

Gamification of Enterprise Systems

Fiona Fui-Hoon Nah ^{1,*}, Brenda Eschenbrenner ², Craig C. Claybaugh ³ and Perry B. Koob ⁴

¹ Department of Business and Information Technology, Missouri University of Science and Technology, Rolla, MO 65409, USA

² Department of Accounting, Finance, and Economics, University of Nebraska at Kearney, Kearney, NE 68849, USA; eschenbrenbl@unk.edu

³ Department of Business and Information Technology, Missouri University of Science and Technology, Rolla, MO 65409, USA; claybaughc@mst.edu

⁴ Department of Information Technology, Missouri University of Science and Technology, Rolla, MO 65409, USA; koobp@mst.edu

* Correspondence: nahf@mst.edu; Tel.: +1-573-341-6996

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Abstract: Enterprise systems have become an integral part of an organization's operations. However, they also pose many challenges to organizations from the perspective of implementation, user training, as well as use and acceptance. Without effective usage, enterprise systems may not be able to provide the strategic or competitive advantages that organizations desire. Therefore, organizations may consider gamification to enhance training, acceptance, and usage. We discuss the various ways in which enterprise system challenges can be addressed through the lens of gamification and present a framework for gamification of enterprise systems. The framework is comprised of basic principles and key design elements of gamification, as well as their application to enterprise systems. The specific principles of gamification include Challenge, Interactivity, Goal Orientation, Social Connectivity, Competition, Achievement, Reinforcement, and Fun Orientation. Design elements, such as points, levels, badges, leaderboards, progress bars, quests, and avatars, represent the application of these gamification principles, which can foster engagement with enterprise systems. The framework was validated by a group of experts. We also provide practical and theoretical implications, as well as suggestions for future research.

Keywords: gamification; design elements; enterprise system; challenge; interactivity; goal orientation; social connectivity; competition; achievement; reinforcement; fun orientation

1. Introduction

The enterprise resource planning (ERP) software market is expected to be worth \$41.69 billion globally by the year 2020 [1]. Technousa [2] reported that 81% of organizations are either in the process of implementing enterprise systems or have completed the implementation. ERP systems are software systems that integrate the various functions across an enterprise, including finance, accounting, human resources, sales, manufacturing, and procurement, and are used by organizations to conduct their day-to-day activities [3,4]. ERP systems are also referred to as enterprise systems or packaged software systems. They can scale to the entire enterprise, and hence, are critical to a firm's continued operations [5]. Enterprise systems not only help to automate and streamline business processes, but they can also provide transparency and visibility to support organizational and strategic decision making. Best practices for business processes are integrated in enterprise systems, thus creating opportunities for improvements through implementation [6].

Despite the benefits of enterprise systems, organizations face major challenges with implementation and upgrades, as well as with user adoption and system usage [7,8]. For instance,

one salient challenge is resistance from users [9]. User resistance can create issues, such as failure to meet implementation deadlines, cost overages, and underutilization, creating inability to fully realize the system's benefits [9,10]. In order for organizations to realize the full benefits from their investment in enterprise systems, it is important to identify mechanisms that will enhance such factors as attitudes, user acceptance, and continued usage.

One potential mechanism that organizations can consider is gamification as an overarching strategy [11]. Although organizations have used enterprise systems with success, the value offered by enterprise systems can be further enhanced. One way to enhance the value is to apply gamification principles to address motivation issues and reacquaint the staff with familiar or challenging tasks that have been transformed to fit a fun orientation [12]. Several researchers have also identified the use of gamification for application in work and business contexts [3,13,14].

Gamification, which refers to "the use of game design elements in non-game contexts" [15] (p. 9), can be used to enhance training and user experience with enterprise systems, as well as facilitate the process of implementation of enterprise systems. For example, ERPsim [16] is a simulation game that was developed with the purpose of gamifying teaching and learning of enterprise systems. Gamification can also be used to improve user attitudes and satisfaction with enterprise systems to increase user engagement and acceptance [3,17]. Gamification of enterprise systems is similar to the use of "serious games" in that both "focus on training, education, and working motivation in a playful way" [17] (p. 186). As Schacht and Schacht [17] have put forth, one of the goals of gamification of enterprise systems is to motivate users to complete mundane tasks with enterprise systems, including data entry, such that users provide remarks like "I had so much fun when entering the customer data into our Enterprise Systems" (p. 181). Gamification can also be used to facilitate teamwork, project championship, project management, change management, software development and testing, monitoring of progress, and evaluation of performance during the implementation process to enhance the success of enterprise systems [18,19].

Next, we review the literature on enterprise systems, as well as the principles and design elements of gamification. Then, building upon previous work and this literature review, we present a framework on the application of gamification to enterprise systems. We also present the results of validation of the framework by nine experts in enterprise systems.

2. Enterprise Systems

Enterprise systems are not only salient in large organizations, but are also adopted and used in small and medium-sized enterprises and government organizations [20,21]. The key literature on enterprise systems has focused on implementation [7,18,22–27], upgrades [5,23,28,29], acceptance [8,30–32], benefits [33,34], usefulness [35], vendor relationships [26,27,36], and assimilation [37–39].

An extended review of enterprise systems literature is provided by Romero and Vernadat [40]. Enterprise systems include systems to support organizations' functional areas, such as planning, manufacturing, sales, marketing, distribution, accounting, finance, human resources management, project management, inventory management, service and maintenance, transportation, and e-business [41,42]. As such, multiple systems can be included in these definitions, such as email, reporting tools, and ERP systems. Current research on enterprise systems includes a focus on cloud computing, big data, and cyber security [43]. Cloud computing has become a thriving technology that companies across all industries have adopted. Cloud, big data, business analytics, and a competitive business environment are challenging the functions and effective use of enterprise systems, as well as driving businesses to realize new "actionable insights" and better outcomes from these new capacities [44]. Therefore, there is a rich and emerging research stream in this domain.

Firms that use an enterprise system tend to have a greater perceived relative advantage with technology and a readiness to use the system [20]. Enterprise systems are utilitarian rather than hedonic systems. Furthermore, they are not voluntary systems but mandatory systems for the users or intended users [45]. Hence, symbolic acceptance, which refers to users' voluntary mental acceptance, of enterprise systems is critical for effective usage [31]. Factors influencing use and acceptance include computer self-efficacy, organization size, organizational support, technical

support, social influence, receptivity to change, innovativeness in technology, ability to experiment with the system before adoption, beliefs about the system, compatibility, fit, and top management support [8,31,32,46]. User attitudes and satisfaction are also two important aspects of acceptance of enterprise systems [8,47–49]. Training, which plays a critical role in enterprise system implementation, can help overcome some of the challenges in acceptance and use.

