforms like magazines, newspapers, and books (Krug, 2006, p. 23). Due to the fact that individuals scan information very quickly, it is important to design simple, distinct, and structured visual hierarchies. Correspondingly, major pieces of information should be placed in predictable and visible

locations, and also grouped with similar functionality. This breaks large amounts of content down into visually manageable portions (J. Johnson, 2010, p. 30). “A visual hierarchy allows people, when scanning information, to separate what is relevant to their goals from what is irrelevant instantly” (p. 30). For example, website navigation and company logo, two very important pieces of information, are generally located across the top of the site or along the top left side of the page. Based on the “F” pattern observed by Nielsen, the location of these two items is optimized for primary scanning. Each part of the layout relies on visual hierarchy to promote a beneficial UE.

The more accessible the design is to the individual the more effectively and efficiently they can use the web page. To implement effective design over an entire site, consistency and cohesion are necessary (Nielsen, 2011). Individuals quickly learn required behavior based off of UID and UXD and will begin to predict successive actions (J. Johnson, 2010, p. 109-131). If design conventions differ throughout an interface, the amount of unique actions to be learned increases, causing the individual to focus on using the platform and not on achieving their goals (p. 97). Consequently the platform design may discourage further use. These conventions become increasingly important in online platforms that are used frequently.

To design a universal platform that is highly functional, or exhibits a high level of usability, a set of UID guidelines can also be applied. Also known as Heuristics, these design rules are “based on human psychology: how people perceive, learn, reason, remember, and convert intentions into action” (J. Johnson, 2010, p. xiii). Many guidelines have been developed as technology has changed, but all are based on human actions, thus resulting in recurring similarities throughout each set (p. xiii).

Although Heuristics are design “goals” rather than “rules,” and do not address specific aesthetics or functionality best practices expressed in design conventions, they assist designers in sculpting a better UE (p. xi).

To develop a content heavy platform, like the ARIE, it is best to build from the proven design conventions of similar platforms (Bruce, 1999; as cited in Salarian, Ibrahim, Nemati, 2012, p. 1). The designs of online aggregators exhibit a high level of content usability. The implementation of consistent design is crucial to usability and has made it possible for individuals to browse through vast amounts of content, with reduced visual fatigue (Ponton, 2008). High content platforms have started to recontextualize Internet content, restyling the content to conform to their unique design standards. Content can then be reviewed in a neutral and consistent environment without the juxtaposed style of the sources’ original website’s design standards.

A neutral environment facilitates higher engagement with content, thus enhancing content discovery. Presentation of content in a grid view has changed the way information rank is perceived and allows for cross-pollination of content in the mind of the individual. Andre, et al. (2009) stated that, “Within such an environment, extracting the potentially serendipitous results and displaying as part of a less-obviously ranked view could aid serendipitous encounters” (p. 6).

Before online aggregators became popular, individuals would have to visit each unique website, interacting with each website’s UID and UXD. Now individuals can view content on a singular platform, with one UID and UXD approach. Consistency of design elements has made it possible for individuals to browse through endless flows of content, with little visual fatigue.

The implementation of effective UID and UXD in any new online platform promotes optimal usage and assists the individual in achieving their goals. In the ARIE, a properly designed environment will foster a better research UE.

III. STATEMENT OF THE PROBLEM

Technology has been expeditiously woven into the very fabric of most societal infrastructures. No single innovation has been more widely adopted than the Internet. Its existence has had a profound effect on the creation, storage, and access of content. Yet, with access to innumerable amounts of content, search engines have impeded the use of the Internet to conduct quality research.

The act of research not only describes a process performed by industry professionals and academics, but can also include the efforts of general laymen to gain understanding or develop an idea. These researchers use search engines to fulfill their inquiry. While some individuals are casually searching for immediate information, others are persistently seeking content regarding a specific topic. Search engines do not fully embrace the individual's ability to (a) effectively perform ongoing research about an inquiry; (b) store findings; (c) organize information; (d) evaluate found information; (e) annotate thoughts. To fulfill this need an array of online platforms are used to search and store information. Search engines are used to find information, not to explore information as over filtering has restricted content discovery.

To fully enhance the research process, the digital environment must also facilitate ideation in order to maximize the individual's creative potential. Increased creative potential enables the individual to produce more unique Ideation outcomes. To increase the creative potential in a digital environment, varying degrees of order and disorder can be applied throughout the environment to promote serendipity. By exposing individuals to a targeted and varied range of search results, a much greater perspective of information can be review. Nurturing chance findings and connections between disparate pieces of

information can greatly improve the uniqueness of Ideation.

Currently, no existing online platform has been specifically designed to maximize research development as outlined in this Thesis. Search engines are the prevailing online platform to conduct research. As the primary online platform for individuals to source research information, the functionality severely limits the abilities of the individual to conduct research—as defined under “Broadening the Meaning of Research.” Limited functionality, over-filtering, platform biases, and consumer related information have restricted the individual’s ability to source quality material. As a consequence, the exploration of content to expand knowledge has been restricted. The functionality of search engines need to be reevaluated as an effective research and Ideation tool. Additionally, filters and algorithms need to be designed to allow for much looser connections to the individual’s inquiry.

To address the deficiencies of online research, the creation of a new platform, the ARIE, will be created. The ARIE will be a uniquely designed digital environment with the sole purpose of enhancing the research process, while also maximizing the Ideation of the individual in the process. By providing a central location to seek, collect and, evaluate content, while also enhancing these functions, the management of research can exceed any current online platform or combination of online platforms. Additionally, the implementations of effective UXD and UID will create a better UE than traditional research platforms or methods. The combination of improved functionality and effective CD will improve the process of research for any individual, researching any topic.

IV. OBSERVATIONS

The Defining Attributes of the ARIE

The gained knowledge from the research exhibited in this Thesis has led to the development of defining attributes that should be included within the design and functionality of the ARIE. These attributes are as follows:

- Design with the goals of the individual in mind, which is to maximize the research potential any topic.
- Fundamental functions of a research-driven online platform include the ability to search internet content, save found sources, organize saved sources, review saved sources, annotate saved sources, and create general notes within a singular online platform.
- The UID and UXD should promote creativity. A properly designed UE can extrinsically enhance creativity levels, regardless of the individual's creative disposition.
- Exposure to a diverse selection of content promotes creative connections between disparate information. The diverse content is both similar and variably dissimilar to the current exploration direction (order and disorder). The curation of content by unique algorithms increases the probability of serendipitous findings and is different from the filtering techniques used by standard search engine platforms.
- Assist the individual in discovering connections between disparate content.
- Encourage continual engagement with research content and annotated thoughts. This will sustain the circulation of ideas and stimulate Ideation.
- Reactive and proactive abilities of the platform are essential. The platform should

variably influence the individuals' research directions, but not restrict the freedom to navigate through content. This will help break the individual free from their own biases when conducting research.

