# Data-Driven, Data-Informed, Data-Augmented:

# How Ubisoft's Ghost Recon Wildlands Live Unit Uses Data for Continuous Product Innovation

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## Abstract

To stay ahead of the competition, firms must continuously learn from their customers and swiftly adopt those lessons to improve their products. A unit at Ubisoft, a leading game publisher headquartered in Paris, has established a three-pronged approach to drive product innovation based on three practices: data-driven exploration, data-augmented ideation, and data-informed validation. By establishing processes and capabilities for these practices and blending them in a portfolio approach to product design, they maximize the value generation potential of the data at their disposal. Product development in a variety of industries can benefit from the lessons of these data-oriented innovation practices.


## Introduction

In the digital age, competitive advantage can be fleeting. No sooner does a product developer gain an advantage than its competitors catch up. To stay ahead of the competition, firms must continuously learn from their customers and swiftly adopt those lessons to improve their products. Currently, product-assisted learning[1]—the ability to learn from deployed products and

user feedback—is finding its way into a variety of product development applications, from smartphones and wearables to automobiles and buildings.[2]

Video game developers have been at the forefront of product-assisted learning from the beginning. Developers have been learning from the usage patterns of their players for years.[3] Sophisticated video game publishers like Ubisoft compete for users via customer-centric innovations informed by the activities of their players, from community feedback to market research. Ubisoft is perennially one of the world's most successful companies and they thrive in an industry of continuous disruptive innovation. Using data, Ubisoft continually innovates in a way that differentiates their products from those of competitors, delights their customers, and keeps them engaged. Product development organizations in a variety of industries can benefit from lessons learned by their teams.

Ubisoft's Ghost Recon Wildlands live unit has three practices to drive product innovation through data analytics: data-driven exploration, data-augmented ideation, and data-informed validation. *Data-driven exploration* refers to open-ended analysis of product-based data to identify behavioral product consumption patterns, investigate these patterns, and uncover anomalies that then feed into product design cycles. *Data-augmented ideation* refers to how they leverage their data during innovation processes to assist designers in sharpening the ideas they have for product enhancements. *Data-informed validation* refers to a process of testing design insights against product data, often by triangulating them across different data sources. By establishing processes and capabilities for all three practices and blending them in a portfolio approach to product design, Ubisoft's Ghost Recon Wildlands Live Unit maximizes the value of the data at their disposal. In this paper, we explore how they manage their three data-oriented innovation practices (see Appendix for a description of the research).

## Data-Oriented Product Innovation at Ubisoft's Ghost Recon Wildlands Live Unit

Ubisoft competes in an industry with high stakes. One in three people play video games,[4] and the video game industry is estimated to be worth $138 billion.[5] Individual video games can generate revenues of $6 billion.[6] But well-known "triple-A" games also require investments upwards of $100 million and sales tend to drop soon after release.[7] Because of the stakes in high-end video games, the pressure to innovate rapidly and continuously is enormous. Lost sales can mean a significant setback. Moreover, companies like Ubisoft need to comply with a variety of data-oriented and privacy-related regulations that are constantly updated to protect consumers.

As a global leader in this high-stakes industry, one of Ubisoft's strategic weapon for maintaining its competitive advantage is to innovate their products through the analysis of product-based customer data. Over the years, this has resulted in many perennially successful franchises in an ultra-competitive market—including the *Assassin's Creed*, *Watch Dogs*, *Far Cry*, and *Tom Clancy* (*The Division*, *Ghost Recon*, *Rainbow Six Siege*, etc.) franchises.

*Ghost Recon Wildlands* is the biggest Ghost Recon game. It had the largest open Beta in Ubisoft's history, with 6.87 million players. Within the first few months after its initial launch in March 2017, it was the top selling game in the industry and it has maintained success in subsequent years. Given the game's success beyond the initial launch, Ghost Recon Wildlands has become one of Ubisoft's internal benchmarks for how to implement live product updates post-release.

Because the stakes are so high, video games are no longer one-off products. Instead, they are ongoing experiences that change over time. Publishers provide continuous innovations after game launch in order to satisfy player needs and prolong the lifetime of a game—sometimes for

years beyond its initial release.[8] These incremental changes can range from simple bug fixes to dramatically new content that changes the nature of the game. New content might include new missions, new appearances of characters ("skins"), new maps (i.e., virtual game spaces through which players navigate) to extend the game world, or new features. Sometimes, entirely new game modes are launched after the initial game release. For example, in *Ghost Recon Wildlands*, Ubisoft launched an increment that included *Ghost War*, a Player-versus-Player (PvP) mode that dramatically extended the possibilities for cooperation in the game. Introducing these changes is a delicate act: given that popular games can have an estimated 250 million users,[9] typically not all players will approve of changes. The wrong move can be costly. In a famous example, Blizzard Entertainment, one of Ubisoft's competitors, released an unpopular expansion pack (*Warlords of Draenor)* to their popular *World of Warcraft* game, and this resulted in the loss of 10 million subscribers.[10]

In order to generate valuable insight, Ubisoft relies on heterogeneous data sources, including playtest data, in-game data, market research data, communication data, and explicit text-based feedback from the community through community forums and other interactive media. They leverage this variety of data sources in different ways to continually innovate their product after it has gone live.

