Leveraging IoT and Blockchain Technology

to Automate Risk Management for Nautical Vessels

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1 OVERVIEW

During hurricanes, boats become dangerous pollution vectors strewn by strong winds both inland and out to sea, costing owners, insurance companies, and the environment dearly by leaving oil, gasoline, fiberglass, and shrapnel in their wake. These crises can be significantly mitigated by leveraging the Internet of Things (IoT) and decentralized ledger technology (DLT) to automate risk management protocols that keep boats and the environment safe in the era of climate catastrophe.

1.1 PURPOSE

This article will address the deployment and benefits of IoT and Web3 technology to automate risk management for nautical vessels through Ahoy smart contracts.

1.2 STRUCTURE

After considering the cumbersome, existing risk management procedures for nautical vessels, this paper will detail how oracles and hardware interact with decentralized ledger technology (DLT) via Ahoy smart contracts and provide a use-case example of relocation procedures ahead of extreme weather conditions. The paper will conclude by considering the benefits and challenges of implementing Ahoy as a new risk management model.

This technology can also ensure the integrity and efficacy of the laws created to protect the environment. The MARPOL 73/78 Convention—as amended—is the international convention for the prevention of pollution from ships and affects every person and every ship that goes to sea. Annex 1[1] covers oil pollution, specifically waste streams containing petroleum products.

Breaking oil pollution laws is enforceable even if the act was committed unintentionally. Violators are subject to civil penalties and/or criminal sanctions including fines or imprisonment. All crew members and vessel owners must participate in waste reduction and the elimination of marine pollution.

The International Maritime Organization (IMO) drafted the current MARPOL Convention.[2] Boat owners are responsible for any containment and clean-up expenses resulting from oil pollution or contamination caused by their vessels. It's important that your boat or yacht insurance policy covers your liability for those clean-up expenses because vessel owners are liable under the Oil Pollution Act of 1990 up to the statutory limit (current $939,800).

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[1] International Maritime Organization MARPOL Annex I – Prevention of Pollution by Oil
  https://www.imo.org/en/OurWork/Environment/Pages/OilPollution-Default.aspx
[2] International Maritime Organization. (1992). MARPOL 73/78...: articles, protocols, annexes, unified interpretations of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto. *https://digitallibrary.un.org/record/246517*

Figure 1-1: Path of Hurricane Ian across the Caribbean into Florida. *Source: National Hurricane Center.*

1.3   INTRODUCTION

In late September 2022, Hurricane Ian rampaged through the Caribbean, the Gulf of Mexico and the Atlantic Coast from Cuba to South Carolina, achieving Category-4 status by the time it reached southwest Florida. The storm took both animal and human life and changed entire stretches of the coastline beyond recognition. Thousands of boats were left behind as their owners evacuated or attempted to fortify their homes. Whichever vessels remained afloat eventually broke free of their moorings, were surged aground by the rising ocean, and crashed into other boats or even buildings. The full extent of Ian's environmental damage remains to be seen, but it is certain that the freed boats caused extra property damage to the affected communities and additional liability to their owners.[3]

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[3] Marine Industry News. "WATCH: Devastating Cost of Hurricane Ian to Marine Community," 2022. *https://marineindustrynews.co.uk/watch-hurricane-ian-destroys-boats/*

It is only a matter of time before the next hurricane strikes. The onset of climate change is unequivocal, and research shows undeniable increases in the frequency and intensity of tropical cyclones in the North Atlantic Basin since 1970.[4] That said, we will have to wait to see the exact shifts that future storm patterns will take. Secondary factors such as marine cloud brightening (the process by which the sulfur in fuel causes clouds to reflect more sunlight, causing ozone depletion, acid rain, and increased respiratory problems) and wind changes may influence storms in ways that we cannot yet fathom, and the exact distribution, frequency, and intensity of storms in individual basins will likely vary across years and decades.

With so many unknowns, now is the time for preventative action. We cannot control weather-related disasters, but we can prepare for all eventualities by creating and installing new risk management systems that will mitigate the failures of our current structures. The advancement of IoT and blockchain technologies provides a unique opportunity for us to redesign existing procedures in a way that will protect the future of the boating industry.