Observations of the Research Process

The thesis problem presented itself in the midst of researching to generate potential thesis topics. During this process, it was observed that a dedicated online research platform did not exist. Exploring information, saving content, annotating, and organizing data led to the use of many online platforms. A singular online platform designed to facilitate research was desired. Moreover, intermittent research sessions broke down the fluidity of research progression making it difficult to recommence from previous search explorations. These issues prompted contemplation about a new online research platform. Current technology can support better research methods, as defined in this Thesis, but an online platform fulfilling this need has not yet been developed. Further research and Ideation about this issue provided answers on how to effectively create a digital environment that supported this research. Continued research and design development produced a working idea: the ARIE.

After the thesis topic was chosen and insight was gained about what attributes facilitate beneficial research, it became evident that no singular online platform supported research, as defined in this Thesis. The primary online platform used to execute research, the search engine, lacked the necessary attributes to maximize the individual's Ideation. Combinations of online platforms like Google search, Google scholar, and Evernote were used in tandem to keep track of findings and thoughts. The use of these online platforms to conduct research was cumbersome and met with frustration. The desire was to work

within one online platform that could execute all the functions necessary to research effectively. Moreover, an online platform that could enhance Ideation through better research could maximize the overall process.

Evaluation of Online Platforms

During the course of this research and the design development of the ARIE, the functionality of many online platforms were comparatively reviewed to determine effectiveness in supporting research functions. To assess each online platform, a list of requirements was produced from the acquired knowledge exhibited in the Preliminary Research chapter. The Preliminary Research chapter produced a list of minimum requirements necessary to conduct quality research online within a singular platform:

- 1 – the individual’s ability to search all Internet content from within the platform
- 2 – the individual’s ability to aggregate content from the Internet
- 3 – the individual’s ability to save web sources and computer files
- 4 – the individual’s ability to organize saved content
- 5 – the individual’s ability to review saved content
- 6 – the individual’s ability to create general notes
- 7 – the individual’s ability to annotate saved content

Description of Online Platforms

- Google is an online search engine used to search for any type of information.
Reference can be found at www.google.com
- Readcube is an online platform designed to manage scholarly research literature.
Scholarly research PDFs can be downloaded into this platform and reviewed,

organized, annotated, and cross-referenced with other PDFs. Reference can be found at www.readcube.com

- Evernote is an online platform that allows individuals to save files and online sources and organize them by category. Individuals can also generate notes within each category. Reference can be found at www.evernote.com
- Mendeley is an online platform, like Readcube, that is designed to manage scholarly research literature. Scholarly research PDFs can be downloaded into this platform and reviewed, organized, annotated, and cross-referenced with other PDFs. Reference can be found at www.mendeley.com

Table 1. The Evaluation of Research Functions Within Current Online Platforms
This table identifies attributes that each unique online platform provides the individual to aid in the process of research.

	#1	#2	#3	#4	#5	#6	#7
GOOGLE	×	×					
READCUBE			×	×	×	×	
EVERNOTE			×	×	×	×	
MENDELEY			×	×	×	×	

* This denotes the ability to only save PDF files

Conclusions from the Evaluation

Currently, no singular online platform employs all the basic functionality, as shown in Table 1, to conduct online research. To maximize the individuals ability to

research and produce more creative Ideation outcomes, the ARIE will not only fulfill the list of minimum requirements in the “Evaluation of Online Platforms” section above, but also employ the attributes outlined in the “The Defining Attributes of the ARIE” section.

Survey to Analyze Search Engine Usage and Preferences

A survey was issued to an exploratory group of individuals who utilize search engines for research in order to obtain information about the functions desired during search engine use. The survey results were used to validate the viability of the ARIE. The survey questions and inline assessments are shown below.

1. Are search engines easy to use: (a) Yes; (b) No

Based on the survey results, the respondents answered, “(a) yes” with the exception of one vote for “(b) no.” Based on the results, the consensus is that search engines are easy to use.

2. Are the search results satisfactory in fulfilling your search inquiry: (a) Yes; (b) No

Based on the survey results, the respondents answered, 70% “(a) yes” and 30% “(b) no.” Based on the results, the consensus is that search engines do fulfill the individual’s search inquiry.

3. Does it take more than one search query to find the desired information: (this includes opening a new window to create another search query, or starting over to reword the search criteria with the hope that it provides better results: (a) Always – I always have to try multiple times to find the desired information; (b) Often – I have to try different phrases or search topics to find my information; (c) Never – I find the information the first time.

Based on the survey results, the respondents answered, 76% “(a) often” and 34% “(b) always” with no responses for “(c) never.” Based on the results, all the respondents found that they search results did not produce the desired results on the first try. All the respondents found that they “always” or “often” had to retry search terms to fulfill their inquiry.

4. When searching for non-consumer related information online, do consumer related links or ads cloud your search results: (a) Yes; (b) No

Based on the survey results, the respondents answered, 76% “(a) Yes” and 34% “(b) No.” Based on the survey results, the respondents found that consumer related links or ads cloud the their ability to find the search information they desire. An interesting observation is that the majority of the respondents that answered “(a) Yes” on this question also indicated that they search for “(b) Consumer Related Information,” which shows that even when specifically searching for consumer related information, their search process is still impeded by an excessive amount of consumer related information or ads that do not pertain to their search query.

5. When using a search engine, are you searching for: (Check more than one if needed): (a) Hobby Interests; (b) Consumer Related Information; (c) Professional Work; (d) General Information; (e) Medical Related; (f) Other

Based on the survey results, there was no preferred search interest, with all the respondents searching evenly between all choices, with the exception of one respondent who answered “(f) other.” This question was posed in order to better understand the types of information that is searched. This

question can then be compared to other questions in this survey to find connections between the respondent's impressions and search activity.

6. **When searching for ONE specific topic, do you: (Check more than one if needed):** (a) *Quickly search and locate your desired information;* (b) *Casually search throughout the day;* (c) *Continually search over long periods of time.*

Based on the survey results, only 47% “(a) Quickly search...” and do not “(b) Casually search...” and/or “(c) Continually search...” The majority of the respondents, 53%, do express the need for some level of continual usage through a search engine.

7. **Are search engines effective for searching for the same topic or related topics over multiple sessions:** (a) *Yes;* (b) *It could be improved;* (c) *No;* (d) *I don't search for the same type of information more than once*

Based on the survey results, 65% of the respondents answered that the effectiveness of search engines to continue ongoing search activity about a topic or related topics “(b) could be improved.” 24% of the respondents felt that search engines were effective at continued use over multiple sessions.

