Wildfires: A Global Challenge in Need of Technology-based Solutions

A Glimpse of What's "Possible"

On December 10th, 2050 the Nobel Peace Prize was awarded to the International Coordination Center for Wildfire Management, Technologies, and Response (ICC-WMTR) for creating a global wildfire management platform that has reduced the number of wildfires caused by humans to practically zero. ICC-WMTR organization was started by a firefighter, a retired power plant manager, a public school teacher/volunteer social worker and three high school programmers.

Wouldn't it be magnificent if the aforementioned news flash came to fruition?

A Painful Reality

Based on a comprehensive research conducted by experts, the forecast is for extreme fires to increase up to 14% by 2030, 30% by the end of 2050, and 50% by the end of the century on a global basis.

While in some parts of the world the number of wildfires have slightly decreased due to improved monitoring and prevention, on a global basis the frequency of occurrences has increased. The severity and intensity of wildfires have dramatically increased, and the loss of life, economic losses and the aftereffects of wildfire (including the deterioration of air quality) have alarmingly increased.

The painful reality is that wildfires are a global phenomenon that will continue to occur in many countries, some on a regular basis. The list of countries that experienced wildfires in 2023 include Algeria, Morocco, Tunisia, Kazakhstan and Turkey, Greece, Italy, Spain, Canary Islands, and the U.K., Canada, U.S. (in 13 States), Chile, and Australia.

No continent, no country, no province, State, city or municipality is insulated from the destructive effects (including loss of life, loss of property, economic cost of rebuilding, deterioration of air quality, degradation of watersheds, contaminated and toxic wastes) of wildfires.

Primary Causes

On a global basis it is estimated that only 5% - 10% of the wildfires are caused by nature; the balance of 90% - 95% are caused by human beings. Prevention measures undertaken by most governments around the world (including increased awareness programs, safety regulation, guidelines and monitoring, coordination of fire prevention and response agencies) are making an impact, however, wildfires caused by failed utility company equipment, fallen utility lines, carelessness in campfires, arson, reckless deforestation, lack of urban planning, and several others continue to result in dramatically increased losses.

Technology-Based Solutions

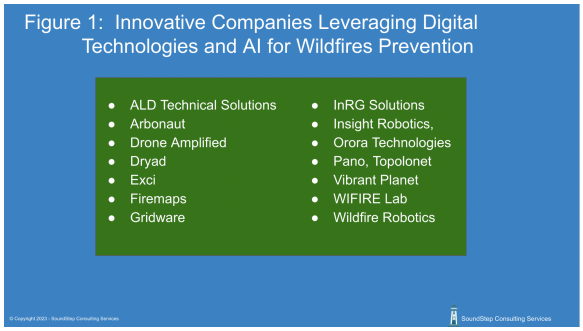
There is a critical need for technology-based solutions to address the causes of wildfires - especially those that are caused by human beings. Today's digital and AI technologies are powerful enough to create technology-based solutions that focus on wildfire prevention, monitoring, information sharing on a global basis, wildfire management and rapid response. They are powerful enough to create reliable early warning systems and alarms that can provide people the precious time they require to evacuate if a wildfire could not be prevented or controlled. They are powerful enough to support information and solutions sharing ***on a global basis***!

Technology Companies and Laboratories Focused on Wildfires

There are companies and laboratories who have stepped up to the challenge of preventing wildfires and driving toward reducing the amount of time necessary to collect, aggregate, analyze and distribute critical information required by fire specialists, firefighters and other responders, forest landowners, utility companies, and governments to make informed real-time decisions that can save lives and property. Every second they can buy homeowners, business owners, firefighters, and governments by applying the latest digital and AI technologies to react and take preventative action will save lives. The prevention of wildfire disasters such as those in California, Oregon, Maui, Australia and numerous other locations is the primary target of these innovative and driven companies and institutions.

There are approximately 450 companies and research institutions to-date that are focused on combating wildfires.

A short list of innovative companies that are leveraging digital and AI technologies is provided in Figure 1 below.



