Aspect Based Sentiment Analysis to Explore Gameplay Topics in Game Software Evolution (Robocraft Study Case)

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Abstract. The digital game industry has experienced rapid growth driven by increasing demand for digital entertainment, giving rise to online distribution platforms such as Steam that provide review features enabling players to share their gaming experiences. Player reviews accumulated in large volumes represent a strategic source of information for developers seeking to understand community perceptions toward each game update. This study analyzes player review sentiment in Robocraft toward gameplay mechanism aspects — encompassing Building Mechanics, Player Progression, and PVP System — across major patch updates from July 2014 to November 2019. Employing a two-stage pipeline combining BERTopic for topic exploration and BERT-based Aspect-Based Sentiment Analysis (ABSA) for sentiment classification, the study processed over 15,000 unique reviews collected via the Steam API. Results identify 2016 as a permanent turning point in community sentiment, wherein the progression system overhaul during the CPU Update + Epic Loot period triggered a negative sentiment dominance that never recovered through the game's server shutdown in 2025. These findings indicate that Robocraft's decline was driven more by monetization decisions perceived as exploitative rather than a failure of its core creative concept, which remained consistently appreciated throughout the game's development.

Keywords: aspect-based sentiment analysis, topic modeling, BERTopic, BERT, player reviews, game software evolution.

1 Introduction

Entertainment has become one of the main driving factors behind technological development. With the increasing need for entertainment in the digital era, the game industry has grown very rapidly. Games that originally existed in the form of consoles have now evolved to become more accessible through online platforms. This allows players from various parts of the world to connect and participate in the gaming ecosystem more broadly.

© The Author(s) 2026
M. Murtadha et al. (eds.), *Proceedings of the 2026 11th International Conference on Sustainable Information Engineering and Technology (SIET 2026)*, Atlantis Highlights in Computer Sciences 26,
https://doi.org/10.2991/978-94-6239-828-3_24

One online-based game that is interesting to study is Robocraft, a vehicular combat game that allows players to build robots and battle other players. Since its alpha version in 2013, Robocraft managed to attract more than 300,000 players within just one year, as reported by Gamasutra in 2014. Over nearly a decade of development, Robocraft underwent various significant changes, ranging from major patch updates that altered building mechanics and reward systems to its monetization model. Each of these changes had a major impact on the overall gameplay experience, which is reflected in the dynamics of player reviews on the Steam platform.

If we looked at Robocraft's Steam page today, an interesting phenomenon is brought to light almost immediately, with reviews tagged as “Recommended” being laced with nostalgia and love for a certain version of the game in the years of 2014 until 2015, whilst reviews tagged as “Not Recommended” clearly showing disdain towards the later versions of the game. This phenomenon shows that player reviews can serve as an important indicator for assessing the quality of a game, as well as function as a strategic source of information in development decision-making. Using an aspect-based sentiment analysis approach, it is possible to deepen the analysis by identifying patterns and the progression of positive and negative sentiment toward gameplay aspects throughout Robocraft's development.

Gameplay mechanics are defined as the tools of gameplay, or the objects that serve as the basis for player interaction. This study will focus on the gameplay aspect by specifically examining gameplay mechanisms as the foundation of the gameplay experience. In Robocraft's case, the gameplay mechanism aspect will encompass discussion of topics such as levels, player points, weapons, and others.

This study aims to analyze the general public sentiment of gameplay quality throughout Robocraft’s developmental phase based on its player reviews on its official Steam page. This is done by exploring the distribution of topics through topic modeling that emerges during specific periods of the game's evolution, particularly those related to gameplay aspects, and then to analyze the sentiments toward those aspects as Robocraft developed and find when exactly did the overall public sentiment underwent an enormous shift. The results of this study are expected to provide a practical contribution to understanding how player reviews of patch updates can influence the longevity and success of a game.

2 Research Methodology

There are seven major steps included in the implementation of this study, starting with data collection up until the final evaluation of the process. These methods are crafted with the idea of crafting an observational hypothesis through sentiment analysis in mind. With that, the step taken in order to achieve that are as detailed in Fig.1.