Not only do enterprise system assimilation and user acceptance pose challenges for organizations [9], their implementations are also challenging [50]. Factors that are critical for the success of enterprise system implementations include project championship, teamwork, project management, change management culture and program, software development, software testing, as well as monitoring and evaluation of progress and performance [18]. Enterprise systems follow a lifecycle approach that can benefit from gamification [51]. Several other researchers also suggested the use of gamification in enterprise systems [52,53]. Swacha [52] highlighted benefits in performance, work attitude, social relations, as well as onboarding and training. Raftopoulos [53] conducted a survey of 25 global organizations and identified key success factors, barriers to success, and ways to optimize the design process of gamification of enterprise systems.

This paper examines the use of gamification to help address the challenges and issues related to implementation, training, and usage of enterprise systems. The next section will review the gamification literature, and the following section will discuss, as well as illustrate, the application of gamification to enterprise systems.

3. Gamification-Principles and Design Elements

Gamification refers to the use of a set of principles and design elements to increase motivation, engagement, and performance. Based on a review of the literature on gamification, we identified eight basic principles or strategies of gamification [54–57]: Challenge (C), Interactivity (I), Goal Orientation (G), Social Connectivity (S), Competition (C), Achievement (A), Reinforcement (R), and Fun Orientation (F). We termed them the CIG-SCARF principles of gamification. The definitions and explanations for each of the principles in their application to enterprise systems is provided in Table 1, along with design elements that are associated with each of them.

Table 1. Principles of Gamification and their Design Elements.

Principles of Gamification (CIG-SCARF)	Design Elements
Challenge (C)-opportunities for growth, learning, and development	Points, Levels, Badges, Leaderboards, Quest, Feedback/Progress Bars, Performance Graphs, Prizes/Rewards/Bonuses, Rules, Marketplace
Interactivity (I)-potential for immediate feedback	Points, Quest, Feedback/Progress Bars, Performance Graphs, Avatars, Roleplay
Goal Orientation (G)-setting clear and systematic goals	Points, Levels, Badges, Leaderboards, Onboarding, Prizes/Rewards/Bonuses, Customization/Personalization
Social Connectivity (S)-opportunities to interact with others	Leaderboards, Social Engagement Loops, [use of] Teams [for Collaboration], Avatars, Roleplay
Competition (C)-opportunities for social comparisons or winners to emerge	Points, Levels, Badges, Leaderboards, Quest, Feedback/Progress Bars, Prizes/Rewards/Bonuses, Rules, Marketplace
Achievement (A)-recognition of effort and/or accomplishment	Points, Levels, Badges, Leaderboards, Feedback/Progress Bars, Performance Graphs, Prizes/Rewards/Bonuses
Reinforcement (R)-structure of rewards based on performance	Levels, Badges, Leaderboards, Onboarding, Feedback/Progress Bars, Prizes/Rewards/Bonuses
Fun Orientation (F)-creating interest, curiosity, and enjoyment	Quest, Prizes/Rewards/Bonuses, Rules, Marketplace, 3D Space, Avatars, Storyline (Narrative Content), Roleplay, Customization/Personalization

Each of the CIG-SCARF principles of gamification has the potential to motivate and engage users [55,56], and their effectiveness may vary based on the demographics of the users. The CIG principles, which are comprised of Challenge, Interactivity, and Goal Orientation, are related to three basic antecedents of the optimal experience called flow, which refers to the holistic experience of total concentration and immersion, as well as intrinsic motivation [58–61].

Challenge refers to providing opportunities for growth, learning, and development [55]. In the context of enterprise systems, a moderate and reasonable amount of challenge can be created to encourage learning, problem-solving, and creativity. Users should view challenges in the enterprise system as a way to improve themselves and their work, and hence, be motivated by the opportunity for advancement. The degree of challenge will need to be appropriately determined as a high level of

challenge can cause anxiety or frustration, and a low level of challenge can create boredom or apathy [62]. Hence, the level of challenge will need to be adjusted to match the skill level of the individual.

Interactivity has been referred to as “the extent to which users can participate in modifying the form and content of a mediated environment in real time” [63] (p. 80), as well as a medium’s “potential for immediate feedback” [64] (p. 271). Given that enterprise systems are not a form of mediated systems, such as a virtual world or virtual reality, the second definition for interactivity, i.e., its ability to offer immediate feedback, is more appropriate. Providing clear and immediate feedback is an important antecedent for flow as it keeps users engaged with the system [59].

Goal orientation refers to setting clear and systematic goals that are related to one’s personal goals. In the context of enterprise systems, the system can assist and encourage users in setting such goals. Such goal setting activities can help to improve users’ involvement, competence, and performance in using the system [65,66]. Having a project champion for an enterprise system can also facilitate goal setting, especially in legitimizing change [23].

The SCARF principles, which are comprised of Social Connectivity, Competition, Achievement, Reinforcement, and Fun Orientation, cover the advanced principles that are fundamental to gamification [55,56].

Social connectivity or interaction has been studied in the context of flow in gaming and identified as a key factor contributing to the flow state [67]. Social connectivity offers opportunities for collaborating on a task, which enhances three key dimensions of the flow state—focused concentration, time distortion, and enjoyment [68]. Similarly, collaboration has been shown to increase immersion and enjoyment [69]. Social connectivity facilitates social relatedness, which creates shared goals and a sense of relevance, thereby increasing intrinsic motivation in system usage [70].

Competition refers to “a contest in which two or more parties strive for superiority or victory” [71] (p. 113). Motivation is enhanced in competitions using intrinsic or extrinsic rewards [56]. Competitions allow people to compare their performance or behavior with others, which in turn can increase motivation, engagement, and learning [72]. When competing with others of similar skill levels, one also applies more effort and spends more time [71].

Achievement is a psychological need of human beings to enhance their self-esteem [73,74]. Achievement motivation or drive for achievement increases one’s effort and engagement to accomplish a goal [74]. People are inherently motivated by meaningful goals that give them a sense of achievement or accomplishment. They are also motivated by rewards or recognitions for positive outcomes such as performance.

