



Software Architectures and the Creative Processes in Game Development

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Introduction

- Game development != Software development
 - Less reuse of modules
- Increase in resource and complexity proportions
- Absolute real-time requirements to support creative processes



Research goal + Research Questions (RQ)

Research goal:

“examine how software architecture is used and how creative processes are managed from the point of view of a game developer in the context of video game development.”

- RQ1: What role does software architecture play in game development?
- RQ2: How do game developers manage changes to the software architecture?
- RQ3: How are creative processes managed and supported in game development?
- RQ4: How has game development evolved the last couple of years?



Method

- Literature study
- Questionnaire
 - Agree - Neutral - Disagree - N/A + free text
 - Nordic booth at Game Developer Conference 2021
 - Direct emails to game developers

Results RQ1 1/3

- “Oversight in the game software architecture may lead to serious dead ends, leading to a need to rewrite the entire system”
- the importance of quality attributes such as performance (frame rates), portability, testability, and modifiability, which are very hard to change after release
 - the increasing focus on network games demand more focus on security (to avoid cheating) and availability for game servers
- “Main goals are: Performance and Memory consumption.”

Table 1. Statements related to the design of software architecture in game development

ID	Statement	Agree	Neutral	Disagree	N/A
Q1	Design of software architecture is an important part of our game development process	69%	15%	8%	8%
Q2	The main goal of our software architecture is performance	54%	15%	23%	8%
Q3	Our game concept heavily influences the software architecture	69%	8%	15%	8%
Q4	The creative team is included in the design of the software architecture	69%	15%	8%	8%
Q5	Our existing software suite provides features aimed at helping the creative team do their job	92%	8%	0%	0%
Q6	Our existing software architecture dictates the future game concepts we can develop	15%	47%	38%	0%

Results RQ1 2/3

- Almost 3 out of 4 of the game developers agreed that the game concept heavily influences the software architecture
 - Surprising - game engines should ideally make the software architecture less dependent on game concept.
- How much the game concept will influence the game software architecture is really a question about where the boundary between the game and the game engine.
- Too general game engines will most likely provide overhead in code and thus result in poor performance and memory usage

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Results RQ1 3/3

- The large majority of the respondents agreed that the creative team was included in the design of the software architecture
- Game development is all about creativity and coming up with new game concepts. The response from statement Q6 shows that the software architecture does not to a large degree dictate future game concepts (15%)
 - “This is primarily market-driven”
 - “It may influence, but not dictate whenever possible”
- Cost-benefit trade-off - The higher cost of change, the more influence the existing software architecture exert on the game concepts.

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Results RQ2 1/2

- “The game design comes first, then we build what is necessary to make it happen.”
- trade-off between creative freedom and the technical limitations. Either the ideas must be adapted to the technology, or the technology to the ideas.
- The creative team can demand changes to the software architecture
 - Depends on:
 - How far in the dev process
 - Size of change
 - Who requests the change
 - “[...] the odds of re-factoring an entire system late in production are close to nil, but the development team keeps an open mind at all times”

Table 2. Responses on how game developers cope with change to the software architecture

ID	Statement	Agree	Neutral	Disagree	N/A
Q7	The creative team has to adopt their ideas to the existing game engine	31%	46%	23%	0%
Q8	During development, the creative team can demand changes to the software architecture	69%	31%	0%	0%
Q9	The technical team implements all features requested by the creative team	69%	15%	8%	8%
Q10	It is easy to add new gameplay elements after the core of our game engine has been completed	70%	15%	0%	15%
Q11	During development, the creative team has to use the tools and features already available	47%	15%	38%	0%

Results RQ2 2/2

- requirements error can cost up to 100 times more after delivery if caught at the start of the project
- Q10 - comment: Adding new gameplay elements after completing the core game engine is often not possible, recommended or wanted
- “[...] the creative team judges how important the change is, the technical team decides if it is realistic and the management makes sure it can be afforded So mostly, it is a team decision”

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The response to the question about who decides if change-requests from the creative team are implemented is shown in the table below (Q12):

Technical team	Management	Creative team
10%	40%	50%

Results RQ3

- However, substantial changes to game play and changes of the game engine itself usually cannot be changed in run-time.
- Until the game engines can optimize the scripts automatically, the technical team often must assist the creative team with scripting.

Table 3. Responses to how creative processes are supported

ID	Statement	Agree	Neutral	Disagree	N/A
Q13	Our game engine supports dynamic loading of new content	92%	8%	0%	0%
Q14	Our game engine has a scripting system the creative team can use to try out and implement new ideas	70%	15%	15%	0%
Q15	The creative team is included in our development feed-back loop (e.g., scrum meetings)	86%	8%	0%	8%
Q16	Our game engine allows rapid prototyping of new levels, scenarios, and NPC's/behavior	86%	8%	0%	8%

Results RQ4



- Q17 - comment: “buying a good middleware will provide a better result than what an organization can produce at the same prize”
- Q18 - comment: “The complexity of games and the players’ expectations have increased over the years, but the tools and the engines have also made it easier to manage complexity as well as achieving higher fidelity”
 - “[...] developing a great game is still as challenging as before, the problems to solve just have evolved”
 - “Technically and graphically, yes. Conceptually, no.”

Table 4 shows the results on how game development has changed the recent years.

Table 4. Responses to how game developer has changed the last couple of years

ID	Statement	Agree	Neutral	Disagree	N/A
Q17	Today our company uses more 3 rd -party modules than 3 years ago	46%	15%	8%	31%
Q18	It is easier to develop games today than it was 5 years ago	77%	8%	15%	0%
Q19	Middleware is more important to our company today than 3 years ago	55%	15%	15%	15%
Q20	Game development is more like ordinary software development today than 5 years ago	38%	24%	38%	0%

Conclusions: 1/2

- RQ1:
 - SW arch. is important in game development
 - The game concept heavily influences the software architecture mainly because it dictates the choice of game engine.
 - The creative team can affect the software architecture
 - Existing software architecture may or may not dictate future game concepts depending on a cost/benefit analysis
- RQ2:
 - The creative team has to some degree adjust their game play ideas to existing software architecture based on a cost/benefit analysis.
 - Decisions on change-requests are usually made by involving personnel from technical team, creative team and management, but the management has the final word.
 - Easy to add new game play elements after the core game engine was complete (although not recommended late in the project)
- RQ1: What role does software architecture play in game development?
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Conclusions: 2/2



- RQ3:
 - Almost all of the game developers said they used game engines that support dynamic loading of new game elements (although not everything in run-time)
 - The majority of the respondents use game engines that support scripting. Only game developers with own developed game engines did not support scripting.
 - The majority of the developers said they used game engines that enabled rapid prototyping of new ideas
 - RQ4:
 - There has been an increased use of third-party software, middleware has become more important, and it has become technically easier to develop games.
 - Although the majority of respondents said the technical aspects of game development have become easier, game development in itself has not become easier due to higher player expectations and higher game complexity.
 - there was no clear conclusion whether game development has become more like conventional software development
- RQ1: What role does software architecture play in game development?
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Questions?

