

Case Studies and Practices in Local Game Jam Software Development Organization: A Software Engineering Perspective

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ABSTRACT

This paper provides an overview and analysis of *local* computer game jams as game making organizations that identify important problems relevant to game developer students who know and interact with each other within a physically local community of practice. Different kinds of game creation organizational forms are identified, followed by five field studies of different game development organizational forms that are described and examined. Attention is directed to problems in team-based software development projects as found in game making, such as teamwork processes for computer game software engineering (CGSE), game software requirements engineering, game software design, game making tools, game software reuse, and global CGSE. From these studies and results, it becomes possible to identify and outline eight observations, lessons learned, or learnable lessons for future computer game jam research opportunities that may be appropriate for consideration by game jam organizers, game development scholars and students.

Categories and Subject Descriptors

D.2 [Software Engineering]: Software Development, D.2.9 [Management]: Project Management, H.5.3 [Group and Organizational Interfaces] Organizational Design; K.8 [Personal Computing] Games.

General Terms

Management, Human Factors, Measurement

Keywords

Computer Games, Software Engineering, Game Jams, Organizational Practices

1. INTRODUCTION

Many students and independent game developers participate in computer game development competitions, hackathons [35], or game jams [10,14,17,18,24,28,36]. These team-based game making efforts typically focus on clean-sheet production of a playable game usually in a limited time frame, like 24-96 hours though shorter and longer competitions have been engaged. Sometimes these jams have external for-profit or non-profit sponsors, who in turn may offer financial or technology product rewards to motivate participants to excel. Other times, jams offer no tangible rewards, but instead focus on going “for the win,” résumé building, demonstrating game development competency, earning local geek status, and shared learning experience as the desired outcome.

Game jams vary in geographic scope, from *global* game jams to regional or venue-specific (hereafter, *local*) game making events. This paper focuses attention on local game jams and game

creation efforts, with an eye on examining organizational practices and possibilities in such game development activities. Local game jams, game development competitions and game-making events are those where game developers commonly know one another across teams, and celebrate the *strum and drang* of their mutual game development successes and problems together. As such, such locality more readily embraces convivial as well as competitive game development.

An interesting set of research potentials arise associated with game jams, perhaps most relevant to empirical studies of alternative computer game software engineering (CGSE) processes, practices, methods or tools used. For example, within local intra-mural game jams, it may be possible to structure and balance the game development teams by team size, game developer roles, and SE skill level from students at hand. Students can indicate their skill level and developer role preferences, then have participants be randomly assigned to teams in ways that balance team size, role and skill level. This can mitigate against pre-formed teams with established collaborators, high skill distribution, and relatively mature game development capabilities. How might such teamwork structures affect how games are made, or the quality of the game products that are produced? Such questions require empirical study, and game jams may provide the venues for such studies to be conducted.

Short duration jams mitigate against the consequences of team failure or participant drop out, and instead make these events more of a CGSE learning experience. In this way, in addition to focusing on game production, the overall game jam can serve as a “field site” where selected CG design, SE processes and technologies [e.g., 13,14,24] can be comparatively investigated, following empirical SE approaches introduced more than 25 years ago [1,2]. Such field sites can allow for informal or systematic empirical study of teams using a new game software development kit (SDK) for indie game development [7], or development technique (e.g., SCRUM, agile development, or game modding) vs. those who do not; or those who produce traditional SE documents (requirements specifications, architectural designs, test plans) and follow SE processes for their game vs. those who just focus on game design methods. Intra-mural game jams so structured may therefore be well-suited for longer durations (e.g., from days to weeks), though ultimately this is a game jam design choice.

Game making competitions may stress short duration and co-location, along with targeted game production on a topic that is announced at the beginning of the competition. Inter-mural game jams, those open to teams from different schools, may not be so readily structured or balanced at little cost, but instead may address other CGSE questions that better match their natural field organization, geographic distribution, and project heterogeneity. However, there is no inherent requirement that game development

competitions must be short duration, as it is possible to create or find examples of those extending for years.

