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# TECHNOLOGY AND DISASTER MANAGEMENT:

## LESSONS LEARNED FROM THE PHILIPPINES

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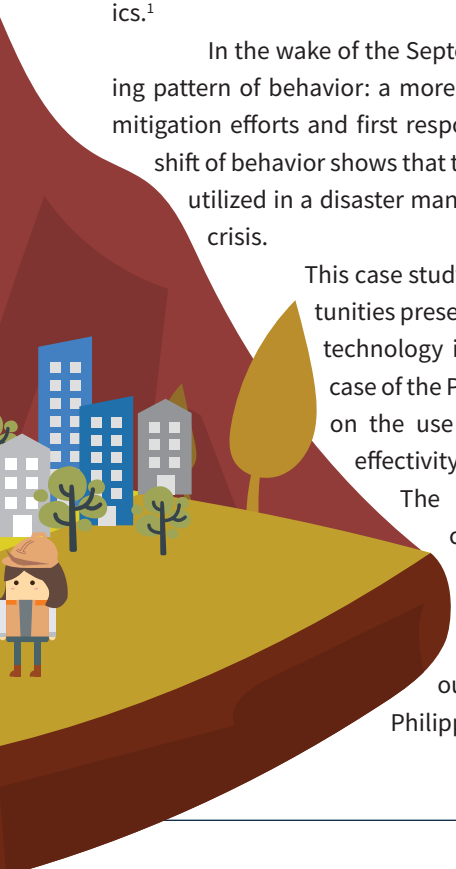
## Summary

The case study will explores the opportunities presented by the utilization of information technology in disaster management. It will look at the case of the Philippines, where disaster management relies on the use of AI and big data sourced from social media. This is seen to increase the effectivity and efficiency of the system in general. The forms of information technology that this case study will focus on to be incorporated to the disaster management system are: AI and big data.

## Introduction

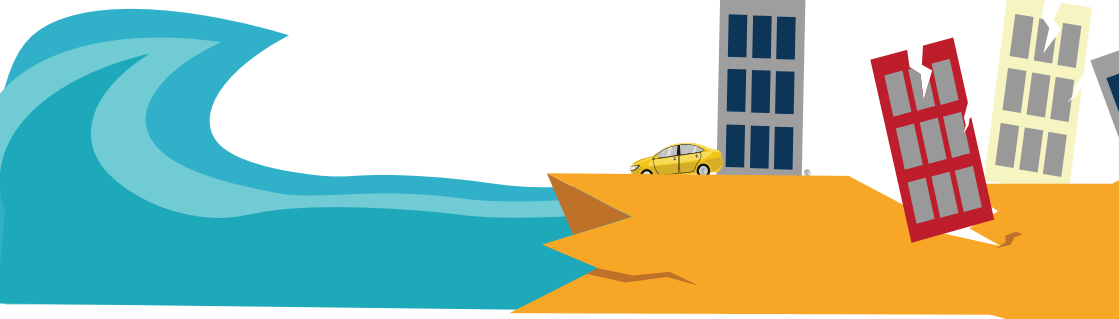
As a country which situated on the ring of fire, Indonesia can be categorized as a disaster-prone country. According to a BNPB (*Badan Nasional Penanggulangan Bencana* – National Disaster Mitigation Body) document, Indonesia is highly prone to both natural disasters, such as earthquake; tsunami; or volcanic eruption, and (potentially) man-made disaster, such as flood; drought; and the spread of infectious epidemics.[1]

In the wake of the September 2018 Palu Tsunami, CfDS observed an interesting pattern of behavior: a more widespread participation of societies in the disaster mitigation efforts and first responses enabled by the existence of social media. This shift of behavior shows that the sweeping impact of information technology can be utilized in a disaster management system to gather more input in the times of crisis.



This case study, therefore, will be dedicated to exploring the opportunities presented by the all-encompassing presence of information technology in disaster management. CfDS will further study the case of the Philippines, where the disaster management had relied on the use of AI and data from social media to increase the effectivity and efficiency of the system.

The Philippines is also a disaster-prone archipelagic country located in Southeast Asia, which possesses a degree of similarity to Indonesia and thus chosen as the case study. This case study will be structured as follows: we will be specifying the terms used throughout the case study first before looking at the case of the Philippines.



After examining the impact of utilizing AI and data from social media in the case of the Philippines, we will then move to reflect the opportunities and challenges to implementing such a system in Indonesia. This case study will focus on two kinds of technology that could be incorporated into the disaster management system: AI and big data.

