

# Making Random Fun

*Investigating the design principles and balancing techniques of a modular weapon system*

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## ABSTRACT

*This paper will explore the uses and benefits of a modular system for asset production, specifically within weapons systems. Balancing systems and types will be explored and theming for successful asset integration will be looked into - as well as the impact this has on the response to the system.*

## Keywords

*Modular, Game Object Balancing, Asymmetrical balance, Thematic, Atomic Statistics, Procedural, Worldbuilding*

## 1. INTRODUCTION

This paper will explore the ways in which developers have used modular systems to add variety, interest and longevity to their weapons systems. This will naturally lead into a discussion on balance since when assets are not being produced individually, the developer needs a guarantee that the weapons produced by the system scale in a way that feels fair to the player.

This paper will explore *Magicka* [4], *Borderlands 2* [3] and *Mercenary Kings* [5] as key players in this field and draw some conclusions from their particular strengths. These games come from a variety of different studio sizes and received various levels of critical acclaim. The goal of this investigation will be to inform future developers who hoping to utilise these ideas in their own games.

## 2. FIELD

Game developers and studios of all sizes should be interested in methods that will compliment the feel of the game that they are building and reduce workload in a way that is adaptable to all workflows. Taking the time to think about the root of the experience and how to extrapolate this out with procedural generation can add a lot to an existing system or form an entire game base by itself.

Any mechanic could be improved or built using these concepts. This paper will be focussed on designing a modular weapon system using these principles, with an additional focus on how to balance this kind of a mechanic.

## 3. KEYPLAYERS

The key players referenced here cover a spectrum of team sizes and commercial viability.

### 3.1 *Magicka*

While not specifically a modular *weapon*, the magic system in this title from swedish developers Arrowhead Game Studios is an interesting example of modular design. The team here was a

small one [7](Pilestedt, J, 2011) with just 8 full time developers and 4 contract workers. The size of this team will have influenced the types of mechanics that were viable, in this case the magic generation system meant that less work was required upfront and more time could be placed into making an interesting world with enjoyable interactions for the player.



Figure 1: *Magicka* Gameplay [4]

### 3.1.1 *Magic System*

The player chooses from a set of 10 elements and then uses one of four casting styles [6]. The resulting magical effect is calculated from a set of predetermined rules about how each element interacts with all the others. A list of all possible combinations and how each element alters the spell can be found at the *Magicka* Gamepedia page.[8].

A wide variety of different effects can be produced in this way, but the total number of combinations (and therefore the workload required for balancing) has been reduced by implementing the fact that some elements will cancel out others effects. For example cold and fire cannot be used within the same spell and will simply nullify each others properties (see Figure 2).

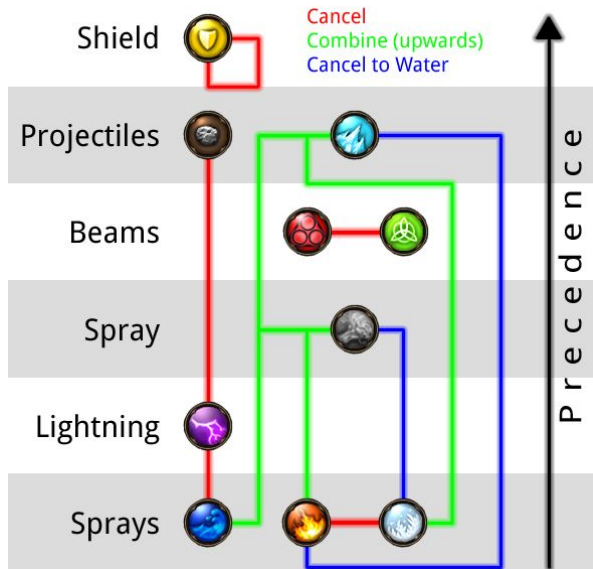


Figure 2: Element Relationships [10]

Each element is unique when compared to all the others and even when there is overlap, each element always has something to differentiate itself. For example the stone element and the ice element are both projectiles, but stone will do more damage and ice will provide a slowing effect. Having this clarity is useful since having to press so many buttons just to cast one spell is unorthodox and making this process as easy to learn for new players is a definite priority. Uniqueness of properties is an important takeaway from this system - it keeps every component (*element*) feeling useful and interesting rather than just a worse version of something else.