More generally, game jams offer the opportunity to organize, design, and conduct empirical studies in CGSE that can inform both new game design practices or processes, as well as new SE practices and technologies [6]. Some game SDK vendors have sponsored game jams that focus on participating team usage of specific proprietary products or platforms (e.g., Epic Games' *Make Something Unreal* and Microsoft's *Imagine Cup: Game Design*). These competitions can be used to address CGSE research questions in ways under-utilized in SE research, and thus highlight similarities and differences between traditional approaches to computer game design and software engineering [13]. Ultimately, this can mean that game jam-focused SE can be viewed as a competitive team-based sport activity that can be fun for students, as well as structured to support careful empirical study [24], rather than SE being a business endeavor to produce application systems hosted on back-end infrastructures accompanied by voluminous documents that few will ever read.

Finally, it is also possible to recognize new, under-explored ways and means for organizing game jams for further empirical study. For example, local computer game jams may be organized and designed as a kind of *meta-game*. Such game making events can be organized as a game, whose form resembles a game-based course, where student participants earn points and rewards while leveling up to higher level of academic proficiency [27]. Such jams may take organizational forms whose goal is to structure the outcomes (i.e., the games produced) to embody certain functional features, or the CGSE production processes to reward accumulative levels of progress achieved or skills mastered by different teams ("leveling up"), rather than just leading to winning and losing teams. Alternatively, game jams may be both experimentally modeled and studied as teamwork structured, CGSE role-playing games [15]. Last, game jams may focus on exploring cross-cultural CGSE development processes, whereby teams involve participants who collaborate across time, space, or cultural distance, via global CGSE processes and practices.

With these alternative forms for organizing game making events, it is now appropriate to identify and briefly describe different kinds of local game jams that we have been able to put into practice and study.

2. ORGANIZATIONAL FORMS FOR LOCAL GAME JAMS AND RELATED GAME CREATION EVENTS

Local game jams may be located in academic settings of different kinds. This may be especially important to academic scholars in game design or game studies, who seek innovative ways and means for conducting some form of empirical or experimental approaches to game development. Much like team-sports in schools, game development competitions can be organized as *intra-mural* (within school) and *inter-mural* (across schools). These team-based game development efforts can be undertaken in ways that complement formal CGSE (or just SE) educational principles and practices [4,5,24,28,34]. Sub-types of intra-mural and inter-mural game jams can be identified, for example when external sponsors are involved and tangible rewards are offered as incentives to motivate game jam participants, in contrast to jams where there are no external sponsors or tangible rewards so that game developers focus on symbolic rewards and convivial learning experiences as their motivation to participate. Such variations allow for examination of whether and how external

versus internal motivations affect the resulting games, local game development practices, teamwork, and the satisfaction of overall participant experience [17,18,36].

Capstone project courses are growing in popularity in computer game design, software engineering, or computer science degree programs. These projects are organized and managed by faculty who determine constraints on matters like team composition, choice of game SDK, or game deployment platform (e.g., games for Android smartphones, web browsers, or PCs). Alternatively, faculty may allow their students to make some/all of these choices. The faculty often serve as coaches that mediate and motivate student teams to be creative and collaborative, yet assured in their need to develop and deliver a complete project, along with required documentation, demonstration and final presentation. Sometimes these project courses benefit from external or non-academic project sponsors who see capstone project courses as a low-cost means for prototyping new game concepts, utilizing emerging technologies, or making serious games targeted to some appropriate application problem domain.

Another variation of the capstone project can be seen in tracing back the roots of jams to earlier exemplars in (non-game) domains like "Anijams" introduced and popularized for years within the film animation production community (not to be confused with *Ani-Jams* which are more recent community events for anime fans). Legendary animator Marv Newland and his International Rocketship Ltd. production company created a collaborative animated film making project where 22 animators in different locations each created a short animated film segment, given only the first and last key frame (graphic image) that they would then create the in-between frame sequences that would be included in the final composite film [16]. This collaborative development project effectively employed a common baseline visual outline that served as an animation storytelling architecture via the sequence of key frames. The project was envisioned to accommodate the independent, parallel creation of in-between animation sequences. A game oriented repurposing of this approach might take the form of a multi-team game development project where the game segments conform to a common software architecture design and run-time platform environment [33]. These semi-autonomous games could then be treated as modular architectural plug-ins, can interoperate to exchange game-play data/content assets across game modules.