8. **When information is found within a search engine, would having the ability to save or bookmark the information within the search engine platform be more advantageous than saving to third party platforms:** (a) *Yes;* (b) *No;* (c) *I don't ever save found information*

Based on the survey results, 71% of the respondents answered that, “(a) Yes” the ability of search engines to save or bookmark found information

would be advantageous to their search activity. Only 18% of the respondents answered that, “(b) No” the experience would not be improved with the saving or bookmarking functionality and 11% voted that “(c) I don’t ever save found information.” These findings show that increasing the ability to save and bookmark found information would improve the experience for the majority of the respondents.

9. **When searching for the same or related topics over multiple sessions, would it be advantageous for the search platform to continually present fresh content that is related to your topic: (a) Yes; (b) No; (c) I don’t search for the same type of information more than once**

Based on the survey results, 71% of the respondents answered, “(a) Yes,” it would be advantageous for search engines to continually present fresh content related to your topic. This conclusively shows that the majority of the respondents would benefit from improved functionality of current search engines.

10. **When information is found when searching, would it be advantageous to have the ability to add notes to your bookmarked or saved information: (The notes might included: reasons why the information was saved or personal thoughts about the saved information: (a) Yes; (b) No; I don’t ever save found information**

Based on the survey results, 82% of the respondents answered, “(a) Yes,” it would be advantageous to have the ability to add notes to bookmarked or saved information. This conclusively shows that the majority of

respondents would benefit from improved functionality of current search engines.

The information gained from this survey support the viability of the ARIE to improve individual's UE of online research. Based on the results, the functionality of search engines should be reevaluated in order to improve the deficiencies discussed in the survey. The conclusions gained from the survey include (a) search engines are easy to use; (b) search engines do fulfill the individual's need to source information; (c) although search engines are easy to use, they almost always require multiple search query attempts to find the correct information; (d) consumer related or ad cloud search results for most individuals, even individuals searching for consumer related information; (e) the types of information most individuals are searching are consistent, with no specific interest preferred; (f) an information query conducted through a search engine over multiple sessions could be improved (g) The majority of individuals do express the need for the search experience to support continual search activity; (h) the ability to save and bookmark information within a search engine is desired and would improve the search experience; (i) the ability of a search engine to continually provide fresh content about a topic is desired and would improve the search experience; (j) the ability to add notes to saved and bookmarked content is desired and would improve the search experience.

The results of this survey also support the attributes to conduct the quality of research as described in the "Evaluation of Online Platforms" subsection. These attributes include (a) the individual's ability to search all Internet content from within the platform; (b) the individual's ability to aggregate content from the Internet; (c) the individual's ability to save web sources and computer files; (d) the individual's ability to organize

saved content; (e) the individual's ability to review saved content; (f) the individual's ability to create general notes; (g) the individual's ability to annotate saved content.

Target Audience

Like search engines, the target audience for the ARIE encompasses a wide demographic. A recent report found that individuals who use search engines range from ages 18 to 65+ years old (Eberhart, 2013). A core objective of the ARIE is to aid any individual who wants to conduct research online, as defined in this Thesis, on any topic they choose—as long as they have access to the Internet. Further research and development will provide a better determination of the viability the ARIE for more specific demographics.

V. METHODS

An interface design wireframe was created to maximize the effectiveness of research and Ideation. The process of developing the ARIE's interface design was a product of the information gained from the Preliminary Research chapter of this Thesis. The Observations chapter also provided firsthand experience with the challenges of conducting online research. Concurrent Ideation throughout the production of the Preliminary Research and Observations chapters produced many ideas that ultimately gave way to the final design direction of the ARIE.

The Design Process of the ARIE Interface

When designing the ARIE it is imperative that each element of the design supports the overall desired experience. The UID and UXD should instantly communicate the purpose of the online platform, confirming to the individual that the online platform aligns with their own goals (Anderson, McRee, Wilson, 2010, p. 27). The individual's benefit of the online platform should be immediately communicated (Dirksen, 2012, p.219). The usefulness and subsequent adoption of a new online platforms is a result of effective UID and UXD to create a successful UE. Based on the Technology Acceptance Model, if a new platform is to be adopted by the individual it should be perceived as useful and usable (p. 220). Krug (2006) also stresses the importance of creating a simple and obvious interface. He stated that, “[The individual] should be able to ‘get it’—what it is and how to use it—without expending any effort thinking about it” (p. 11). Acceptance of the online platform can be gained by designing the UID and UXD in a way that easily communicates its purpose.

The level of intuitiveness and appropriateness of a design are based on the

individual's previous experience with similar online platforms or functions (J. Johnson, 2010, p. 1, 122–124). Evaluation of these online platforms is a necessary way to glean design perspective from highly adopted conventions. The design of a new online platform should benchmark against current standards or it will be perceived as inferior. According to Anderson, McRee & Wilson (2012), "If the visual design belies the modern capabilities of the product, individuals will tend to trust it less and have a more fretful experience using it" (p. 27).

The design process of the ARIE interface can be separated into two progressions of thought: the first interface design solution and the final interface design solution. The developments of these two design solutions are documented below.

The First Interface Design Solution

The first interface design solution focused on heightening the researcher's perspective of their research process. By enabling the individual to better visualize their process, the solution would make it easier to assess and plan subsequent researching actions. The individual's process would originate at one visual point on the screen, the starting point of the idea, and be built out linearly as new thoughts emerged, as shown in Figure 1.



Figure 5. ARIE – Design Layout for the First Interface Design Solution. This is a visual layout created during the first interface design solution. This shows how an individual would build their ideas through the use of connecting nodes. Each node would be representative of an idea or thought. Together they encompass the full progression of a project throughout the research process.

By enabling and an overall review of thought progressions, the platform design would make it easier for the individual to move through ideas and develop solutions. Like the commonplace book, this would allow the information to remain on the surface and not become buried. Correspondingly, repeated exposure to previously documented information would keep ideas circulating and tangential thoughts evolving, gradually progressing ideas.

The functionality of this solution enabled the individual to input data and

information in a mind-mapping interface. As the individual began developing thoughts, sequential nodes would be created and linked together, like breadcrumbs originating back to the original node. Each node would have the ability to store data that was saved to the platform. This included but was not limited to: notes, computer files, and web page bookmarks. As new tangential ideas broke from the previous line of thought, a branch—or fork—could be created. A new string of nodes could be created from the original node if a new area of interest needed to be explored; eventually a network of tree like structures would flare out from the original node.

After this first interface solution was created, a short hiatus from the design process took place. During this break, further UID and UXD research spawned new ideas about the first design solution. The hiatus also allowed for a more critical evaluation of the initial direction. After reengaging with the design process, it became evident that a change in design direction was required. It was observed that while consistently working within the interface, with relatively short breaks in between each session, the growing structure could be easily committed to memory. By way of building the structure piece by piece, the structural logic was easily decipherable to the individual. Each time new structural relationships were created or revised, changes were easy to implement based on learned knowledge of the greater context. This could be likened to an architect creating architectural plans. By designing the structure through continuous production, the location of each element could be committed to memory. However, after some time passes and no development of the plans structure have occurred, the ability to begin work again and remember each detail would be reduced. The same issue became evident with the first interface design solution. After further critical review, four overall issues were

observed: (a) the familiarity of the structure and corresponding information had diminished during a hiatus from the information, creating confusion when trying to reassess the information; (b) the overall sizing of the nodes and text, made it difficult to discern the significance of each node, as depicted in Figure 1; (c) the limitations in screen size made it difficult to view the entire structure.