### 3.1.2 Scaling

Scaling is not done through slowly revealing more elements as the player progresses as you might expect, instead all are available to the player straight after the tutorial. The scope of your magical ability instead increases when you find “Magicks” [9]. These are specific combinations of elements which, when cast, create a distinct spell rather than a series of effects (for example, invisibility). These are awarded to the player as they progress through the single player and add depth to the combat over time. Complexity is also added, to a lesser extent, by allowing the player to add more elements to their spells as they learn more about the game.

## 3.2 Borderlands 2



Figure 3: Borderlands 2 Gameplay [3]

Borderlands 2, developed by Gearbox Software (Texas), is one of the primary examples in the field of modular weapons generation.

This is a key example of a large studio employing procedural techniques, and is a good reference for the sheer scale and variety that can be gained when the feature is a key mechanic of the franchise. Costing around \$30-\$35 million [11], Gearbox had the time and the budget to make something great.

### 3.2.1 Thematic Branding

The Borderlands development team, and concept designer Kevin Duc, wanted to expand on the manufacturer system that had been implemented in the first game. In that case it was just basic abilities and names. This time around they needed to be interesting and unique; their mechanics defined and clear; and their visuals indicative of their brand [11].

*“Our goal for the second one was really making players care about those differences, and pushing the visual art styles to visually show those differences.” (Duc 2012)*

The weapon manufacturers also feature in the written story of the game, so not only will the player become familiar with their capabilities as guns but also how they interact with the world and with other characters. The example given by Duc as to why this quick identification is useful can be seen here:

*“When you grab a gun, you will know what to expect from it just by how it looks. In a game with millions of different guns, where they literally litter the ground after a firefight, the ability to quickly assess what will work for you and what won't is kind of a big deal.” (Duc 2012)*

All this brand development however, is merely a method by which to make the enormous number of guns in the game feel integrated and as if they make sense for the world.

### 3.2.2 Gun Generation

The basic system begins when a gun needs to be generated. First, the game will choose a weapon type from a pool of options, then a manufacturer will be chosen (each has a limited list of weapon types they produce) which has the capacity to produce the relevant weapon type. Finally a grade is chosen. The weapons grade is to differentiate between common weapons and legendary ones, as well as some other unique items. Once the core weapon specifics have been chosen, one component for each available slot is picked. For most weapons these options are material, body, barrel, magazine, accessory, sight, stock (or action for pistols), and grip. These components will all alter the statistics of the gun in some way or how it functions. Each and every one of these elements has a whole set of modifiers and pre-requisites and shows what a large budget can do for the quality of the system. [13]

## 3.3 Mercenary Kings

Mercenary Kings (Tribute games, Montreal) is an example of a small indie studio using modular weapons to add a large amount of content to a low budget game. Their system for balancing different gun components to one another has been well documented in a report [14]. This game uses more stats than most, but their techniques are robust and would scale nicely to a project of a different size.



Figure 4: Mercenary Kings Gameplay [5]

Mercenary Kings has 300 different gun parts. Each part has between 6 to 12 different values associated with it. This means that there were somewhere between 1,800 and 3,600 values to consider and balance. For a team of nine, this is quite a feat. Jonathan Levigne (Co-founder of Tribute Games) has since revealed some of these techniques.

The first is to ensure that a high level view (see Figure 5) of the items as they currently stand is always available. In the case of Tribute Games, this was a spreadsheet which categorised all the different guns in the game and what their rarity was in comparison with other items found at the same level.

Mercenary Kings - Distrib			
Rarity	1	2	3
Mission Ranks	Recruit & Private	Corporal	Sergeant
Firearm Min. DPS	600	1000	1400
Knife Max. DPS	1050/1250	1650	2050
Enemy Health	200 to 1500	290 to 2900	465 to 4660
Handguns	Bolt 45, Klein P8, Jäger, Peashooter, Shotgun, Bolt Six Shooter	Frazetta, K9 Pistol	Tracker, Frazetta 93S, Frostbite
Magnums	Hand Cannon, Jackal	Razorback	Golden Volume
Sub-Machine Guns	Artillery Jäger, Flasher, Mammoth	Tommy Gun	Singer
Assault Rifles	Sturm Rifle, Patrol Rifle, Steel Assault, Spiral Rifle	Frostbite, Scan Rifle, Freedom Fighter	Toxic Tempest, Spec Ops Rifle
Shotguns	Durali, Red Shoe, Trombone	Black Thorne	Szinker, Shockwave

Figure 5: Mercenary Kings Balance Table [3]

Next was a heavy reliance on functions and maths. Among these functions, in relation to the last point, is an average dps calculator. The team were able to plug in a random assortment of components and see what the average DPS of that weapon was. In this way it could be ensured that the results were as expected, and followed the planned difficulty curve.

