Waste Management in the Cruise Port – A Web-Based System in Brazilian Ports

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BIOGRAPHY

Graduated in Geography from the Universidade do Estado do Rio de Janeiro (1983), Masters in Nuclear Engineering and Energy Planning at the Universidade Federal do Rio de Janeiro (1988) and Ph.D. in Economie del Environnement – École des Hautes Études en Sciences Sociales – EHESS – Paris (1994). Currently Professor and Head of the Programa de Planejamento Energético [Energy Planning Program] of COPPE/UFRJ (since 10/2011) and Executive Coordinator of the Instituto Virtual de Mudanças Globais [Virtual Institute of Global Change] (IVIG / COPPE / UFRJ) (since 05/ 2005). Member of IPCC – Group III – since 2008 , in Renewable Energy. Has experience in energy and environmental planning, with emphasis on Interdisciplinary Energy. Develops applied research in the following topics: energy (renewable and non-renewable sources); regulation and water management (weather, inland and coastal); licensing and environmental management, climate change, biomass, sustainable development, Amazon, infrastructure, technology and natural resources (ports, roads, production facilities and power). Superintendent of Hydrologic Studies and Information National Electric Energy Agency (ANEEL – 98-2000), Director of the National Water Agency (ANA – 2000-2004), Executive Secretary of the National Reference Center on Biomass (97-98), Hydrologic Advisory Brazilian with the World Meteorological Organization (WMO – 1998 to 2004) and adviser of the Committee on Hydrology of the World Meteorological Organization (WMO – 2004 to 2008).

PAPER

ABSTRACT

The obstacle to the growth of marine tourism (cruise ships) in Brazil is not the absence of demand, but rather the inadequate port infrastructure. In this context, an item that deserves attention is the issue of sustainability. In relation to environmental management in port areas, one of the points to be considered is the large volume of solid waste concentrated in cruise ports. Proper management of port waste in accordance with the National Policy on Solid Waste (PNRS) is fundamental for the sustainable development of port activities in the country. Some factors are limiting the adequacy of port waste program. These factors include the lack of training of personnel, lack of integrated action of the institutions involved and mainly the lack of applied research to generate primary data (MMA, 2011). In this sense, the project named Compliance Program of Solid Waste and Liquid Effluent Management in Brazilian

SeaPorts, created by the Secretariat of Ports of the Presidency (SEP/PR) and implemented by the International Virtual Global Change Institute (IVIG/COPPE/UFRJ) was developed. Among the obstacles found at the Brazilian ports by this Project, the most relevant were the practices related to the control and generation of the information regarding waste management issues. In order to support solving this issue, this work consists on the presentation of a tool for electronic registry developed to attend the Project of SEP/PR in partnership with IVIG/COPPE/UFRJ. This web-based database system tool was developed to enable a normalized information and control of solid waste generation, liquid effluent and harmful synanthropic fauna from various port areas. This information requires a very great control, documentation, archiving, and high investment in human, logistic and financial resources. The combination of the computer technology of internet and the registration system facilitates the integration and distribution of cases in each of the ports, being its intent to find a single standard protocol for all entries received. In this way, the digital media can become an effective tool to support and control. It is important to emphasize that the web-based system was developed for the port area, including common areas not leased, leased areas and vessels, including cruise ships.

Keywords: Brazilian seaports; web-based database system; waste management.

INTRODUCTION

Brazil is notoriously one of the countries in the world that features a set of propitious natural conditions for the development of marine tourism due to the vast coastline along the Atlantic Ocean (with over seven thousand kilometers), tropical climate and diversity of natural resources. Thus, this segment of tourism is configured as a favorable area for new investments (Amaral, 2002; Leal *et al*., 2013).

According to the Brazilian Association of Representatives of Maritime Companies (ABREMAR), 2010 was the longest cruise season in the country compared to other periods. This period showed an increase of 66% compared to the passenger traffic recorded in the previous year. However, against this development, in the 2011-2012 season, the number of vessels fell to 17, representing a drop of 17%. This decline, despite the growing demand, is justified by the desire for a future with better conditions that support the current demand (Leal *et al*., 2013).