Reinforcement refers to providing a structure of rewards (i.e., positive reinforcement) based on performance. The idea is consistent with Skinner’s [75] operant conditioning, where positive reinforcement (e.g., rewarding performance) encourages repetition of behavior. In general, motivation can be enhanced by reinforcement of positive performance and desirable behaviors. In enterprise settings, positive reinforcement can motivate users to learn and explore, as well as fully utilize the system. Positive reinforcement can also be used to facilitate coordination and teamwork among the different parties involved in enterprise system implementation.

Fun orientation refers to creating interest, curiosity, and enjoyment in a task or environment, and is associated with increased intrinsic motivation and engagement [59,62,76]. In addition, a fun and enjoyable experience can also increase loyalty and behavioral intention, such as usage [77–81].

The following design elements for gamification have been identified from our review of the literature [15,55,56,70,76,82,83]: Points, Levels, Badges, Leaderboards, Onboarding, Quest, Feedback/Progress Bars, Performance Graphs, Prizes/Rewards/Bonus, Social Engagement, [use of] Teams [for Collaboration], Rules, Marketplace, 3D Space, Avatars, Storyline (Narrative Content), Roleplay, and Customization/Personalization. Table 2 provides more information on each of these design elements.

Table 2. Descriptions of Design Elements.

Design Element	Description
Points	Scores to indicate progress or performance
Levels	Milestones to indicate completion of intermediate goals
Badges	Recognitions for achievement/accomplishment
Leaderboards	Listing of leading scorers and their scores
Onboarding	Aids and scaffolding to help with progress and advancement
Quest	Pursuit or journey toward a specific mission or goal
Feedback/Progress Bars	Track and display progression toward goals or sub-goals
Performance Graphs	Display performance information over time
Prizes/Rewards/Bonuses	Rewards that can take different forms
Social Engagement Loops	Reinforcements of re-engagement and calls to social events
Use of Teams	Use of social dynamics for engagement
Rules	Principles and regulations for procedure and action
Marketplace	Simulations of an economy
3D Space	3D graphic-rich environment
Avatars	Animated characters to represent different persons
Storyline (Narrative Content)	Narrative context or theme for engagement
Roleplay	Taking on specific roles or characters
Customization/Personalization	Enhance fit and relations with individuals

Points, levels, and badges are three basic design elements of gamification [84]. The point system is a scoring scheme to indicate progress or performance. Levels refer to milestones for intermediate goals, and badges are awarded to signify a certain level of accomplishment. A leaderboard shows a listing of top scorers, whereas onboarding refers to scaffolding or aids to help with advancement. A quest refers to a journey to pursue specific goals. Feedback/progress bars show the status or progression toward specific goals, whereas performance graphs show one's performance information over time, i.e., relative to previous performance. Prizes/Rewards/Bonuses are different kinds of extrinsic rewards. The social engagement loops refer to "positive reinforcements and feedback loops" that keep a person engaged [3] (p. 536). Each loop comprises four stages [3,83]: (i) motivating emotion (e.g., connecting, expressing, collecting, ranking, exploring, and searching that are associated with emotions); (ii) re-engagement (e.g., challenges or activities that entice one to return to the task or application; (iii) social call to action (e.g., call to social activities or events); and (iv) feedback and reward (e.g., recognitions and rewards that further trigger or motivate emotion to begin another loop). Hence, social engagement loops use the power of social connectivity to sustain or maintain engagement. The use of teams for collaboration is also a powerful motivating factor for engagement.

The rules of the gamified system or environment in terms of how the gamification mechanisms work need to be clearly specified, as clear goals and feedback are essential for engagement [60]. The use of a marketplace or economy can also help increase the challenge and fun components of gamification by introducing competitions into an environment. The use of 3D space creates a rich and vivid environment for interactions, which further increases engagement. Avatars can be used to create interactivity, social connectivity, and fun components to enhance engagement. The use of narrative content or a storyline draws one into a story, making a task more meaningful and easier to relate to, thus increasing motivation and engagement. Having a storyline also offers greater opportunities for roleplay, which further enhances engagement. Customization/Personalization can be carried out to adapt to one's capabilities or enhance the relatedness with oneself, both of which can improve engagement and the overall experience.

Among the ten ingredients or elements identified by Reeves and Read [82], we adopted all of them for application to the enterprise system context except Time Pressure. In the context of enterprise systems, which is work oriented and less "gameful", introducing Time Pressure may take

away quality or effectiveness, which is key to enterprise systems. Organizations may still adopt Time Pressure to increase gamefulness of enterprise system implementation, training, or usage as appropriate.

The design elements in Table 2 support the eight principles of gamification discussed earlier that are shown in Table 1. The application of the design elements and their associated principles to enterprise systems is discussed in the next section. The application was also evaluated by a group of experts and the results are reported in the next section as well.

4. Application of Gamification to Enterprise Systems

In this section, we discuss the application of gamification principles and their design elements to enterprise systems. We discuss these principles and their associated design elements in three parts: gamification in user training, effective usage and ongoing acceptance of the system, and implementation of enterprise systems. We also provide examples and illustrations on the use of gamification to support enterprise systems in organizations.

4.1. Gamification in Implementation of Enterprise Systems

Enterprise system implementation can be fraught with challenges, which include the need to work in cross-functional teams, to have a high-level executive to champion the project, and to implement a change management program to facilitate cultural shifts that are necessary for successful implementations [7,18,24]. Software testing and project management are two other key success factors of enterprise system implementation, where the monitoring and evaluation of their progress and performance are important for success [7,18].

Cross-functional teamwork is a critical success factor of enterprise system implementation [7,18]. The Challenge (C) principle can apply by posing problems and issues to the cross-functional teams in the form of a quest that encourage their communication and collaboration. Principles of Goal orientation (G) and Achievement (A) can be applied by setting clear goals in the quest and recognizing the achievement of these goals. Social connectivity (S) and Competition (C) principles can also be used to facilitate collaboration and teamwork. Social connectivity (S) across functional teams can lead to shared goals and cross-team collaboration. Competitions (C) across functional teams can be used to encourage participation and contribution.

For example, if an issue arises in the receipt and updating of inventory during an implementation, a cross-functional team can be assigned a challenge in the form of a quest to find a resolution to the issue. The team can be assigned goals to find a resolution by a certain deadline and rewards provided if the deadline is met and an effective solution implemented. Members of the team can also be rewarded for their contributions to identifying the solution and for the effectiveness in collaborating with parties from other departments to do so. Duarte et al. [85] and Fernandes et al. [86] have examined the utilization of gamification to improve collaboration and participation in requirements elicitation. Competing and collaborating across functional teams can also create opportunities for innovation networks to develop within an organization, as people with innovative mindsets and different approaches begin to interact [87]. Innovation can be important during implementation, which relies on organizational members embracing change and viewing problems in new ways, as well as developing consensus and agreement on key issues in implementation.

