

# Online Multiplayer Games for Crowdsourcing the Development of Digital Assets The Case of Ingress

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**Abstract.** Crowdsourcing has emerged as a cost-efficient solution for companies to resolve certain tasks requiring vast amounts of human input. In order to motivate participants to harness their best efforts for the crowdsourcing task, companies are gamifying or creating complete games around crowdsourcing problems. The location-based game Ingress integrated the development of a geographically distributed database of points of interest in its game design. Players submitted and later peer-reviewed PoI candidates for Niantic for free, who then used the crowdsourced database as backbone for such popular games as Pokémon GO and Harry Potter: Wizards Unite. This study analyzes the solution in Ingress from two main perspectives: (1) how the game motivates players to participate in the crowdsourcing tasks and (2) how crowdsourcing fits into the game creator Niantic's revenue model. The results show that Ingress players are provided multi-layered motivation to participate in crowdsourcing. The crowdsourcing tasks influence the game world, but are not limited inside it, and can be used elsewhere. Adopting crowdsourcing as a business strategy has served Niantic well, making Niantic an international multi-billion dollar company. Therefore it is predicted that more online multiplayer games implementing crowdsourcing as a revenue stream are likely to emerge in the near future.

**Keywords:** Crowdsourcing, revenue stream, Location-based games, Ingress

## 1 Introduction

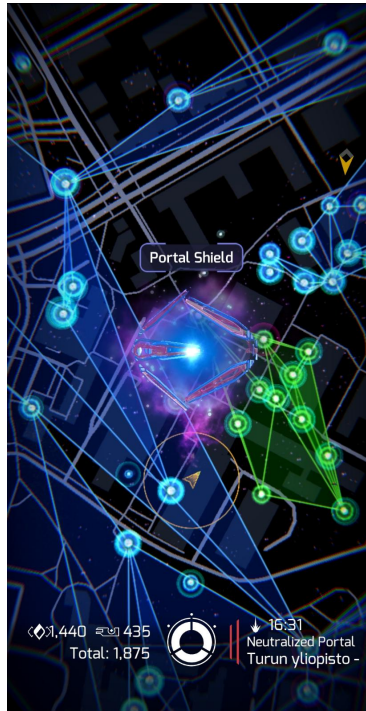
From the viewpoint of business, crowdsourcing is a sourcing model where part-products or services are produced by outsourced companies and/or individuals [1]. Typically crowdsourcing refers to externalizing the development of tasks requiring human input to a large disconnected crowd of people [2]. Recently, crowdsourcing the development of digital assets has gained popularity as a more prominent part of companies' business model [3]. Successful crowdsourcing projects rely on maintaining the participants' motivation, either intrinsic, extrinsic or both [4, 5, 6, 7, 8]. One of the most common extrinsic motivators for participating in crowdsourcing is money, and, platforms such as the Amazon Mechanical Turk provide crowdsourcing services in exchange for a monetary

compensation [9, 10]. This has led to some scholars making predictions that participating in crowdsourced projects might be considered an employment in the future [11, 12], and therefore, unsurprisingly, participants in for-profit crowdsourced projects have been found to be more extrinsically motivated [12]. However, recent studies highlight the importance of intrinsic motivation, especially in more complex crowdsourced projects, for good outcomes [13]. Intrinsic motivation is also cheaper to maintain, assuming that the main way to provide extrinsic motivation is money [14], and therefore, several crowdsourced projects have resorted to gamification, that is, the usage of game design elements in non-game contexts [15], in their crowdsourcing projects [16, 17, 18].

Moving beyond simple gamification such as awarding points for participating in crowdsourcing [13], recently, several popular multiplayer online games have emerged where players are tasked to create playable content for each other such as Super Mario Maker [19], Minecraft [20] and Ingress [21]. In the first two cases, the created content remains, at least mostly, context-specific to the game where it is created, and therefore has little value outside the game. The current study makes a difference between crowdsourced digital assets that can be utilized purely in the game-context they were created, and digital assets which extend beyond the game-context into other games and possibly other applications as well. Even though creating versatile multi-purpose digital assets via online multiplayer games might be the preferable option from a business standpoint, if the crowdsourcing task is completely unrelated to the game inside which participants are recruited, they might not have the intrinsic motivation to participate [22, 23]. Thus, the ideal case for utilizing crowdsourcing as a way to generate digital assets by using online multiplayer gamers as the workforce, is to tie the crowdsourcing project into the gameplay. In addition to consciously created data, other kinds of data such as players movement and behavior can also be regarded as digital assets, even though digital assets created this way do not fall under popular definitions of crowdsourcing [2]. Nonetheless, not all games are suitable crowdsourcing platforms and not all projects are suitable to be crowdsourced via online multiplayer games [24].