2 CURRENT RISK MANAGEMENT PROCEDURES

Based on the retail sales figures, the modern boating industry was valued at USD 44.47 billion in 2022 and is expected to expand at a compound annual growth rate of 5.4% from 2023 to 2030.[5] It provides recreation, builds community, and fosters tourism. Boating activity is highly determined by the weather, with no guarantees for optimal sea conditions or blue sky days.

Typically, the specific outcomes of extreme weather conditions for the boating industry cannot be anticipated. While we do have existent risk management procedures to protect boats, Hurricane Ian revealed that these are cumbersome, costly, and wasteful at best. The foremost risk management procedures in place today are insurance policies and suggested emergency protocols.

2.1 BOAT INSURANCE

Boat insurance functions similarly to car insurance. Policies cover incidents such as accidents, theft, injury, and property damage. Some policies include protection for components such as boat trailers, boat accessories, and towing costs while other policies do not. The top three most common claims for boat owners involve collisions with other vessels or objects such as docks,

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[4] IPCC. Climate Change 2013: The Physical Science Basis.
https://archive.ipcc.ch/report/ar5/wg1/citation/WGIAR5_Citations_FinalRev1.pdf

[5] Grand View Research. Report Overview. Leisure Boat Market Size, Share and Trends Analysis Report by Type (New Leisure Boat, Used Leisure Boat, Monitoring Equipment), by Region (North America, Europe, Asia Pacific, South America, MEA), and Segment Forecasts, 2023-2030.
https://www.grandviewresearch.com/industry-analysis/global-leisure-boat-market

hurricane destruction, and the striking of submerged objects. As the climate becomes more variable, hurricane damage can often take the number one slot for claims.[6]

Unfortunately, following a bad hurricane season such as 2022, insurance companies become more reluctant to write policies for new boat owners. If they do, the terms of the policy will be quite unfavorable. Policy holders can now expect a huge deductible, with no coverage during the hurricane season. For instance, the owner of a brand new $3 million dollar 67 foot vessel, recently paid $38K per year, with an $80K deductible. The insurance company required this boat owner to employ a mandatory full-time captain, and this covered his vessel for only the non-hurricane months. He must now search for additional coverage.

Insurance costs vary based on the type and size of the insured boat, the location of the boat's use and storage facility, and coverage limits. While these insurance policies hold value, boat owners are not required to purchase them and insurance agencies themselves are often ill-prepared to respond to wide-reaching, catastrophic events.[7]

In the wake of Hurricane Ian, the existing insurance infrastructure prolonged the environmental and navigational risks caused by the piles of landlocked boats. Insurance companies were unable to process the number of claims rapidly enough to ensure swift removal, while boat owners had to assume the stress of navigating deductibles and policies in addition to looking after their family's housing needs and physical safety. Owners with insurance policies were often encouraged to find their own means of removing their boats. Owners without policies, for whom self-removal was the only choice, were often unable to pay the salvage costs.

While hurricanes are not preventable, the process by which owners protect their assets can be strengthened. Debbie Davis, a resident of Sanibel Island, spoke of her own experience during Hurricane Ian:

"Once the hurricane happens, it is an insane process for the consumer to have to call our 'agent' to report a claim (when we have no phone service, internet, or power for weeks). After that, they expect us to wait around for the adjuster and then just accept their quote because most local marinas in the same area are also hit hard by the hurricane. Maybe there is a way to utilize the Ahoy technology to connect with 'adjustors' outside the area of the catastrophe?"

Debbie continues, "We had many friends whose boats ended up in neighbors' pools, screened porches, down the canal, or even just upside down in their own slip. They had no means to find resources at that time to move their boat to preserve the damage to the environment or to mitigate the damage to their boat. We couldn't find crane services and weren't sure who was

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[6] Top 10 Marine Insurance Claims - BoatUS Magazine
https://www.boatus.com/app/views/201808/top-10-marine-insurance-claims.asp
[7] Kilroy, Ashley. "The Basics of Boat Insurance Explained," 2022.
https://www.forbes.com/advisor/legal/auto-accident/boat-accident/

responsible for moving the boat: the boat insurance or the homeowners. Whose responsibility was it?"