It is evident that the obstacle to the growth of this activity in Brazil is not the absence of demand, but rather the inadequate port infrastructure. In this context, the problem of physical space, the need for construction of new terminals and develop new destinations and new ports to receive the vessels is highlighted. One of the items that also deserve attention is the issue of sustainability, since it is not only the terminal that should be adequate to receive the ship, but the whole harbor area (Leal *et al*., 2013).

An important factor in the sustainability issue is the proper management of port waste. In Brazil, the Law No 12.305/2010, which created the National Policy on Solid Waste (*Política Nacional de Resíduos Sólidos* PNRS), brings together a set of principles, objectives, instruments and guidelines for an integrated solid waste management in the country and must be incorporated by all generators of solid waste, legal entity, public or private, that generate solid waste through their activities.
The proper management of port waste, in accordance with the PNRS, is fundamental for the sustainable development of port activities in the country. However research is needed to adequate the management of waste in ports with the legislation, since several waste management failures still occur in most Brazilian ports (MMA, 2011). Thus, the Compliance Program of Solid Waste and Liquid Effluent Management in Brazilian SeaPorts, which is an initiative created by the Secretariat of Ports of the Presidency (SEP/PR) and implemented by the International Virtual Global Change Institute (IVIG/COPPE/UFRJ) was initiated in 2010 to overcome this need, among other objectives.

The Compliance Program of Solid Waste and Liquid Effluent Management in Brazilian SeaPorts used the academic literature and the fieldwork to diagnose the solid waste generated in ports and vessels (data on generation, classification, identification, quantification, frequency of generation, expected destination and forms of packaging), liquid effluents (with focus on sanitary wastewater, oily wastewater, storm drainage and analysis of rainwater utilization) and the harmful synanthropic fauna (its occurrence and uncontrolled multiplication caused by accumulated and/or improperly stored waste in the primary areas of ports, indicating the location, classification, potential risks to public health and the environment, origin and maintenance, prevention and mitigation). The project includes 22 Brazilian ports.

Among the obstacles found at the Brazilian ports by the project, the most relevant were the practices related to the control and generation of the information regarding waste management issues. Little information is available for access and fewer can be found in databases. In many cases the information is not recorded in any database, or even studied, in order to manage and publish an evaluation of a port. This scenario is seriously harmful to the management of waste, since the control and the generation of information related to this management is fundamental to know the profile of waste in a port and thus, to be possible to elaborate solutions and decision-making relating to an efficient waste management (SEP/PR and UFRJ, 2013).

So, create a structured system to be able to document, to archive and to make available technical documents and information about the waste management infrastructure of the Brazilian ports is an important and relevant issue. This kind of investment will help to report information between research institutions and to study ways to reach the principles and objectives of the Law No 12.305/2010 (PNRS).

The web has a signficant impact on all aspects of our society, from business, education, government, entertainment sectors, industry and our personal lives (Garousi et al., 2013). The main advantages of adopting the web for developing software products include (1) no installation costs, (2) automatic upgrade with new features for all users, (3) universal access from any machine connected to the Internet and (4) being independent of the operating system of clients (Dogan *et al*., 2014).

Therefore, the main objective of this work consists on the presentation of a tool for electronic registry, considering the amount of information, the complexity and the dynamics of the variables and their interaction, developed to attend the Project of SEP/PR in partnership with COPPE/UFRJ through IVIG (Compliance Program of Solid Waste and Liquid Effluent Management in Brazilian SeaPorts). This web-based database system tool was developed to enable a normalized information and control of solid waste generation, liquid effluent and harmful synanthropic fauna from various port areas. This information requires a very great control, documentation, archiving, and high investment in human, logistic and financial resources. The combination of the computer technology of internet and the registration system facilitates the integration and distribution of cases in each of the ports, being its intent to find a single standard protocol for all entries received. In this way, the digital media can become an effective tool to support and control. It is important to emphasize that the web-based system was developed for the port area, including common areas not leased, leased areas and vessels, including cruise ships.

METHODOLOGY

In 2011, Santos and co-workers developed a web-based waste inventory system (Chemical Management Information System - CMIS) for chemical and hazardous waste in accordance with Philippine government regulations using PHP and MySQL language programing to manage, control and provide information such as safety data sheets; tracking system using barcode stock-levels monitor, consumption rates, movement and expiration dates and other applications. That system was created to facilitate the inventory, purchase, storage, waste

management and disposal of chemicals, providing multi-level access and support the reporting requirements to government agencies.