Niantics' Ingress, shown in Figure 1, is an example of an online multiplayer game where the creation of certain digital assets, mainly Niantics global database of geographic points of interest (PoIs), has been successfully crowdsourced. This database is arguably one of Niantics currently most valuable assets, being part of the backbone for such megahits as the location-based games Pokémon GO and Harry Potter: Wizards Unite [25, 26]. Most PoIs in the database are submitted by Ingress players, and since 2017 have also been peer-reviewed by players [27]. A big chunk of maintenance of the Niantic PoI database is also currently crowdsourced. The case of Ingress is interesting from a scholarly perspective as at least up until the release of Ingress Prime in 2019, the game was free, contained no ads and provided only minimal incentive to players for in-app purchases. Even though there were other revenue streams for Ingress such as selling merchandise, the game can be seen as one of the pioneering examples of online multiplayer games utilizing crowdsourcing to generate assets.

This conceptual case study investigates crowdsourcing as a new emerging revenue stream for online multiplayer games and summarizes findings from previous studies for formulating an understanding of crowdsourcing in the context of online games. Ingress is used as an example, as it is a prominent example of successfully harnessing crowd-



**Fig. 1.** A screenshot showing the main user interface of Ingress Prime.

sourcing to create digital assets. Via Ingress and previous studies, the following research questions are investigated:

**RQ1** How online multiplayer games, which utilize crowdsourcing, motivate players to participate in crowdsourcing?

**RQ2** How Niantic has integrated crowdsourcing as a part of their revenue model?

As mainly Ingress is observed, critical evaluation is needed whether the findings translate to other games [28]. Due to the fact that both multiplayer games and crowdsourcing problems can be extremely complex, it is likely that repeating the success story of Ingress will not be a trivial challenge. However, recent studies have advanced the understanding of what makes crowdsourcing succeed to the degree where it seems now more feasible than ever to adopt in game design [18].

## 2 Background

### 2.1 Crowdsourcing as a sourcing model

In 2012, a study of revenue models of apps in the Android Market found free apps to generally have complex revenue models, with a single application often utilizing

multiple revenue streams [29]. A closer look revealed there was no indications that any of these apps were utilizing the crowdsourced development of digital assets, however, one app relied on the donation model, which can be interpreted as a close relative of crowdsourcing [30]. It can thus be argued, that crowdsourcing in online games has only lately gained popularity. The difficulty of implementation as well as the challenge to find tasks suitable for crowdsourcing in online games are likely causes for this [31]. Furthermore, crowdsourcing is best utilized in cases where the collective wisdom of crowds outclasses that of a limited set of professionals [32].

Crowdsourcing can be divided into four categories: (1) crowdprocessing, (2) crowd-solving, (3) crowdcrating and (4) crowdcreating [33, 34, 35]. In the first two types of tasks, the value is derived from individual contributions whereas in the second two, value is derived from combining multiple solutions. Depending on the problem at hand, one or more of these can be utilized in online multiplayer games. For example, Ingress uses crowdsolving for submitting new portal candidates and crowdcrating for evaluating them. If a crowdsourcing task is simple, and over in short time frame, it might not be cost-effective to create an entire online multiplayer game for solving that problem, and monetary compensation for participants or simple gamification might work better. On the other hand, if the task requires a lot of focus from participants, gamification must be used with care [36]. For example, in the case of Wikipedia where participants are tasked to write, review and edit articles, the task itself is attention-demanding enough so that any additional gamification elements to the work process itself might only disrupt the flow of contributors [37].

## **2.2 Crowdsourcing and gamification**

Video games are a rapidly growing industry with the market size of US\$ 96 billion in 2018, bypassing Hollywood as a biggest entertainment sector [38]. Gamification by definition means using game design element in non-game contexts. The origins of the term 'Gamification' dates back to the end of the first decade of 2000, the usage of the term increased explosively after mid-2010. [39]. The border between gamified application and a game is obscure, as even when the two are linked, the terms cannot co-exist because of the definition of gamification [40]. For example, it can be argued that the popular physical activity increasing location-based game Pokémon GO [41] is in fact not a game, but rather a gamified sport application.

