

'Amazing, Stimulating, Reassuring'

Dialogue

By LONG Yun, BI Weizi & DAI Xiaopei

When a train arrives on time or when a power grid stays online during a storm, most people see reliability. Italian scientist Enrico Zio, however, sees a carefully balanced equation of risk, resilience and human judgment.

As a leading engineer and researcher in the safety and reliability of complex systems, Zio has spent over three decades asking deceptively simple questions: How do things fail, and how can we prevent them from failing? And if they fail, how can we minimize the damage and recover from the failure? His work focuses on the intersection of system engineering, probabilistic modeling, AI and human behavior — especially concerning systems where failure is not an option, from nuclear reactors and aerospace missions, to smart cities and interdependent critical infrastructures.

In a recent interview with *Science and Technology Daily*, he shared insights from his decades of research, his deep collaboration with Chinese institutions, and his vision for the future of science in an increasingly interconnected world.

Making sense of risk
At its core, Zio's work is about understanding failure, not to dwell on it, but to prevent it and manage it.

"This means trying to characterize the wrong behavior of a complex system," he explained.

A complex system is made up of physical parts, digital components and human beings, all working together to produce and deliver services such as transportation, energy or communication. But when one piece fails, the entire system can be disrupted, he noted.

"Studying risk and resilience means looking inside the system, its components, their connections, the physics of the mechanisms of their failure, the way they are operated and maintained," he said. "What can go wrong? What are the consequences? Is there danger to people



Professor Enrico Zio. (PHOTO: Science and Technology Daily)

or the environment? To the system itself? How much? And how often might these failures occur?"

The answers to these questions guide real-world decisions on design, operation and maintenance: for example, how to maintain the infrastructure, how to respond to emergencies in case of failure, and how to recover quickly to be resilient.

"The research benefits coming from searching answers to these questions, solutions to these problems are very tangible," Zio emphasized. For example, when he looks at autonomous cars, he sees beautiful technological advancements, but his job is to ensure there's no risk of accidents caused by system failures, errors in the digital communication, or inaccurate output from the AI used. In all safety-critical contexts, like space exploration or nuclear energy, where public safety and national investment are at stake, rigorous risk analysis is essential.

Witness to China's sci-tech
Having visited China regularly for over 20 years, Zio has witnessed the country evolve from a growing technological player into a global leader.

When asked to describe China's sci-

entific advancement in just three words, he didn't hesitate. "[Firstly], amazing," he said, "because I've seen the change in the efficiency and effectiveness of managing such a complex system, a nation with the largest population, huge distances and immense demands of products and services, of wellbeing for all." From high-speed rail networks running with near-perfect punctuality, to breakthroughs in electric and autonomous vehicles, to effective realization of nuclear power plants, Zio finds China's ability to execute large-scale technological projects nothing short of extraordinary.

"[Secondly], stimulating," he continued, "because the solutions China has implemented in such a complex environment challenge us in the West to reconsider our own systems and solutions. If China can solve these large-scale problems, why can't we?"

"[Thirdly], reassuring," he said, adding that, "China's successful models in the sci-tech field offer hope for tackling global challenges like climate change, energy security and sustainable development."

Nurturing young talent
Zio has collaborated extensively with Chinese universities, including Beihang

University, where he serves as advisory professor; the Harbin Institute of Technology and Harbin Engineering University, where he serves as guest professor and chair professor, respectively. He applauded his Chinese peers for their kindness, respect for collaboration, and depth of knowledge.

Over the years, Zio has made remarkable contributions to these Chinese universities' research and talent cultivation, mentoring more than 10 joint PhD students and guiding them in research projects, academic writing, and methodological development in Milan. His insights and participation have provided significant academic and technical support to these universities' numerous research programs.

During the International Month 2025 held by the China Association for Science and Technology, he participated in high-level discussions with Chinese scientists, reinforcing the importance of international cooperation. "Collaboration is fundamental," Zio said. "The world has too many complex problems for any one country to solve [all the challenges] alone. We need to share perspectives, experiences and knowledge."

He pointed to China's progress in nuclear energy as a prime example. "I've been lucky to witness China's journey in nuclear power — not just building plants, but developing safer, more efficient future designs. This isn't just about technology. It's about skill education, safety culture, regulation and long-term planning." Zio added that China is achieving all this at the speed of light.

Reflecting on his own journey from studying nuclear engineering at Politecnico di Milano, UCLA and MIT, to pioneering work in AI and risk assessment, first under the guidance of his supervisors and then with the contribution of his collaborators and students, Zio offered heartfelt advice to young scientists and engineers: Focus on the work, not the rewards (these come as a consequence). And love what you do.

"Young researchers' goal should be to do the work well, to be passionate, motivated, and deeply engaged in solving real difficult problems," Zio said.

Overseas Echoes

Preserving China and Russia's Cultural Memory

By ZHANG Hao & BI Weizi

Founded in 1795, the National Library of Russia (NLR) is the first public library in Europe and the oldest in Russia. For over 200 years, with its collection of over 40 million rare books, the NLR has been a vast repository preserving Russia's cultural memory and continuing its historical mission.

