

**Gaming Development as A Sociotechnical System: Guiding Designer Behavior to Influence
the Transitioning Sociotechnical Landscape**

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On my honor as a University Student, I have neither given nor received unauthorized aid on this
assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction: Mobile Gaming is an Emerging Technology

There has been an exponential growth in the availability and commodification of gaming and mobile technologies within the past couple of decades. With this has grown plenty of gaming industry gurus across the various platforms available for online, console, and mobile gaming. An arsenal of casual mobile games is available to consumers of various cultural backgrounds, ages, demographics, and technical abilities. There are a plethora of both obvious and adverse design inconsistencies ranging from stylistic differences to disparity between the functionality of various user interactions. Touch screens, and the populated availability of other usable game technologies, have introduced an influx of gamification strategies and techniques by various industries that target the loyalty and attention of the masses. Gamification and its threats to an individual's perceived realities is a genius way to employ control over and remove agency from users. With games infiltrating their way into the majority of what used to be "free-time" as well as other realms such as rehabilitation and education. In 2016, "Gaming Disorder" (GD) was included in the 11th revision of the World Health Organization's International Classification of Diseases (Kamenetz, 2019). This being said, some scholars argue that the Internet's capacity for connecting people across time and space fosters the formation of social networks and personal communities (Wellman & Gullia, 1999). Acknowledging gaming communities as a subculture and tailoring decisions to the needs of all stakeholders is an opportunity for a collaborative environment rather than a destructive one. Within gaming exists a diverse population of communities who, if considered effectively in the design and implementation of gaming systems, have the potential to be brought together despite age, race, class, or other demographics.

There are gaming frameworks and usability guidelines in existence to enhance designers' self-regulation to control content. Design systems are being developed and used increasingly in

the field of user interface/user experience (UI/UX) design to facilitate the development of products, such as websites and apps. Indeed, many large companies have developed design systems which are not “one size fits all,” but offer insights into the orientation of an organization. Such design systems characterize the purpose and shared values of a product with groups of designers who often work semi-independently (Hacq, 2018). However, it is still unclear how to balance the addictive nature of gaming with the games’ ability to enhance social presence. In this paper, I argue that design systems can be integrated as sociotechnical systems, in light of the lack of regulation to mitigate negative social and cognitive implications. This research will look at Corporate Social Responsibility and its implications in the gaming industry (Servera-Francés & Piqueras-Tomás, 2019) and collates concerns that media and gaming pose threats to civic and social institutions in comparison to arguments supporting the benefit of gaming to improve socio-cultural ethical implications (Steinkuehler & Williams, 2006). To craft a path that balances creativity and standardization, I will investigate the function of design systems to incorporate socio-cultural elements relevant to game design. Unpacking the social construction of technology and a Multi-Level Perspective for socio-technical transitions (Geels,2011) will guide a framework that structures game design as a socio-technical system to guide the social transition which is fostered by the decisions made by part of niche actors to affect the existing sociotechnical regime.

Encouraging niche dynamics that facilitate transformations at the regime level can pave the way for sociotechnical change. MLP can be applied to gaming systems to form a cohesive environment where stakeholders from all regimes are considered. The technological shift to mobile accessibility can be modeled with the MLP to highlight dynamics between designers, businesses, and consumers such that the well-being of members of society is upheld. A flexible

design system can guide the shift and will provide an opportunity for designers to preserve creative autonomy as well as be in touch with niche behaviors of other regimes that make up the landscape of a gaming sociotechnical system. Implementation of a flexible design framework that enforces standardization while enhancing creativity will reflect positively in society. These insurances and frameworks guide a symbiotic relationship between and amongst sociotechnical levels. in which gaming technology thrives throughout the cyclical nature of the socio-technical regime as well influences the broader context of mobile gaming as received by society.