Project champions play an important role in enterprise system implementations [7,18,88–90]. Identification of an appropriate project champion is critical to implementation success. Having a high-level executive with the power to set strategic and tactical goals, as well as legitimize change, is essential. The Goal orientation (G) principle can be used to implement these strategic and tactical goals throughout an organization at both the individual and department/unit levels, while using the Achievement (A) and Reinforcement (R) principles to support and motivate the attainment of goals. For instance, a project leader can establish goals for an accounts receivable department to have customer accounts established in a new system by a certain date and with a certain percentage of accuracy. As the department progresses toward the goal, they can receive positive reinforcement by

acknowledging their efforts, the number of accounts established, and the accuracy with which they have done so.

Having a change management culture and program in place is critical to the success of enterprise system implementations [7,18,91,92]. Enterprise system implementations involve organizational changes that are normally accompanied with a cultural change [93]. People tend to resist change especially in the context of a new system implementation [94]. Cultural change and adoption of new norms can take a tremendous amount of time for adjustments and cannot be taken for granted [39]. Areas with the most challenges, apart from technical implementation issues, tend to be areas of most friction between new culture and old culture, or between dominant players in the organization [25]. The gamification principle most applicable to this issue is Social connectivity (S). Organizations can develop opportunities for individuals to interact in collaborative, team-building gamification activities. For example, teams can be created that participate in a competition to foster team-building, such as creating a mascot that exemplifies the cultural values of the organization. The firm might also seek to foster a sense of Social connectivity (S) between the teams assigned to execute the project. The principle of Fun orientation (F) may also be considered. Providing enjoyable experiences, by utilizing quests or roleplaying, can help to reduce tensions associated with cultural shifts. Creating an atmosphere of creative and collaborative interactions can help to reduce and mitigate challenges faced in teamwork and change management associated with enterprise system implementations.

Testing is needed during an initial system implementation, whereas ongoing testing is typically needed for system upgrades or patches. The software development life cycle is dependent upon testers who are trained and motivated to conduct testing [95]. Testing the system through Alpha (with simulation data) and Beta (with live data) tests can occur with individuals who are not trained and may not be motivated, which can subsequently be detrimental to system effectiveness and usage. Some testers may even be adversarial to system deployment.

The CIG-SCARF principles of gamification could help motivate testers. Goal orientation (G), Social connectivity (S), Achievement (A), and Reinforcement (R) can be used as motivational tools by facilitating identification of a tester as a member (and contributor) of a team, establishing performance goals, and subsequently recognizing and rewarding successful performance outcomes. For instance, goals with specific amounts of transactions to be entered effectively and within a given time frame can be established. Testers can be grouped and assigned to teams, and each team given more explicit goals to achieve [96]. Points can be earned at an individual level and leaderboards used to track total team points, with specific monetary or nonmonetary achievements awarded based on the outcomes. Using the Competition (C) principle to track, monitor, and compare the levels of progression through the testing phase can help motivate testers to conduct testing and users to offer feedback.

Adversarial feelings toward an enterprise system may be redirected in the form of a quest toward abilities of finding issues using the Fun orientation (F) principle, which can lead to feelings of accomplishment and recognition using rewards. Moreover, some of the software development can be accomplished by teams, and team perceptions of expectations can serve as a form of motivation [97]. For example, Microsoft uses an internal productivity game called *Communicate Hope* to motivate its employees to participate in the testing process of a new platform [17]. Users collect points by providing feedback and submitting bugs, and product testers collect points by responding to users. The accumulated points can be converted into monetary rewards. The gamification approach to testing generated 16 times more feedback.

Project management is a critical component of enterprise system implementation [7,18,89,90]. During an ERP implementation, it may become necessary to have both the old and new processes operating concurrently. An enterprise system implementation may require a phased roll out, in which parts of the system are deployed at different times [98]. To maintain continuity of business during the implementation, system users may need to enter data into both systems (i.e., dual entry). This process may be more prevalent in organizations that do not have an existing enterprise system in place before the new enterprise system is fully implemented and accepted [99].

Dual entry leads to repetitiveness, increased workload, and is a clear representation of change. Organizational members perform the same task in both the legacy system and the new system, which facilitates direct comparisons of the systems' attributes, such as ease of use. One team may enter data into the legacy system, while the other enters the data into the new system. Issues may arise if proficiency with data entry in the legacy system is contrasted with the lack of proficiency with the new system. This phenomenon could reduce the motivation to adopt and use the new system due to frustration with inefficiencies using the new system while users are still learning to use the new system. Gamification can incentivize dual entry, but organizations would still need to be cautious as to not portray the use of quotas as performance measures versus game design elements. The use of quotas, or the setting of arbitrary numbers as performance measures, could generate anxiety in both system users and leadership. Gamification elements, such as leaderboards, progress bars, and performance graphs, can be used to compare an individual's progress and improvement over time, or against the progress of others in the spirit of competition.

The CIG-SCARF principles of gamification can be used to address dual entry and dual system usage. The challenges can be posed in a meaningful way to foster users to learn and develop their proficiency with the new system. Points could be awarded for correct data entry or levels of proficiency that are achieved. Goal orientation (G) and Interactivity (I) can be used to provide clear goals for users to achieve and receive feedback as they are working toward their goals. Progress bars and performance graphs that integrate goals and display levels of proficiency can be implemented. For instance, goals for efficiency and accuracy of entering customer orders can be established. Progress bars can track the percentage improvements or progress made toward these pre-established end goals.

Social connectivity (S), Competition (C), Achievement (A), and Reinforcement (R) can be used to foster social engagement of team members inputting data or executing dual business tasks. Team competitions can be implemented that assign points to teams based on efficiency, accuracy, or degree of improvement. Improvement levels may be considered in design elements so teams that struggle more than others do not get discouraged and give up competing. Successful teams can receive rewards and company-wide recognition by executive leaders to reinforce the importance of their success to the organization. Fun orientation (F) may be essential considering dual entry may not be enticing. Design elements may include creating game-like quests for accuracy or efficiency in using the new system.