ALD Technical Solutions provides a patented high strength yet composite reinforcement system that can withstand high temperatures that will enable utility companies to improve the reliability and resiliency of their grid infrastructure and contribute toward preventing utility-caused wildfires.

Arbonaut develops information gathering and GIS solutions for forest inventory and natural resource management by leveraging LiDAR and GIS technologies, data processing and analysis, decision support systems, and digital twins technologies.

Drone Amplified focuses on the use of unmanned aerial technology to effectively leverage 'prescribed burns' - the controlled application of fire to reduce hazardous fuel in areas prone to wildfires. IGNIS by Drone Amplified is a firefighting system that is controlled by an App designed to integrate drone platforms making aerial ignition an

affordable solution for private and public lands.

Dryad focuses on early forest fire detection and monitoring sensor networks for public and private forests, and leverages low-cost, solar-powered gas sensors, IoT sensor networks, and cloud analytics.

Exci leverages AI/deep machine learning algorithms to analyze satellite and ground-based sensor data enabling the fast detection of wildfires (bushfires).

Firemaps provides a platform for homeowners to analyze their risks and vulnerabilities to wildfire by leveraging satellite and drone images to generate 3D maps which are used for creating home hardening and defensible space plans, and for providing access to qualified contractors to implement the plans.

Gridware leverages a low-cost hardware platform that is deployed to power poles to create a grid monitoring system that enables utility companies to identify and locate faults such as those caused by equipment failure and downed power lines.

InRG Solutions is focused on designing and building innovative solutions that will enable the continuous monitoring of the physical condition of a grid to help reduce the number of utility-caused wildfires.

Insight Robotics leverages its GIS platform to process and analyze data collected through robots and sensors to provide an active wildfire risk management capability to forest owners and enable them to make informed decisions based on real-time data.

Orora Technologies leverages data from over 20 satellites to provide risk assessment, early detection, and real-time monitoring services to support a wildfire intelligence solution that can be leveraged on a global basis.

Pano provides AI-based solutions to identify threats of fire, confirm fires, and distribute the information to fire detection specialists and responders in real-time with the aim of accelerating response times. Specialists are provided a single, unified view of information gathered from UHD cameras, satellites, field sensors, and alerts that can be shared among teams in real-time.

TopoloNet provides a solution to dynamically calculate the current carrying capacity of transmission lines and predict potential failures of power grid components in real-time in order to prevent wildfire and other adverse events.

Vibrant Planet provides cloud and data science analytics and technologies-based solutions to deliver real-time scenario planning, monitoring and reporting to natural resources decision makers with the aim of providing wildland resistance to wildfires and climate change.

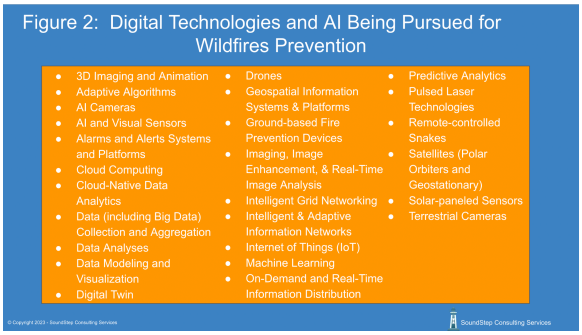
WIFIRE Lab has developed an all hazards cyberinfrastructure that serves as a management layer for real-time data collection, modeling and analyses for research and operational support services.

Wildfire Robotics leverages the power of robotics technologies for wildfire containment via its self-propelled and remote-controlled robotic snakes that can be deployed even in rough terrains.

Digital and AI Technologies

A short list of digital and AI technologies that are being leveraged to prevent and combat wildfires is provided in Figure 2 below.

Figure 2: Digital Technologies and AI Being Pursued for Wildfires Prevention



The extent to which each technology is being utilized greatly varies. For example, satellites have been leveraged very successfully, and their positioning, quality of images captured, and reliability have dramatically improved in the past three years. On the other hand, the use of digital twins to simulate wildfires with real-time data is in the experimental, early pilots stage.