Figure 2-1: A man takes photos of boats damaged by Hurricane Ian in Fort Myers, Florida, on September 29, 2022. *Source: Giorgio Viera/AFP via Getty Images.*

To help with this issue, the Florida Fish and Wildlife Conservation Commission (FWC) decided to extend its Hurricane Ian Waiver program through the end of 2022.[8] The waiver required boat owners to relinquish ownership of their vessels so that the vessels could be removed from hazardous locations. This allowance was a blessing to many under the circumstances, but it required the owner to call the FWC Hurricane Ian Vessel Hotline to request the turnover. Fines and legal action would still be imposed on any boat that was not brought into compliance.

All the while, the environmental and navigational hazards caused by the piled-up boats remained, and continue to remain, even after removal. The fact that many of the insured boats will be replaced is not enough to justify our current protocols as satisfactory risk management procedures.

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[8] "Florida Extends Hurricane Ian Salvage Help Deadline," 2022.
https://boating industry.com/news/2022/11/29/florida-extends-hurricane-ian-salvage-help-deadline/

2.2   EMERGENCY PROTOCOLS

The obvious shortcomings of the current boat insurance systems within an extensive disaster scenario should lead us to ask what, if any, preventative actions could occur prior to a pending storm. While lists of such actions do exist in the form of suggested and mandated emergency protocols, they are not sufficient to prevent property damage and insurance claims.

The National Boat Owner's Association (NBOA), for instance, has an entire list of hurricane preparations for boat owners. These include developing a detailed plan of action to secure the boat at its home port. Assembling suggested supplies and learning to use them in advance of an event. Alternatively, making plans to physically relocate the boat to a previously identified boat refuge. However, if you, as the owner, are not readily available, then arranging for a capable individual to carry out emergency plans is your final option. NBOA also recommends maintaining photo or video records of all valuable items onboard and carrying important telephone numbers of appropriate authorities.[9]

As valuable as these suggestions from the NBOA may seem on paper, these suggested or mandated policies are not assuredly feasible during times of disaster. Hauling one boat can require multiple contracts, rental agreements, lease agreements, plans with marinas, and involvement with insurance companies. The boat's owner, a friend, or a family member may not be available to move the boat even if the necessary paperwork is in place. Even if a boat is transferred, there is no guarantee that the receiving marina will have enough space to shelter it or that the boat will survive collisions with other boats in the case of congested waterways. The stress of coordinating detailed emergency plan logistics and the meticulous record-keeping they require may deter individuals from becoming responsible boat owners in the first place. Most importantly, even the best tips for placing lines, tying storm-worthy knots, and running automatic bilge pumps cannot forestall the destruction caused by storms of Hurricane Ian's caliber.

Emergency protocols and insurance policies have sufficed as the "best practice" for nautical vessel risk management for past generations, but they are not necessarily the best methods for the present day. Technological advancements exist that could help prevent Hurricane Ian-level damage to nautical vessels in the future.

3   LEVERAGING IOT AND BLOCKCHAIN TECHNOLOGY

3.1   TOOLS OF THE TRADE

To understand Ahoy's potential to leverage IoT and blockchain to automate risk management for nautical vessels, we must first understand the relationships between the technologies it uses.

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[9] NBOA. "Hurricane To-Do's—Are You Ready?"
https://www.nboat.com/blog/boat- insurance-hurricane

3.1.1 AHOY

Ahoy is a next-generation peer-to-peer ecosystem designed for the ownership economy of the marine industry, setting the standard for marine-based Web3 utilization. Web3 is a set of values and technical applications that define a new era of the World Wide Web. Prime Web3 examples include ubiquity, decentralization, artificial intelligence, IoT, connectivity, blockchain technologies, and token-based economics.

For boat enthusiasts, the traditional barriers to entry are immense. To properly enjoy it, newcomers must first overcome a steep learning curve and then eat huge ongoing costs. Ahoy is removing these traditional barriers, standardizing business systems, and creating opportunities for engagement across the entire boating ecosystem. Furthermore, Ahoy can dramatically drop the costs of an initial boat purchase and give control over personal data back to the user. In doing so, Ahoy hopes to better the overall boating experience for everyone.