In addition, when enterprise systems are implemented, adoption of new business processes may be necessary. These new processes represent best practices that are inherent in the new system's structure. These processes may be different than those followed under the previous system. People are inherently resistant to change and may try to build a workaround to continue performing tasks in a similar way or a way that is familiar to them. Principles of gamification such as Challenge (C), Reinforcement (R), and Achievement (A) can be considered to address this issue. Users can be given opportunities to learn and adopt the new processes, and be recognized with different levels of badges or specific titles, as well as rewarded in meaningful ways for successfully doing so. For example, if fixed asset purchase requisitions require new procedures, individuals can receive Reinforcement (R) for utilizing the new procedures and accomplishing new Achievements (A) that are recognized in newsletters or emails. They can also be rewarded for the number of fixed asset purchase requisitions completed using the new procedures. These achievements could earn points or tokens that employees could eventually exchange for actual rewards or prizes (e.g., extra vacation days, gift cards).

Monitoring and evaluation of progress and performance are important aspects of an enterprise system implementation process [7,18]. Milestones and targets are set and progress can be actively tracked and monitored. Hence, the CIG principles of creating Challenges (C), Interactivity (I) (in terms of receiving constant or immediate feedback), and Goal orientation (G) (in the form of milestones and targets) can be implemented through a gamified tracking and monitoring system. For instance, the modules that are to be implemented can be tracked in terms of the percentage of completion and this information shared daily so all organizational members can assess progress

toward pre-established budgets, deadlines, or modifications made. The SCARF principles of gamification are also applicable. The gamified system can create Social connectivity (S) by facilitating communication among implementation team members (e.g., through online forum or chat), incorporate Competition (C) by identifying the best performing implementation team in reaching the team, unit, or overall organizational goals (e.g., through the use of leaderboards), encourage Achievement (A) by recognizing effort and progress (e.g., through progress bars and performance graphs as well as through points, levels, badges, and rewards/prizes/bonuses), introduce Reinforcement (R) through rewards and recognitions (e.g., through progress bars and performance graphs as well as through levels, badges, and rewards/prizes/bonuses), and create a Fun orientation (F) by enhancing the overall experience of gamifying the monitoring and evaluation of progress and performance.

4.2. Gamification in User Training of Enterprise Systems

In conjunction with the implementation of a new enterprise system, users will need to be trained [100]. Learning the system is a significant goal for an ERP implementation [101]. User training can be carried out throughout the life cycle of an enterprise system. There will be initial training as the system gets rolled out or training during the post-operations phase after the system has been in use throughout the organization. By the end of an implementation, all users should be fluent with using the system. If users are concerned or hesitant about learning and using a new system, training may not be as effective and productive as desired. Inducement of positive emotions and perceptions about the system through a fun and meaningful training session can be effective at fostering users' willingness to learn a new system [102]. Enhancing trainee engagement can also increase their knowledge retention and usage satisfaction [103].

Therefore, training can be structured into a game format [5,16,104,105]. Gamified systems for training are effective as users are more engaged and more likely to be interested and motivated to attend the training events [106]. The CIG-SCARF principles of gamification can be utilized to enhance the effectiveness and efficiency of training, as well as produce positive learning outcomes. Challenges (C) and Interactivity (I) can be introduced to foster learning and development. Users can receive immediate feedback and points as they progress through various levels of training. For example, Microsoft has used *Ribbon Hero*, which is a gamified system to train users on their Office Suite [17]. Users have to complete challenges which introduce them to PowerPoint, Word, Excel, and OneNote in order to gain experience points and compete with their colleagues for high scores. Schacht and Schacht [17] also suggested using gamification principles in training employees.

The Goal orientation (G) principle can be utilized by setting process goals, performance goals, or outcome goals [107]. Process goals refer to learning goals used to encourage the acquisition of new skills, such as onboarding, which is based on the Reinforcement (R) principle. Performance goals are set relative to one's own standards. For example, pre-assessments of one's current knowledge and skills using the system to run various financial or operational reports can be made. Based on this information, idiosyncratic goals can be established that include both short-term (e.g., weekly) and long-term (e.g., monthly or final) targets. The use of points, levels, badges, and leaderboards exemplify such goals.

Outcome goals refer to establishing very specific outcomes, such as individual and overall department or unit goals. Setting specific, measurable, and attainable goals to clearly state what the expectations are is extremely helpful and important in gamifying enterprise system training [108]. As goals are achieved, prizes can be awarded accordingly. Social connectivity (S) can be leveraged to allow team-based support or learning through training. Users can collaborate to complete exercises during training to practice applying their newly acquired knowledge and skills, and leaderboards can be used to track each team's progress [109]. For example, creating a simulated system issue that teams have to research and solve can be introduced during training, and the teams with the most innovative and efficient solution recognized. Doing so provides an opportunity for the purpose of training to resound in users' minds as achieving the overarching goal of mastery of system skills.

Competition (C) can be used to motivate users to engage in training and improve retention of the learned knowledge [103]. A sense of challenge and teamwork in a training session can motivate users to effectively learn the new system. This can be accomplished by providing opportunities to monitor one's progress in comparison to other users or teams of users. Achievement (A), Reinforcement (R), and Fun Orientation (F) can also be applied. Giving out rewards for completing training quickly and with no errors could be instituted. For instance, after training is completed for accounts payable, users can be given a list of tasks to perform (e.g., entering a vendor invoice) and points awarded to users who complete them in the least amount of time and with highest accuracy. Training can be designed to be enjoyable or incite curiosity in users. For instance, treasure hunts to identify help functions could be used. Prizes and recognition for positive outcomes can be awarded to those who are successful during training. Customization helps to create a learning environment that adapts to the individualized needs of the learners [110].

Unfortunately, an extensive amount of time may lapse between when training is received and when the new system is used in a live environment. This delay may be caused by the timing of the training sessions or shift schedules. Because of the lack of use or practicing what they had learned, users may forget how to use the functions or execute certain tasks that they had previously been trained to do because of these delays [111]. The CIG-SCARF principles of gamification can be leveraged to encourage system users to continue practicing what they had learned, be motivated to retain the knowledge gained from training, and spend additional time using the new system to retain the skills they have developed [112].

Challenge (C) and Interactivity (I) can be applied to encourage users' desire to retain and grow their knowledge base and skill sets. Users can continue to practice using the system and evaluate their development through progress bars which provide immediate responses as well as assessments of their knowledge and skill retention and growth. For example, users from the purchasing department can assess their knowledge and skills immediately after training, and then do so weekly afterwards to continually monitor their retention (e.g., creating or modifying a purchase order). If their knowledge or skills fall below desired levels, users can engage in reinforcement training to enhance retention.