As stated earlier, the power of digital and AI technologies exist today -waiting to be harnessed! The problem is that there aren't enough people and financial resources to leverage today's powerful technologies.

The number of entities (companies, governments, and research agencies) involved in preventing and combating wildfires is relatively small. There are fewer than 300 entities worldwide in the *Wildfires Prevention, Management and Control Ecosystem* - and the human and financial resources of each entity is severely limited.

Many of the companies have been in business less than 10 years and some are recent start-ups. While these companies are highly innovative they continue to struggle with financial backing from governments and venture capital firms.

What's Needed?

To achieve the dream of eliminating human-caused wildfires on a global basis, the growing list of requirements is provided in Figure 3 below:

Figure 3: What's Required to Eliminate Human-Caused Wildfires

It's important to note that in recent years the entities currently involved in wildfires prevention, management, and control have made significant progress in each item in the aforementioned list. Note also that they are not lacking in what needs to be accomplished, rather, in how to leverage today's technologies to deliver effective and reliable solutions faster and cost-effectively.

Who Can Contribute and In What Area(s)?

A brief list of the talent required and the area of opportunity to contribute toward the application of today's technologies and know-how to fighting wildfires is as follows:

- ***Cloud Computing Experts*** - To assist utility companies, government agencies, private and public

companies, and research organizations involved in combating wildfires in migrating their dated, in-house computing platforms to the cloud. This will enable them to have on-demand computing power, higher availability and reliability, and lower IT operating costs and capital expenditure. Specific areas include the design, development and implementation of:

a. Cloud-based or Cloud-Native Infrastructures
b. Cloud and Edge Computing
c. Cloud-Native Data Analytics

- ***Networking and Telecommunications Experts*** - To assist in the design and implementation of Intelligent Grid Networks, Intelligent & Adaptive Information Networks to facilitate information and data sharing, Neural Networks and Self-Healing Networks to increase network availability and reliability, and improve monitoring of sensors, alarms, and equipment.

- ***Designers, Developers, and Product Managers with Expertise in Internet of Things (IoTs)*** - To bring digital technologies-based devices and equipment to replace aging/dated technologies including analog-based equipment. This will enable the deployment of more reliable, cost-effective devices that are not fully reliant on wired connections to power sources. It will also enable the deployment of 'intelligent and learning' devices to locations where they are needed (e.g. high risk forests, high risk commercial property and neighborhoods).

  Specific IoTs that need IoT experts include the design, development, and implementation of:

  a. AI and Visual Sensors
  b. AI Cameras
  c. Alarms and Alerts Systems
  d. Ground-based Fire Prevention Devices
  e. Solar-paneled Sensors
  f. Terrestrial Cameras

- ***Developers of Microservices and APIs*** - To convert dated wildfire management and control systems, and utility company systems and applications into service-oriented architectures to enable ease in operation, enhancements and adoption to changing requirements. Utilizing more application interfaces (APIs and Open APIs) will help in the exchange of critical wildfire management data among agencies, governments, and companies.

- ***Adaptive AI and Machine Learning Developers*** - To develop company-wide or institution-wide systems, and large platforms that can react to changing wildfire management and control conditions in real time. This includes experts who can enhance existing systems and platforms with *Adaptive Algorithms* especially since the nature of wildfire monitoring, management, and containment requires real-time decision-making and actions.