Game development workshops are another kind of game making event that can explore or structure the development of games products and artifacts. Workshops can also experiment with and determine the practical efficacy of different tool/SDK selections, as well as the enactment of CGSE processes, project team forms, and work practices. Again, these workshops may be intra-mural or inter-mural, though it is easier to see them as open in some way to participants who are not specifically seeking academic coursework credit, but more an advanced or focused game development experience. Furthermore, such workshops may be externally sponsored and invite international participants, perhaps in ways that resemble the once-popular NATO Summer School Workshops that attract graduate or post-doctoral students in local scientific or policy problem-solving programs.

Intensive workshops rely on the organizers to provide intellectual leadership and technical guidance for the participants. In practical terms, a game development workshop may differ from an intra-mural game jams or capstone project through administrative and management choices. For example, a game development

workshop may involve the engagement and direction of multiple project leaders or subject-matter experts who serve to formulate, plan, and guide that activities engaged by workshop participants. Workshops may have an explicit curriculum and process plans that articulate a schedule of activities that correspond to the delivery and engagement of participants with specific topics. A CGSE workshop may therefore have faculty or industry experts who lecture (perhaps using a “flipped class” format) on a topic like a selected game software architecture and run-time environment that is conceived to demonstrate and embody SE concepts like: mini-games as architectural plug-ins; extension mechanisms that support multiple target platforms and modding via the use of multiple databases; and use of specified interfaces (APIs) to online banking/commerce services for encrypted user-specific transactions. Addressing such issues is commonly beyond what can be done in short-duration game jams, or game making events where participant teams are open and *ad hoc*, such that game makers determine the design of everything in the game.

Game development showcase festivals may be organized as either intra-mural, inter-mural, or open to independent game developers (whether or not affiliated with a university, school or game studio). Game showcase festivals are organized in ways similar to film festivals (e.g., Sundance, Tribeca, Berlin), where game development processes, tools used, team structure, artifacts produced, budget, schedules, etc. are all non-issues in the festival, which instead focuses near-exclusive attention to the games as products (or online services). With a product-centered focus, game developers focus attention to winning awards or recognition, as well as possible publication, distribution, or investment deals from third-parties (now including crowdsourced funders). So game showcase festivals can marginalize the significance of game development practices, other than to telegraph that winning teams must somehow be creative and technically competent in game development, but with little/no knowledge of anything learned or experienced by the game developers or of game development.

Other variations: Beyond the game jam types just identified, it is also possible to classify other recurring models of multi-game production competitions as game jam variations. For instance, game modding communities and portals routinely host contributed games/mods developed by teams, which are then played, reviewed, and ranked by other online game players. Example mod development competitions include the *Thief Modding Contest*, *Make Arma Not War*, and *Star Citizen Modding Competition*. Next, there are multiple, independent yet coordinated team research projects funded by external sponsors or government agencies, like the DARPA Crowd Sourced Formal Verification initiative called *Verigames* [32] in which a number of research-grade university teams are undertaking sustained, multi-year efforts to produce, deploy, and assess games that embody different approaches to crowdsourced gameplay for verifying large software systems (e.g., the Linux Kernel). Last, there are also competitions that focus on game materiality, such as costumes and wearables as game controllers [29], and case modding. Examples of the latter include Nvidia's *Mod24*, a full day long case modding competition, and *Cooler Master* case modding competition. So there is no shortage of formats, platforms, and venues that address different configurations of game development competitions.

Any or all of the above categories can be classified as collective, participatory teams working in parallel to make games or game technologies. Most often, attention is directed to the *products* of

game development efforts, principally the games produced. However, game jams can also focus attention to the comparative study of *game development practices*, collaborative game software development *teamwork processes*, evaluation of game development *artifacts* (game design versus run-time implementation versus game post-mortem), efficacy of *game development tools/SDKs employed*, or some combination of these socio-technical elements. Game competitions can also be extended to support other CGSE challenges like team-based game play-testing jams, or be aligned with game playing competitions, depending of the participants sought, and the audiences (or external sponsors) to be embraced.

With these different organizational forms for game making events, we now turn to describe a set of five field studies where we have observed multi-team game making events.