Problem Definition: Emerging Gaming Technology Poses a Threat to Social Cognition

Mobile and video gaming have become a vehicle for entertainment in pastimes, hobbies, sources of income, and spaces for familiar or intense competition. The immediate availability of virtual entertainment has indeed amplified everyday personal and interpersonal life efficiency but has also led to the premature introduction of the vacuum of mobile and online gaming to children in their most influential and foundational years. Although technologically assisted learning practices have proven to be beneficial in improving self-esteem amongst disabled users, computer, console and mobile games have catalyzed social isolation as these technologies are integrated into the mental framework of learning (Clements, 2002). From isolation stems boredom and the growing natural tendency to revert to the comfort of a screen. Addiction is an impulse stemming from the loss of both control and limitation of a given source of dopamine and adrenaline to the brain (Shoukat, 2019). Increases in socially legitimizing gaming as leisure behavior encourages prolific use of video or mobile games and perpetuates the reliance on the feeling a game provides. Abstaining from these methods of temporary “euphoric” experiences

leads to various negative emotional states such as anxiety due to lack of necessary stimulus to the areas of the brain which control the perception of self and behavior (Koob, 2010). This becomes dangerous because in-game behavior now becomes linked to external reality, thus distorting individual perceptions and devaluing society as a whole.

Money is the root of Corporate Neglect

The various functional swim lanes of the gaming industry are not blind to the predisposition of gaming users to the addictive nature of their products. From the design to integration and development, engagement strategies are employed to ensure maximum user retainment (Dickey, 2005). As mobile device usage and gaming become increasingly available and integral to an everyday routine, various strategies have been employed to commodify users' gaming experiences. Online and mobile gaming production strategies take into consideration various personality traits and psychological tendencies to most effectively develop and maintain the attention of mobile and online gaming users (Mehroof, 2010). The mobile gaming industry's total revenue in 2020 was 77 billion USD (*Video Game Industry - Statistics & Facts*, 2021). Gaming is a growing multi-billion-dollar industry with a populous customer base, diverse in all demographics. The tailored concern and consideration for the well-being and satisfaction of the consumers become overshadowed by the mass profit benefits that the game companies reap. In-game experiences are further commodified by purchasing systems that employ tactics that incentivize users' spending by capitalizing off of informational advantages and data manipulation. This leads to difficulties in users' ability to delay gratification and an increase in their vulnerability to overspending especially since many offers are designed to provide immediate benefit (King et al., 2019). Consumers need effective protection against these tactics targeting their cognition. The development of "brain-games" has created a cognitive correlation

between the repetitive, monotonic user interactions performed in these games and the perception of received satisfaction and true happiness (Green, 2015). Consistently falling victim to psychologically dangerous digital situations can translate the associated feeling and behavior to other, non-related situations. The effectiveness of techno-economic developments surrounding player strategy is amplified each time interaction with the technology occurs. This escalation eventually leads to a deeply personal relationship between users and their mobile or gaming devices. There are few public policies in place that aim to lessen the strength of the grip that gaming developers and designers may have on users. Still, various usability and user experience principles are often used to draw and maintain the attention, desire, and money of consumers (Fiejoo, 2012). Without appropriate structure through the process of a game's design, users will still fall vulnerable to unethical practices, both intentional and unintentional, of game designers and businesses.

Existing Design Guidelines are not sufficient for Consumer Protection

User experience guidelines promote usability and consistency within and amongst designs of interfaces. Usability focuses on maximizing the effectiveness, efficiency, and satisfaction of users and is an integral part of game and software production. Mobile device manufacturers have been enforcing usability constraints on aspects of design such as touch gestures, size and location of icons and buttons, device orientation and size, simplicity, and format of text (Desharnais et al., 2012). These documentations of standards and principles are unique to each brand and are referred to as design systems. They exist to guide standardized and compatible aesthetics and interactions among interfaces. Due to their often-rigid requirements on structure and uniformity, traditional design systems can discourage flexibility, creativity, and customization. Thus, highly innovative designers may opt to forgo the use of a design system to

preserve their creative autonomy. Along those lines, however, when creativity is prioritized over standardization, designers may lose focus on how their artistic nuances fit into a coherent holistically designed product. In addition to restricting creativity, traditional design systems can be hard to implement with well-established products whose user base is growing and require frequent updates.

The development and implementation of applications in the mobile space should not only be functionally sound but also encourage user satisfaction such that designers can create material that is healthy and enjoyable for consumers. Game design still lacks a common framework to guide cohesiveness between designers and the attitude of consumers. This disharmony facilitates inconsistencies within and amongst game designs and ultimately impacts end-user experiences. It is important to reduce the potentially detrimental impact that these games have on individual cognition which provides a mutual benefit for the business faction of the gaming industry as well.