- ***Architects, Developers, and Implementation Experts of Major Systems and Platforms*** - To create company or institution-wide platforms utilized to be utilized for
    a. Information Management
    b. On-Demand and Real-Time Information Distribution
    c. Communications
    d. Geospatial Information Systems & Platforms
    e. Alarms and Alerts
    f. Wildfire Prevention, Management and Control
- ***Data Management Experts, Data Scientists and Engineers*** - To develop solutions for capturing, processing, distribution, storage, retrieval, and archiving of Big Data. This includes experts and specialists in managing satellite data.
    a. Big Data Collection and Aggregation
    b. Satellites (Polar Orbiters and Geostationary)
    c. Pulsed Laser Data

- ***Data Modelers, Data Visualization Analysts and Artists, and Data Analysts Analyses*** - To convert data into forms that facilitate the understanding of decision-making information. These include skills in:
    a. 3D Imaging and Animation
    b. Data Analyses
    c. Data Modeling and Visualization
    d. Imaging, Image Enhancement, & Real-Time Image Analysis
    e. Pattern Recognition Pulsed Laser Technologies
    f. Predictive Analytics

- ***Digital Twin and Simulation Experts*** - To create the capability to simulate wildfire conditions in a controlled environment using real-time data captured from sensors, cameras, satellites, drones, and other IoT devices, and to simulate wildfire prevention solutions and controls in order to improve on solutions being utilized to combat wildfires. This includes the capability to process data in real-time and offline.

- ***Robotics Designer and Developers*** - To create remote controlled systems and devices such as remote-controlled crawlers and snakes that can be deployed to locations that are difficult to access (e.g. terrain) both for preventative measures and for deployment in active wildfires where information must be gathered without risks to firefighters and responders.

- ***Drone Designers and Developers*** - To expand the use of cameras and sensors mounted on drones in order to monitor large areas, to distribute firefighting equipment and supplies, to deliver fire extinguishing chemicals during actual wildfires, and to enable controlled-burning by dropping fire igniting balls (aka dragon balls).

- ***Risk Management Experts*** - To define the data required to assess, model, quantify and rate the risks associated with wildfires in order to provide fact-based preventative measures as well as insurance

coverage to governments, commercial businesses, and homeowners. Risk management experts in the insurance and reinsurance industries including underwriters, actuaries, data analysts, and business analysts possess the required skills, competencies, and experience.

- ***Digital Transformation Program Management*** - To lead major transformation programs in governments and their agencies' systems, utility companies' management, monitoring and control systems, and private and public institutions' and associations' wildfire prevention, management and response systems from dated systems to being digital technologies and AI-based platforms and systems.

- ***Change Management Leaders*** - To successfully implement the major transformative changes required to shift from the antiquated systems, technology, and practices in place today to digital technologies and AI-based solution platforms.

- ***Connective Tissue Design and Architecture Leaders*** - To define and develop a digital technologies and AI-based connective layer within a company, or intercompany or inter-governments that will facilitate real-time exchange of wildfire prevention information and coordinate firefighting efforts during actual wildfires.

- ***Human Interface Designers and Developers*** -To enable easy-to-use, intuitive solutions that enable people involved in wildfire prevention, management, control, and firefighting coordination to seamlessly interact with the technology-based platforms and systems used to combat wildfires.

- ***Public Communications Experts*** - To improve the dissemination of ***fact-based*** wildfire prevention, management, and responses that promotes constructive thinking and constructive actions between the parties involved in fighting wildfires and the public.

Bright Minds

There is a need to attract young, bright minds - curious, eager-to-learn, fresh thinkers who can be motivated toward altruistic endeavors. Every new generation continues to be more adept and comfortable with using technology than the prior ones. This phenomena will create a growing pool of future digital technologies and AI innovators who will be more skilled in tackling the major problems faced by humanity today.

Educators

Like all important life values altruism is best learned early in life. While parents are in the best position to impart altruism to their children, teachers, especially those teaching elementary and high school students, are in the best position to reinforce altruism, and to guide, motivate, and teach students digital technology and AI skills.

STEM Education in the U.S. continues to do well based on several studies including the Center for Excellence in Education's (CEE) annual index of STEM education that ranks how each participating country's STEM program is performing.

The U.S. ranked second in 2023 (third in 2021 and 2022. China has dominated the International STEM Olympiad and remains in first place. Note well that there is a direct correlation between economic growth and the strength of scientific innovation which is fueled by how well the next generation of innovators excel in Biology, Chemistry, Physics, Math, and Informatics.