The observations made after the first interface design solution proved to be very valuable, initiating a new Ideation about the interface design of the ARIE. These issues also prompted further contemplation about the goals of the individual and how to better design an appropriate environment.

The first interface design solution focused on visualizing the individual's researcher process and not the process of research. The final interface design solution is oriented around the fundamental aspects of research, as defined in this Thesis, and the type of environment that would produce the enhanced Ideation. The goals of the online platform changed from process-oriented to a holistic research driven platform that fosters Ideation, with the potential side effect of promoting creative outcomes. The new goals required a completely different set of functionality requirements and a new UID and UXD direction.

The Final Interface Design Solution

After a critical review of the first interface design solution revealed major UID and UXD challenges, it was decided that a new design approach needed to be conceived. The first interface design solution did not properly address the issues outlined in the Preliminary Research and Observations chapters. Furthermore, Ideation changed the direction of the platform design. This new UE would function differently than the first

interface design solution, therefore would require a unique UID and UXD. Additionally, exposure to a wide variety of online aggregators provided inspiration for the final interface design solution.

The final interface design solution focuses on improving the facilitation of the individual's research objectives and creating a more effective research experience. The attributes that should be included within the design and functionality of the online research platform, previously stated in the Observations chapter, were used to benchmark the final interface design solution. The primary functionality necessary to fulfill the minimal requirements of a holistic research platform are the abilities of the individual to (a) search for internet content; (b) save found sources; (c) organize saved sources; (d) review saved sources; (e) annotate saved sources; (f) create general notes. Using the online platform, the individual will begin a search much like a search engine. Query results will then be retrieved, displayed, and subsequently reviewed by the individual, but that is where the similarities between the ARIE and search engines end. Within the ARIE, found content can be saved and later retrieved for further evaluation. Additionally, annotations can be made on specific content or as general notes. By enabling the individual to actively review and create notes within the ARIE the information can be easily organized, retrieved, and reviewed. Like the commonplace book discussed earlier, this helps keep thoughts and ideas on the surface, stimulating further inquiry and Ideation. As the individual's research progress continues, the ARIE will begin to find and display more information based on the individual's usage habits, saved data, and annotations. These actions will perpetuate the delivery of uniquely curated types of content that align with the current research path of the individual. The new content

choices displayed to the individual will be based on unique algorithms specially designed to maximize exposure to wide varieties of content. As stated in the Observations chapter, exposure to a diverse selection of content promotes creative connections between disparate information. The ongoing research process is continually influenced by both the individual's actions and the content curated by the ARIE. The ARIE will proactively and reactively lead the individual through content that aligns with their topic, careful not to constrict the range of information. The continuous stream of content stimulation will intensify the opportunity for content discovery. Allowing the ARIE to have varying degrees of control over the search process will aid the individual in breaking free from their own biases towards the topic, a defining attribute, stated in the Observations chapter. Correspondingly, the individual can experience a completely unique journey through content exploration by relinquishing some control. This culmination of all functions within the ARIE is intended to increase the probability of serendipitous findings and unique connections that could significantly influence the overall research and enhance Ideation.

To enable maximum usability, the ARIE's interface layout was broken down into three distinct areas (a) a top area where navigation, major platform functions, and account information are displayed; (b) a sidebar area placed along the left vertical edge of the layout, where generated feedback from the individual can be input and platform-generated feedback can be displayed; c) the main content review area (MCRA) of the platform, where the individual will review content. The location of each area is supported by Nielsen's (2006) study of the "F" shaped eye movements of individuals on the websites. It is necessary to partition and organize the layout because a well-defined visual

hierarchy allows the individual to focus their attention on each distinct area at a time, which breaks down the complex process of content review into manageable actions (Anderson, McRee, Wilson, 2010, p. 30). A consistent and appropriate organization of information also helps the individual anticipate the distribution of new content, promoting positive successive actions (U.S. Dept. of Health and Human Services, 2006). The structure of research platform layout is consistent, organized, and defined through visual hierarchy.

One of the challenges with the ARIE is that the complexity of information and functions could easily overwhelm the individual. The intended high usage by the individual increases this concern. To address this challenge, the overall aesthetic was modestly designed, to bolster a high level of usability. Without a well thought out and designed digital environment, the individual would begin to focus heavily on using the online platform, taking away from the intended UE (Anderson, McRee, Wilson, 2010, p. 22-23). Ensuing usage of the ARIE would become taxing instead of enjoyable and disorder would create a feeling of anxiety resulting in discontinued use.

The MCRA showcases the search query results that the individual will continually review (see figure 2 & 3).