3. LOCAL GAME JAM AND GAME PRODUCTION FIELD STUDIES

Game development competitions can arise in diverse settings with different constraints and game development affordances. Five different kinds of game making efforts have been systematically observed as field studies in multi-team game development. These include: (a) local intra-mural game jams hosted by a student-run game development club, just for the fun of the experience; (b) local intra-mural serious game jams with external sponsor and post-jam development contract to the overall winning team; (c) a regional inter-mural game showcase with teams from different schools, along with multi-school teams; (d) intra-mural game capstone project course for academic credit; and (e) an international multi-team game development workshop focused on producing game modules for incorporation within a common game software architecture. Each is described in turn, then comparatively analyzed to identify observations, lessons, and opportunities for how to organize and design game jams. Such results may facilitate playful game making learning experiences and potentially innovative games, as well as do so in ways that generate new, empirically substantiated game software engineering research findings.

3.1 Intra-mural game jams at UCI VGDC

Video game developer clubs (VGDCs) are up and running at many colleges and universities. As a student-run venture, they can elect to host game jams as extra-curricular activities that are non-academic (no faculty mentors, no course credit) and open to all students who voluntarily attend. The UCI VGDC has students from many academic majors, including those not directly connected to computer games (e.g., biological sciences), as well as students from off-campus groups (e.g., nearby high schools and technical schools).

Since 2009, the VGDC has organized and run game jams, commonly three times per year. As the VGDC annual membership fluctuates between 60-100+ students per year, the game jams also serve as a recurring, core social event for the Club that focuses on student teams building games on short schedules (weekend or week long) on a single topic or theme (e.g., electricity, health, friction) that is randomly selected at the beginning of the game jam. Dozens of games have been developed and demonstrated across the jams, with 5-12 games presented at the end of each jam. The resulting games are demonstrated live before a public audience and panel of faculty judges. The live demo presentation includes a brief post-mortem, that highlights team-specific lessons learned. Much like [8], the post-mortems reiterate common problems with team projects, such as running out of time, need to

continually reduce game design scope, and a small number of team members under-performing or failing to perform as promised. The volunteer faculty judges evaluate the games on subjective criteria jointly identified with the VGDC (e.g., game graphic design, interesting use of sound/music, user experience, and efficacy of the post-mortem confessional). The judges are asked to provide overall rankings, as well as brief written feedback for the teams. The winning team receives hardy applause from the audience, and pats on the back, along with symbolic pride points and improved local reputation. The success and frequent recurrence of these local game jams as a fun but challenging way for game development has even caught the attention of local news media [9].

Over time, and in concert with student-voiced demands, the jam organization has evolved to forms where team members are chosen at random by role preference (programmers, artists, musicians, modelers, producers, writers) and balanced. This means team have roughly the same number of team members and skill sets, and do not necessarily have prior game development teamwork relationships. This helps to ameliorate that chance for established collaborators teaming up time and time again as an uneven competitive advantage, since VGDC students prefer “friendly competitions” that stress challenges that are bounded and learning-oriented, rather than cut-throat, winner-take-all competitions. This is a recognition that most competitions produce few/one winner, but mostly produce “losers”, which goes against the spirit of a learning environment, where gentle (and sometimes frequent) failure leads to improvement.

Student teams are free to choose the game development tools and techniques they want to use. So teams may choose complex game software development kits (SDKs) like Unreal Development Kit or Unity, or something very generic like open source Java game development libraries, or things in-between like Microsoft XNA libraries (which seem to reinforce development of 2D platformer games). Students have not chosen game SDKs like Aurora for Never Winter Nights, GameMaker, extensible virtual worlds like Second Life, or open source game software approaches [20], out of a lack of prior experience, lack of interest, or belief that these are not “professional” game development environments. Tool choice is generally decided by team programmers based on their prior experience or current preferences.

Teams also decide which game/software development artifacts to produce. Most common are game design documents, but also shared persistent chat transcripts, online/in-game user tutorials, and game jam demo presentation slide decks. Finally, some teams find sufficient self-interest and enthusiastic play-testing responses from users that they elect to continue to develop the game after the jam, with the goal of publishing the result in an online game store like Microsoft Xbox Live or Google Play. In contrast, student teams do not produce CGSE documents like explicit functional or non-functional requirements, nor systematic test and integration plan specifications [3]. Thus it is unclear if this is a missed opportunity or just something the students find irrelevant to their game jam development efforts [26].