## The Unit's Data-Oriented Practices

Ubisoft's Ghost Recon Wildlands live unit leverages game play data, stored in a data lake on company servers, for continuous product innovation in three ways: data-driven exploration, data-augmented ideation, and data-informed validation (Figure 1). **Data-driven exploration** relies on the analysis of heterogeneous game data (e.g., in-game data) to generate new insights and

identify new design alternatives. **Data-augmented ideation** involves the interplay of designer creativity and the analysis of game data (e.g., community and in-game data). **Data-informed validation** starts with a design idea and tests it using game data (e.g., playtest and in-game data).

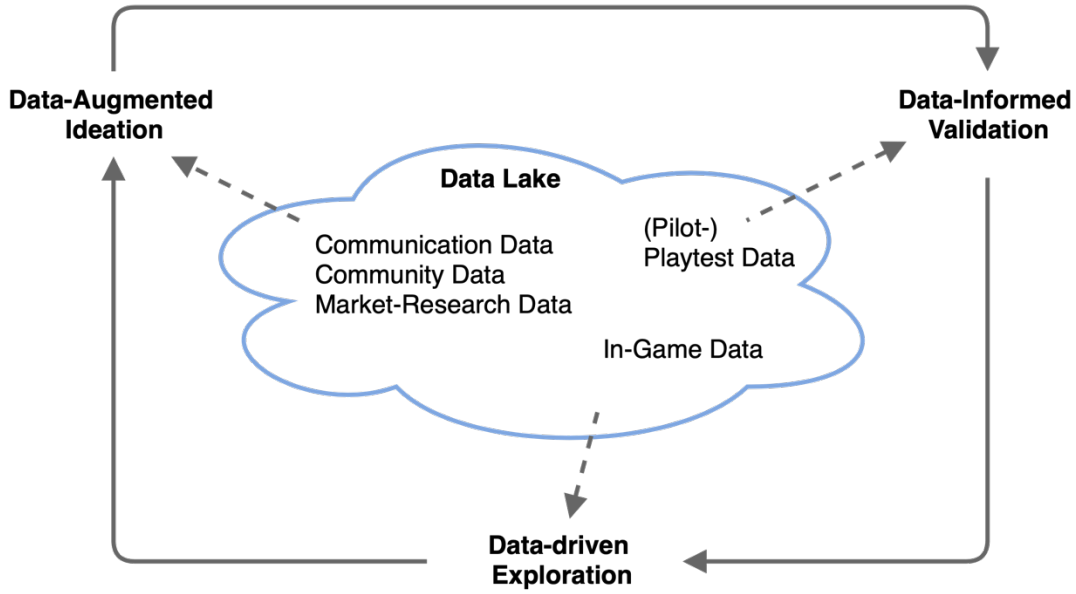


**Figure 1. Product-Assisted Learning in Video Game Development.**

It is critical for the Ghost Recon Wildlands live unit to understand and segment their users for each of these practices. They categorize users into "playstyles" or "clusters" and then continually refine this understanding over time. Playstyles capture how different users play the game in different ways—groups of users have different approaches to the game and different areas of interest in the game, and these different styles can be grouped into categories. For example, a "sniper" prefers long range shooting, whereas an "executioner" prefers close range combat. Similarly, "sandbox" players roam free in the open world, whereas "rushers" focus on completing main story missions. The development and refinement of different profiles of players is critical to all of the unit's data-oriented practices. Table 1 provides an overview of the unit's three data-

oriented innovation practices, the capabilities required to execute them, and examples to explain each practice.