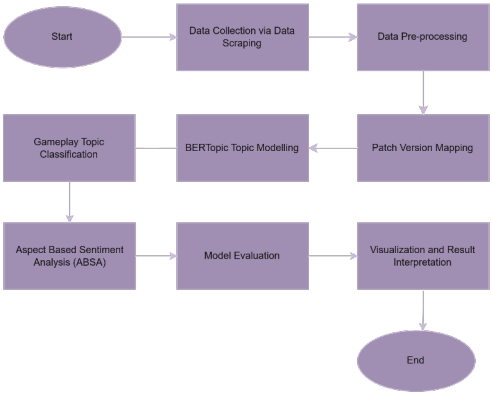


Fig. 1. Methodology Flowchart

2.1 Data Collection

Data was collected using the non-participant observation method through the Steam API, which produced review text along with its publication timestamp, stored in CSV format. The Steam API was chosen because it provides comprehensive access to the entire history of Robocraft reviews, yielding approximately 57,000 raw reviews from July 2014 to November 2019.

2.2 Data Preprocessing

Preprocessing was carried out sequentially through six stages: duplicate removal, filtering of short reviews (fewer than five words), filtering of non-English-language reviews, text normalization (case folding, contraction expansion, removal of URLs and noise characters), lemmatization and stopword removal using SpaCy, and opinion-unit extraction based on sentence segmentation for ABSA granularity purposes.

2.3 Timeline Mapping

Research that traces the evolution of game software using the mapping and progression of game updates is not an unfamiliar concept. In Zhong & Xu (2022), the success of three types of game updates, namely large updates implemented infrequently, large updates implemented frequently, and small but frequent updates is assessed. This stage was carried out to achieve the objective of this study, namely to observe the progression of Robocraft players' opinions regarding gameplay aspects throughout the development period. The gameplay aspects that are observed in this study are namely building mechanisms of the vehicles, the player vs. player feature of the game, as well as the progression system for its players. These defining gameplay aspects are decided from Robocraft's game description on their official Steam page. This stage was carried out to define which updates fall under gameplay-aspect updates, as well as the scale and significance of the updates that have been made. Updates that involve significant changes to the gameplay mechanism aspects will be denoted as major patch updates, and will become the main focus of this study. Defining major patch updates is done by noting every single official patch update announcement and categorizing them into MFUs,

MiFUs and IUs through the significance of the updates extracted from the official patch notes.

2.4 Manual Dataset Validation

Validation was carried out using a semi-supervised model-assisted validation approach, in which a model trained on a portion of manually annotated data sampled from the original pre-processed dataset will then be used to generate predictions on the another portion of the manually annotated data labeled as validation data. The model is trained on 70% of the manually labeled data and validated by the rest of the 30%. Discrepancies between model predictions and manual labels were used as an indicator of annotation consistency and used to improve dataset quality before final training. Validation is done by using metrics such as Confusion Matrix, Accuracy, Precision, Recall and F1-Score.

2.5 Topic Exploration and Classification

Using the MDA framework by Hunicke et al.(2004), the foundation of game design can be divided into three aspects: Mechanics, Dynamics, and Aesthetics. This research defines game mechanics as the various actions, behaviors, and control mechanisms given to a player within the context of the game. The example given by this framework is the mechanics of shooter games, where the relevant game mechanics trace weapons, ammunition, and player spawn points. This framework serves as a strong reference in defining the gameplay mechanism aspects and the game features that can be considered part of gameplay mechanics. With this reference in mind as well as Robocraft's defining features and descriptions taken into consideration, we then assembled a hybrid approach of both topic modelling using BERTopic, as well as a lexicon based approach to ensure nuance in discussion is still considered in classification. The sample details of keywords used are: building, battle, blocks, match, exp, cube, matchmaking, farm, armor, rank, progression, etc.

Topic extraction was carried out using BERTopic with a three-stage pipeline: document embedding using BERT, dimensionality reduction using UMAP, and clustering using HDBSCAN. A separate BERTopic model was trained for each patch-version group in order to observe the dynamics and distribution of topics over time. After this topic exploration was done, we then used a lexicon based approach by using a list of token keywords to extract player reviews that incorporated those keywords in its topic extraction. We also conducted a separate lexicon based approach by making use of strong and weak keywords to make sure that reviews with more nuance and layers will not be lost in the outlier.

2.6 Aspect Based Sentiment Analysis

The use of an aspect-based sentiment analysis approach to trace the various aspects underlying the design of game software has also been carried out. In (Yu et al. 2023), an analysis framework using an aspect-based sentiment analysis approach combined with topic modeling results in an output consisting of various topics found in player

reviews; these topics are then analyzed to find the relationship between player concerns written in reviews and the targeted game aspects.

Sentiment classification was carried out using a two-stage pipeline, the first being token-level classification for aspect classification and the second being sentence-level classification to determine sentiment (positive and negative) for those aspects (Bilgin & Turan, 2025). The aspect classification stage for gameplay topics was carried out using a dictionary-based partial and exact string-matching method that was compiled and developed according to the context and features of the game. The keyword sets in this dictionary relate directly to the game's vehicular building mechanics, the player progression system, and the player-versus-player system.