Goal orientation (G), Social connectivity (S), Achievement (A), and Reinforcement (R) can be leveraged as well. Retention and growth goals can be established for individuals as well as teams [112]. Teams can be encouraged to interact regularly to encourage each other to achieve their team and individual goals. Feedback can be provided on progress toward achieving set goals, with achievement of individual and team goals being publicly recognized. For instance, new knowledge and skills for users of the purchasing department can be identified and goals established for acquiring the new knowledge and skills. Monitoring of retention, as noted previously, can be integrated as well. Teams can meet regularly so individuals can discuss their progress, both individually and as a team, and have their questions or concerns addressed.

Competition (C) and Fun orientation (F) could also be considered to motivate individuals to practice using the system in a fun but competitive, game-like manner [113]. Individuals or teams could compete to achieve certain levels of mastery, with their progress noted on leaderboards to motivate them to improve their skills further. For instance, teams with the most purchasing-related transactions entered accurately and in the least amount of time could be rewarded with free lunches, and individuals with similar achievements being recognized with prizes. Specifically, the ERP simulation game [114], which is also called ERPsim [16], uses narrative and roleplay design elements to deliver the Fun orientation (F) in user training, in which there is Competition (C) among teams of participants in a simulated industry. As described by the authors, the ERP simulation game uses "an innovative 'learning-by-doing' and 'problem-based' approach to teaching ERP concepts and competencies" [114] (p. 329). Narratives are presented to participants who take on different roles in organizations that compete in a simulated industry to make decisions involved in a business cycle. Hence, participants need to understand the constraints of other actors in the same and different organizations in the simulated industry to compete successfully in the marketplace.

Users may not begin with a consistent level of understanding or experience with the system, which implies they need customized training. A typical training session assumes some rudimentary and consistent level of knowledge among the trainees, and aims to extend knowledge and skills from a presumed uniform starting point for everyone. However, standardization of training programs can give rise to feelings of frustration and confusion [115]. The design element, customization/personalization, can be used to tailor the delivery and content of training to individual users and their relative starting point. In other words, the training should be customizable to individuals based on their current level of knowledge, skills, and abilities, as well as their learning goals.

4.3. Gamification in Effective Usage of Enterprise Systems

After an enterprise system is implemented, organizations will need to identify ways to encourage effective usage of the system. The principles of gamification can potentially enhance effective usage and discourage undesirable usage behaviors. Data entry, information processing, error detection and corrections, and reporting accuracy are paramount considering organizations' reliance on the information extracted from an enterprise system. Users should be encouraged to try to review their work and make appropriate corrections if needed. Also, if an issue or question arises, users should be encouraged to seek assistance versus guessing and potentially entering data or running processes incorrectly. In addition, users may be expected to use the enterprise system the way it was intended, but may not be motivated to do so. Hence, gamification can offer a better overall user experience to help users achieve effective usage and increase utilization of applications embedded in enterprise systems [17].

Data entry is often considered a mundane and boring task by users, but it is a critical aspect of enterprise system operations. For example, SAP, which is an enterprise system software vendor, introduced the *Gamification Project* to increase SAP users' motivation in entering and maintaining vendor data [17]. Users earn points for data entry and these points can be used to improve their status or participate in challenges. Hence, gamification principles such as Competition (C), Achievement (A), and Reinforcement (R) can be utilized to motivate users by creating fun and competitiveness in data entry. Furthermore, poor data accuracy is one of the reasons for enterprise system failure [116]. Since data entry is error-prone, especially if users are not attentive or engaged with the task, gamification principles can be used to encourage error reporting (e.g., with points, badges, or trophies for using their expertise to assist with quality assurance) or track accuracy in comparison to others (e.g., with performance bars and leaderboards). Hence, users can be rewarded or recognized for quality control, as well as reporting and correcting errors. Those exceeding established levels of achievement in attaining high accuracy or correcting the highest number of errors can be provided with monetary rewards or bonuses.

Goal orientation (G) and Achievement (A) principles can be applied at both the individual and team levels to achieve this endeavor as well. For example, goals for accuracy can be established at a department or unit level. Accuracy could be tracked at the appropriate level, compared to the established goals, and the entire department or unit rewarded accordingly. These principles and design elements can also be applied to enhance efficiency and productivity at the individual user or department/unit level.

The Fun orientation (F) principle can also be implemented to make seeking help enjoyable and potentially foster users' curiosity, such as designing help functions to have the semblance of a quest to complete. Competition (C), Achievement (A), and Reinforcement (R) can also be used to incentivize users to get help or to seek answers to questions. For example, rewards can be given to recognize the efforts of users seeking assistance. Social connectivity (S) can be leveraged by creating work teams in which team members review each other's work for accuracy. Team points can be earned for accuracy levels that are achieved.

Additionally, Social connectivity (S) can be applied through the creation of online communities of practice for individuals to seek expert advice. Competition (C), Achievement (A), and Reinforcement (R) can be used to encourage system users to utilize these online communities, as

well as identify expert users and foster their participation to share their expertise. Users accessing these online communities to request help or extend their knowledge of the system can be recognized for their efforts with prizes. Participation could be in the form of a competition, in which users compete with one another or until a certain mastery level is achieved. For expert user contributions, leaderboards can be created which identify expert users' contributions to the online communities. Badges can be awarded as certain levels of contributions are achieved by these expert users. An example implemented in one organization is the use of quests to encourage continued development and updating of knowledge-sharing documents [117]. The quests would identify documents needing modification and include aspects of collaboration by requiring consultation with experts in a particular subject matter.

After enterprise systems are implemented, users may discover new functions or opportunities to leverage the system that had not previously been envisioned or addressed in system training [118]. In order to enhance the effectiveness of the system to the organization, it is important for users to share this newly discovered knowledge. Gamification can be utilized to encourage sharing of information, such as the principles of Challenge (C) and Achievement (A). For example, a user can post their discoveries in a blog or shared site and a leaderboard can be used to track the number of posts by each user. Users can earn recognition for their contributions by earning badges or points. Points can later be exchanged for rewards such as event tickets or club memberships. In a study on the use of enterprise social network systems [119], removing gamification in the enterprise system reduced overall participation and contribution.