| Table 1. Data-Oriented Product Innovation Practices | | | |
|---|---|---|---|
| **Practice** | **Definition** | **Key Capabilities** | **Example** |
| Data-driven exploration<br><br>(*data->design*) | Open-ended analysis of heterogeneous in-game data to identify opportunities through patterns in game play. | Anomaly detection; pattern recognition; visualization; open-ended exploration. | ***"Heatmap"—*** The analysis of in-game data showed how various areas of the game space were frequented differently. This insight led to the design of the new feature to help players see how other players travel. |
| Data-augmented ideation<br><br>(*data<->design*) | Interplay of insights derived from analysis of product-related data and designers' expertise and creative thinking skills during design ideation. | Close collaboration between analytics and design teams; process of incremental triangulation and refinement idea through data. | ***"Institute"*** **—**Designers developed aesthetic ideas for a new level called the Institute; and data analysts used playtest data, community data, and, most importantly, in-game data to help the production team spot issues to fine-tune level features. This cycle of design and analysis continued throughout the level design. |
| Data-informed validation<br><br>(*design->data*) | Testing specific design hypotheses against game data and corroborating the feasibility and utility of the design idea. | Hypothesis generation; rigorous testing approach; decision validation. | ***Prestige Credits -*** The monetization and performance team developed a new credit and prestige economy system. The new design was based on some uncertainties related to player progression. The analytics team used playtest data and in-game data based on the previous economy system that existed to validate the artist-driven design hypotheses. |

***Data-Driven Exploration***

*Data-driven exploration* refers to an approach to developing product innovations, such as game changes, where product developers explore the data in a variety of open-ended ways to uncover patterns in the data that point to opportunities for product enhancement. This ultimately leads to the generation of new designs.

Because video games are products operating entirely in a digital space, customers leave traces of everything they do within a game and it is critically important for Ubisoft's Ghost Recon Wildlands live unit to distill useful data from this overabundance of traces, as well as comply with all regulations. One approach for doing so involves implementing gameplay tracking events in the game code to understand how the game is being played. Events measure certain activities in the game at pre-defined points or with regards to pre-defined player actions. Such tracking events are triggered accordingly every time the requirements are met. For example, one event might monitor how players use specific items within the game and will be triggered every time an item is used by a player, whereas another tracking event might measure the success of specific character classes in specific gameplay situations, at the end of a PvP match, for instance. Events can contain varying amounts of relevant game play metrics, which are then stored in a big data infrastructure with which the analytics team works.

The in-game data collected through tracking events facilitates exploration of this data using a variety of analysis techniques and visualizations. There are two main analysis foci: *player centric* and *feature centric*. *Player centric* analysis aims to help developers learn about how players interact with the gameplay environment, while *feature centric* analysis enables developers to learn about the efficacy of specific game features, game modes, or assets within the game environment. The team follows an inductive approach to product innovation. This process is typically initiated

by game data analysts who have an intimate understanding of tracking events, data structures, game design, and measurements. After game data analysts identify an interesting pattern, anomaly, or idea, they typically explore the context in greater detail—which can involve reaching out to users and playing the game themselves in different ways. According to a user research manager:

> "*[W]e had data from our millions of players. We did not understand, at some point, one part of it. We introduced interviews, player behavior, real people into the loop, so that we'd better understand what they were doing, exactly.*"

Once the process of exploration generates a product idea, the analytics team needs to get the attention of the design team in order to prioritize a change or enhancement. That is, they need to find sponsors within the design organization to promote the idea, further test the idea, and push it to implementation. This approach is not without challenges. At times, data-driven ideas might be dismissed. The analytics team can be overruled by the designers, who have artistic authority and might have an incompatible vision for that aspect of the game. To ease this process in the Ghost Recon Wildlands production team, the lead game data analyst is not part of a transversal team but directly belongs to the production team and works closely with the design team. When the production team agrees that there is a need (e.g., an issue that dissatisfies users) or an opportunity (e.g., a potential game feature that may keep players engaged), they develop a prototype and gradually release it through a series of incremental updates.