After aspect classification, sentiment classification was carried out using BERT, which uses pre-trained transformer models to classify the emotion behind each opinion unit that has already been categorized into the gameplay topic aspects, as either positive or negative. The output of this stage produces player reviews that already have a gameplay-topic-aspect classification, along with the resulting sentiment. Training of this model was trained and validated using the manually labeled dataset, with 70:30 ratio of training data:validation data.

Insights obtained from the analysis of player review sentiment plays an important role in the evaluation of a game. This is demonstrated in Li et al. (2021), which, using a combination of sentiment analysis, classification, and topic modeling, found that review-data-based methods can serve as an effective method for evaluating player perception and can be used to trace the strengths and weaknesses of a game.

2.7 Evaluation

The evaluation process began by tokenizing the validation data using the same method as in the training stage, in order to ensure consistency of input representation. Next, the model produced predictions in the form of a probability distribution for each sentiment class, which was then converted into a predicted label based on the highest probability value. These predictions were then compared against the ground-truth labels to calculate various evaluation metrics. The main metrics used include accuracy, weighted F1-score, and macro F1-score. Accuracy measures the overall proportion of correct predictions, while weighted F1-score accounts for class distribution, making it more representative for imbalanced datasets. Meanwhile, macro F1-score provides a picture of model performance across each class equally, without regard to sample size, making it very useful for evaluating a model's ability to recognize minority classes.

3 Results and Discussion

3.1 Manual Dataset Validation Results

Aspect classification validation was carried out on 100 manually labeled reviews in multilabel format. All three aspects met the 80% accuracy target: PLAYER_PROGRESSION achieved the best performance with 92% accuracy, 95% precision, 92% recall, and an F1-score of 93%; BUILDING_MECHANICS achieved

82% accuracy, 89% precision, 80% recall, and an F1-score of 84%; while PVP_SYSTEM achieved 80% accuracy and 83% precision, with a recall of 63% reflecting the challenge of detecting PvP discourse that is often expressed narratively. Sentiment model validation using a 70:30 split produced 96% accuracy and a 96% macro F1-score, with only two discrepancies in the validation data, indicating that the model shows no bias toward any particular sentiment class.

3.2 Gameplay Topic Exploration Results

BERTopic produced a total of 286 topics across all patch periods, of which 44.7% (131 topics) were classified as gameplay topics. This proportion indicates that game mechanisms consistently form the main thread of the Robocraft community's discussion. The patches with the highest proportion of gameplay topics were Respawned and Overclocked (52.2%), Battle for Earth (50%), and Fast and Formidable (50%), indicating that mechanically significant patches drove community discussion that was more focused on gameplay aspects.

3.3 Gameplay Aspect ABSA Results

Table 1. Total Aspect Occurrence and Sentiment Distribution.

Gameplay Aspect	Negative	Positive	Total	Negative (%)	Positive (%)
BUILDING_MECHANICS	2.686	5.882	8.568	31.55%	68.65%
PLAYER_PROGRESSION	5.750	2.650	8.400	68.45%	31.55%
PVP_SYSTEM	2.687	2.388	5.075	52.95%	47.05%

The final ABSA inference produced 22,043 review-aspect pairs from 15,755 unique reviews. BUILDING_MECHANICS was the most-discussed aspect (8,568 occurrences), with a positive sentiment dominance of 68.65%, reflecting players' appreciation for Robocraft's core creative concept. In contrast, PLAYER_PROGRESSION recorded the highest negative sentiment at 68.45% out of 8,400 occurrences, reflecting deep dissatisfaction with changes to the progression and monetization systems. PVP_SYSTEM sat in the middle with 52.95% negative sentiment out of 5,075 occurrences, generally related to matchmaking issues and team balance.

3.4 Aspect Analysis per Update Timeline

The overall ABSA inference produced more than 20,000 gameplay-aspect mentions from more than 15,000 unique reviews. The overall number of gameplay-aspect mentions reflects the intensity of player discussion during each period of the game's development. Player discussion peaked in 2016 with more than 4,000 gameplay reviews, followed by a consistent decline that reached its lowest point in 2019. This decline can be correlated with the reduced frequency of game updates after 2016, which was also

driven by a series of controversial updates carried out that year, thereby impacting the overall decline in player community engagement

Looking at the distribution of mentions per aspect, discussion around the PLAYER_PROGRESSION aspect was one of the main drivers of the surge in gameplay mentions in 2016, with nearly 3,000 mentions, exceeding both the BUILDING_MECHANICS and PVP_SYSTEM aspects. This indicates that changes to the player progression system during that period were the issue most widely discussed by the Robocraft player community.