The web-based system presented here is being developed to reach a matured and similar system to that one developed by Santos et al. (2011) allowing in the future, the management and control of solid waste and effluent generated in port areas, as well as the harmful synanthropic fauna. The system is being created using the languages programming C # DOT NET, Ajax and SQL Server. The protocols were assembled and separated by large areas - being, "Solid Waste", "Fauna" and "Effluent" - and subsequently made available through the web.

As manager of WEB applications, the IIS (Internet Information Services) was used and as the system version controller was used SVN Tortoise software, being also used the database SQL Server 2008 R2, Microsoft manufacturer. The WEB server was needed to make the system available for use in the field, through a microcomputer DELL Server type, with Windows 2003 Server operating system, network card 10/100 Ethernet 3COM, connected through the internet network of an outsourced company (Synapsis of Brazil LTDA), with support 24 hours a day and 7 days a week.

In all methods for database construction, various equipment and methodologies were used like Scrum 15 days interval methodology and tools for creating diagrams using DBWrench. The Visual Studio 2010 program was used to develop "web sites" for the system in C # dot net. Thus, the entire system was designed for web environment, being able to be accessed through computers PCs, tablets, phones, or cloud computing. As the project management tool, DOT Project version 2.1.3 was used and the project manager PMP certified as a member of PMI (Project Management Institute).

All access to the system created can be done by any device that has access to the internet with a web browser (Mozilla, Chrome, Internet Explorer or another browser on the Internet).
Initially, a registration protocol was set for data collection at Brazilian ports. With these protocols determined, the structures of the database were created for each of the input points needed to build the system. Entries protocols served to map the needs of each port, what they have in common, and thus create the tables and relationships in the database. This material created was generated by programming language C # dot net (Asp net), with Ajax and made available in Hyper Text Markup Language (HTML) format.

To make this material available was necessary to create a safety mechanism that does not allow other users to access the content. This mechanism was developed in C # dot net (Asp net) with JavaScript / Ajax, where users must be registered before entering any of the items. Thus, each of the ports shall have an insight into their own space, not being allowed to see the results of other ports, while access to the university and the Secretariat of Ports allows evaluating all.

The protocols and data were collected by biologists, engineers, geographers, and other professional participants of the project. All information was digitally recorded in the documentation and gave rise to the tables and relationships of the system for application in data collection.

The diagram of entities and relationships of the developed system is shown in the Figure 1.