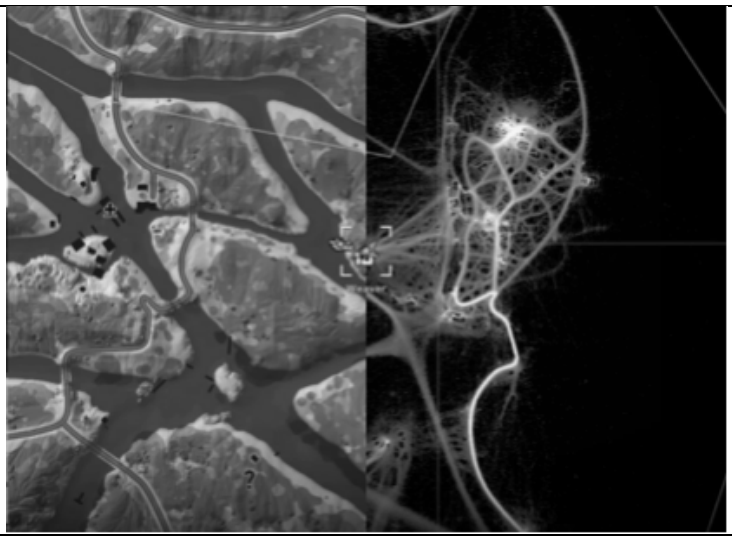

**Figure 2. Example Screenshot Comparison**

**(Left-side Normal Map, Right-side Heatmap showing popular paths through the map.) © Ubisoft**

In one example, developers noticed that certain areas of a map were highly frequented in particular ways—that is, players used these parts of the game space more than other parts. This led to the creation of a *heatmap* feature, showing gamers the popularity of certain paths and areas within the game. The heatmap uses and analyzes player movement data in the open world in order to show interested players where they might find new information for their missions and in-game progress (see Figure 2 and Table 2).

**Table 2. Feature "Heatmap"**

| | |
|---|---|
| **Trigger** | • Data exploration and the idea to do something fun with the data<br>• Testing and exploring the use and fit of machine learning models |
| **Development** | • Explore data and create predictive map of player movement<br>• Implement the predictive map<br>• Use player movement to create heatmap of often traveled paths in the open world<br>• Allow players to de-/activate the feature |

| | |
|---|---|
| **Team members involved** | Data analysts, production team member |
| **Tracking the new feature** | Analysis of the use of the feature after launch shows:<br>• "Infiltrators," who are trying to avoid killing the enemy, but rather "mark" enemies, are the ones using this feature the most<br>• They use it to analyze travel patterns of prior players in order to identify threats |

***Data-Augmented Ideation***

While data is a key asset, the development of video games is still an artist-driven process that is closely tied to the creative vision of the designers. This vision provides the direction for exploring new content designs, such as features, missions, maps, or skins. When the designer's creative vision is augmented with data, however, new and more innovative ideas emerge. A performance director described how one of his successful ideas "*was based on my inference from mobile [apps]. It was based on data as well.*" This dialectic between the designer's view and what the data suggest leads to an interplay of creativity and data analytics that can help to generate better game enhancements. Figure 3 shows an example. Ubisoft designers created a new multiplayer map called the "Institute." The introduction of in game data then showed an imbalance of the win rate because of how the map was designed—the level was difficult to defend—and these insights made the artists to rethink their design and produce a new, innovative map level design update. The imbalanced win rate suggested the need to make map level changes in order to find a more balanced design. Following the relocation of one target and the increase of the map's play area, the level became more difficult for the attacking team to win. As this example illustrates, in general, evaluating data from playtests, prototypes, and live games can strengthen the argument of a designer to implement or update a newly designed mission or a map the designer already had in

mind, and then continually enhance this idea in conjunction with the data, before and after it is released.