In general, data refer to distinct pieces of digital information formatted in a specific way and can exist in a variety of forms, such as but not limited to, numbers, images, and texts.[2] In this case study, thus, the data that would be referred to will denote pieces of information (in their respective forms) pertaining to the occurrence of a disaster. Big Data refers to data sets or the mixture of data sets whose size, complexity, and rate of growth make them difficult to be analyzed by traditional technologies and tools.[3]

Big Data is characterized by the Five Vs: (1) the quantity of generated and stored data (volume), the type and nature of the data (variety), the speed at which the data is generated and processed (velocity), inconsistency of the data set (variability), and the quality of captured data (veracity).[4] The sources of Big Data come mainly from sensors, devices, video/audio, networks, log files, transactional applications, web, and social media - generated often in real time and in a very large scale.[5] As has been mentioned before, the sheer size of Big Data requires a non-traditional method of analysis—Big Data Analytics is the process of making sense of a large data sense to uncover correlations and patterns.[6]

Artificial Intelligence (AI) generally refers to the ability of the computer to simulate human intelligent behavior—or more specifically the designing and building of intelligent agents that receive percepts from the environment and take actions that affect that environment.[7] Disaster management denotes a science which seeks to improve measures relating to prevention, mitigation, preparedness, emergency response, and recovery through systematic observation and analysis of disaster.[8] This definition of disaster management denotes several steps, which are: prevention, mitigation, preparedness, response, and recovery—which this case study will generally focus upon.

## The Philippines Case:

# Using AI and Social Media in Disaster Management System

In this section, the case study will explore the use of AI and social media in the Philippines' disaster management system. This case study chooses the Philippines because it sees a similarity of the disaster-risk profile of both Indonesia and the Philippines. Both are archipelagic countries in the Southeast Asia region, lies on top of the ring of fire, and have a similar climate.[9] In addition to being on the ring of fire, the Philippines is also situated along the Typhoon Belt.[10] This exposed the Philippines not only to tsunamis, earthquakes or volcanic eruptions but also to the high risk of typhoons.[11] This also put the Philippines as the fourth most frequent country to be hit by natural disasters over the last 20 years.[12]

Both the Philippines and Indonesia have a high settlement rate in hazard-prone areas, have a moderate to high level of poverty, and experience the degradation of forests and coastal resources.[13] This gives Indonesia and the Philippines a similar starting point in regards to disaster risk profile. Having established the comparable characteristics between Indonesia and the Philippines, this case study will explore how the Philippines utilizes Artificial Intelligence (AI) and social media in their disaster management system. This case study sees that the incorporation of such technology had succeeded in creating a more effective and efficient disaster management system.

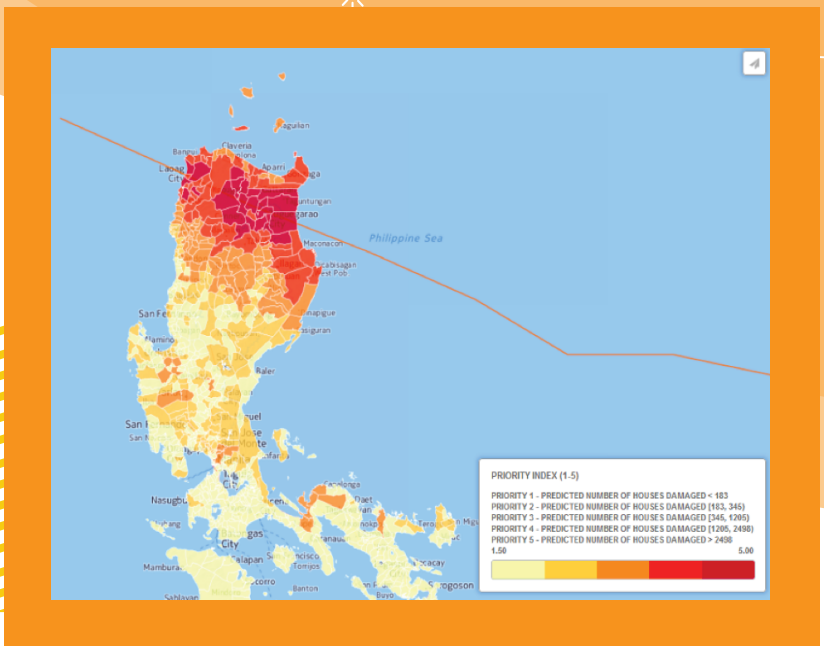
## Artificial Intelligence in Responding to 2016 Super Typhoon Haima