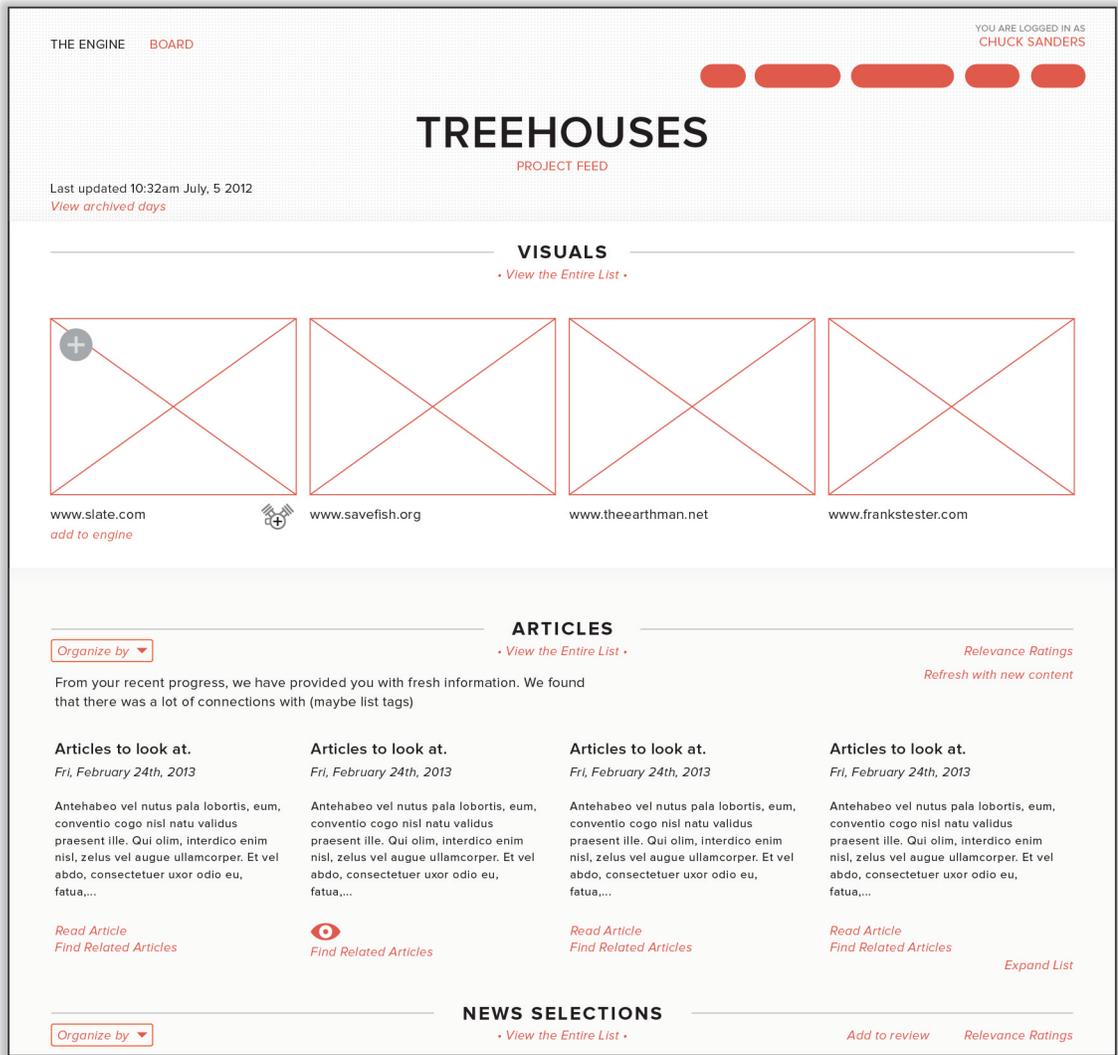


Figure 6. ARIE – Preliminary Layout of the Final Interface Design Solution. This is a preliminary design produced during development of the final interface design aesthetic as showcased in Figures 3, 4, 5, 6 & 7.

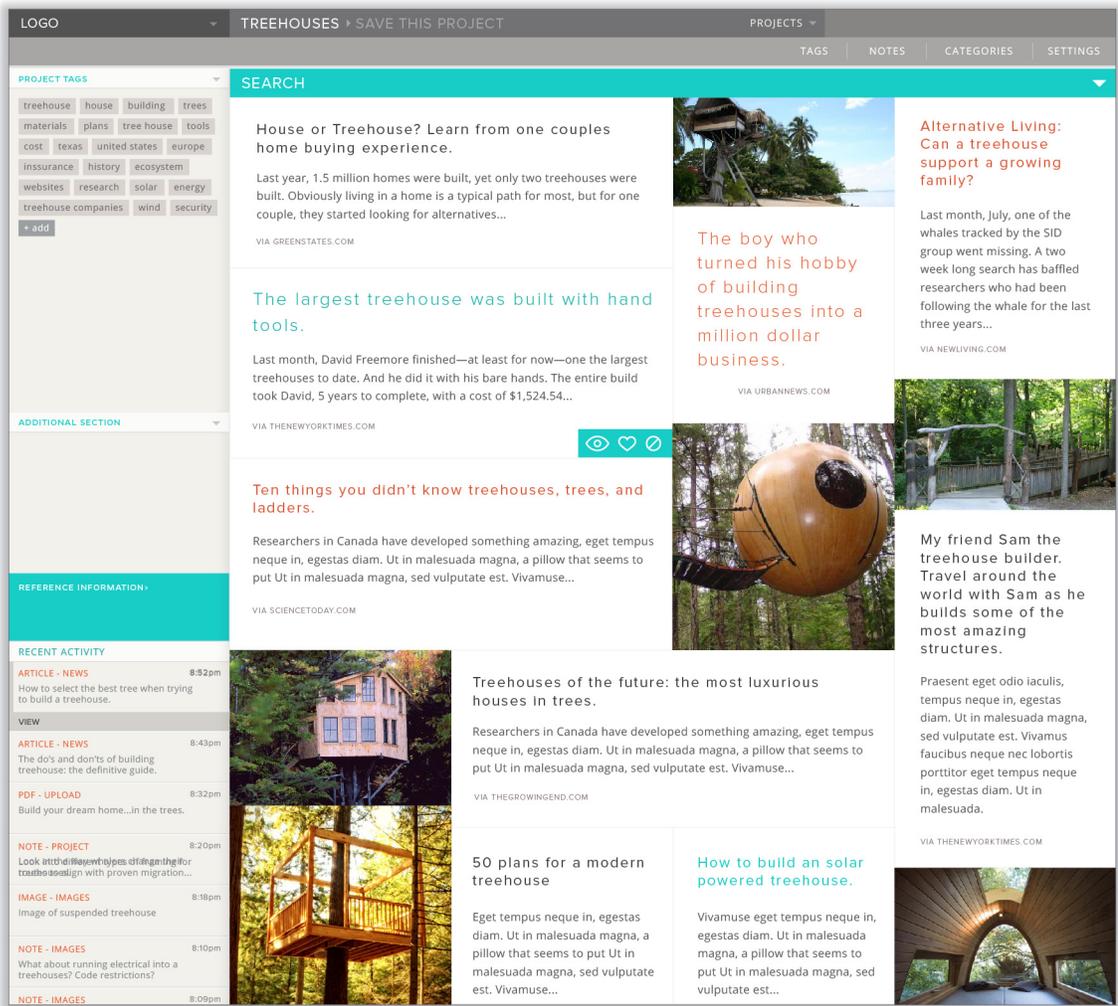


Figure 7. ARIE – Layout of the Review Area in the Final Interface Design Solution. The MCRA enables the individual to quickly scan through various types of content that align with their search query.

The MCRA layout has a flexible grid structure to allow for different types and lengths of content to be easily updated and populated into the ARIE while conforming to the overall visual style. Although each piece of retrieved content exists on the Internet in its own visual design style, it is recontextualized and displayed in the established aesthetic style and hierarchy of the ARIE. The use of a grid is also crucial in dynamic digital environments where the individual is expected to review vast amounts of content.

According to Lynch and Horton (2011), “The design grids that underlie most well-designed paper publications are equally necessary in designing electronic documents and online publications, where the spatial relations among on-screen elements are constantly shifting in response to the individual’s input and platform activity” (para. 1). Consistency and structure allow the individual to visually manage information within a layout resulting in an increased readability of content (Ponton, 2008; Krug, 2006). Moreover, the grid will allow individuals to anticipate the location of newly presented pieces of information. The display of each piece of textual content within the MCRA will be an abbreviated snapshot of the original source. Enabling the ability to quickly scan through abbreviated information to find selections that align with their own interests is a common practice among news and content aggregation sites. Once the individual chooses a selection from the MCRA, the content will be displayed in its full entirety.