By utilizing the decentralized architectures as discussed in the following subsections, Ahoy can reduce costs and friction in risk management processes for nautical vessels. The ecosystem offers weather data-capturing oracle solutions for boats to initiate claims through smart contracts that account for maritime weather conditions in real-time, via IoT, which will ensure voyages and modernize predictive logs.
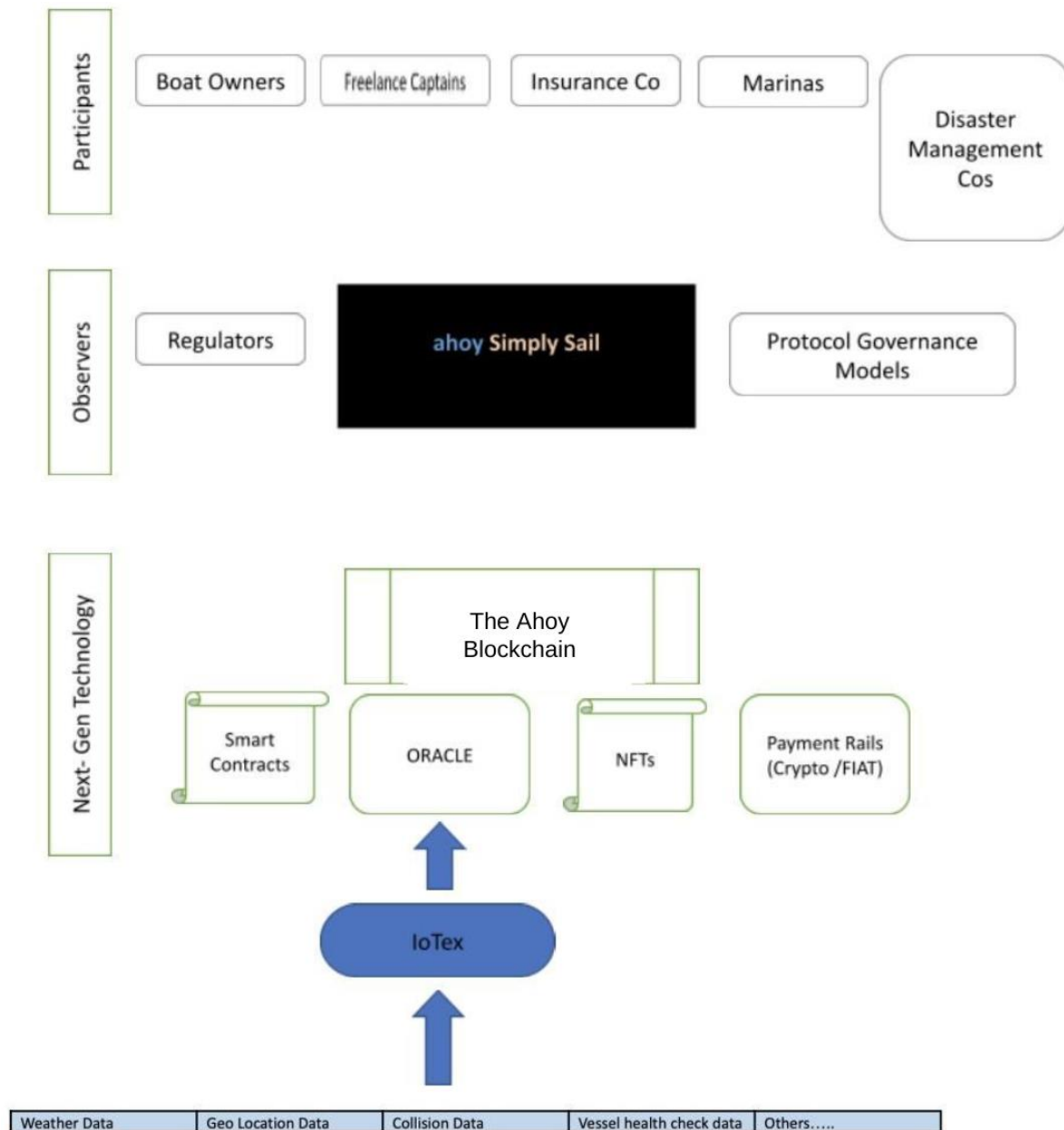
Figure 3-1: The Ahoy blockchain.