Located in the typhoon belt, the Philippines is particularly prone to get hit by typhoons which possess a destructive power. The Philippines is vulnerable to as many as 20 typhoons each year, 5 of which are destructive in nature.[14] In October 2016, the country was devastated by Super-Typhoon Haima, "one of the most powerful typhoons to ever hit the Philippines" with winds

measured at 225km/h (140mph), and wind gusts of up to 315km/h. [15] This typhoon, known in the Philippines as the “Lawin" typhoon, swept the northern provinces of the Philippines and affected the Cagayan, Isabela and Kalinga, Abra and Apayao provinces. [16] This typhoon affected almost 5 million people, claimed more than 7,000 lives, and had caused catastrophic destruction.[17] The storm had a significant impact on agriculture and education in the land, and about 10 million people across the northern parts of Luzon were facing a risk of the typhoon.[18]

In responding to the outbreak of this Super-Typhoon, the Philippines Government incorporates artificial intelligence in the disaster relief effort. The Philippines Government cooperated with 510 Global, an initiative proposed by the Netherlands Red Cross which aims to provide faster and more cost-effective humanitarian aid through the use of Big Data Analytics.[19] This initiative uses data to build a "Priority Index" for typhoons in the Philippines using data such as wind speeds, precipitation rate, and datasets from the previous disaster.[20] This Priority Index can help in predicting worst-hit area and thus facilitating faster distribution of aid to those areas.[21] In the aftermath of the disaster, the availability of information can be seen as a matter of life or death. The Priority Index released by 510 Global, thus, can provide immense help to the disaster relief effort, seeing that the initiative had the ability to release the Index hours after the disaster occurred.[22] Compared to the damage assessment provided by 510 Global, the damage assessment provided by official bodies can take weeks to be done, due to the logistics; safety constraints; or the workload.[23]

Besides the accelerated availability of information provided by 510 Global, the accuracy of the information was also verified by later damage assessment by the Philippines officials. According to the Department of Social Welfare and Development (DSWD) and the National Disaster Risk Reduction and Management Council (NDRRMC), the prediction provided by 510 Global initiative proved to be correct.[24] The system is still in development though, as the system still had difficulty to predict really low and really high damage, and still has a concern regarding data privacy and security.[25] Below, we presented the Priority Index generated by the 510 Global in the aftermath of Typhoon Haima of October 2016 in the Philippines.

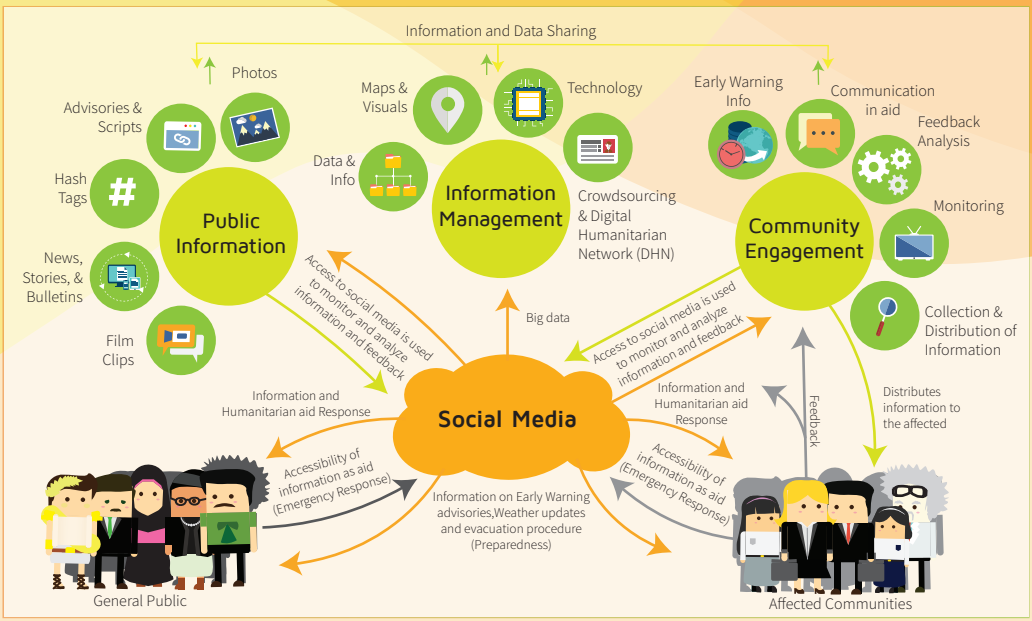



Source: Progrss (2016)[26]