Last, VGDC students have stated their interest to prefer to participate in these local intra-mural game jams where they can know the other students developing games and participate in a local game making scene., This is in contrast to their seeking the same level of participation in events like the Global Game Jam. In previous years, VGDC students indicated they felt the GGJ was

too remote and weakly engaged, and open to teams with independent game development “ringers” who may unbalance the game jam playing field competition, thus focused more attention to prize winning (and thus to producing mostly losing teams and games that are lost in large under-differentiated game submission repositories). Similarly, the UCI VGDC students have multiple game jams to elect to participate in, including those described below. Nonetheless, in 2015, the VGDC mobilized participation and game submissions for the GGJ, due in large part to the leadership and encouragement of a new faculty member focused on Computer Games (Josh Tanenbaum) who recently joined UCI.

3.2 VGDC intra-mural serious game jams

As the VGDC developed a reputation for engaging under-graduate students in independent game development outside of their coursework, outside industry, academic, and government partners have sought to sponsor game jams aligned with their institutional interests. In this regard, these outside groups want to sponsor a jam that produces serious games that address their interests. Oftentimes, these jams are envisioned to allow the external sponsor to reach out to students as way to encourage student innovators/entrepreneurs, or as a form of job recruitment. These arrangements may bypass the engagement of the host school, their faculty, external grants development offices, and student placement services, but in general no major administrative problems or resistant academic politics seem to surface.

As an example, the local chapter of the American Heart Association approached the VGDC to sponsor a game jam whose game efforts would focus on the topic of “healthy hearts” and related healthy lifestyle choices. Six teams completed and presented their games after a week long jam for review and evaluation by panel of judges from the AHA, local game industry, and UCI faculty. The winning team then received a cash prize, along with a six month contract to further develop the game for possible deployment and release under AHA sponsorship.

The winning team, once beyond the constraints of the initial game jam, and with external resources in hand, then recruited additional student contributors, to expand, enrich, extensively playtest, and polish (“balance”) the game play experience. As ongoing development continued, the development team went on to enter the enhanced game into an inter-mural game showcase where they received a special achievement award for best serious game. The AHA sponsor then sought to push towards a commercial-grade game to be released, if more substantial funding could be mobilized from other external sponsors, such as the Entertainment Software Association Foundation. However, since the students team would now need some business and administrative capabilities, then elected to engage the author as a faculty advisor, who could serve as a Principal Investigator at UCI in preparing and submitting a grant application to the ESAF. Though the proposal was selected as a finalist, funding award was not received, so after 1.5 years of effort, the student team elected to wrap up their game development effort and move on. Overall, the student participants indicated it was a great experience in learning what it really takes to get a game from a local, short duration game jam through external funding and partnerships with multiple enterprises, all well beyond any coursework they have taken. The temporal boundaries of game jams thus merit further attention.

3.3 Inter-mural game development showcase

Based in part from the successes and experiences of the intra-mural game jams at UCI, and the growing participation of students from other nearby trade schools, colleges and universities, an effort was mounted to elevate these regional game jams into an inter-mural form. As a number of faculty, both local to UCI and nearby, were also active in the local chapter of the IEEE Computer Society (as well as the Independent Game Developers Association) that hosted a special interest group in Games (SIGG), and the local IEEE advocates were searching for new ways to enlist students into their profession (mostly populated by mature engineers), then a relationship with SIGG emerged to establish and host such an inter-mural event. However, as different schools have different levels of student interest and coursework in computer games (e.g., UCI has 4 year CS degree program with a dozen game focused courses, while other schools may offer only 1-2 courses in game design), the SIGG people decided to organize the game jam in a manner more like a game showcase (similar to IndieCade or film festivals), rather than as a time-limited game jam. This means student teams would be unbalanced, could take as long as they wanted to make their game, engage whatever tools and techniques they found appropriate, and even be able to submit games that were projects in a capstone project course, or those submitted from other game jams unrelated to this competition and its sponsors.