3.1.2 INTERNET OF THINGS (IOT)

The *Internet of Things (IoT)* is a system of objects, devices, people, and/or mechanical and digital machines attributed with unique identifiers (UIDs) that interrelate across computing devices. This system allows for data transfer over a network without human-to-human or human-to-computer interaction.

IoT uses embedded processors, sensors, and communication hardware to gather, share, and utilize environmental data. These devices send information to nodes that store the data and

interact with DLT using protocols such as IoTex's W3bstream. Through IoT and its capabilities, the existence of smart cities, with smart harbors, allows for massive operational improvements. The information gained from IoT devices used in cities will also contribute to the adoption, efficiency, and efficacy of the metaverse. As more operable data from the physical world crosses into the digital, Ahoy will help usher in an era when assets, resources, and services can be tracked across both sides of this technological reality.

3.1.3 DISTRIBUTED LEDGER TECHNOLOGY (DLT)

Distributed Ledger Technology (DLT) is an infrastructure and protocol that allows the secure functioning of decentralized digital databases. DLT is managed by multiple participants, across multiple nodes. Through DLT, records can be validated, updated, and simultaneously accessed by users across networks that span multiple entities or locations. DLTs allow for automation, replacing the need for slow central control, and accurately approving the process. Even more important is the removal of a single point of failure through decentralization. These capabilities allow for efficient, transparent P2P sharing (blockchain is one type of DLT).

Decentralized networks remove the need for protection by central governing authorities because all copies across the network would need to be manipulated simultaneously for a cyber-attack to be successful. In the case of risk management for nautical vessels, DLT ensures streamlined, tamper-free record insurance contracts and other record-keeping use cases such as storing and exchanging ownership records. A boat's NFT can log the Builder's Certificate, the MSO (Manufacturers' Statement of Origin), Engine Serial Numbers, and even the original paint used on the hull for later use in the network. This technology's potential is already being rolled out to help track regulatory matters by agencies such as the California Department of Motor Vehicles.[10]

3.1.4 BLOCKCHAIN

Blockchain is a type of DLT where transactions are recorded with an immutable cryptographic signature called a hash. As the name suggests, *blockchain* is a new type of network that can execute transactional data, storing the information of these transactions in immutable blocks.

These individual *blocks* are linked together in a cryptographic chain with every block containing the hash of the block before. First developed for Bitcoin, blockchain keeps an immutable record of transactions by assigning each "block" of transactions a cryptographic signature known as a *hash*. Once finalized, that hash gets added to the chain. Each block contains a timestamp and detailed transaction data that cannot be altered without the adjustment of all subsequent blocks. Due to this interconnectivity between blocks, data manipulation, which is considered malicious behavior in the context of blockchain, can easily be identified.

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[10] "California DMV to digitize car title management system via Tezos," 2023. *https://cointelegraph.com/news/california-dmv-to-digitize-car-title-management-system-via-tezos*

In the case of risk management for nautical vessels, blockchain allows the implementation of seamless smart contracts enabled by oracles, through decentralized applications and a layer-one chain for settlement. Each insurance document becomes an NFT, accessible on-chain. Blockchain can store even the tiniest details of an insured event or policy contingency which can then trigger smart contracts into action. Every event can be added to the data of the NFT in an automated fashion as an update and, if not explicitly required, without human intervention.

3.1.5 NON-FUNGIBLE TOKEN (NFT)

A *non-fungible token* (NFT) is a unit of data, stored and secured on a blockchain, that creates a unique digital signature for a given asset and attributes proof of ownership. While some NFTs share attributes, each is irrevocably unique from every other NFT, beyond even its digital signature. As NFTs can provide proof of ownership beyond copyright for creative assets such as art and music, their use in the boating industry would primarily apply to physical assets such as vessels, engines, slips, and valuable gear.

3.1.6 ORACLES

Oracles are entities that allow interoperability between blockchains that link to external systems. By functioning as a bridge between on-chain and off-chain transactional data.

On-chain transaction refers to a transaction that is processed and stored with blockchain. These transactions are validated by all the network nodes to ensure the transparency, security, and validity of the network's public ledger. The nodes are formed by many devices, which are usually computers that collectively participate in and safeguard the blockchain network.

In contrast, off-chain transactions don't require the blockchain network to execute transactions, and the data isn't publicly available. So, off-chain transactions only need the blockchain network for integration after the completion of transactions elsewhere. Like on traditional infrastructures.