3.5 Sentiment Trends

The early development period began with the initialization of the Alpha version and the opening of Steam Early Access in July 2014. In the same month, the Mars map and the Tech Tree progression system were added in the Mars Update. The early development period, from Initial Alpha + Mars through Megabots, consistently received dominant positive sentiment. However, the first turning point occurred when Robocraft released the major patch update Team Orders. During this period, the amount of negative sentiment found exceeded the amount of positive sentiment for the first time, with a proportion of 60.36% negative sentiment and 39.64% positive sentiment. Following this first turning point, a number of improvements were made by the development team to restore player perspective. Player opinion shifts continued to fluctuate across several updates following Team Orders, but the overall trend remained dominated by negative sentiment.

3.6 Turning Point Identification

To identify the overall turning point in player sentiment, it is important to observe the distribution of positive and negative reviews throughout the game's development. The distribution of total aspect mentions indicates that the biggest turning point occurred in 2016, where positive sentiment experienced a consistent decline while negative sentiment began to dominate the discussion continuously from that period onward.

Table 2. Aspect Sentiment Percentage per Year

	BUILDING_MECHANICS		PLAYER_PROGRESSION		PVP_SYSTEM	
Tahun	**negative**	**positive**	**negative**	**positive**	**negative**	**positive**
2014	18.91%	81.09%	49.65%	50.35%	36.59%	63.41%
2015	26.18%	73.82%	60.27%	39.73%	47.58%	52.42%
2016	42.75%	57.25%	77.45%	22.55%	64.34%	35.66%

2017	33.65%	66.35%	74.64%	25.36%	59.07%	40.93%
2018	37.45%	62.55%	73.39%	26.61%	56.58%	43.42%
2019	40.98%	59.02%	76.80%	23.20%	61.43%	38.57%

Table 2. shows that although negative sentiment toward the BUILDING_MECHANICS aspect fluctuated over time, positive sentiment consistently remained dominant in mentions of this aspect throughout Robocraft's development. This condition indicates that players generally held a positive view of Robocraft's core concept as a robot-building game. Although negative sentiment also increased in 2016, the amount did not significantly exceed positive sentiment, so the BUILDING_MECHANICS aspect remained a relatively appreciated element by the player community. This finding aligns with the overall positive sentiment proportion for BUILDING_MECHANICS, which reached 68.65% of its total mentions. This indicates that throughout Robocraft's development, the BUILDING_MECHANICS aspect consistently remained the game's main strength as a platform for creativity and player freedom of expression, and its quality was maintained until the end of active development. Unlike BUILDING_MECHANICS, players clearly expressed their dissatisfaction with the PLAYER_PROGRESSION aspect. Negative sentiment fluctuations were detected as early as 2015 and reached a significant peak in 2016. The extreme spike in negative sentiment during this period can be attributed to a number of updates that introduced fundamental changes to the game's progression system, which many players interpreted as a shift of the game toward an increasingly dominant pay-to-win approach. In line with the pattern found for the PLAYER_PROGRESSION aspect, the PVP_SYSTEM aspect also experienced a similar sentiment shift, albeit with more gradual fluctuation. Early indications of player dissatisfaction with the PvP System were detected as early as 2015 but had not yet reached the point where negative sentiment fully exceeded positive sentiment. The shift toward negative sentiment dominance occurred more decisively in 2016 and continued in subsequent periods.