The showcase requires that game software and content assets must also be packaged and posted on servers, for download and installation. Also, teams had to submit a 5 minute or less video of the game team and design pitch (present the game concept) and recordings of live play sessions. Game teams compete for recognition from game industry veterans, who select the best games and game demo/presentations, to determine the winners in different categories (e.g., best mobile game, best game overall). The industry judges include executives and lead designers from large multi-million dollar game studios, long-term independent game developers, or leading game artists/musicians, all of whom are familiar and experienced with publishing successful, money-making games. The judges final decisions then determine prize winners. Noteworthy here is that some of the overall game showcase winning game teams have gone on to receive external investment from either angel investors who attend the showcase and observe audience reactions/interest, or from crowdfunding sites (Kickstarter, Indiegogo). Such investments thus help to evolve and transform a student team game jam result or game project into a new venture. Again, the boundaries and outcomes of the competition merit further consideration and study.

As this form of game development competition as an inter-mural activity that engages students teams from multiple university or colleges, then it may be natural to ask in the competition can be formalized into something approaching an intercollegiate sport—again, game development as a team sport [24]. While scholars like Taylor [30] and others have examined the socio-technical, material, and creative dynamics of e-sport events that focus on competitive game play, it is probably too early to expect that inter-mural game jams may get elevated to full-fledged collegiate sport. But maybe our expectations are too low or mis-directed. Alternatively, inter-mural game jams can grow to incorporate teams that span multiple schools that are geographically dispersed, thus affording participants first-hand experience in distributed, multi-site project work that relies on shared online

information, social media, and related information repositories, all of which are key to the future of work in the Internet age.

3.4 Capstone game development project course

Faculty and students are increasingly familiar with capstone project courses whose goal is to unify and demonstrate what students have learned through their prior coursework. Such project courses can span common academic periods like 10 week quarter or 15 week semester, or longer (UCI's game capstone project courses for majors is now 20 weeks). These project courses are not explicitly organized as formal competitions with winners and losers, but more like long-duration intra-mural game jams, where sustained focus, hard-work, collaborative development, and self-satisfaction are all desirable elements of open, multi-team software development project work [21,22].

Capstone projects have been employed in SE education programs for decades. SE project courses first appeared in the 1970's (cf. "Programming in the Large" c. 1975) and began to flourish in the 1980's, along with the establishment of the Software Engineering Institute at Carnegie-Mellon University in the mid-1980's. Part of the early charter of the SEI was to encourage and advance SE Education (SEE) as a national priority. Different project organizations and SE processes were thus encouraged and celebrated in research papers addressing SEE. Some educators further specialized in operationalizing their SE project courses as research test-beds where experiments or other empirical studies of SE could be performed, analyzed, compared, and published [1,2]. Among the SE practices that were subject to empirical study were the use of rapid prototyping versus conventional approaches to software development [2], and utilization of balanced student teams developing common formal and informal software development artifacts, with/without reusable exemplars, on a short schedule [1]. Other SEE projects employed either a common software architecture [33], or one with plug-in modules for each team to development [34], or else a common software development infrastructure of tools/services [19].

As game capstone project courses are still emerging, as is the community of practice focusing on CGSE, then it is still common to find such courses organized as independent student teams each pursuing their personal interests in their game development efforts. Again, this also reflects popular practices that are used in independent game festivals and inter-mural game showcases. At UCI, the first capstone project course featured three student teams, while the most recent effort featured nine teams, reflecting the growth of this local program.

3.5 International game development workshop

In Fall 2014, the author and other faculty at UCI were approached by a group of companies and universities from South Korea and China. They were interested in us developing and offering a computer game development workshop for international students from these nations. The resulting Workshop is planned for 2016, so the description here is a mix of proscriptio of what it may be (i.e., "work in progress"), rather than an historical record describing what it was.

The Workshop is conceived and organized as a multi-week summer school, in the spirit of the NATO Summer Schools research topics. The 30 or so participating students are grouped in near-balanced teams (to accommodate the uncertainties in student

experience and game development capabilities), with six or so teams anticipated. There are five academic faculty who are co-organizing and co-teaching the Workshop, which is to be run as a large game development studio with all teams working on a common game architecture and target deployment platforms (e.g., online Web and mobile devices). The faculty have also recruited more than a dozen game industry veterans to serve as guest lecturers on specific topics, or who may participate in student project reviews. A common software architecture has been designed, along with a common game development infrastructure of tools to be used, and game development artifacts to be produced for faculty and peer review. The game software architecture is structured around plug-in game modules, where each module provides, at minimum, a complete mini-game experience, as well as exchange and interoperation of game play assets (in-game resources and play scores that can move across modules, accumulate and persist). The game development infrastructure assumes multiple loosely-coupled repositories for sharing game software files (versioned, as done using GitHub), in-game content/assets models and textures (versioned), user play data (in-game character customizations, resource holdings and scores), and anticipated online store repositories for game distribution.