One other point that Tribute Games makes is that sometimes the best designed systems are not the systems which make the most mathematical sense, sometimes overpowered or underpowered weapons are necessary to add a level of interest and unexpectedness to the weapons.

### 3.4 Summary

#### 3.5.1 Magicka

In Magicka, each spell (representing a weapon) is constructed from a number of smaller components (elements). Each is very intentional and has a specific use case within the game. This

intentionality makes the gameplay feel thoughtful and when the player happens upon a good combination, it feels rewarding.

Considering the use case for each element, and in what circumstances each might be used, allowed the studio to make a game system that felt large and polished enough to have been made by a much larger team with only 10 elements. The reason for this is that if each element feels thought out, the combinations will too.

#### 3.5.2 Borderlands 2

Borderlands 2 was built by a large team with a large budget. This means that special attention could be paid to things like fitting the guns into the world and developing their manufacturers as brands and as characters. This really helps to ground the often ridiculous guns of Borderlands and seat them truly in the world Gearbox has designed.

The player knows what type of weapon they are about to pick up purely from its design, this feeling of understanding is something that would be beneficial to replicate for other developers, albeit usually to a much smaller scale.

#### 3.5.3 Mercenary Kings

Mercenary Kings is another small team, but they have been very transparent with their players in terms of the development and balancing of the weapons in the game. They used some well documented methods [14] for balancing their 300 odd gun components. In terms of bringing development aspects forward, their tables and rules provide some good inspiration.

Tribute Games have also been known to respond positively to the playerbase's opinion, for example some examples have been given of older guns that were broken in terms of their balance, these have since been patched out and other improvements have been made. This does show however, that it is challenging for a small team to balance that number of components well - even with systems in place specifically to that end. Allowing time for this balancing throughout the project will lead to less work required at the end, when players find a large number of combinations that break the balance and flow of the game.

Table 1: Key Player Comparisons

Game	Strengths	Weaknesses
Magicka	Small, precise components	Potentially strays too far from a conventionally viable strategy
Borderlands 2	Worldbuilding, depth of variation	Not reproducible by a smaller team, overly complex
Mercenary Kings	Control is in the hands of the player, well balanced	Took a lot of time to get the balance to where the team wanted it to be

### 3.5 USP

All the key players here had an interesting hook which caused players to have an interest in the title and the developer.

#### 3.6.1 Magicka

A key point of interest for Magicka, is the fact that it is such an unusual and interesting input method. Most would advise against having the player input up to 7 different button presses just for one attack, but this never phased the studio. Even going

so far as to emblazon “A game for everyone is a game for no one” across their website and interviews [7]. It is a risky state of mind, but paid off for Arrowhead Studios. But it paid off when the team were applauded for their innovative input methods.

Multiplayer and singleplayer were handled well by the developers. The system is intricate enough to be used and enjoyed solo, but when played as a group players can assume different roles, friendly fire and even combine effects into more powerful spells. These all feel like natural extensions to the core game loop and are integrated really smoothly.

### 3.6.2 *Borderlands 2*

The procedural generation in borderlands is so much more in depth than almost everything else on the market, that it’s quality of weapon variety and generation is (in itself) it’s primary selling point. When paired with good writing, interesting worlds to explore and satisfying combat it’s a recipe for a bestseller. Naturally this is only possible with a AAA studio the size of gearbox.

The generation is in depth enough that the guns all feel handcrafted and hand designed, even when there are so many unique options that the same one will probably never come up twice.

### 3.6.3 *Mercenary Kings*

Mercenary kings used a nice visual style and a dedicated fan base to build popularity for its small studio. This paired with the unique weapon building system and fun arcade gunplay lead to a strong success. Tribute Games were also not afraid to be a bit silly with their concepts while maintaining a fairly regular gun structure. being a little looser with realism when paired with modular systems is always a good idea, as proven by Borderlands and their wacky yet grounded world building.

Due to the fact that Tribute Games managed to balance their weapons well, community discussions about weapon types were frequent and founded a solid community discussion topic. Consistent discussion can provide publicity to a small studio as well as feed high quality feedback back into the development loop.

## 3.6 *Technologies/Approach*

The following are some general use approaches which have been identified from the key players previously detailed in this paper.