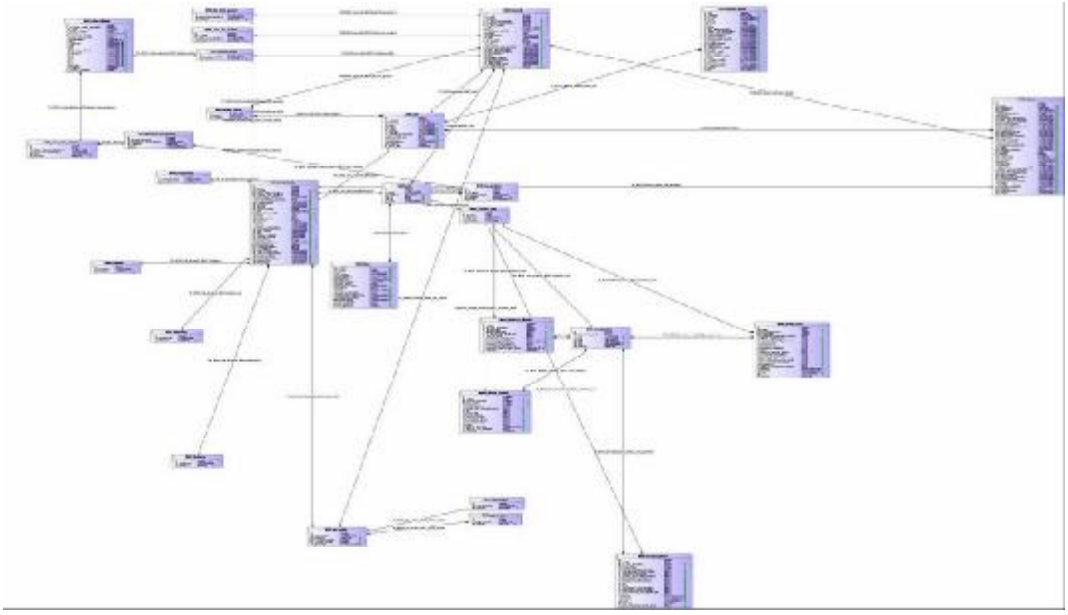

Figure 1: Diagram of entities and relationships of the system

RESULTS AND DISCUSSION

The data collected in the field are included and stored in the database and can be accessed by the address http://sistema.ivig.coppe.ufrj.br/sep/Login.aspx, where the user must enter username and password (Figure 2). The identifier is previously registered and the password is generated and sent by the system to the registered email. After login, the access to the system is released. All information recorded through a port are analyzed and does not automatically enter the database, prior generating a control of all search types and documented information in ports, considering that these records can be shared.

Figure 2: System login screen

The system was developed in a way that separates several indicators, including the ports themselves, place of registration, type of issue (solid waste, liquid effluent, fauna), date of registration and others.

After logging in, the system displays the modules that the user has access. At the presented profile (Figure 3 and Figure 4), the user has access to academic production module and to the waste module (including synantrophic fauna and effluent). When navigating with the mouse on the system, it displays the managing options available that includes Graphic Report and Analysis of Handling Report, among others.

Figure 3: System overview

Figure 4: System overview II

At the Handling Report item (Relatório de Movimentação) it is possible to visualize the data stored in the system with their quantities and characteristic. At the Graphics Report item (Relatório Gráfico), the system displays the information graphically (Figure 5). The system allows specific selection of parameters such as ports, dates, and others parameters. After the selection of the parameters, the system displays the information selected with a graphical presentation of the data.

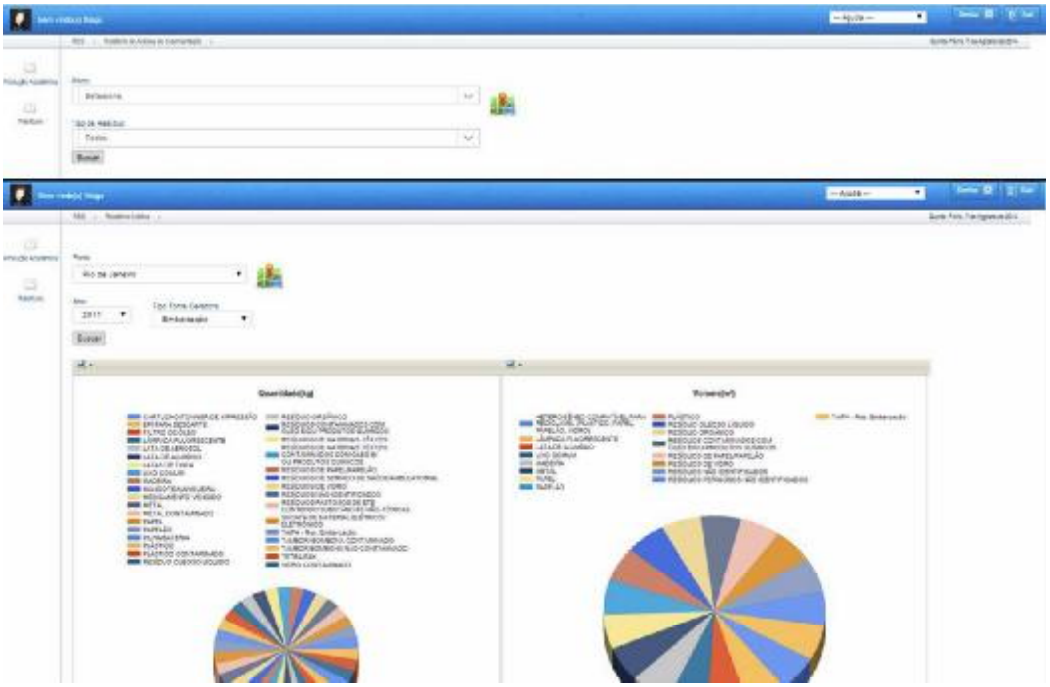

Figure 5: General system overview – Handling and Graphic Reports

In the map option, it is possible to view the geographic location of the ports, as shown in the Figure 6, which presents the Port of Rio de Janeiro (RJ) and Port of Santos (SP).