So what kind of a game making event is this Workshop? Is it a game jam? First and overall, the Workshop is inspired by the alternative game jam organizational forms described above, with elements drawn from intra-mural jams (all local teams, working collocated and in parallel on same schedule, producing common deliverable types), inter-mural jams (students are from different schools in their home countries, though student teams are expected to be pre-formed at the home institution before the Workshop), and capstone project following the SE project forms that utilize balanced teams working on recurring short (bursty) schedules to produce targeted game artifacts (design documents, character designs, etc.).

Second, competition in the form of comparative assessment of each participating team's effort, along with team pride, can be utilized as a constructive motivation [10,17,18]. Also, as the team's are expected to produce games (or game modules) that will be part of a commercial release, then the short product development cycle tends more toward a game jam, where severe time limitations help to encourage (or force) timely decision-making on creative or technical choices.

Last, whether this style of game jam is one that relies on or practices: gamified coursework [27]; advanced CGSE education [4,5,12,13,,34]; rapid prototyping [2,14]; or software development work forms that resemble industrial "playbour" [11,31] rather than hard work and fun that is mutually beneficial and exploitative for both game studios/sponsors and game modders/hobbyists [22]; is an open question for further study. Suffice to say that other large software development projects have followed such development organizational forms, that the effort merits investigation as yet another viable method for a game jam, in this case, one that focuses all teams to contribute to the development of a single overall game experience, but one that is factored into plug-in functional modules that can share and exchange common game play resources and assets.

4. OBSERVATIONS, LESSONS LEARNED, AND LEARNABLE LESSONS FOR GAME JAM ORGANIZATIONAL FORMS

A number of observations follow from these five field studies of local game jams.

First, local game jams are a promising venue for empirical studies of game development and software engineering. Many different kinds of configurations for organizing such jams have been identified. More potential configurations and reconfigurations therefore seem likely. Similarly, there is more potential opportunity to look for ways and means for structuring such software development competitions, or for analytically framing such competitions as a team sport, and thus also suitable to further gamification.

Second, most game jams, whether local or global, often focus primary emphasis on *the product* of the development effort—the game produced—while discounting or ignoring attending to the affordances and capabilities that are rendered in: game development artifacts (e.g., game design documents; persistent online game developer chat transcripts to codify the knowledge and team logic underlying a game's development; choices made regarding use of game development tools or SDKs as a mediating factor in game production; whether development teams are balanced by role and team size versus ad hoc and open; and more. Game development competitions also represent a relatively unexplored domain for empirical studies of collaborative software development teamwork [12], particularly those that rely on online artifacts (e.g., game design documents, persistent chat transcripts, game screen layout and artwork mockups, game mods) moving within/across shared repositories and social media [21], which may therefore represent a promising approach to renovate traditional non-game software development projects.

Third, local game jams accommodate organizational design variables that may be more readily structured and (experimentally) controlled compared to open global game jams. This is not to say that local is better than global, but instead to draw attention to what variables can be addressed in different or comparative studies of game development competitions. Global game jams are well-suited to studies of cross-cultural game development practices, and perhaps readily extended to also investigate global SE or global CGSE issues. Much remains to be investigated, observed, analyzed, and compared here. So spatial, temporal and cultural distances within or across GGJ teams, or within international game development workshops, seems like another opportunity to explore or put into practice.

Fourth, game development competitions are yet (?) to embrace participation in large-scale game development (e.g., MMOG) whereby teams compete based on their contribution to an overall established game software and asset/content architecture as the common focus for all participating teams. Game jams (rather than singular game development teams) could also be designed to focus on development of new "features" for established free-to-play games that are taking over the world of online, mobile games. Game jams with such foci may be of great interest to the game studios old and new, as ways to demonstrate whether/how such game jams can create MMOGs/F2P features with plausible economic value as well as enabling (student) participants experience in game development practices that are not as well

addressed by traditional game design approaches. As before, whether such competitions are seen as providing asymmetric benefit to the game studios (thus denoting a playbour dynamic [11,31]), or are also mutually beneficial to participating students/indie game developers [22,26], remains an open question.