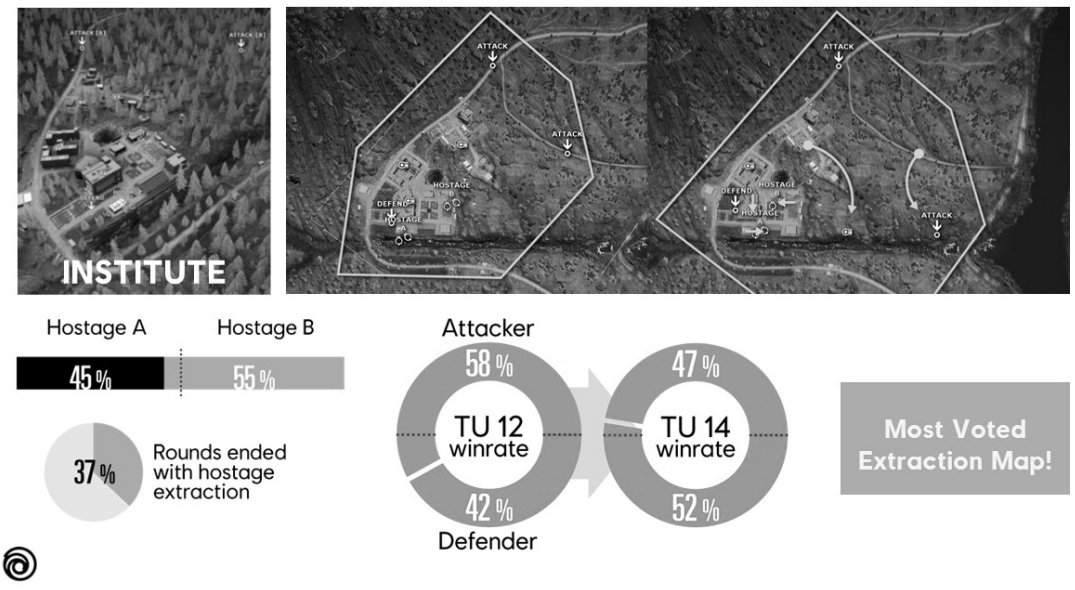


**Figure 3. Data-informed level design updates. © Ubisoft**

It is important to note that using data to augment the creative process is a challenging effort. It requires close collaboration among the design and data teams to develop a common understanding of the design and its goals and creative vision, while at the same time extract and interpret relevant design cues from different data sources. For instance, community data might suggest that some players are dissatisfied with the perceived impact of a feature (e.g., a new weapon) on game balance, but an in-depth analysis of in-game data may show a factually near perfectly balanced win/loss ratio in situations where the new feature is used. In such situations, designers and analysts come together—often sitting side-by-side—to review and adapt design ideas in conjunction with game data (e.g., community and in-game data). In this way, the teams

jointly ideate a design solution that is original, matches community expectations, and maintains gameplay balance.

Although often the designers trigger this data-augmented ideation practice, it can also be triggered by the data analytics teams. Consider how the product team of Ubisoft's Ghost Recon Wildlands live unit implemented their "Mood Matchmaking" feature (see Table 3 and Figure 4): the analysis of playstyles and coop experiences (i.e., experiences of players who played cooperatively with other players) led the team to realize that player groups matched different "moods." As a result, the data analytics team had the idea to match people with similar play styles, or "moods," and designed a feature accordingly, in collaboration with the user experience team. This idea was subsequently refined and improved using the data that was collected. One key realization was that playstyles can vary from session to session. Hence, the team implemented a mood matchmaking system that allows players to select their own, current mood, inspired by the profiles identified in-game through analytics. As a result, the player is matched with players with the same mood and a similar progression level. For example, players can indicate that they want to focus on the main story mission. The system will then find players that have a similar progression level along the main storyline, and the two matched players can make joint progress within the game.

**Table 3. Feature "Mood Matchmaking"**

| | |
|---|---|
| **Trigger** | • The analysis of playstyles and coop experience led to the identification of groups that matched different moods. |
| **Development** | • Shadowing profiles and dividing players by playstyle<br>• Matchmaking based on this turned out to be successful<br>• The data showed that there are different clusters and ways to experiment<br>• Implementation of an active matchmaking |

| | |
|---|---|
| **Team members involved** | Data analysts, user interface designers, production team members |
| **Tracking the new feature** | • The analysis of the profiles using the feature shows that it is particularly successful among sandbox players, i.e., players that use the game mainly for simulations.<br>• Tracking the matchmaking mood to see which player profiles match which moods |