Methods: Multi-Level Perspective for Sociotechnical Systems

Geels (2011) investigates socio-technical transitions from a multi-level perspective (MLP). The MLP views transitions as results of interaction with developments at the micro, meso, and macro analytical levels. Micro-level houses technological niches which consist of niche actors who foster innovation within their dimension. These are the spaces in which actors perform development and improvement on the systems that exist in the sociotechnical regimes. Niche-innovation development is primarily driven by are the actors' ability to adapt to expectations, and to build social networks amongst themselves. At this level, innovation and new

ideas that test the status quo are developed and begin to gain momentum as mutual expectations are more broadly accepted within the level. The sociotechnical regime exists at a meso-level and serves as rules that govern and marry the attitudes of stakeholders associated with aspects of the technology as pertaining to a particular aspect of society. Science, technology, politics, user-preferences, and cultural meaning are the primary regimes through which systems and processes circumnavigate. Across regimes, linkages exist when the rules of different social groups are merged (Geels, 2004). This level encompasses the similarities and nuances of the rules that

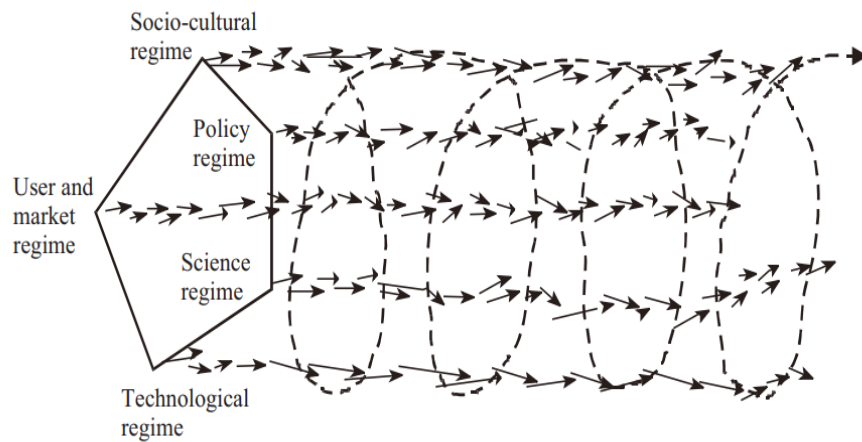


Fig. 1. Alignment of ongoing processes in a socio-technical regime.

govern the different sub-regimes. Figure 1 (Geels, 2011) illustrates the continuous dynamic of coordination that exists between the sub-regime environment.

Geels explains how the locus of established practices and associated rules that stabilize existing systems, that is the sociotechnical regime, can promote alignment between sub-regimes and provide additional stability to the system and stakeholders. Understanding the network of regimes guides cohesiveness as change is proposed to the systems as there is more wholesome governance over system operation and implementation. Climbing to the macro level of systems, the sociotechnical landscape is the overarching fabric through which the threads of socio-technical regimes flow. It is the social values, political ideologies, and societal dynamics of niches and regimes that make up the landscape or apparent reality of a system. Each level of the

system functions independently and collectively to allow effective analysis of structural changes in society.

Mobile Gaming as a Sociotechnical System

Geels argues that the structural divisions exist to differentiate scale relative to their impact on the degree of stability. It is important to remember that these levels are not independent of each other. Rather, they are influenced by the dynamics of levels below them. He notes that nice-actors should be aware of the rules in place for various regimes in the sociotechnical system such that the relationships can be fostered and implemented as the landscape is slow to change. Figure 2 illustrates these relationships as an iterative process through and amongst levels is achieve as society is guided through a transition. Integrating niche