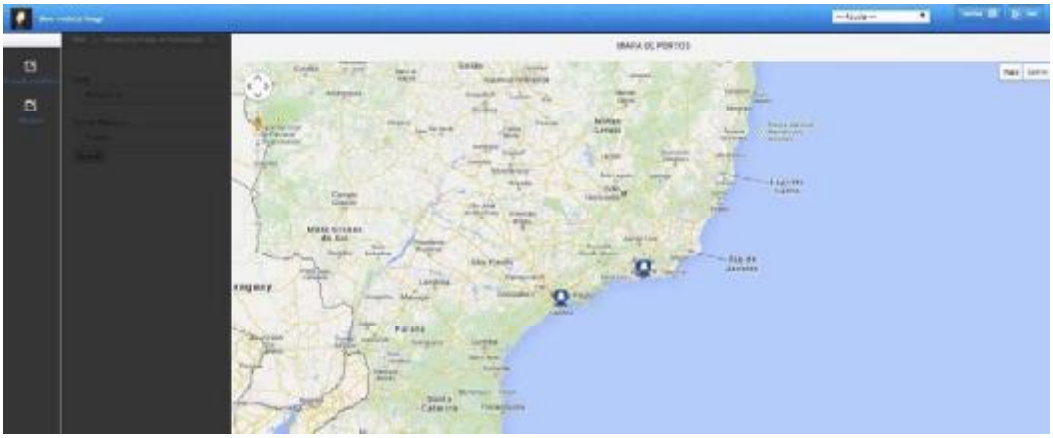

Figure 6: Port of Santos and Port of Rio de Janeiro Location

When navigating through the system, moving the mouse over the desired port, it is possible to check the existing georeferenced data about waste, effluents and fauna.

The information for solid waste by the system is presented in the Figure 7 and it includes location, waste type and quantity. The data for synanthropic fauna by the system is presented in the Figure 8 and it includes location, number of individuals identified and information about species. The data for effluents by the system is presented in the Figure 9 and it includes

location, existence or not of rainwater drainage as well as their conservation status, existence or not of segregated drainage, potential for generation of contaminated effluent, existence of sewage treatment station, characteristics of the effluent (existence of barriers or retaining basins, tanks; existence of filters; launch or not the effluent in the receiving body).