3.7 Implications

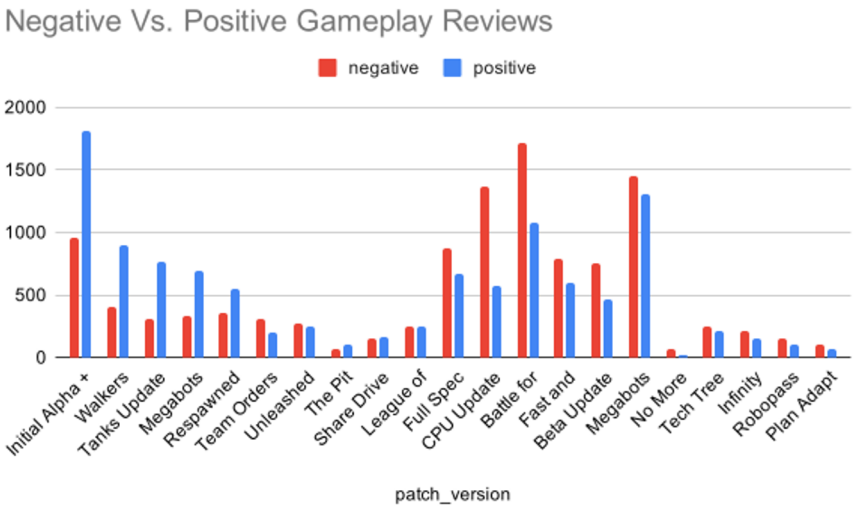


Fig. 2. Sentiment Trends Throughout Robocraft's Development

During the Team Orders period, players expressed their disappointment with the newly introduced minimum tier restrictions, as well as the implementation of a CPU cap for each tier. This update significantly limited player progression by restricting the number of blocks and components that could be used, even though players had previously already had access to those components. In response to this negative community reaction, the developers then removed the Team Orders update during the Unleashed period by eliminating the tier system entirely.

The next major fluctuation occurred during the Full Spec Combat period. Released in December 2015, this update introduced a number of changes, including accessibility of game modes for players of all ranks, a map overhaul, and a matchmaking system update. Although there were some positive aspects, such as increased accessibility to more game modes, changes to the PvP system fundamentally altered the game's approach to its PvP system. This sparked controversy among players who had developed specific vehicle designs tailored to previous strategies, which became less effective in combat following the update.

After Full Spec Combat, two major updates were released in succession in April 2016: CPU Update and Epic Loot, which through observation, is assumed to be the turning point in Robocraft's development history. Due to their close release timing, these two updates were treated as a single period for consistency with the update cadence of at least once per month. The CPU Update + Epic Loot period received the highest negative sentiment ratio of 2016, with 70.6% negative sentiment and 30% positive sentiment. In these two updates, fundamental changes occurred to the game's CPU system as well as a complete overhaul of the progression system, which was replaced with a loot-crate-based system accompanied by a thorough reform of the in-game currency. From then on, negative sentiment consistently dominated discussion of

gameplay mechanism aspects, although it decreased in volume in line with the overall decline in the number of gameplay reviews submitted. Dissatisfaction with this change continued to be voiced by the player community throughout the remainder of Robocraft's development until its server shutdown, with many players lamenting the state of the game prior to that turning point. Loyal Robocraft players, who had dedicated tens to hundreds of hours to this game, never tired of expressing their disappointment over the development trajectory of the game they loved.

4 Conclusion

This study successfully applied a two-stage computational pipeline — BERTopic for topic exploration and BERT-based ABSA for sentiment classification — in analyzing more than 15,000 unique Robocraft player reviews throughout its development cycle from July 2014 to November 2019. BERTopic identified a total of 293 topics, of which 44.7% were related to gameplay aspects, indicating that game mechanisms consistently dominated community discourse. Out of a total of 22,043 identified aspect mentions, BUILDING_MECHANICS was the most-discussed aspect (8,568 mentions), followed by PLAYER_PROGRESSION (8,400 mentions), and PVP_SYSTEM (5,075 mentions). The largest discussion surge occurred in 2016, with PLAYER_PROGRESSION as its main driver, reflecting that changes to the progression and monetization systems were the community's central concern during that period.

The three gameplay aspects showed significantly different sentiment trajectories throughout Robocraft's development. BUILDING_MECHANICS consistently maintained a dominance of positive sentiment (68.65% positive overall), reflecting players' sustained appreciation for the game's core creative premise. In contrast, PLAYER_PROGRESSION recorded the highest overall negative sentiment proportion (68.45% negative overall), with the peak of dissatisfaction occurring during the CPU Update + Epic Loot period (2016), which triggered a fundamental overhaul of the loot-crate-based progression system. PVP_SYSTEM followed a similar trajectory but with a more gradual deterioration, with negative sentiment dominating from 2016 onward (52.95% negative overall), driven mainly by matchmaking issues and increasing reports of cheating in matches.

The most significant finding of this study is the observational identification of 2016 — specifically the CPU Update + Epic Loot period — as a possible turning point in Robocraft's community sentiment, where no subsequent patch was able to restore the dominance of positive sentiment. This pattern reveals broader implications for free-to-play game developers: changes to progression and monetization systems carry a far greater sentiment risk than changes to core gameplay mechanisms. Robocraft's decline was not caused by the failure of its creative concept — which was, in fact, consistently appreciated until the end of its development — but rather by a series of monetization decisions perceived as increasingly exploitative, which ultimately eroded community trust permanently and irreversibly.

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