## The Use of Social Media in Disaster Management

Besides the utilization of AI in providing a swift information regarding the worst-hit area, the Philippines seems to be increasingly aware of the role that social media can play in ensuring a swift and effective disaster relief effort. As has been mentioned before, the availability of information in a disaster situation can be a matter of life and death. Social media is increasingly perceived as a valuable source of information in the onset of the disaster.

Social media has been used to provide warning of unsafe areas or situations, access information regarding the safety of loved ones, and raise funds for disaster relief efforts.[27] The easiest example of social media usage in the face of an emergency situation is the safety-check feature on Facebook, which let users mark themselves safe during an emergency situation and share that information to their friends and family. Facebook also cooperates with several organizations engaged in emergency relief, which includes Information Systems for Crisis Response and Management (ISCRAM), The Humanitarian Free and Open Source Software (FOSS) Project, as well as numerous universities with disaster-related programs.[28]




Source: UN Office for the Coordination of Humanitarian Affairs (UNOCHA) (2015).[29]

In the Philippines, the utility value of social media in disaster management had been increasingly recognized by the prominent stakeholder. This allowed the Philippines Government to harness the power of social media in the event of a disaster. The Philippines Government, for example, had advised the use of a single hashtag on Twitter to access emergency information during the time of the disaster in order to ease the process of monitoring, tracking, and consolidating information before, during, and after a natural disaster.[30] Hashtags such as #ReliefPH, #RescuePH, and #SafeNowPH had been consistently used in the onset of disaster to monitor the distribution of aid, track people that need to be rescued, or inform loved ones about one's safety.[31] This case study will now focus on the occurrence of Super-Typhoon Haiyan, considered one of the strongest typhoons around the world, that hit the Philippines in 2013.

The Super-Typhoon Haiyan, or is commonly known in the Philippines as the Super-Typhoon Yolanda, struck Eastern Visayas provinces in 2013—dislocating almost 4 million people, and killed almost 10,000.[32] The typhoon destroyed around 70%-80% of the building in the Leyte province, and it was estimated that up to 10,000 people had died as a result of the destruction created by the typhoon.[33]

The typhoon sustained winds of about 315 km/h and gusts as strong as 380 km/h, making it the strongest tropical cyclone to hit land anywhere in the world[34] (Mullen, 2013). The typhoon, too, seemed to serve an important lesson for the Philippines Government to respond adequately to super-typhoon and disasters in general, as

the government is seen to be more prepared to the onset of the upcoming Typhoon Mangkut when compared with the level of preparation they had for Typhoon Haiyan.[35]

This case study will particularly highlight efforts by Filipino officials to utilize social media as a tool of information on the onset of Super-Typhoon Haiyan. Peter Meier, the director of social innovation at the Qatar Foundation's Computing Research Institute in Qatar, developed MicroMappers—an online tool that helps sort through online data (from tweets to pictures) and display them on satellite maps.[36] By doing this, MicroMappers provide a bird's-eye view as events unfold to allow disaster managers to gain more situational awareness in order to allocate resources and coordinate logistics effectively.[37]

Another platform that facilitates the processing of information through social media is Agos. Agos was a combination of two separate projects, Rappler's Agos and Ateneo's e-Bayanihan system, that was merged in 2015.[38] By combining the two platforms, Agos combined academic analysis and research with crowdsourcing, content creation and community engagement. Agos helped in facilitating the cooperation between the top-level government official and members of the society by establishing an Alert Map which integrates and manages critical information much needed in disaster management. [39]

The community of volunteers in both platforms (Agos and MicroMappers) help by confirming the validity of critical information (such as the needs of the victims and worst-hit areas), and thus allow relevant stakeholders to take actions.[40] By doing so, data analytics platforms such as Agos and MicroMappers had allowed collaborations by incorporating data sourced from the civil society through social media, to the disaster relief efforts. This would allow efficient and effective distribution of disaster-relief aid.