Oracles provide a way for the decentralized Web3 ecosystem to access existing data sources, legacy systems, and advanced computations. Decentralized oracle networks (DONs) enable the creation of hybrid smart contracts, where on-chain code and off-chain infrastructure are combined to support advanced decentralized applications (dApps) that react to real-world events and interoperate with traditional systems.

Ahoy will utilize oracles hosted by the National Oceanic and Atmospheric Administration (NOAA), Accuweather, and the Weather Channel to provide trusted weather data to its smart contracts for its boating use cases. On the other hand, because boats themselves come equipped with onboard sensors and gauges to take measurements of wind and sea conditions, they can become oracles that gather data, which Ahoy can package up and sell back to these companies.

3.1.7 SMART CONTRACTS

Smart contracts are self-executing agreements that do not require an intermediary. They are a set of programmed instructions that perform specific actions when predetermined conditions are met. By removing the need for filling out forms, initiating claims, and calling hotlines, smart contracts simplify and hasten insurance processes while helping to prevent the fraud and errors that plague current insurance systems.

One benefit of smart contracts is that they are highly adaptable. Contracts can be designed for any number of specific scenarios: accidents, collisions, fire, seizure, warranties, recall, and weather relocation services. As aforementioned, disaster situations often occur unexpectedly and within shorter timeframes than insurance companies are able to comply. Smart contracts have the potential to minimize risks to life, limb, and property by allowing instant, secure transfer of all records and relevant data between the insured and the insurer.

In the case of risk management for nautical vessels, smart contracts could guide any transaction between a given boat and other parties—from marinas to captains to insurance companies. Self-executing insurance procedures, for example, could work from a decentralized weather data-capturing solution. Voyages will be protected as real-time event data is logged through the onboard IoT oracles or sensors. From there, that data can be interpreted and acted upon by smart contracts, allowing for predictive adjustments of location or status based on these weather conditions. In this sense, if foul weather approaches one dock, a vessel can issue its own alert and, through smart contracts, secure a captain to move it to safer ground—without the owner needing to step foot outside of their own home.

3.2 ADVANCED RELOCATION OF VESSELS USE CASE

If properly utilized, today's IoT and blockchain technologies could alleviate the pitfalls of existing emergency management systems. Through a combination of edge computing devices that capture data closer to the source (i.e. the oracles onboard Ahoy vessels or assets), and smart contracts that automate processes that formerly ate up time and money Ahoy has the potential to create a more efficient system for insurance claims, dramatically reduce costs and friction in risk management processes, and minimize environmental and property damage—even when faced with Category-4 storms.

When registering with Ahoy, boaters can supply their Insurance Policy Number and other appropriate information regarding their policy. From there, should an incident occur involving the Ahoy asset, smart contracts can make dealing with insurance far more efficient. By providing insurers with all relevant data they need for a payout, automatically triggered by the smart contracts already in-place, both insurers and boaters can move faster and get the matter settled.

However, Ahoy also opens up even more opportunities in situations that can hopefully cut down on the need for damage claims in the first place. What if instead of buying replacement boats and parts, insurance companies paid for the services of a licensed captain to move the

policyholder's boat out of harm's way to a safe harbor before a storm occurs? Ahoy makes such transactions possible by hard coding the right data and business logic into smart contracts. The following use case example follows the necessary process.

Both boats and marinas must first agree to be outfitted with Ahoy's customized hardware devices which will send weather conditions and additional off-chain data to IoT hardware oracles. Ahoy further digitizes each real-world asset as an NFT that includes all relevant data about that asset. Such data would include comprehensive physical specifications (length, height, draft, water depth, price per footage, etc.) as well as pertinent events in the asset's history (damages, maintenance records, travel logs, etc.). The value of each asset is also stored on the blockchain, enabling digital ownership and transfer, and also allowing transportation in case of an emergency. At this point, vessels now fully exist as both physical and digital assets.

This setup enables Ahoy assets to digital counterparts to interface with blockchain and IoT applications—such as weather pattern trackers. Picture this: a storm is coming that will require the relocation of a vessel. Chain-link nodes allow AccuWeather to make its data instantaneously available to smart contracts. The storm's data meets certain criteria that trigger the smart contract tied to that vessel in the marina, issuing its need for relocation to another safe harbor.