Nowadays gamification has been successfully utilized in several crowdsourcing endeavors, and in many cases, has managed to increase engagement and participation rates [13, 16, 35]. Simple and straightforward tasks have generally used simple gamification tools such as points, however, more complex problems have been gamified in a more nuanced and creative fashion [13]. When discussing real games with built-in crowdsourcing, the motivating elements can be multi-layered. This can mean simple rewards such as points, but also things such as social pressure, new gameplay opportunities and gratifications from permanently influencing the game world among others [13, 16]. Furthermore, people have been found to contribute more to gamified crowdsourcing systems when organized in teams, and cooperative elements increase users' willingness to recommend the crowdsource-system more, when compared to a competitive design [18]. When participating in crowdsourcing where participants create things together,

motivators can include career advancement, peer recognition, contribution to a collaborative effort, self-expression, having fun, and learning new skills and knowledge [6]. Peer recognition, for example, can be highlighted in game design by showing other players what their peers have contributed.

Crowdsourcing the development of digital assets via online multiplayer games has been applied to such games as, for example, hand-crafted action and dialog generation models for a social robot [22, 42] and analyzing images of infected thick blood smears [43]. From the business perspective, revenue models often consider revenue streams as money streams, however with crowdsourcing, the added value comes in the form of digital assets.

### 2.3 Ethical Considerations of Using Crowdsourcing in Games

As gamified crowdsourcing harnesses human resources for work, often without any need for signing legal documents, questions about the ethical aspect of such revenue model arise [44]. Can crowdsourcing potentially be utilized as means to circumvent existing legal protection for the working class? What about child labour? Transparency and quality control[45]? According to Brabham [6] motivators for participating in crowdcreating especially include contribution to a common effort among others. Thus, in addition to these pressing issues, participants in crowdsourcing projects can regard the end result as a shared property, even though it may legally be owned by a private company [6, 35]. If participants consider the crowdsourced outcome as a common property, does the company with the legal rights to the created assets have a moral responsibility to keep providing participants the outcome of their work? To address the ethical concerns, four dimensions: privacy, accuracy, property and accessibility of information (PAPA) have been looked at in crowdsourcing business [46]. Participation in crowdsourcing runs the risk of exposing sensitive information to the crowdsourcing platform [47], however, with online multiplayer games this risk already exists, arguably even in greater magnitude [48]. Companies utilizing crowdsourcing should pay attention to include PAPA in their design to avoid legal and ethical misconduct [46].

The ethics of using gamification have also troubled researchers. The worries concerning gamification can be divided in two categories: *Limiting*, situations where player is optimizing the work required to complete task, or *harmful* distracting users from the main purpose of actions, issues. The dark side of gamifications can be discussed when the elements of gamification are used for example in casino environment or with game addicted people [40].

Finally, there are some risks of bias in crowdsourcing. First, there can also be large differences in who contributes to the crowdsourcing projects, with some participants perhaps working hundreds of times more than others, which can skew the outcome to the direction of those working more. In addition, there can be differences and biases in participants age, gender, situation in life and geographical location. For example, when Wikipedia's crowdsourcing was studied, a bias between men and women content creators was revealed [49]. Whenever a bias is significant, it can be questioned whether the content is biased.

### **3 Research process**

This study presents a conceptual analysis of crowdsourcing in the game Ingress. Ingress is a free-to-play game from the market leading company in terms of revenue in location-based games (LBGs), Niantic. Several studies have focused on the gamification of crowdsourcing [18], but analysis of success cases of crowdsourcing in online multiplayer games are missing. Ingress is ideal for this kind of a study, as the creation and partially also the maintenance of a geographically distributed global database of PoIs corresponding to real world locations was successfully outsourced to the players of the game [27]. What makes Niantic and Ingress further interesting is that there are two cases where the crowdsourced PoI database has been applied outside the context of Ingress: the LBGs Pokémon GO and Harry Potter: Wizards Unite. Thus, in the following sections the crowdsourcing solutions of Ingress are observed and analyzed and the motivating factors for participating in the crowdsourcing are derived by looking at the game design. Afterwards, crowdsourcing is looked at more broadly from the perspective of Niantic's revenue model, in order to gain insight of how crowdsourcing can fit into the current video game ecosystem.