Fifth, as game jams vary in the duration, product/artifact submission requirements, team size and role composition, then there are conceptual challenges for how to articulate both plausible and reusable research methods for field studies or systematic artifact studies. Similarly, how might a game jams be designed to focus the efforts of participating teams on maximizing product quality and development productivity, within limited duration jams? Such a question addresses a classic challenge in identifying how best to engineer a new software system within time and budget constraints.

Sixth, the five field studies and different forms of game development competitions help reveal that such events vary by the amount of technical and creative leadership versus free choices provided by the organizers. The more short-term and informal, the less guidance and commitment required, while longer-term and more structured, the greater guidance, commitment, and quality assurance oversight required. This is of course a lesson learned long ago within the SE community, and thus one that is shared and re-learned by game jam organizers and focused game development project leaders. The competitive element of game making on a common schedule (if any beyond submission deadline), and on reliance of project leaders to mentor, plan, and guide development teams, helps better prepare participants for understanding what is required for making games that must go beyond a “weekend wonder.”

Last, game jams traditionally ignore or marginalize topics that are important to commercial game software success. These include: (a) how to support secure game play and secure in-game purchase systems or payment service interfaces; (b) how to develop games that resist efforts of players to cheat, or create grief for unsuspecting players; (c) how to embrace the rise of game architectures for free-to-play games that are centered about periodic addition of modular “features” (new in-game play objects or character adornments rather than expansion packs) that support game play update experiences and micro-transactions for purchasing in-game (or across game) resources/assets; (d) game jams that encourage user-directed extension or repurposing other existing games that are open to such evolutionary adaptation [22,25]; (e) how to make serious game jams more open to participants with domain-specific expertise who may not be skilled in game design, programming, or artwork creation, but who can help specify valuable domain topics for players to learn or master; and (f) how best to rapidly produce games within a jam style competition that embrace software sustainability issues that do arise (e.g., software designed for reuse as a sustainability technique), or do not arise (games that are not envisioned as products, but instead as demonstrations of mastery or development skill potential) in game development competitions.

5. CONCLUSIONS

Game software development competitions are fun but hard work, low-cost, of varying duration, and intensive. Most are neither motivated nor rewarded academically (i.e., no transcript grades or formal examinations given). However, they can be intra-mural or inter-mural, and can stipulate balanced or *ad hoc* team configurations. Capstone game projects can also be organized as

intra-mural competitions that may or may not have external game project sponsors. In such capstone project courses, emphasis is generally focused on learning how to practice and demonstrate competency in game software development, but in the future may also focus on computer game software engineering (CGSE). Game competitions can also be open-ended or closed-ended. But their organization oftentimes impose constraints that may unnecessarily inhibit the competitors, limit their skill development or learning, impose game development frameworks that limit rather than facilitate creativity and rapid development.

Multi-team game development competitions vary by the amount of leadership, commitment, and guidance provided to participants by the competition organizers. Lower effort requires more independent choice by game makers, greater risk of making common/known mistakes, and good luck, while higher effort reduces choices, requires more resources and project management, may produce more sophisticated and accomplished results, yet does not guarantee a winning product. Such are the lessons so far seen within CGSE as a lens focusing on game jams and related game making competitions.

Game software development competitions can serve as a testbed for exploring, observing, or evaluating new SE tools, techniques and concepts. Such events can therefore also serve a field sites for careful empirically grounded field studies of game making processes and practices. Equalized and balanced competitions represent time-compressed ways and means for conducting empirical SE studies. Competitions can precede or follow software engineering education (SEE) coursework, as follows: jams conducted before SEE coursework draw attention to raw talent, while jams after SEE coursework emphasize demonstration of learned SE skills that is more accomplished and better balanced, if the SEE was successful. This may help students and others in industry understand the value of presenting SE experiences in ways that entail tough technical, time-constrained team collaboration challenges that are ultimately perceived as a fun thing to do.

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