After an enterprise system is fully released into a live environment, problems or new circumstances may arise requiring modifications. Although initial system training may be adequate for a majority of the tasks that need to be accomplished in a system, others can be problematic or require innovative ideas. These circumstances may require collaborative problem-solving and innovation. Gamification principles of Social connectivity (S), Competition (C), and Achievement (A) can be leveraged to engage users in ad-hoc problem-solving or brainstorming committees, or meetings to identify resolutions to issues or develop innovative ideas. For instance, the system's architecture may need modification to address these problems or implement innovative ideas. Cross-functional teams can be created to enhance social engagement across the organization, and meetings can potentially be held in virtual worlds via avatars. Alternatively, sub-teams can be formed that compete with other sub-teams for the most creative, cost efficient, or effective solution, with the winners recognized for their achievement.

4.4. Evaluation of Framework on Gamification of Enterprise Systems by Experts

To assess the framework and ensure that it has theoretical and practical meaning to enterprise system contexts, we recruited a group of nine experts—two academics and seven practitioners—to assess the framework in three application contexts—user training, implementation, as well as use and acceptance. Among the seven practitioners, six of them are enterprise system consultants and the other is a senior manager of a major enterprise system vendor. A survey consisting of eight statements concerning the framework in Table 1 was presented to each expert. We presented these eight principles and their associated design elements in three parts: gamification in user training, effective usage and ongoing acceptance of the system, and implementation of enterprise systems. The experts were asked whether they agreed or did not agree with statements describing the gamification principles and their associated design elements in each of the three contexts, generating a total of 24 scenarios to be evaluated. Table 3 presents a summary of the findings.

All nine experts agreed unanimously with the application of the principles of Challenge (C), Interactivity (I), and Achievement (A) being appropriate in all three contexts. A salient majority agreed with the application of the rest of the gamification principles to enterprise systems in the three contexts. Also, all experts agreed with the principle of Competition (C) in implementation, but one expert did not agree with applying this principle in training and usage. One expert also cautioned that corrosive competition elements should be avoided. Hence, the principle of Competition (C) should be oriented toward hedonic and motivational purposes.

Table 3. Experts' Agreements on Application of Gamification Principles to Enterprise Systems.

Context Principle	User Training	Usage	Implementation	Overall
Challenge (C)	9 of 9 (100%)	9 of 9 (100%)	9 of 9 (100%)	27 of 27 (100%)
Interactivity (I)	9 of 9 (100%)	9 of 9 (100%)	9 of 9 (100%)	27 of 27 (100%)
Goal Orientation (G)	7 of 9 (78%)	7 of 9 (78%)	9 of 9 (100%)	23 of 27 (85%)
Social Connectivity (S)	7 of 9 (78%)	7 of 9 (78%)	8 of 9 (89%)	22 of 27 (81%)
Competition (C)	8 of 9 (89%)	8 of 9 (89%)	9 of 9 (100%)	25 of 27 (93%)
Achievement (A)	9 of 9 (100%)	9 of 9 (100%)	9 of 9 (100%)	27 of 27 (100%)
Reinforcement (R)	7 of 9 (78%)	7 of 9 (78%)	7 of 9 (78%)	21 of 27 (78%)
Fun Orientation (F)	8 of 9 (89%)	8 of 9 (89%)	7 of 9 (78%)	23 of 27 (85%)
Total # of Agreements	64 of 72 (89%)	64 of 72 (89%)	67 of 72 (93%)	195 of 216 (90%)

In terms of Goal Orientation (G), all experts agreed with its application in an implementation context, but two did not agree with its application in user training and system usage. We believe the two experts did not agree because goals tend to be quantifiable rather than focused on quality, but quality is the most essential element in user training and system usage [118]. With regard to Fun Orientation (F), two experts did not agree with the statement on Fun (F) in implementation and one expert did not agree with the statement on Fun (F) in user training and usage. The reason could be that the risk of enterprise system implementation is so significant that it is very hard to make it fun. In addition, most enterprise systems are very complex and unintuitive to learn and use.

Similarly, not all experts agreed with the application of Reinforcement (R) and Social Connectivity (S) principles in enterprise systems. Of the nine experts, seven agreed with the statements regarding Reinforcement (R) being relevant to the context of user training, effective usage, and implementation. Seven of the nine experts agreed Social Connectivity (S) was relevant to training and usage. Eight of the nine experts agreed that Social Connectivity (S) was relevant to implementation.

Additionally, several experts left comments describing their perceptions of the relevancy of gamification elements in the contexts presented to them. Some provided examples of how the gamification principles have been applied in their organizations. For those with dissenting opinions, they did not perceive the applicability of the elements in the context provided. For example, one expert felt that receiving training relevant to one's job was already a motivating experience and additional incentives would not be needed. Another expert felt that all eight of the framework elements would not be necessary as using four of them would be sufficient. Hence, future research can examine which of the elements are ideal in specific settings, and possibly the right amount or the right number of them to apply in specific contexts.

5. Conclusions, Implications, Limitations, and Future Research

In this paper, we have reviewed the literature on gamification and identified their application in the context of enterprise systems. We discussed the use of gamification from three aspects of enterprise systems: implementation, user training, and effective usage.

In the context of enterprise system implementations, we propose using gamification principles and design elements to strengthen the key factors for successful implementations. For example, Goal orientation (G), Social connectivity (S), and Competition (C) principles can be used to motivate cross-functional teams to work toward their shared goals by connecting and communicating with one another, with progress toward the shared goals assessed through competitions. The change management program requires persuasion and communication, and hence, the Social connectivity (S) principle is key to facilitate these conversations and relatedness with the organization. In

addition, the Fun orientation (F) principle could be incorporated in the form of a quest or roleplay to help with the change management process. Testing is a key component of enterprise system implementation, where many of the gamification principles can be applied, such as Goal orientation (G), Social connectivity (S), Achievement (A), Reinforcement (R), and Fun orientation (F) to create individual or team goals, connect with other testers and the users for feedback, be rewarded for achievement or reinforcement of progress and goals, and be carried out in the form of quests. Through gamification, testers' quality is expected to increase due to the increased amount of feedback from users and reinforcement of progress in testing. Gamification can also help with project management, as well as monitoring of progress and evaluation of performance using the CIG-SCARF principles by posing challenges, increasing interactivity, setting clear goals, connecting team members, creating competitions for performance, rewarding achievements and progress, and making the process fun, such as completing tasks as part of a quest.