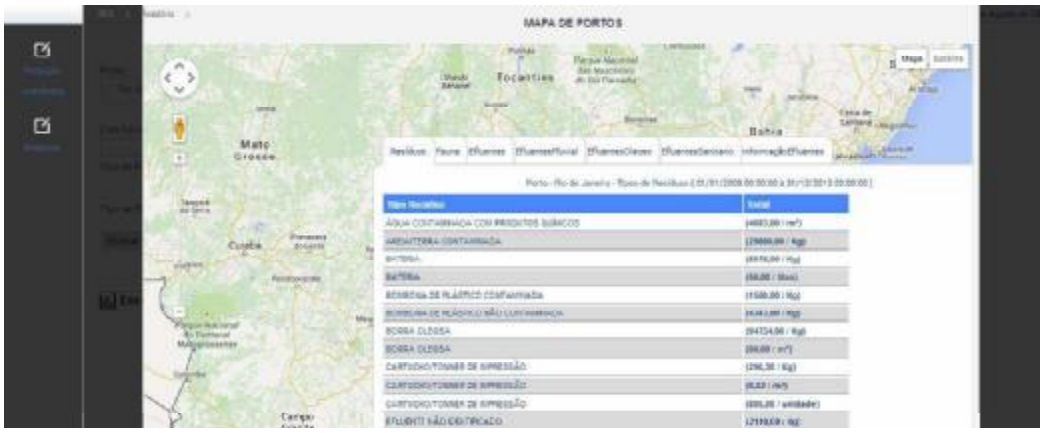

Figure 7: Parameters for solid waste

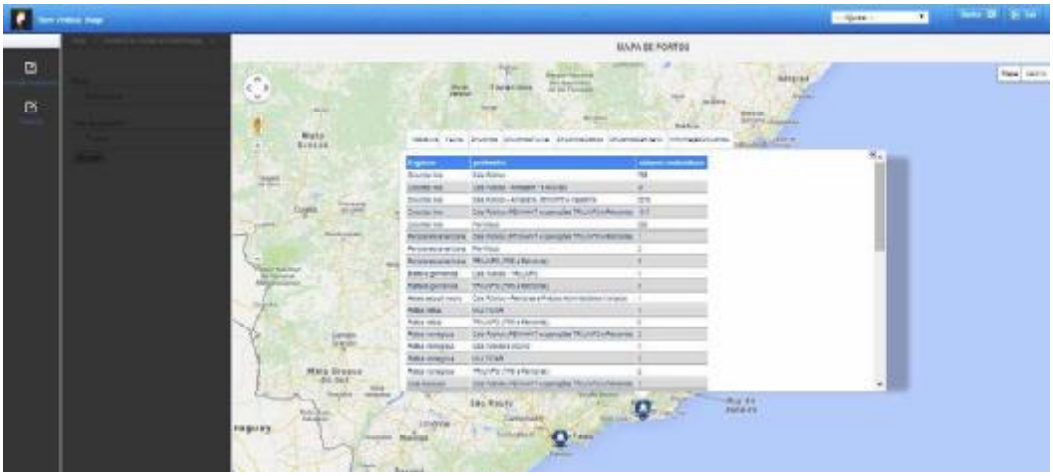

Figure 8: Parameters for synanthropic fauna

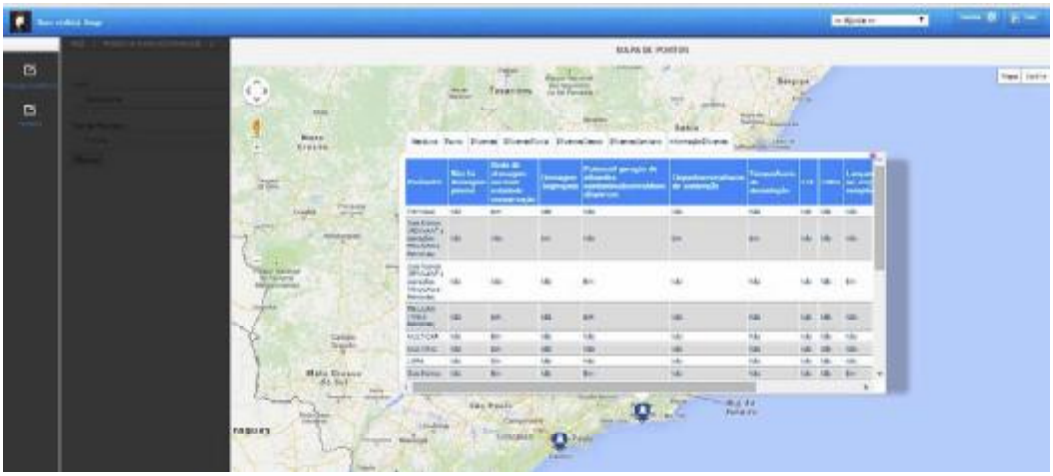

Figure 9: Parameters for effluents

CONCLUSION

There are several economic benefits from the cruise industry (Brida, 2010). In Brazil, besides the coastal cruises (national), which run only along the Brazilian coast, there are the international cruises, which make scales in the country and bring a high quantity of foreign tourists, promoting the increased flow of foreign money for the Brazilian economy. There is a big potential for creating new destinations and a strong consumer market for the provision of the cruise market in the country. Thus, it is clear that the obstacle to the growth of this activity in Brazil is not the absence of demand, but rather the inadequate port infrastructure. Because of this fact, some shipping companies operate in a limited way in some ports, such as the case of Rio de Janeiro and Santos (Leal et al., 2013).

The context of port infrastructure includes the issue of sustainability, and within this issue, the proper management of port waste.

The main objective of this work was to provide a tool and a database to allow Secretariat of Ports and IVIG to manage and control solid waste and effluent (sewage and wastewater) generated in port areas, as well as harmful fauna. The system aims to enable an automatically control that can be held with any device like tablet, mobile phone or even using cloud computing instead the use of paper filed records. Thus, the data regarding waste management of the Brazilian port areas could be recorded in a standardized manner into a single shared database.

Although the present system is not fully complete, since the project with SEP/PR have not been finished and the data from previous years are still being recorded in the database, it is possible to realize the advantages of the system developed through the results and indicators derived from the application of this technology.

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