A captain utilizing IoT applications to manage their own work receives a notification and they accept the job of moving the vessel. Meanwhile, as the captain pilots the boat to safety (assisted by more data-driven information collected by Ahoy, from waterway traffic to real-time storm data), the vessel's owner receives updates every step of the way, as their vessel is brought to safety. Imaging devices could even take snapshots of the vessels while they are in transit and when they reach their destination, increasing accountability measures as well as the owner's peace of mind.

Captains will no longer need to rely on late or unfair payment for their services or trial and error to determine if they can make it safely to a port. Once a job is accepted, the billing process occurs automatically through the Ahoy ecosystem, utilizing Ahoy tokens. This simplifies the economics and logistics of important jobs. For example, during a storm, a vessel owner can focus on their own evacuation and safety, knowing their vessel is in capable hands.

If a boat fails to reach a safe harbor or is damaged along the way, the reason will be clear. With the wealth of data captured by onboard systems such as the hardware oracles, the person "at fault," or the weather condition that led to the damage or delay, can be identified and appropriately handled by the smart contract. Boaters can be fully or partially refunded depending on which conditions of the smart contract are met.

Even if a second party is involved in an incident, the two parties can seamlessly and transparently manage their assets and claims through the blockchain thanks to their unique digital identifiers. Or, should a boater choose to forgo a certain action while docked at a marina, the marina's own policy protect smart contract can self-execute.

As this use case example shows, Ahoy could help foil many disastrous outcomes before they happen. For whatever eventualities do occur, smart contracts can update and process claims instantly, preventing such environmental hazards as those created by the cumbersome bureaucracy that led to the boat pile-ups in the wake of Hurricane Ian.

4 ADDITIONAL CONSIDERATIONS

4.1 MEASURABLE BENEFITS

Today's marina management systems are highly fragmented across disparate enterprise systems, resulting in siloed data and increased back-office costs for marinas. Currently, marina managers are using middleman software companies who seek to impose standards to extract monopoly rent. Ahoy would meet these variances in ways that lead to measurable benefits.

The usage of smart contracts would allow for the large-scale standardization of insurance protocols across the entire boating industry, allowing for greater safety and security. As more boats become fully insured and certified, compliance issues, duplicated work, and human error instances would diminish.

Insurance is all about collecting data and information, analyzing it, and then utilizing that information to make accurate decisions and payments. Clearly, an insurer might dramatically improve its results through the application of cutting-edge digital technology. The innovation of blockchain is a pivotal moment, as it provides the foundation to bring together advanced analytics, artificial intelligence, and automation software and hardware. Widespread deployment of blockchain and smart contract solutions across the insurance industry would not just improve the lives of those who make claims—but the profit margins of insurers too.[11] For this reason, this transformative shift feels inevitable.

That many insurers have not yet achieved this is a function of an opposing force: the zeal with which these companies guard their data. When an event requires an exchange of information, most insurers strive to share the least amount possible, in many cases using manual, paper-based processes. This is the insurer's way of making sure that there are no sensitive leaks, and it reflects the fear that digital exchanges of data may not be secure. Blockchain changes all of this through its immutable and secure operating structure.

Further savings would occur through insurance premium decreases. With cash flow increases for marinas utilizing the automated processes of smart contracts coupled with decreases in overall damage claims due to the result of more effective relocation services, processing times for insurance claims will shrink—and so will premiums. Additionally, exaggerated claims, misclassification of damage causes, false inflation of repair costs, charity fraud scams, claims filed by unaffected individuals, and other fraudulent activities would be minimized through the more

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[11] The First All-Blockchain Insurer *https://www.bcg.com/publications/2018/first-all-blockchain-insurer*

accurate and formidable record keeping of blockchain technology. This could lower the extra $400-700 billion per year in premiums that the FBI estimates insurance fraud currently costs families.[12]

In addition to financial benefits, personal security levels would also improve with cryptography's superior ability to prevent the leakage of sensitive and personal data. Such protection would mitigate the push-back that off-chain insurance providers often encounter if a client feels uncomfortable sharing necessary personal information.[13]

Ahoy's potential to significantly increase financial, personal, and property security will have positive ramifications for boat owners well beyond the nautical industry. All told, the elimination of middlemen by way of decentralized marketplaces on Web3 and blockchain has the potential to save vast amounts of money, each year, in operating costs across any and every industry that depends upon complex logistics and data tracking.