### **4 Case: Ingress**

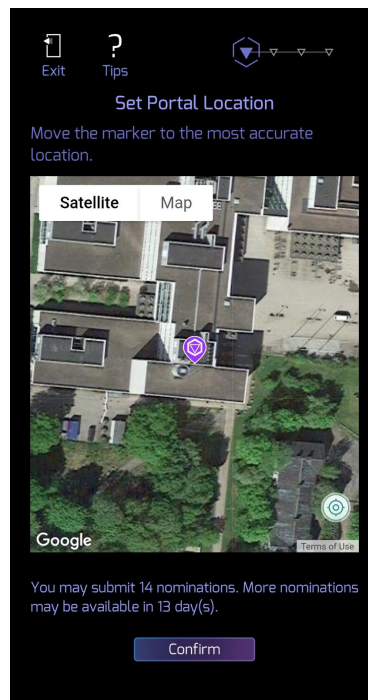
Ingress, initially released in November 2012[50], is a pervasive LBG by Niantic. The gameplay revolves around travelling to PoIs called portals and linking them together to create triangles. Links between portals cannot cross existing links, and the bigger the created triangle, the more points (mind units) the player receives. The game world is shared with other players and there are two teams called factions competing against each other: Resistance and Enlightened. As Ingress is gameplay revolves around the PoIs called portals, their quality and location are important. Contrary to many other LBGs such as The Walking Dead: Our World and Jurassic World: Alive, Ingress PoIs corresponds to real world objects [51]. Many of the successful crowdsourcing projects in online multiplayer games have the game designed specifically for the crowdsourcing endeavour [23, 42, 43], and, as portal submissions became available right at the launch of Ingress, it is evident that crowdsourcing was embedded in the creation process of Ingress and possibly also influenced the design of the gameplay. [52]

Besides crowdsourcing the development of their PoI database, Ingress allegedly monetizes itself via user data collection and their location surveillance [50]. Collecting user data and selling it onwards is becoming an increasingly popular revenue stream for online games [53, 54, 55], however, as a pervasive LBG, Ingress is able to generate data on users' movements and daily activities, something many other games are unable to do [26, 50].

#### **4.1 Crafting the Portal Network in Ingress**

When Ingress launched, it contained a few pre-created PoIs as portals from the previous Niantic pilot game Field Trip and the social picture sharing platform Panoramio. Alternatively, these pre-existing candidates could have been obtained from other services

such as Open Street Maps [27]. Some of the initial candidates were perhaps not entirely accurate, however, right from the beginning the evolution of the Portal Network can have been regarded as a continuous process where new candidates are being accepted and old obsolete ones are being removed. Immediately upon launch, players had the ability to submit new portal candidates for Niantic to review, but otherwise had no means to participate in the development of the PoI database. The submission screen the player sees inside their Ingress app is depicted in Figure 2.



**Fig. 2.** A screenshot taken from the beginning of an Ingress Portal Submission using the Ingress Prime app.

#### **4.2 How Ingress motivates players to participate in crowdsourcing**

Being a free to play game, Ingress provided several reasons for players to contribute portal submissions for their PoI database. These included (1) the ability to permanently influence the game world (2) the ability to create more playing opportunities in the local area (3) Obtaining score to an in-game medal in Ingress called “Seer” and (4) the willingness to support Niantic in their attempt to create a global database of cultural hotspots, among others. Soon however, Niantic became overburdened in their attempt to manually review all portal submissions and sometime around 2015-2016 the portal

submission option was removed from players in several countries [27]. As a resolution, in addition to crowdsourcing the portal submission system, in 2017 Niantic released Operation Portal Recon (OPR), a browser-based system for players to peer-review the portal submissions. To motivate players to start working in OPR, Niantic gave the peer-review system a cool name and created a badge to Ingress which could be leveled up by doing OPR. The OPR system is currently handling new submissions, portal name edits, location changes and description changes which are all affected throughout all Niantic games utilizing their PoI database. However, some aspects Niantic employees are still responsible for themselves, such as portal appeals, portal removals and the acceptance of new picture submissions to existing portals. Sometime around 2018-2019 Niantic also gave Pokémon GO players the ability to submit new portal candidates [56], however only Ingress players above level 12 are allowed to review them. By limiting who can participate in crowdsourcing Niantic protects itself against possible abuse from, for example, scripted low level accounts trying to influence the crowdsourcing.