The MCRA will also be used to evaluate individual pieces of content. In this view, annotation tools will be displayed (see Figures 3, 4, & 5). Annotations can be documented within the ARIE, rather than using other online platforms or the traditional pen and paper. The benefit is that all of the information lives together, can be organized, and synthesized in different ways. The logged information can also be used by the ARIE to aid in curating more search selections for the individual. Once the content is evaluated, the individual can return back to the MCRA and repeat this process.

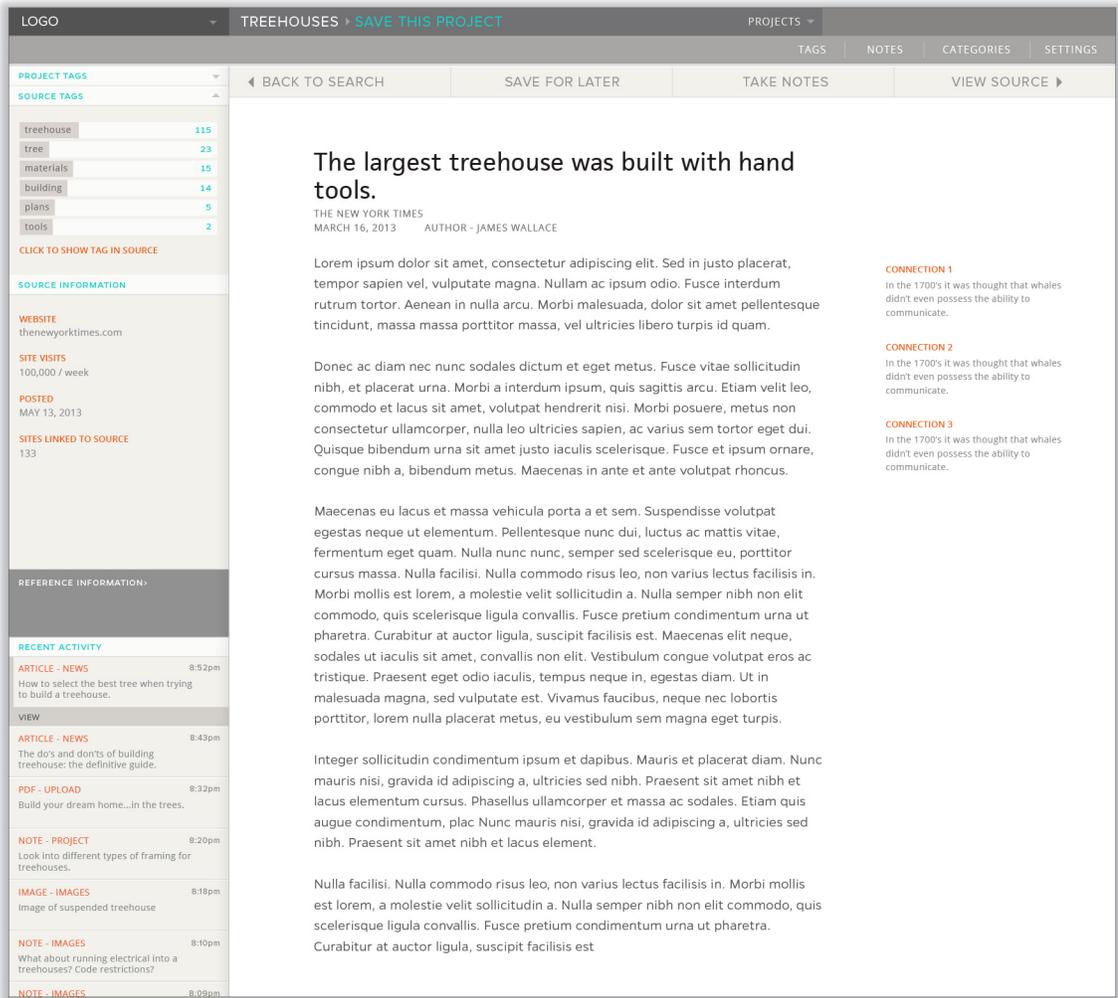


Figure 8. ARIE – Layout of Isolated Content in Review Mode in the Final Interface Design Solution. This showcases the layout of an isolated piece of content after the individual selects the content from the MCRA. This view allows the individual to quickly review the information as well as refer to the side panel for additional information.