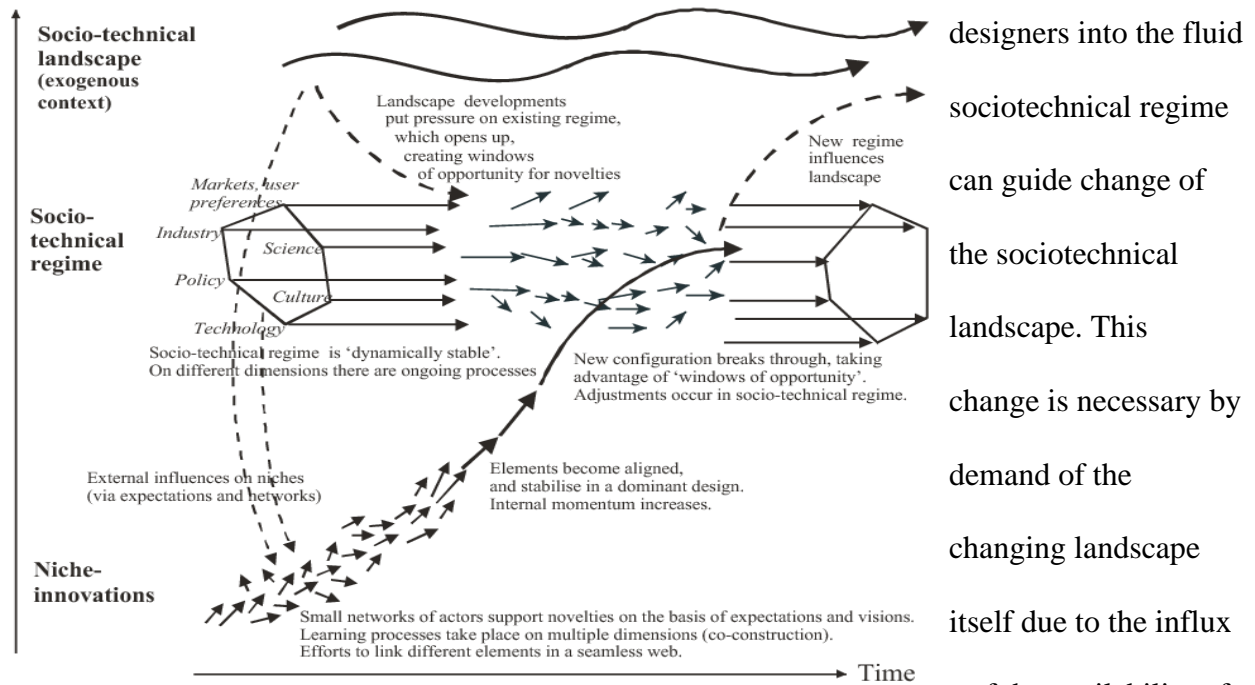


Figure 2 Illustration of affective relationship between micro, meso and macro levels of a sociotechnical system

designers into the fluid sociotechnical regime can guide change of the sociotechnical landscape. This change is necessary by demand of the changing landscape itself due to the influx of the availability of mobile gaming devices. The actions

of niche actors involved in the design and production of the technical product are integrated into

the sociotechnical regime. This integration fosters stability within the sociotechnical regime, which requires an intimate dynamic among existing systems. In application to this research, the current unregulated practices and user dangers call a need for actions to be taken by niche designers. Such actions must cater toward influencing the landscape, or emerging concerns relating to cognition and experience of gaming communities.

A global shift towards mobile device usage has paved the way for a boom in mobile gaming in particular. With these technologies emerging throughout factions of society and impacting societal behavior and attitudes, the model outlined by Geels highlights the need for a sociotechnical change. As society is increasingly impacted by a technology, the resulting shift in the behavior of that society will ultimately trigger necessary adjustment of that technology such that an appropriate transition is guided at the landscape level. The circuitous nature of processes and decisions as they exist in the socio-technical regime exemplifies the need for cohesiveness between designers, policymakers, and users of the technology. Game design inconsistencies and resulting cognitive and social implications are indicative of a fractured relationship between designers, policymakers and consumers within the sociotechnical regime.

Results: A Flexible Mobile Game Design Framework Will Guide Sociotechnical Change

As the sociotechnical landscape is affected by the dynamic of the actors and existing system, the nature of game design requires adjustment to ensure safe and effective transformation. The resulting design inconsistencies and usability issues can be mitigated with a multi-level perspective. The MLP supports this landscape transition as an opportunity for niche innovations. Such innovations require a flexible framework in which designers' agency is

protected, yet the dynamics at the niche level do not jeopardize the health or experience of the user. These actions taken at the niche level by game developers or business companies demand consideration of the game experience early in-game production processes as they dictate the flow of existing and emerging mobile gaming technology (Polack, 2017). There's no predicting with 100 percent certainty what will happen in a single game when you start it. It's all about the players, their style/strategy, and how they react to one another. If the result of the interactions at the most primary niche level is not consistent and diverse within the sociotechnical realm, the desired reward and affective environments will not be reflected in the in-game experience or the real-world implications of those experiences.