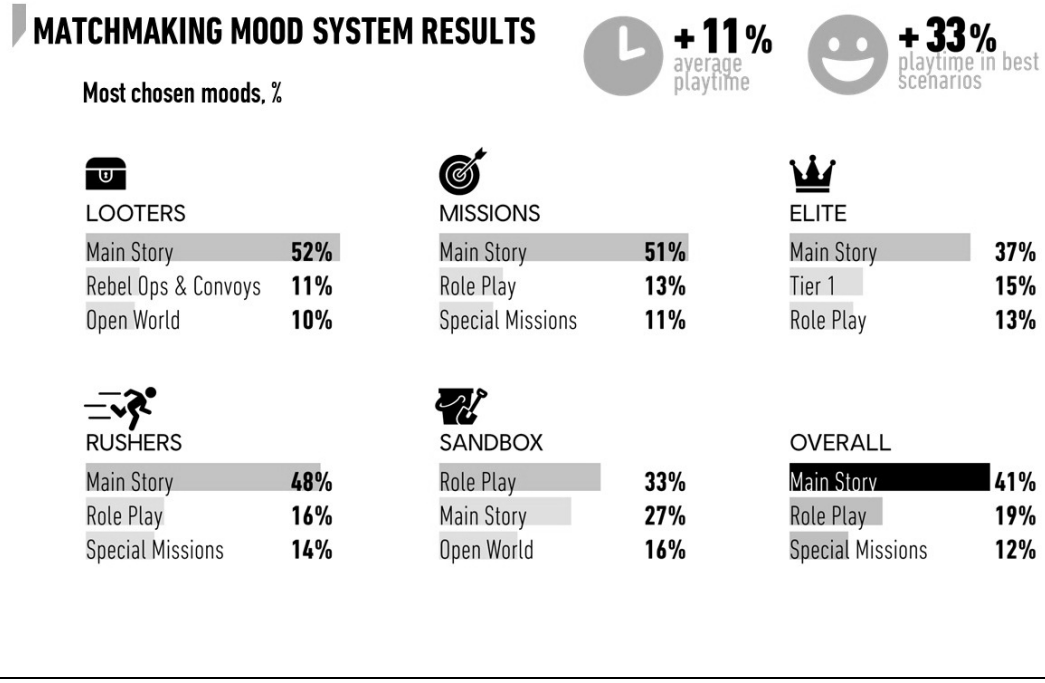


**Figure 4. Overview of Mood Matchmaking feature. © Ubisoft**

***Data-Informed Validation***

Ubisoft's Ghost Recon Wildlands live unit engages a process of data-informed validation using multiple data sources to test and learn about their design decisions. A typical example is when a new item (e.g., a new weapon in *Ghost Recon Wildlands*) is developed and the product team wants to learn how this item will likely be accepted and used by the player base. This will help the team to adjust the new item before it is implemented and deployed in the game. Such

validation is based on combining findings from a variety of analyses fueled by different data types. For instance, the process could include data generated through playtests, in-game tracking data, and community data collected from player forums. Corroboration from these heterogenous sources validates design expectations and inferences. When using data to validate a creative idea, it is important the team has an initial design hypothesis, so that it can be confirmed or rejected. It is absolutely critical that designers be open to the analytics results and not be overly committed to their ideas and this sometimes requires a different mindset for the designers. The performance director exemplified this mindset:

> "*I'm super happy to be wrong. Even though I challenge the results when I'm wrong, so that I'm really sure that I'm wrong. But in the end, it's very interesting to confront our views.*"

After the decision is made to follow up on a new idea, and the new feature is implemented, additional data is generated through playtests by inviting a target group of players into Ubisoft's laboratories. Playtest data is generated and can be analyzed in order to enrich the designers' choices when creating and refining new product content. Following the decision to launch new content, the team implements new tracking events that allow them to monitor and measure the success of the new content and to identify possible improvement opportunities that can be realized in later increments.

For example, the introduction of the multiplayer mode after product launch led to the inclusion of a second virtual currency, "prestige credits," which can be earned through in-game progress. Players demanded a change in the credit and prestige economy, as they could only spend their prestige credits on a limited set of classes and characters. When integrating the two currencies, the team had to take players' progression and earned credits into consideration, in order to avoid the currencies' under- or over-valuation in comparison to the players' efforts (see Table

4). The “Credits and Prestige Economy” feature relates to a conceptual idea that changes the in-game economy and was put forward by a marketing & community manager, validated through a series of efforts using community data and through playtests.

| **Table 4. Feature “Credits and Prestige Economy”** | |
|---|---|
| **Trigger** | • New PVP mode led to the introduction of “prestige credits”<br>• Players demanded an update due to the limitations of the system and because they were familiar with better concepts from other Ubisoft games |
| **Development** | • Expansion of the prestige credit system to also include it in PvE (Player vs. Environment) games and missions<br>• Designing two pieces of content, one that could be earned and one that could be purchased<br>• Identifying player progression for accurate rewards within PvE progression<br>• Using players’ progression history for the analysis |
| **Team members involved** | Data analysts, marketing & community manager |
| **Tracking the new feature** | Tracking was not implemented as expected and prevented the team from further analysis and optimization of player spending of prestige credits. As a result, the team could not compare actual data with initial simulations and the previous economy system. |

The challenge in artist-driven product design is that different designers and other involved stakeholders will often have different, perhaps competing views—for instance, one designer might expect that a certain player class will use a certain set of features, while another designer might expect that class to use a different set. Looking at data can help identify which perspective is accurate or indeed produce an entirely different result, necessitating alternative alterations. Using various forms of data, designers can test creative ideas before they implement them through prototypes and associated playtests.

## Key Lessons

Ubisoft has managed to continually create successful products in the ultra-competitive video game market. Ubisoft does this through an innovation strategy that includes building capabilities in a variety of data analysis approaches, and maintaining close ties and a productive working relationship between the data analytics and product development teams. Through the various data-oriented practices, Ubisoft's Ghost Recon Wildlands live unit has been able to consistently generate exciting content to keep players engaged, extend the lifespan of their video games, create a steady revenue flow, and gain a sustainable competitive advantage.

There are a number of key lessons to be learned from how Ubisoft alters their products post-launch. For organizations to embark on data-oriented product-assisted learning, they need to build core capabilities—both in terms of infrastructures and skill sets—and they need to learn how to change their established design processes. We identify five such lessons: *build data-oriented capabilities, use diverse data sources, understand the data sources, iterate between exploration and confirmation,* and *augment and inform designer visions*.