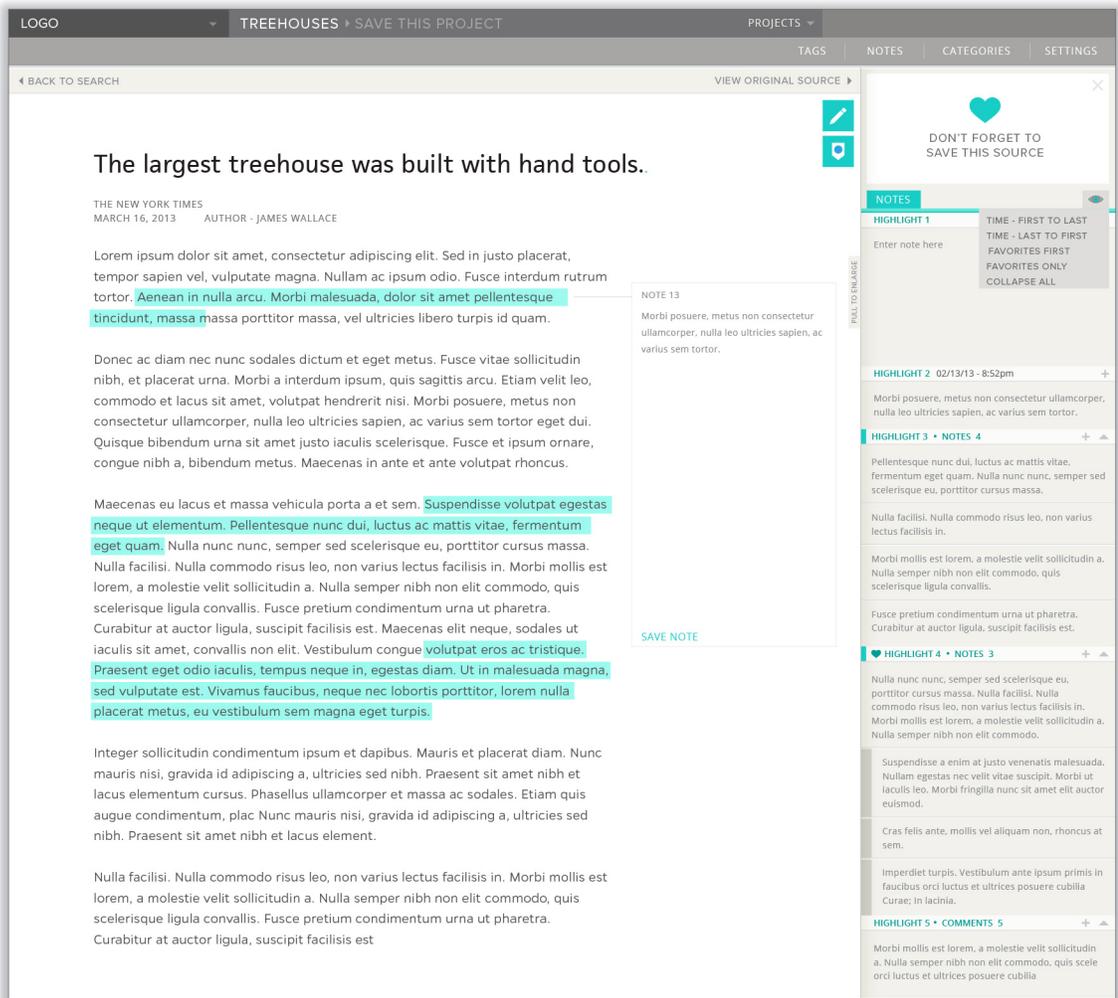


Figure 9. ARIE – Layout of Isolated Content in Annotation Mode in the Final Interface Design Solution. This showcases the layout of an isolated piece of saved content that the individual can evaluate and annotate. The sidebar on the right showcases a quick reference of all annotation activity. The sidebar can be expanded to provide the individual with a more engaging annotation experience.

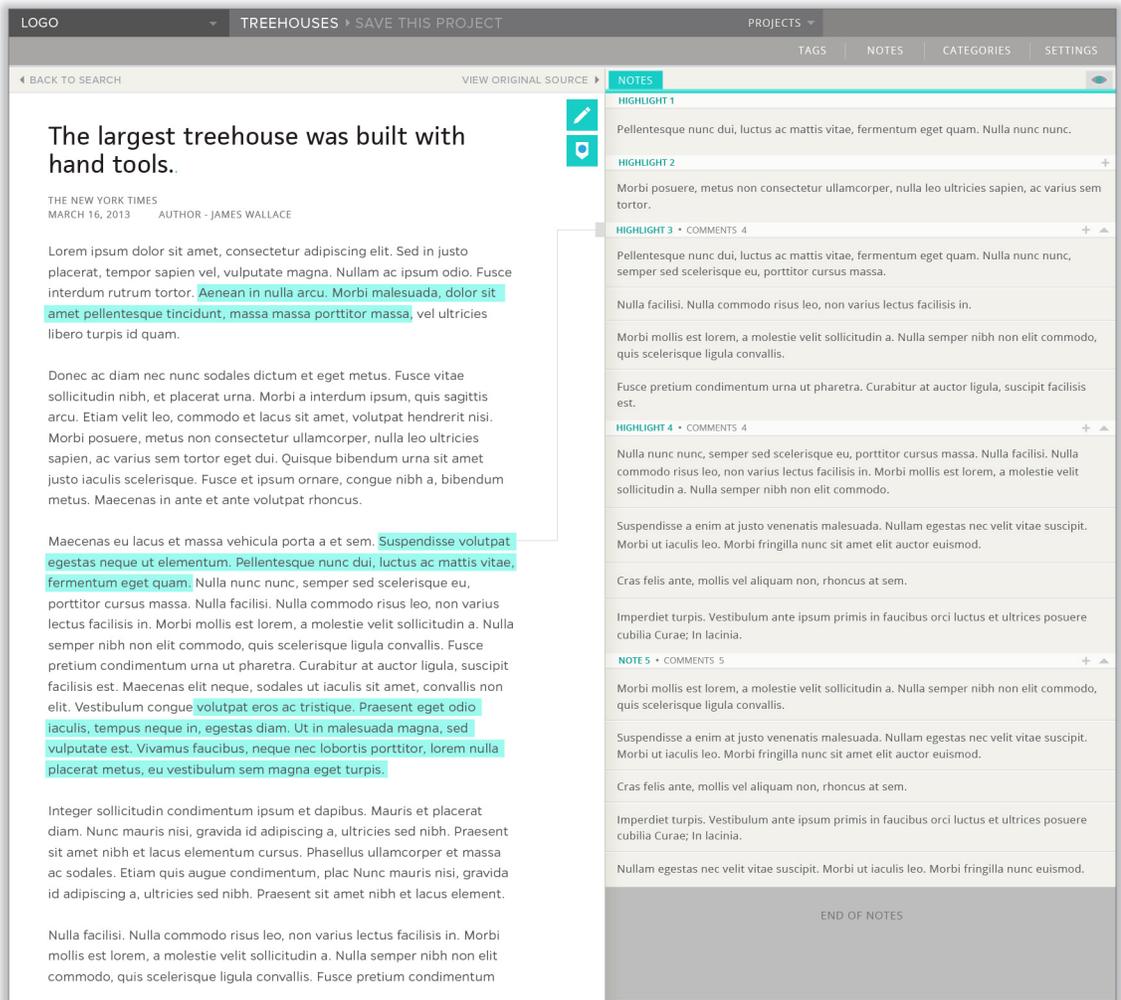


Figure 10. ARIE – Additional Layout of Isolated Content in Annotation Mode in the Final Interface Design Solution. This showcases the layout of an isolated piece of saved content that the individual can evaluate and annotate. The sidebar on the right has been expanded to provide the individual with a more engaging annotation experience.