### 4.3 Crowdsourcing as part of the Niantic's revenue model

In this section the observed revenue streams of Niantic related to the game Ingress will be looked at (Fig. 3) in the context of Karl Popp's Revenue Model model [57]. As mentioned before, Niantic currently maintains servers for three games they have developed or co-developed. Out of the three games Ingress has the largest amount of different revenue streams, even though in the light of revenue statistics, it seems to be making the least money. On the other hand, Niantic retains full ownership of its Ingress brand, which gives them the ability to gain revenue from selling merchandise. This is contrasted by the Pokémon [58] and the Wizarding World [59] brands of which Niantic has no ownership. The estimated generated revenue of the most popular location-based mobile games during July 2019 (1 month) according to the mobile app store marketing intelligence company Sensor Tower are shown below.

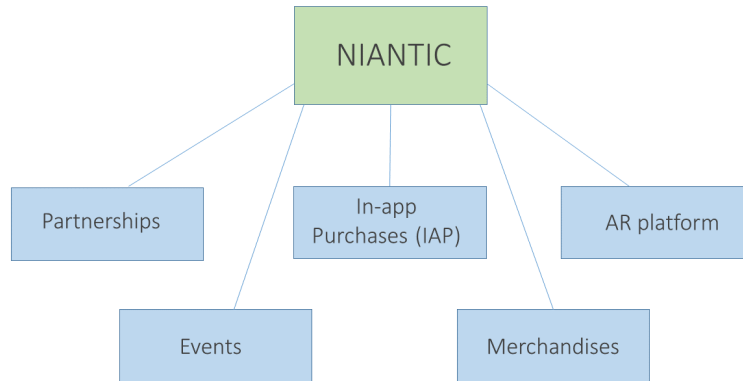
- Pokémon GO 22 million USD
- Harry Potter: Wizards Unite 2 million USD
- Jurassic World: Alive 800 000 USD
- The Walking Dead: Our World 400 000 USD
- Landlord Tycoon: Real Estate Investor 50 000 USD
- Ingress Prime 20 000 USD
- Draconius GO <5000 USD

First, this data highlights the dominance of Niantic in the current LBG market. Second, it shows how Ingress created very little monetary revenue (20 000USD) compared to the other two Niantic games. However, this statistic does not take into account value received from crowdsourcing. Third, a thing to observe from the data is that the four most popular games are all based on pre-existing brands, which vaguely seem to correspond to the overall estimated value of the brand.

Looking at the observed revenue streams, partnerships are used in all three Niantic games to attract big brands such as McDonalds and Starbucks, and they are also visible in the real life events organized by Niantic. For example, Pokemon Go Fest -events



have been held in shopping centers, which have partnered with Niantic. Income from in-app purchases is the most visible revenue stream of Pokémon GO and Harry Potter: Wizards Unite. Especially with Pokemon Go, Niantic approach the potential business partnerships by telling them how often players are attracted by PoIs or how they are changing their regular walking route on a weekly basis to play Pokémon GO [60].



**Fig. 3.** Five observed revenue streams for Niantic

Currently, most of the development of the Niantic PoI database is crowdsourced and automated. This database is currently in use in three games: Ingress, Pokémon GO and Harry Potter: Wizards Unite. Out of these three games, Ingress is generating the least direct revenue whereas the other two currently make well over 20 million USD monthly. Recently Niantic launched its AR -platform, including the PoI database, for developers to rent and use as the backbone for their games [61]. One part of their business offer in AR platform is the content, which players have provided for them via Ingress. With the platform, Niantic has harnessed the content which players have created while playing, for a business outside the original game-context. It is plausible that this kind of a revenue model which utilizes crowdsourcing could also work with other gaming companies and industries. Managing, harnessing and correctly leveraging player motivation to get them contributing in crowdsourcing is the key challenge in this business approach. Designing the multiplayer online game with a specific crowdsourcing goal in mind in most cases helps the issue [42, 43], as does the inclusion of collaborative multiplayer elements [18].

## 5 Discussion

### 5.1 Key Findings

**Motivating players to participate in crowdsourcing in online video games** Online video games seem a promising platform for implementing crowdsourcing as long as a

suitable crowdsourcing problem exists. The problem needs to be such that a game can be created around it so that players can be motivated to contribute. Video games can provide multi-layered motivation to contribute into crowdsourcing beyond simple gamification [13, 16]. Ingress currently provided both simple direct rewards such as points for contributing both OPR reviews and portal submissions, but also higher abstraction level rewards such as recognition from peers and gratification from permanently influencing the augmented virtual world. Cooperative multiplayer elements have been recently linked to increased contributing in crowdsourcing tasks in online games [18], but for effective cooperative gameplay to take place, players need to be given meaningful challenges which they face together. Thus, even if online video games can be effective in motivating players to participate in crowdsourcing, creating successful solutions is challenging.