### *Build Data-Oriented Capabilities*

Data-oriented product innovation practices require significant effort, knowledge, and experience. The investigation of data to identify anomalies and patterns requires the development and deployment of properly designed tracking events that generate a continuous stream of data related to specific product components and their use that allows the company to build an informational basis. In order to triangulate ideas, this informational basis needs to include a range of heterogenous data sources—in Ubisoft's case, for instance, not only in-game data but also community data. While such "external" data is naturally occurring, it still needs to be extracted,

transformed, and understood. Moreover, there are occasions where product-related data is deliberately generated, as in the case of playtest data to test design ideas and associated design hypotheses. Generating playtest data involves setting up a laboratory and using in-game feedback, surveys, or interviews to capture user experiences. Clearly, these heterogenous data sources require a wide range of analytical skills—ranging from applying computational approaches to analyze unstructured data such as text data to analyzing structured data such as in-game data. Moreover, the results of this analysis need to be interpreted and this interpretation needs to be embedded in the organization's design processes. Organizations who want to embrace data-oriented innovation practices thus need to build (1) technical capabilities to manage the data infrastructure, including data extraction, transformation, and storage, (2) analytical and visualization capabilities to explore the data and test hypotheses, and (3) business and design knowledge to ingrain data in everyday design decisions. At Ubisoft, the Ghost Recon Wildlands live unit has built up these capabilities over years and continues to stay abreast of advancements as they become available.

***Use Diverse Data Sources***

Ubisoft's success is partly due to their capability to learn from multiple data sources that provide complementary perspectives on the same phenomenon. Community data, for instance, comes in heterogenous, mostly unstructured forms, relates to a broad array of topics, and provides diverse user perspectives. In-game tracking data, on the other hand, attends to very specific assets or player movements and can thus be regarded as more objective but also is limited to observing elements that are part of the current version of the product. Considering only one data source may mislead design, for instance, by only addressing the needs of a small portion of the user base (e.g., community feedback from only a vocal minority) or by missing creative opportunities (e.g., when solely relying on in-game data collected through the current artifact without considering appeal to

the user base). Triangulation of different data sources, on the other hand, allows consideration for multiple perspectives, combining both endogenous (i.e., in-game data) and exogenous perspectives (i.e., community data). Organizations who want to embark on a data-oriented approach towards product innovation thus need to identify potential data sources, assess the benefits and complementarity of these data sources, estimate the costs of making them available and using them, and then decide on what becomes part of their data lake.

***Know Your Data Sources***

Combining heterogenous data sources requires an intimate understanding of these data sources, including their limitations. This involves, for instance, technical details (e.g., schema, format, volume), knowledge about the granularity (e.g., specific assets versus broader vision), and knowledge about the representativeness (e.g., specific user groups–such as sandbox players that use the game as a military simulation versus all users). Each data source has its advantages and disadvantages. Take the example of community data, for instance. While community data sources provide insight into a broad array of topics, forum discussions are usually dominated by a "vocal minority"—that is, a relatively small number of players who are very invested in the game but may also have strong opinions. These voices are not necessarily representative of the player base as a whole. Tracking in-game data from millions of users provides a clearer picture of how the product is used, statistically, and if the vocal minority is indeed representative or not.

***Iterate Between Exploration and Confirmation***

Ubisoft's Ghost Recon Wildlands live unit use their data sources in two broad ways—exploratory and confirmatory. Exploration is the foundation for generating new ideas. Exploration involves looking for patterns and anomalies that might inspire the creation of novel player experiences. On the other hand, confirmation through testing ideas is the foundation for delivering

products that are appropriate and meet user expectations: just because something is new and creative does not mean that it will enhance the user's experience. Thus, strict protocols for testing and validation are essential, including the definition of key dependent variables or the specification of acceptable thresholds.

Product-assisted learning involves continuous iterative cycles of both exploration and confirmation. Video game development companies are in a constant struggle to be at the forefront of their business through innovating their games while, at the same time, making sure not to disappoint a demanding user base that can easily turn to alternative products. This iterative cycle is an ongoing attempt to keep the player experience fresh and to avoid costly miscalculations.

***Augment and Inform Designer Visions***

Data-oriented practices do not replace human vision and ingenuity. At Ubisoft, data-driven exploration provides cues, but designers are the ones that enact their vision, and, in the end, it is the designers' judgement and style that guides the development of the game. In other words, designers make the final decisions. From this point of view, data-driven practices help augment creativity—i.e., they help produce outcomes that are both novel and appropriate.[11] Take the heatmap example discussed above: here, a novel feature was derived through exploring data, and it is unlikely that this feature would have been developed without the insights gained from that exploration. At the same time, ideas and design decisions need to be tested against the data, ensuring that Ubisoft creates designs that are appropriate and will engage both new and existing customers. This requires a close and effective collaboration between designers and data analysts throughout a project and across projects. This collaborative relationship is critically important to Ubisoft's innovation strategy.