4.2   CHALLENGES

A necessary part of innovation is overcoming challenges. Implementing Ahoy's vessel relocation capabilities comes with its own set of difficulties, some of which are congruent to the challenges facing trusted IoT data for on-chain use as a whole, while some are unique to Ahoy's approach to the nautical industry.

Credibility and trust are essential building blocks of any marketplace. Some insurers remain hesitant about cybersecurity even with the promises of the immutable blockchain. Some customers don't trust the many adaptations and new competitors involved with new technologies. For Ahoy to establish credibility, there must be partnerships with existing boating businesses and boat owners. The on-boarding of enough participants to allow Ahoy's ecosystem to run at full capacity may take time since society typically requires a lengthy period of education and adjustment before it embraces change.

Delays could also occur depending on the speed of IoTeX technology development. The primary limit for Ahoy's needed processes are advances in software and hardware in the Web3 and oracle space. Additionally, regulations for smart contracts need to be updated and standardized for customers to use them with confidence. Only time will tell how, or to what degree, these contingencies will impact Ahoy's development.

Integration may pose another challenge. When dealing with risk management, there is no room for miscalculations. Existing off-chain insurance contracts would need to remain in effect until

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[12] FBI. Insurance Fraud. *https://www.fbi.gov/stats-services/publications/insurance-fraud*

[13] Georgiou, Michael. Imaginovation Insider. "Top 7 Cases of Blockchain in the Insurance Industry (with Examples)." 2022. *https://imaginovation.net/blog/blockchain- insurance-industry-examples/*

the day the digital systems finalize and then transition instantly and seamlessly into the smart contract model.

Practical challenges specific to Ahoy include obtaining funding for initial startup costs as well as finalizing parameters that will seek to measure and guarantee insurance services for forces of nature as tracked by decentralized applications.

In spite of these difficulties, Ahoy is actively monitoring and evaluating feasible, scalable solutions in the multi-chain space as protocol develops. The benefits Ahoy has to offer far outweigh the work required to implement its applications.

4.3   EXPANSION

While this article explores Ahoy's ability to automate risk management for nautical vessels, it is worthwhile to explore positive ramifications beyond this service. Improvements that will be made over time to the boat asset data layer will allow development in other directions. Applications for nautical supply chain management, long-term leasing, slip renting, property transfer, and even fractional ownership will allow Ahoy to act as a "mothership" of remunerative transformation for the future of the boating industry.

Additionally, national weather services and weather forecasting models will benefit from the multiple points of data that Ahoy will inadvertently provide for tracking and recording weather data.

As the world's current economic and legal systems adjust to automated systems, Ahoy's smart contracts will model a payment structure that can develop consumer trust and confidence in the IoTeX ecosystem.

5   CONCLUSION

The climate experts at the National Oceanic and Atmospheric Administration (NOAA) continue to predict active Atlantic hurricane seasons in the coming years. Therefore, boaters in hurricane-prone regions need to take more measurable steps to keep their vessels out of harm's way so that they do not end up adding to the devastation communities and the environment experience after such storms.

To help, Ahoy has designed smart contract protocols leveraging verifiable data that can systematically manage boating assets to bring about more desirable outcomes when faced with extreme weather events. Ahoy is a boating-asset-centered, contributor-focused, consumer-driven platform designed to preserve and enhance the boating ecosystem. It is growing to become a single source of truth for worldwide marine management that will lower costs, eliminate systematic risks, and create transparency.

For all types of nautical disasters, Ahoy will utilize the transformative nature of Web3 coupled with a peer-to-peer networked economy to provide an unparalleled customer experience that has safety at its forefront. Horrible storms are sure to challenge us again but boaters should not forgo their favorite pastime. Ahoy's real-time preventative strategy, provable and actionable, could save billions for the economy if the right technology is implemented appropriately.

Even in its nascent stages, Ahoy promises exciting avenues for expansion to benefit the boating industry as we continue to navigate the brave new world of climate and technological change.

6 ACKNOWLEDGEMENTS

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