The most recent ranking is as follows:

1. China
2. U.S.
3. Japan
4. Taiwan
5. Republic of Korea
6. India
7. Singapore
8. Vietnam
9. Iran
10. U.K.

While definitions vary by usage and by country the term "***Informatics***" is rapidly changing to mean ***harnessing the power of digital technologies and AI to transform data and algorithms into computational systems and platforms that benefit people, organizations, and societies.*** Educators must focus on growing the pool of Informatics-savvy students who will be tomorrow's innovators and problem solvers.

Hands-on & Practical Education

As digital technologies and AI are leveraged to transform how lessons are delivered in classrooms and/or online, there's a tremendous opportunity to bring significantly more ***hands-on activities and projects***. Computer Science education at any level of education must include hands-on programming preferably in languages that are being utilized in the professional world; at present these include Javascript, C#, Python, Kotlin, PHP, Go and several others.

Activities such as after-school coding sessions, programming games, and hackathons must be included, and competition within a school and with other schools should be encouraged. Ideally, the activities and projects should focus on ***solving practical problems, and promote teamwork, collaboration, and altruism***.

For example, creating a basic Java program that downloads online wildfire maps and creating a table showing the regions of the world that are prone to wildfires with possible solutions to prevent them can be a collaborative effort that imparts awareness of world problems, solutioning, and most of all altruism.

Vocational Education with a strong focus on hands-on and practical activities, and on certification should be implemented especially in the U.S. - where vocational education lags severely behind other countries such as Germany, Switzerland, South Korea, Japan, Australia.

Apprenticeships and Internships must be viewed as equal opportunity paths to jobs and careers. Companies (public and private) should include the intake of young

bright minds as apprentices, interns, part-time/temporary workers in their talent acquisition programs.

At present, major technology companies (e.g. Microsoft, Google, Apple, Amazon) and major universities offer online, free and fee-based technology courses and certifications. Computer Science teachers in all grade levels should augment their skills themselves, as well as encourage their students to augment their education with these online, often no-cost courses.

The Gaming Industry and Gamers

The Gaming industry continues to excel in creating multiplayer and team based online games. Digital technologies have been leveraged to provide access to these games from anywhere in the world. Players from different countries who are likely to not meet in person play in teams, collaborate, and solve problems to achieve the games' objective.

The Gaming industry is in a good position to create multiplayer, team-based, and highly cooperative games where the objective is to prevent and control wildfires, strengthen buildings and houses to withstand hurricanes and other convective storms, to safely evacuate communities during catastrophic events, to build drones and robots (similar to many games that exist today on airplane or ship building).

Games can include creating strong cities that can withstand the many effects of global warming. If nine year olds (or even younger) can build impressives structures in Minecraft they can be given game objectives that encourage altruism!

Disrupting Patterns of Destruction vs. Disrupting Industries

Digital Technologies have been promoted as critical enablers to disrupting traditional brick-and-mortar industries. AI is also being promoted the same way today.

One should consider another perspective - shouldn't digital technologies and AI also be viewed as critical enablers toward disrupting the destructive human behaviors and norms that has harmed the planet and has placed all beings at risk?

Awareness and Actions

The goal to eliminate human-caused wildfires can be realized through altruism and by harnessing the power of digital technologies and AI. Companies and laboratories such as ***ALD Technical Solutions, Arbonaut, Drone Amplified, Dryad, Exci, Firemaps, Gridware, InRG Solutions, Insight Robotics, Orora Technologies, Pano, Topolonet, Vibrant Planet, WIFIRE Lab, and Wildfire Robotics*** are leading the way and taking significant steps toward solving this global problem.

Digital technologies and AI experts, educators, and young bright minds are needed, and financial support from government, venture capital firms, and private organizations is required.

This document was created to make people aware of the problem and the solutions that

are being created, and to encourage actions that contribute to addressing the requirements for eliminating human-caused wildfires.