We propose that gamification can be applied to another important aspect of enterprise system implementation—user training. Gamification can be used to foster users' interest, engagement, and motivation. Game design principles, such as Challenge (C) and Interactivity (I), can be used to gather feedback on the progression of users' skill development. The Goal orientation (G) principle can be applied by establishing goals related to skill acquisition, personal standards, and performance outcomes. As goals are accomplished, users can earn prizes or awards. Social connectivity (S) can be used by creating collaborative learning exercises and using leaderboards to monitor each team's achievements. Competition (C), Achievement (A), Reinforcement (R), and Fun orientation (F) can also be effective in training. Users can compete with others and assess their skill development and progress against others. This can be designed as an enjoyable experience, and users can earn rewards and be recognized for their achievements. It may also be beneficial to customize or personalize the training experience considering users may differ in their pre-existing knowledge, learning style, or interest. Also, the time between training completion and actual usage of the system in a live environment may be significant enough that users' knowledge and skills may decline. The principles of gamification can be applied to motivate users to continue practicing and expanding their knowledge and skills. For instance, goals can be established for teams and individuals. Users can monitor their knowledge retention progress, as well as address areas they want to continue to develop or lack proficiency. The structure can be designed to be a fun competition, with achievements being recognized and rewarded with team bonuses or prizes.

Also, gamification can be used to foster effective and efficient usage of enterprise systems. Gamification can be used to encourage accurate and effective system use, and to encourage users to obtain assistance when issues or questions arise. Goal orientation (G), Competition (C), Achievement (A), Reinforcement (R), and Fun orientation (F) principles can be used to create fun competitions for important tasks, such as data entry and review. Users can be recognized and rewarded for their accuracy and quality control accomplishments based on pre-set goals, as well as their efforts to get assistance and resolve issues. Social connectivity (S) can be implemented by having teams support each other's efforts through peer-review processes. In addition, online communities can be created and efforts recognized and rewarded for contributors as well as users of these communities. As new uses of the system are discovered or circumstances arise requiring modifications of the system, gamification principles can be applied that foster knowledge sharing and collaboration. Social connectivity (S) and Achievement (A) can be leveraged to bring unity to cross-functional teams addressing issues or developing solutions.

Previous research has addressed some aspects of gamification in a work context. Research has provided support for the benefit of incorporating gamification in work settings, but most of the existing research has focused on simple gamification features, such as points, levels, and badges [19,119]. Cardador et al. [13] offer a theory of work gamification by theorizing the effects of task enjoyment and access to visible, comparable, and immediate performance information on work effectiveness, work motivation, and performance. Pedreira et al. [19] reviewed the literature on gamification in software engineering and concluded that most of the existing research focuses on software development and less on other aspects, such as requirements gathering and project

management. Thom et al. [119] have found gamification to benefit participation and contribution in an enterprise social network system. Kumar [3] proposed the use of player-centered design to gamification in the workplace. There is a paucity of research that has examined gamification in a work setting, particularly in its application to software development or enterprise system implementation.

In this paper, we draw on several theoretical foundations for gamification to generate ideas for their application. However, due to the space constraint and the goal of focusing on their application, we have downplayed the role of theories in the paper, which may be considered a limitation of this paper. Several other researchers have identified theoretical foundations for gamification [11,70,120]. For example, self-determination theory, which comprises three types of psychological needs—need for competence, need for autonomy, and need for relatedness—has been used to study the use of points, badges, leaderboards, performance graphs, meaningful stories, and avatars [70]. Tondello et al. [107] used goal-setting theory to conceptualize and explain gamification, as well as propose improvements to gamification.

Caution should be exercised when implementing gamification in organizations. Gamification can enhance intrinsic or extrinsic motivation, and the trade-offs between fostering intrinsic versus extrinsic motivation will need to be managed. Intrinsic motivation is “doing something because it is inherently interesting or enjoyable” [121] (p. 55). Extrinsic motivation refers to doing something because of the interest to achieve some other external goals. For the success of projects, intrinsic motivation takes precedence over extrinsic motivation for satisfaction and quality, but not for on-time or within-budget implementation success [122]. Extrinsic motivation contributes to implementation success but not to satisfaction or quality [122]. Mekler et al. [123] concluded that points, levels, and leaderboards are extrinsic incentives that are only effective for promoting performance in terms of quantity. Future research may examine such trade-offs between gamification design elements that give rise to intrinsic versus extrinsic motivation.

A potential limitation of this paper is that it is primarily conceptually-based versus empirically-based. For instance, we did not conduct any experiments to evaluate the effectiveness of these gamification principles versus traditional training methods. Future research can consider conducting such assessments with an experiment, action research, or case study, for example. Although we have validated the design principles and elements of gamification with a group of experts, future empirical studies can be conducted to evaluate the effectiveness of each principle, the most appropriate method of its application, and the potential shortcomings. Also, assessments of different design elements for gamification in different contexts warrant further research. For example, in the context of learning, the use of a leaderboard has been found to reduce intrinsic motivation in the absence of a point system [124]. The result could be attributed to the discouragement or demotivation of not being listed on the leaderboard. When no leaderboard was used, not having a point system resulted in higher intrinsic motivation than the use of a point system [124]. Hence, the application of leaderboards and points in a learning context needs to be carefully evaluated to assess their positive and negative effects on intrinsic and extrinsic motivations.

Another potential limitation of this paper is that we did not empirically assess various outcomes and interactions among the design elements. Therefore, assessments should also be carried out for each individual design element and combinations of design elements to assess their potential interaction effects. Different sets of design elements can generate different outcomes [70]. Badges, leaderboards, and performance graphs have positive effects on competence, need satisfaction, and perceived task meaningfulness, while avatars, meaningful stories, and teammates contribute to social relatedness [70]. Hence, assessing design elements in different contexts, both in isolation and in combinations, is warranted. In addition, three types of motivations—utilitarian, hedonic, and social motivations—can be studied and assessed to more fully understand the impact of design elements on motivations [125], which can affect the implementation, user training, and effective use of enterprise systems. Another limitation is that we did not empirically assess the influence of environmental factors, such as industry dynamics (e.g., competitiveness of industry), or factors such as management influence. Future research can consider these topics as a focus as well.

In conclusion, a lens of “gamification” can be used by firms to drive competitive advantages [126]. Through this lens and the resultant change in mindset, firms can help facilitate large-scale enterprise system implementations to gain competitive advantages. The implementation, training, and usage of enterprise systems are inherently challenging, and gamification can help address these challenges. We provide a review of the principles of gamification as well as the key design elements for organizations to consider. We also discuss the application of these principles and design elements to enterprise systems in the context of implementation, training, and usage, as well as validate their application with enterprise systems experts. Identifying new ways to achieve effective usage, training, and implementation to fully realize the benefits of enterprise systems is a continuous quest, and organizations can utilize gamification to achieve this endeavor.

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