Applying the MLP to mobile gaming defines a need for a method to achieve a cohesive design system that integrates users, designers, and stakeholders affected by emerging mobile gaming technologies. It is important to discuss an intermediate step at the regime level that integrates actors such that game systems are effectively designed, implemented, and received. Addressing the predicament of preserving designer autonomy while enhancing user experience, I propose a method for which designers can tend to existing inconsistencies and prevent the introduction of even further inconsistencies in future product updates as the landscape of mobile gaming evolves. A criteria-based evaluation technique allows designers to create designs that incorporate elements of consistent, standardized practice, yet prioritize designers' creative freedom. This evaluation allows inconsistencies to be managed in a collaborative manner that promotes consensus-based decision-making in stages of design and evaluation. This approach will facilitate interaction between regimes and guide changes to be made to industry design systems. It is important to find a balance between creativity and standardization. As a result, consistency across game designs will be encouraged as mobile gaming technology progresses.

This regime shift and potential contribution to the sociotechnical landscape transformation as applied to mobile gaming platforms highlights the ability of an evaluation technique such as the one proposed to procure the desired responses and user experience. This effort to unite the sociotechnical regime will contribute to unpacking the direction and severity of causality between the socio-technical regime and the broader external landscape.

Niche technical and implementation decisions have the potential to benefit existing methods of gameplay and formative attitudes of such designs. Game development companies are responsible for evaluating how their core mechanics and systems are approached. It's important to discuss that both players and developers benefit from quality systems. Developers benefit through less rigid implementations of the core of their games. Corporate Social Responsibility (CSR) refers to actions taken by corporations with respect to the end-user experience in order to boost attitudes about their products. A core focus for CSR is the 'societal expectations of corporate behavior; a behavior that is alleged by a stakeholder to be expected by society or morally required and is therefore justifiably demanded of a business' ([Whetten et al. 2002](#)). Yet the way in which organizations choose to manage their stakeholder relationships in practice varies considerably, such that stakeholder engagement can represent different features and various theoretical perspectives. (Lindgreen & Swaen, 2010). Applying a sociotechnical perspective to game development will merge actors across regimes, thus more effectively catering to the needs and well-being of the consumer. Proposed actions taken by gaming industry companies to guide a flexible framework to harmonize designers and end-users can be seen as an act of Corporate Social Responsibility resulting in greater customer retention and, affectively, revenue (Servera-Francés & Piqueras-Tomás, 2019). Recognizing the impact of their technologies on the sociotechnical shift across the gaming context is equally important to the

profitability of the company, encouragement of designer autonomy, and maintenance of user experience. The vast connectivity that mobile games particularly have provided society has great potential for influencing a sociotechnical transition as described by the MLP if guided correctly by a self-regulatory framework tailored for design creativity and usability. Enforcing consistency amongst designs in a manner that allows designers to adhere to usability standards while providing unique gaming experiences for consumers will help mitigate unethical practices in the various regimes of mobile gaming as a sociotechnical system.

Conclusion: Mobile Game Designers have the Potential to Foster Social Cohesiveness

In spite of dangerous cognitive effects and inconsistent game design, mobile gaming has the potential to foster social cohesiveness. It is important to take into account the niche actors that play a role in the growing gaming community. In order to do so, actors at the niche level must take the appropriate steps to affect the sociotechnical regime in a manner that supports the development of the societal shift. Affecting the gaming communities' experience will require extensive enforcement of the integration of designer agency into the process of game development. Implementation of a flexible design system may prove difficult with regard to the diverse nature of creativity and gaming. This preservation of creative autonomy inherently requires grand detail amid decisions regarding the customizable design standards. Decisions made on behalf of design teams ultimately affect a game's realization and how it is cognitively received by end-users and impacts the landscape as a whole. Strictly a technical approach to adjusting the manner in which games are designed and implemented will not suffice. Proper training and quality assurance may be the next step in applying the work described and

enlightened by the research in this paper. Adequately employing niche actors with an understanding of the influence their actions have on a transitioning system may better encourage consideration of the cognition and attitudes of the communities that make up the sociotechnical landscape.