Some of the limitations of using such a system are the possibility of data invalidity, as crowdsourced data have a higher chance of misinformation and false perception. Both platforms had managed to get around this by using a volunteer-based verification system. However, this method is time-consuming. As has been mentioned repeatedly in this case study, timely information in the face of disaster is a matter of life or death.

Moreover, the incorporation of social media in disaster management system should also be done before the disaster strike. People who are predicted would be worst-hit by the disaster should be socialized regarding which hashtags to use, what kind of platform they can report to, and to what kind of platform they can find information. In the onset of Typhoon Haiyan, for example, the WHO had just set up a social media account on the aftermath of the Typhoon.

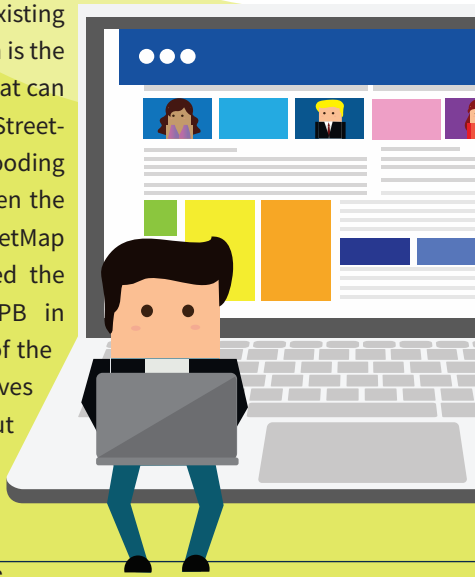
Their report stressed the importance of building a social media presence in non-emergency times that would support the dissemination of public health messages that could educate the public on what to do during a disaster.[41] The report also found that the message disseminated did not reach the targeted audience immediately but through a gradual process,[42] which can prove problematic at times where information is needed swiftly by the general audience.

## Challenges and Opportunities in Indonesia

Having talked about the experience from the Philippines, this case study will then discuss the challenges and opportunities of implementing a data-based disaster management system in Indonesia. The first opportunities of incorporating data into Indonesia disaster management system comes from Indonesian large mass base of internet user. Indonesia boasts as much as 130 million—amounting to almost half of the country's population—Facebook users in 2018, marking it as the fourth-highest number of Facebook users in the world.[43]

This large number of user base had created a massive opportunity due to the simple fact that half of the country population are active internet users—making the country more connected than ever. Another opportunity comes from Indonesia's flourishing digital startup economy. Indonesia is home to some of Southeast Asia's biggest startups, such as Go-Jek and Tokopedia.[44] This shows that Indonesia possesses more than adequate human capital to set up a system and digital infrastructure of digital disaster management system.

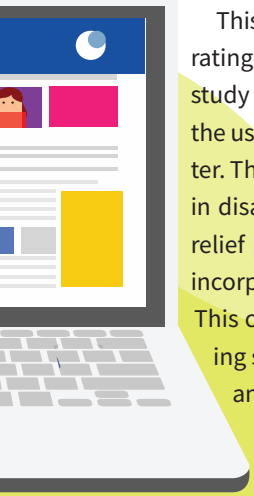
Another opportunity came from an existing technology similar to Agos and MicroMappers, which is the OpenStreetMap. OpenStreetMap is an online map that can be edited by users registered in the platform. OpenStreetMap is used in Jakarta to map out the event of flooding back in 2016 and inviting the collaborations between the Provincial Government and Humanitarian OpenStreetMap Team (HOT) Indonesia.[45] The HOT has also helped the government, through cooperation with the BNPB in Sulawesi to map out the damage in the aftermath of the Sulawesi earthquake.[46] This means that initiatives similar to Agos and MicroMappers had existed, but only utilized in the aftermath of a disaster.



The main challenge to incorporate higher role to data in Indonesia disaster management system came from the inadequate infrastructure to support such action. The case being communication being cut off on the aftermath of Palu earthquake, leaving hundreds of thousands of people without access to the telecommunication and thus, rendering any efforts to use social media as a means of communication practically useless.[47] Another challenge is that Indonesia only uses technologies such as OpenStreetMap after the onset of the disaster, whereas predictive technology, such as 510 Global, would better prepare all affected parties on the upcoming disaster.