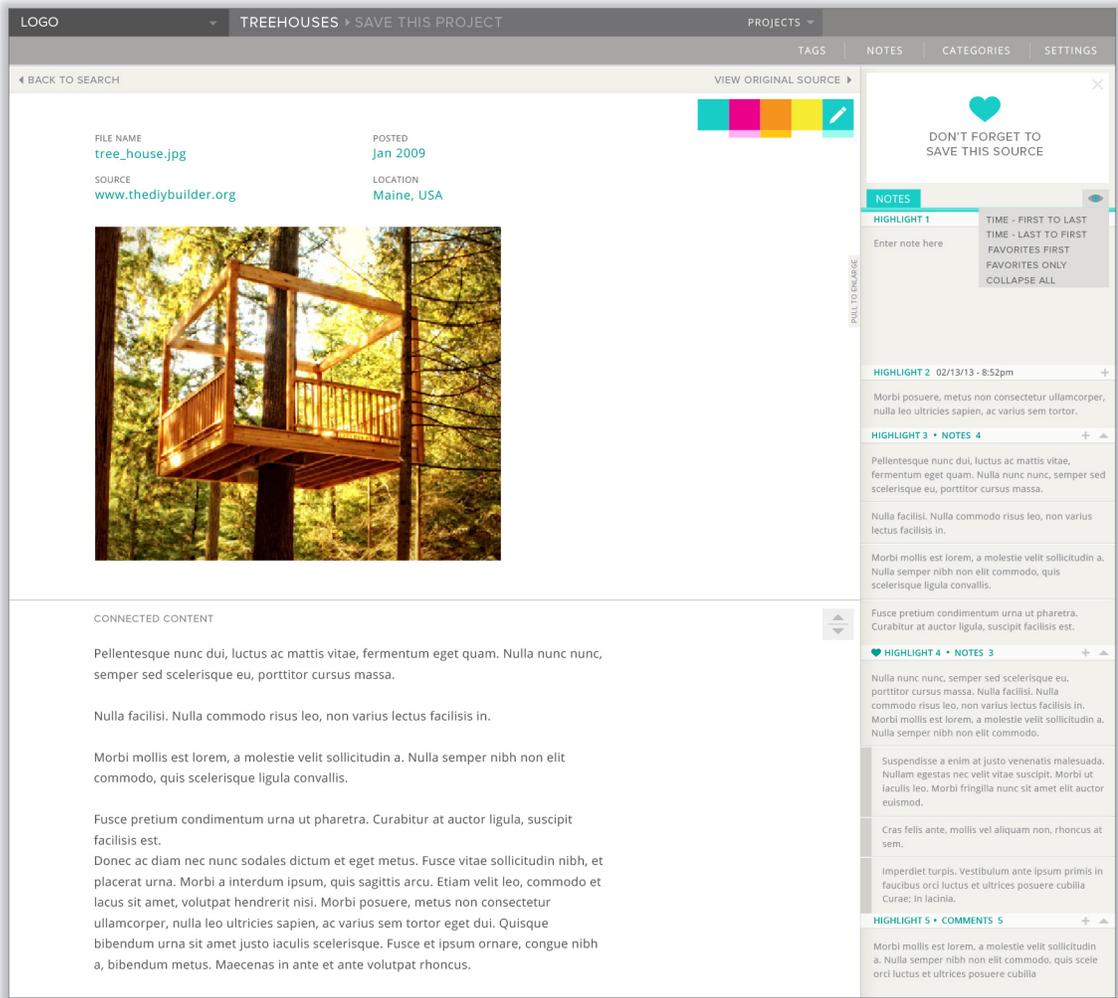


Figure 11. ARIE – Additional Layout of Isolated Content in Annotation Mode in the Final Interface Design Solution. This showcases the layout of a saved image that the individual can evaluate and annotate. The sidebar on the right showcases a quick reference of all annotation activity. The sidebar can be expanded to provide the individual with a more engaging annotation experience.

The design and functionality of the final interface design solution address all current online research issues documented in the Preliminary Research chapter and attributes required for a research-driven platform as described in the Observations section. Once all parts of the ARIE interface design are finalized, a functional prototype can be developed. The prototype can then be testing on a group of individuals to capture feedback on their

ability to effectively use the ARIE interface design. Subsequent evaluation of the gathered feedback can then be used to make necessary improvements.

The Back End Functionality

A large portion of the ARIE's functionality relies on the use of custom algorithms to shape the individual's exposure to data. While many search engines filter out information that does not exactly match the individual's query, narrowing results by obscuring less relational data, the ARIE will be designed with flexibility in mind. The query results will include content that matches the inquiry and also variably contrasting types of content that could expand researching opportunities. This process will continue throughout the duration of the individual's search process. The continuation of increased perspective will allow for further exploration opportunities and also increase the probability of unique connections between information and ideas, enhancing Ideation.

VI. CONCLUSIONS

Research is a process of seeking, collecting, and evaluating information to build new knowledge in order to generate conclusions to facilitate Ideation. The research presented in this Thesis identifies reasons why existing online platforms are deficient in facilitating necessary research functions. This Thesis also identifies extrinsic methods to promote Ideation abilities, enabling the possibility for better outcomes. A uniquely designed digital environment should be created with the sole purpose of managing research and maximizing the Ideation of the individual. By providing a central location to seek, collect and, evaluate content, while also enhancing these functions, the management of research can exceed any current online platform or combination of online platforms.

A properly designed digital environment should expose individuals to information outside their own distinct information seeking behavior. Exposure to a targeted and diverse flow of content will also increase the chances of making serendipitous findings. The gained perspective about an inquiry will enhance the individual's ability to creatively synthesize unique conclusions. Fostering more creative and unique Ideation can also promote overall intellectual growth.

Although the act of research has always been perceived as an academic or industry function, it is a process that can facilitate the act of gaining knowledge to resolve an inquiry. The applications for this type of online platform could have a great impact on society at large, aiding in innovative Ideation for academic, professional and personal projects.

Limitations of Research

The primary limitation of this research is that producing the ARIE, even in a

modest form, will require a substantial amount of funding to create a functional prototype. Moreover, coding the ARIE will require enlisting highly skilled developers. While the UID and UXD portion reached a promising interface design solution, the ARIE cannot be fully tested until a functional prototype is developed. Consequently, gaining any beneficial testing data is impossible to amass until a functional prototype is created.

Although testing was restricted, the research findings paired with ongoing observations were able to aid in the development of the UID and UXD of the ARIE. Future research and development will provide more perspective on the final interface design solution and online platform functionality of the ARIE.

Implications of Research

The conception of this Thesis and the following research were produced with the intent to create a better research experience. Although this Thesis is only the beginning of a much larger scope of product development, the ARIE has the potential to revolutionize the way research is conducted and ideas are formed. From a laymen thinker, to an industry professional, to a doctoral candidate, all can benefit from a better way to discover and engage with information. The research in this Thesis supports the concept that the ARIE can be created and perform as theorized. Producing a functioning prototype is the next step to validate this concept.

Future Research

The Preliminary Research, Observations, and Methods chapters exhibited in this Thesis are the beginnings of continued research and development. The ARIE can have a dramatic effect on academia and industry, as well as provide a powerful online platform for society at large.

As a result of the research and development of the ARIE, new questions have surfaced. To enhance functionality and push this idea to new heights, the following questions and initiatives have emerged:

- The development of a working prototype is the next step in the development of the ARIE. To build a prototype, skilled web developers will be required to take the proposed interface design to a functioning platform. Additionally, a significant amount of funding will be needed in order to create a prototype.
- To provide individuals with the most effective research platform, a functional prototype will need to be developed in order to conduct testing of the ARIE's UID and UXD. By testing the prototype on individuals, more insight can be gained in order to provide individuals with the best research experience.
- To become a commercially viable platform, how can the ARIE be monetized?
- Can the ARIE function, in some capacity, on tablet and mobile devices?
- Can the ARIE become highly customizable to create a more individualized research experience?

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