References

- Clements, D., & Sarama, J. (2002). The Role of Technology in Early Childhood Learning. *Teaching Children Mathematics*, 8.
- Desharnais, J.-M., Abran, A., & Nayebi, F. (2012). The State of the Art of Mobile Application Usability Evaluation. Article in Canadian Conference on Electrical and Computer Engineering. <https://doi.org/10.1109/CCECE.2012.6334930>
- Dickey, M. D. (2005). Engaging by design: How engagement strategies in popular computer and video games can inform instructional design. *Educational Technology Research and Development*, 53(2), 67–83. <https://doi.org/10.1007/bf02504866>
- Geels, F. W. (2004). From sectoral systems of innovation to socio-technical systems. *Research Policy*, 33(6-7), 897–920. <https://doi.org/10.1016/j.respol.2004.01.015>
- Geels, F. W. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions*, 1(1), 24–40. <https://doi.org/10.1016/j.eist.2011.02.002>
- Green, C. S., & Seitz, A. R. (2015). The Impacts of Video Games on Cognition (and How the Government Can Guide the Industry). *Policy Insights from the Behavioral and Brain Sciences*, 2(1), 101–110. <https://doi.org/10.1177/2372732215601121>

Hacq, A. (2018, May 22). *Everything you need to know about Design Systems*. UX Collective; UX Collective. <https://uxdesign.cc/everything-you-need-to-know-about-design-systems-54b109851969>

Kamenetz, A. (2019). NPR Choice page. Npr.org. <https://www.npr.org/2019/05/28/727585904/is-gaming-disorder-an-illness-the-who-says-yes-adding-it-to-its-list-of-diseases>

King, D. L., Delfabbro, P. H., Gainsbury, S. M., Dreier, M., Greer, N., & Billieux, J. (2019). Unfair play? Video games as exploitative monetized services: An examination of game patents from a consumer protection perspective. *Computers in Human Behavior*, 101, 131–143. <https://doi.org/10.1016/j.chb.2019.07.017>

Lindgreen, A., & Swaen, V. (2010). Corporate Social Responsibility. *International Journal of Management Reviews*, 12(1), 1–7. <https://doi.org/10.1111/j.1468-2370.2009.00277.x>

Mehroof, M., & Griffiths, M. D. (2010). Online Gaming Addiction: The Role of Sensation Seeking, Self-Control, Neuroticism, Aggression, State Anxiety, and Trait Anxiety. *Cyberpsychology, Behavior, and Social Networking*, 13(3), 313–316. <https://doi.org/10.1089/cyber.2009.0229>

Polack, T. (2017, September 10). A guide to systems-based game development. VentureBeat. <https://venturebeat.com/2017/09/10/why-and-how-systems-based-game-design-works/>

Servera-Francés, D., & Piqueras-Tomás, L. (2019). The effects of corporate social responsibility on consumer loyalty through consumer perceived value. *Economic Research-Ekonomska Istraživanja*, 32(1), 66–84. <https://doi.org/10.1080/1331677x.2018.1547202>

Shoukat, S. (2019). Cell phone addiction and psychological and physiological health in adolescents. *EXCLI Journal*, 18, 47–50.
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6449671/>

Steinkuehler, C. A., & Williams, D. (2006). Where Everybody Knows Your (Screen) Name: Online Games as “Third Places.” *Journal of Computer-Mediated Communication*, 11(4), 885–909. <https://doi.org/10.1111/j.1083-6101.2006.00300.x>

Video Game Industry - Statistics & Facts. (2021, January 18). Statista.
<https://www.statista.com/topics/868/video-games/#:~:text=Video%20games%20are%20a%20billion>

Whetten, D. A., & Mackey, A. (2002). A Social Actor Conception of Organizational Identity and Its Implications for the Study of Organizational Reputation. *Business & Society*, 41(4), 393–414. <https://doi.org/10.1177/0007650302238775>