Moreover, the source of information for OpenStreetMap only comes from the Humanitarian OpenStreetMap Team, and not the general public. This could limit the form of information that would be available for the stakeholders, such as information of missing people, or the needs of the victims. The last challenge identified is the low-level of maintenance of such technologies. The case that illustrates this challenge is the stolen buoys on the coastal area. Even after planting many of its coastlines with tsunami predictor buoys, all of these buoys got eventually stolen by the locals or was rendered impotent without any effort to replace it.[48] This raises a question of maintaining the upcoming technologies that Indonesia would incorporate into its disaster management system.

## Conclusion



This case study talks about the lesson learned from the Philippines in incorporating digital technology in disaster management system. In doing so, this case study focuses on two things: (1) the utilization of AI in predicting disaster, and (2) the use of crowdsourcing data through social media in the aftermath of the disaster. This case study finds that both the utilization of AI and the use of social media in disaster management had increased the effectivity and efficiency of disaster relief process. This case study then looks at the opportunity and challenges of incorporating such technology in the Indonesian disaster management system. This case study concludes that Indonesia has a lot of opportunity in incorporating such system in the country, yet the challenges of inadequate infrastructure and low-level of maintenance remain.

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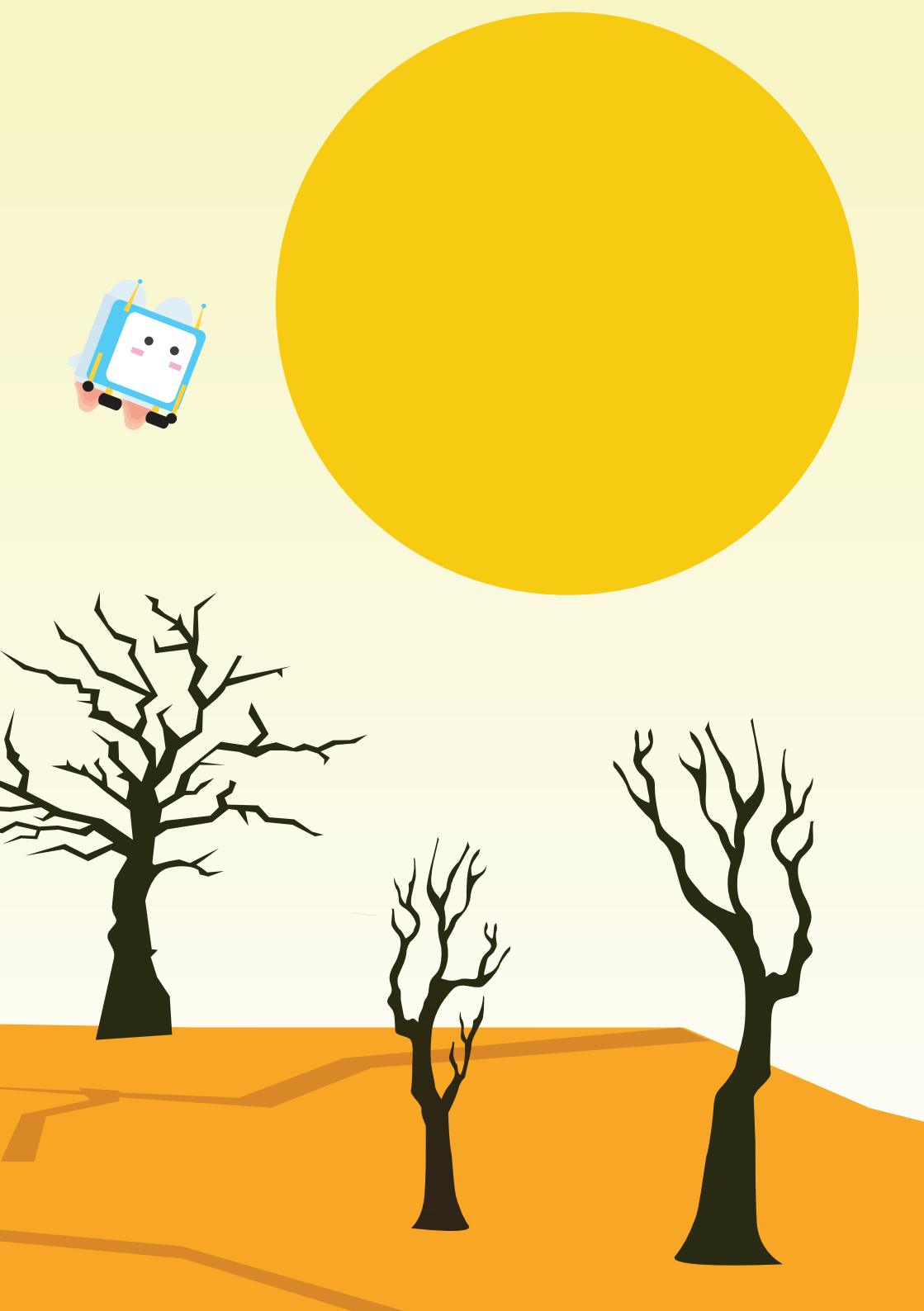