**Crowdsourcing as a revenue model in games** Crowdsourcing has shown promise of being an interesting revenue stream option for game companies. As revenue models of games are rapidly changing and evolving [62], crowdsourcing might gain popularity during the coming years. In theory, multiplayer games are able to harness and utilize the free time of millions of humans whose computational efforts have several benefits compared to computers, especially with regards to solving complex problems or creating new assets. In order to optimize the crowdsourcing, companies might want to look at designing their games with the crowdsourcing task already in mind, to have an accordingly planned revenue model and to ensure that the gameplay seamlessly integrates with the task [42, 43].

Ingress is not the only successful commercial game to leverage crowdsourcing as a means to generate income. For example, Super Mario Maker, based on the popular Super Mario platform games [63], has players create levels and upload them to a server for other players to enjoy. Studies have demonstrated that the Super Mario Games can be also used to crowdsource the development of game aesthetics [64]. These kinds of tasks share similarities with the PC modding scene [65, 66] where game developers give tools for players to create all sorts of content around their core game. These kinds of co-created media [67] have been around for over 15 years, however only recently as crowdsourcing has moved beyond the context of individual games, has it become a feasible option for a revenue stream in online multiplayer games as demonstrated by Ingress.

## 5.2 Limitations and Issues with the Niantic Solution

The Niantic PoI database has received several criticisms, for example, for favoring major cities so that rural areas, and those inhabited by minorities, tend to have a significantly lower PoI-density [25]. There are two main reasons for this: (1) Lack of players and thus lack of support for the crowdsourced creation of portals in certain areas and (2) Causal effects of Niantics chosen PoI criteria for Ingress portals. The first reason is straightforward and has been combated by, for example, Niantic allowing Pokémon GO players to submit portals in addition to Ingress players. The second reason is more problematic, as compromising the portal criteria might result in low quality portals in

well populated areas as well. Tregel et al. [27] proposed their own set of criteria with 21 priority levels to combat this issue, however, no such solution has yet been applied into practice.

There are also biases in the way OPR operates. Firstly, the system is supposed to be a blind peer-review, but at least in Finland, Ingress players have their own chats discussing how to vote for certain candidates, with instructions sometimes being against official Niantic guidelines. In addition, players might want to influence the portal network to favor themselves or to cause harm to players in the opposing faction. As portals located in places which are not easily accessible like islands can cause harm to Ingress players, OPR could show bias in accepting portal submissions in these places. However, because portals can be submitted repeatedly and players rank is punished if they vote against the general consensus, only systematic abuse of the system by several players can really influence the outcome of the peer review.

### **5.3 The future of crowdsourcing the digital assets in games**

Revenue models of games change fast. Every now and then a new type of revenue model emerges which disrupts the video game industry. Examples of these have been the shift from a bulk purchase price towards free-to-play games and more recently, loot boxes. Where loot boxes are quite specific to video games, with only minor applications elsewhere like gambling, crowdsourcing has mainly gained popularity outside video games and has only recently started to be gamified [16, 17] or embedded in games. Based on the success case of Ingress, it is likely that crowdsourcing will make its way into the design of many more future games as a part of their designed revenue stream.

## **6 Conclusion**

In this study the crowdsourcing of digital assets in online multiplayer games was discussed. Results from previous studies suggest that as with many other revenue streams, crowdsourcing the creation of digital assets should be taken into account already in the design process of the online game to maximize potential. Crowdsourcing struggles constantly with how to motivate participants to contribute, and creating elaborate games around crowdsourcing problems might be a solution. Previous studies have shown that a multiplayer design, especially such which focuses on teamplay can have a positive impact on participants motivation to contribute to the crowdsourcing task [18]. Ingress provided players multi-layered motivation to contribute in the crowdsourcing tasks from simple gamification elements such as rewarding points to higher abstraction level rewards such as recognition from peers or gratification derived from permanently influencing the virtual game world across several games. The success case of Ingress will likely motivate several future explorations on how to leverage crowdsourcing as a revenue stream in online multiplayer games.

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