### 3.7.1 *High Level View*

The first recommended approach for balancing a large number of different stats is to be able to view them all easily and how they relate to one another. The system used by Tribute Games is at a much larger scale (between 1800 and 3600 values) than most developers will have to deal with, but the concept of being able to see your stats compared to all others is still a good idea.

This type of table could either be used for comparing the guns constructed wholly, with each component assumed to be from the same set, or it could map individual components against each other.

### 3.7.2 *Using Equations*

In order to be able to quickly debug potential combinations of components, a calculation needs to be put together where options can be selected and a rough value be outputted for DPS.

Equations can also be used for other elements of the balancing process. For example calculating stats for weapons based on already established values.

### 3.7.3 *Make it Thematic*

When the weapons in a game have not been individually designed, the components needs to be given the context necessary to make them interesting enough to the player. It should be intuitive (be it through material, silhouette, or other solution) for the player to quickly identify roughly what the properties of the weapon will be before they use it.

### 3.7.4 *Define Balance Types Required*

Different games need different considerations when it comes to balance. When discussing modular weapons systems, usually this will be a game object style of balancing.

*“Within a system that has several similar game objects (such as cards in a trading-card game, weapons in a role-playing game, and so on), we use “balance” to describe the objects themselves, specifically whether different objects have the same cost/benefit ratio.” [1]*

In the case of a multiplayer game, asymmetrical balance needs to be considered as well:

*“In multi-player games where there is asymmetry (that is, where players do not start with exactly equal positions and resources), we use “balance” to describe whether one starting position is easier to win with than another.” [1]*

### 3.7.5 *Plan for the Long Term*

It is important to recognise that balancing these modular systems and components is going to increase the scope of the project and will take time to complete. The structure for feedback and response to the current values needs to be put in place early so the players can constantly be providing feedback when something doesn’t work well with another module.

Modular systems can cut down the design workload but they definitely have a long term overhead of time commitment to their own to deal with. For a larger studio like Gearbox this can be mostly (if not entirely) managed before the release of the title. In the case of mercenary kings however, with its smaller team, it can take many game versions to refine the system and the audience needs to be understanding enough to allow this.

## 4. CONCLUSIONS

Procedural content works well as a tool for teams of all sizes due to its adaptability and scalability. It has been proven to work in a number of different circumstances and give depth to a great number of mechanical systems.

### 4.1 *Balance*

When the modular system is something that the player has to interact with in order to play the game, it needs to be balanced in a way which is relevant to the game. For example a game object method of balancing should be used to make sure that each component and weapon is valued appropriately when compared to the other weapons and components in the system.

The more common definition of balance should also be considered, this is the overarching difficulty level and ensuring that the game itself is an appropriate difficulty for the audience.

### 4.2 *Theming*

When using modular production methods for entities within the game, it is easy for each element to become generic and begin to blur together. One proven method of countering this is

to put the entities in the context of an interesting world. Giving some interesting factor to the weapons, even just name alterations or visual differences, can make for an overall more robust system and one that will hold players interest for a longer amount of time.

This theming can also prompt the creation of more unique weapons - outliers from the set of rules created for the rest of the asset production. When the player finds one of these more interesting weapons, it means a lot and will be very memorable. In contrast - if the developers were to produce every weapon individually, it would take a lot more resources to consistently create interesting items that the players will remember and find interesting.

The parameters of the world should be defined early in the design process - this means that anything added later on will be able to be designed with the context in mind.

### 4.3 Plan for Feedback

No matter how much planning is done for the balancing of the weapons, it will only ever reduce the amount of work that needs to be done responding to player feedback. This type of system will never be perfect and will have to be tweaked constantly, especially if new content is added after the fact.

Because of this - the importance of the players feedback should be recognised and planned for. Systems for data gathering should be put in place and easy ways to see what your changes are doing to the flow of the whole game needs to be implemented.

### 4.4 Further Investigations

Beyond the topics within this paper, there are a number of directions that could be followed for a more comprehensive view of this whole field of asset production.

Looking into the visual design of these systems and how specifically a gun might be drawn by a concept artist in order to make for a model which can be broken down effectively. Examining how this changes the normal workflow of asset production would be interesting to discover.

Another natural direction to go following this paper would be procedural mesh generation. A procedural method where instead of putting together different modules into predetermined places, the system is a lot more organic and might produce sections of the mesh by itself.

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