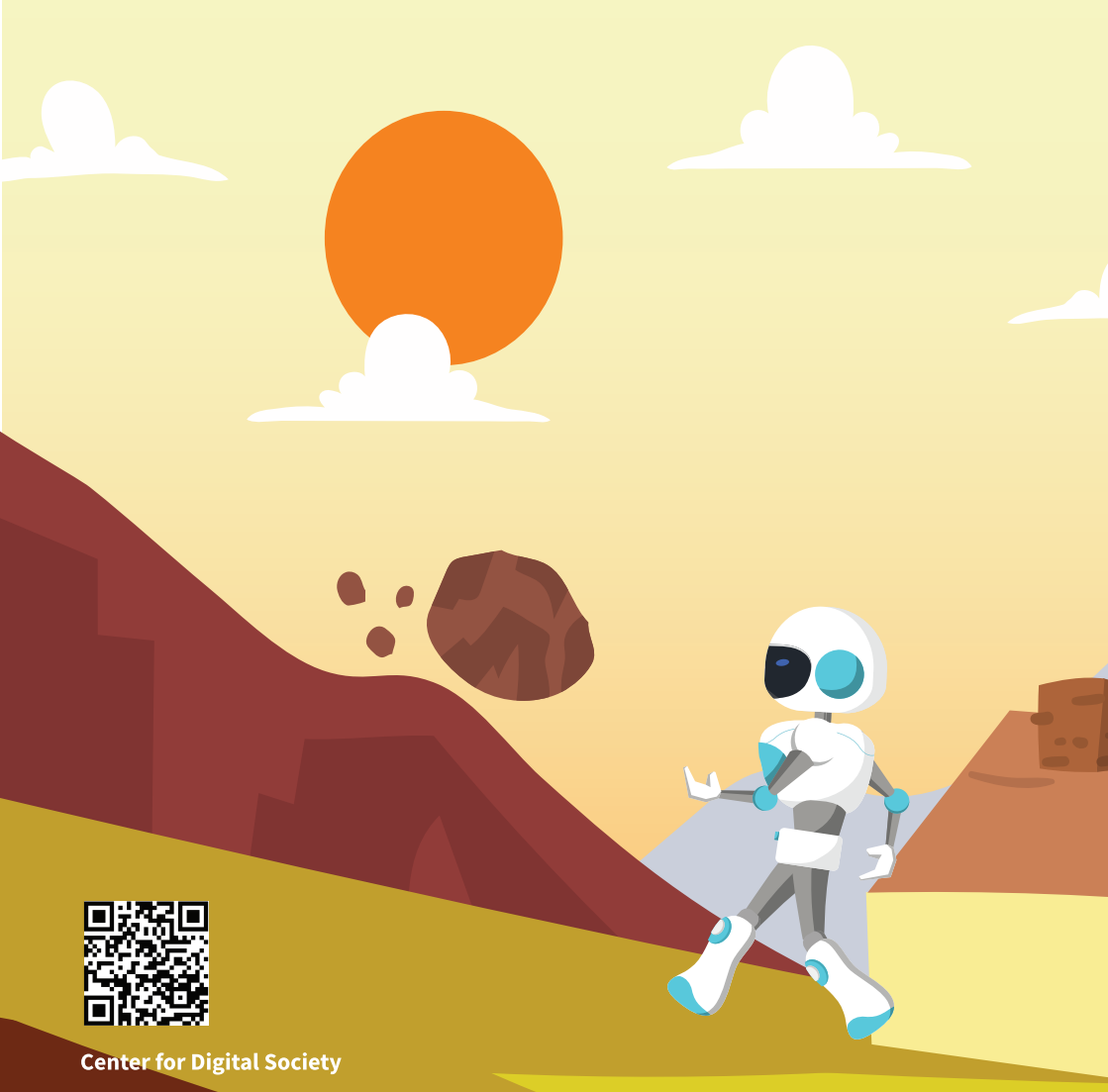

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