It is clear that Ubisoft's designers use data to inform and augment their designs, but they balance this use of data and avoid over-reliance on data. The developers believe that too much reliance on data can compromise creativity and originality. Generating a competitive, innovative product requires a balancing act between human vision and data analytics.

## Conclusion

Product-assisted learning through data-oriented innovation practices may seem like an old hat to natively digital industries: Google uses A/B testing on all their products and Amazon has long leveraged in-book reading data from their e-books to inspire product changes. Likewise, Ubisoft's video games are entirely digitized product environments, and any changes to their environments are entirely software-based. But the experiences and mastery of product-assisted learning in digital-native companies such as Ubisoft provide a golden opportunity for other industrial sectors that have only recently begun to digitize their products through digital sensors, actuators, and complementary software. Physical products from toothbrushes and smartphones to industrial devices like cars, buildings, or airplanes are increasingly augmented, infused, or wrapped with digital features, providing a data infrastructure for new product innovation capabilities. As the automobile sector increasingly equips their cars with sensors, heads-up displays, actuators, and driver assistance systems, they create a digital infrastructure that enables product-assisted learning, which has become a key competitive capability for companies like Tesla who are leading the digitization of this industry. Still, these and other companies now need to establish capabilities and practices to reap the benefits from these vast data-oriented possibilities.

As the world becomes increasingly digitized, nearly all product-based activities leave behind digital traces. Smart product development firms will use product-based data not only to

learn but also to foster continuous product innovation, allowing them to respond quickly to trends, identify and exploit new usage patterns. Ubisoft's Ghost Recon Wildlands live unit's data-driven, data-informed, and data-augmented practices can serve as an inspiration for product development in any—not just digitally-native—organization.

## Notes

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## Appendix: About the Research

Ubisoft is an international video game publisher headquartered in Paris, France. Ubisoft started to develop video game titles in the 1980s and launches multiple triple-A titles every year. Now, it staffs more than 16,000 employees worldwide. We studied Ubisoft because we think their case is a revelatory[12] example of product-assisted learning through data-oriented practices.

The Ubisoft unit that we studied develops *Tom Clancy's Ghost Recon*, an influential military simulation franchise. The unit has developed various titles within this franchise, and *Ghost Recon Wildlands* is the most successful of these franchise games, with a large player community. We chose this franchise and particular game because at the time of our study the game had been available for more than two years—an extraordinarily long time span in the gaming sector—and had gone through a considerable number of post-release game innovations, new missions, features, and patch notes, suggesting "substantive significance" and "theoretical relevance"[13] to the question of data-assisted learning.

We used exploratory, inductive approaches in our research[14] to uncover Ubisoft's data-oriented innovation practices in context. We developed a case study protocol including interview guidelines in preparation and collected multiple sources of evidence (Table 5). We performed both formal and informal interviews, recorded and transcribed formal interviews, and took and compared notes during informal interviews and conversations. Multiple researchers participated in each interview. In addition to the recordings, we took extensive field notes. We collected archival data such as patch notes, presentations, and interviews. We also gained in-game experiences to corroborate the findings from interviews and make sure that we understood the discussed product changes correctly. Making ourselves familiar with the gameplay also helped us discuss pertinent game-related issues with the development team. We involved Ubisoft's Ghost

Recon Wildlands live unit regularly during our analysis of the data, to discuss emergent findings and validate our insights with the development team.

**Table 5. Data Sources, Data Types, and their Use in our Research**

| Data Source | Type of Data | Data Collected | Use in Analysis |
|---|---|---|---|
| Interviews | Interviews with employees involved in the process of game changes (e.g. data collection, data analysis, decision-making, deployment) | Interviews with<br>• Executive Producer<br>• Lead Game Data Analyst<br>• Monetization Manager<br>• Performance Director<br>• Brand Manager<br>• Associate Producer<br>• User Experience Director<br>• User Research Manager<br>• 565 min of interviews<br>• 26 pages of field notes and memos | • Understand what data Ubisoft uses<br>• Understand decision making<br>• Understand justifications for different game changes<br>• Understand types of game changes |
| Archival Company Data (Public) | Different types of publicly available data about game changes<br>• Game Website<br>• Forum, data<br>• YouTube | • Patch notes from 19 game updates (26786 words)<br>• 128 min of videos on game trailers, presentations, and interviews<br>• Three roadmaps depicting the timelines of planed game increments | • Understand the game's historicity and evolution<br>• Understand type of changes being introduced<br>• Understand means of communicating game changes |
| Observations | In-game Experience | Extensive field notes | • Corroborate findings from interviews<br>• Understand relation between game changes toward game experience |