In recent years, the NLR has developed fruitful collaborations with several Chinese institutions. This year, the library hosted the "One War, One Victory" exhibition, commemorating the 80th anniversary of victory in the War of Resistance and the World Anti-Fascist War and showcasing the history of the Chinese and Soviet people fighting together for victory. The recently held opening ceremony highlighted the richness of the two peoples' shared history.

Science and Technology Daily spoke to Denis Tsyppkin, the NLR's director, about the library's collection and development plans, its Chinese document collection, its cooperation with China, and how it is meeting the challenges of the information age.

Tsyppkin said the NLR's current collection of Chinese literature comprises around 50,000 books, 1,200 periodicals and 100 newspapers, spanning various periods and subjects. The most precious of these is the Chinese edition of *The Eastern Journey of Nicholas II* published in 1890-91, of which only three copies were printed. He said the Chinese edition demonstrates deep respect for China's printing traditions and underscores the profound political and symbolic significance of the visit.

The long trip in 1890-91 was significant as "no previous reigning sovereign had enjoyed such an opportunity of seeing first-hand Russia's neighbors," according to reports. The trip through Warsaw covered Egypt, India, Ceylon (today's

Sri Lanka), Thailand, Java, Saigon, China, Japan and Siberia.

The Chinese literature collection of the Department of Asian and African Literature is the library's fastest-growing collection, with over a thousand new Chinese documents added each year.

"This rapid growth in recent years is primarily due to our active collaboration with the National Library of China and other Chinese libraries," Tsyppkin said.

He believes there are significant prospects for cooperation between China and Russia in areas such as the protection and preservation of library collections, document restoration, and the digitization of library collections.

"Our similar views on literary heritage research, book culture, and the promotion of universal reading have also brought us closer together," he added.

In May, the year 2026-2027 was designated as the Russia-China Years of Education. The NLR has already participated in several educational projects aiming to engage young Chinese students studying in Russia.

According to Tsyppkin, both Russian and Chinese libraries consider preserving and transmitting the nation's written memory to the next generation to be their fundamental mission. Their work to foster a love of reading and create a literate society is extremely important as it improves people's quality of life and promotes successful national development.

"For Russian libraries, China's national policies, organization and experience in supporting and researching reading are worthy of attention. Chinese library colleagues may also be interested in the experience of the Federal Center for the Preservation and Conservation of Collections, housed within the NLR, and its work in bibliographic theory and practice," Tsyppkin added.



Denis Tsyppkin. (COURTESY PHOTO)

Traditional Eastern Wisdom

Horse Collar Harnessing: Ancient Carriage Tech

By BI Weizi

In ancient times, horse carriages served multiple functions, including transportation, military use and ceremonies. The history of the carriage goes back a long way, and as its design evolved, so too did methods of harnessing.

Harnessing is the method of attaching one or more horses to a carriage. An effective harness design utilizes the power of all the horses attached to their fullest potential, coordinating their efforts

to pull the carriage, or mechanical device, more efficiently.

The world's earliest harnessing systems can be seen in chariots depicted in ancient Egyptian pharaoh tombs and temple murals. Horses were equipped with both a neck strap and a girth strap. The lead point was located where the two straps met, with the neck being the primary area through which the horse exerted force.

Western carriages often use a neck strap to connect the horse to the carriage, transmitting traction directly

through the rigid strap. However, this method can place excessive stress on the horse's neck, easily causing breathing difficulties.

In ancient China, a painting on a 4th-century BC lacquerware box from the State of Chu shows the earliest known example of a yoke placed across a horse's chest, with straps connected to the chariot shaft. Gradually, the hard yoke was replaced by a breast strap, often depicted in carved reliefs and stamped bricks in Han Dynasty (202 BC — 220 AD) tombs.

The horse collar was eventually invented in China around the 5th century. This harnessing system was a key development in the history of carriage harnessing. The collar used a wide leather belt wrapped around the horse's chest as a traction point, which separated the fulcrum from the load point. This reduced localized stress and leveraged the horse's abdominal muscles, thereby improving the carriage's efficiency. This system was an improvement on the traditional yoke-and-reins method and predated similar Western techniques.

Do Sugar-free Drinks Increase the Risk of Diabetes?

Science Outreach

By Staff Reporters

September is China's National Health Lifestyle Promotion Month. The campaign aims to raise awareness of the health risks associated with modern lifestyle habits, such as relying on fast food deliveries, drinking sugary drinks and spending too much time sit-

ting down. In particular, the question of whether sugar-free beverages increase the risk of diabetes has sparked heated discussions online.

To find out more, *Science and Technology Daily* spoke to Tong Yuling, deputy director of the Department of General Medicine at the Second Affiliated Hospital of Zhejiang University School of Medicine. She said sugar-free beverages are not as healthy as people imagine. Under Chinese national standards, a beverage must contain no more than 0.5 gram of sugar per 100 millilitres to be labeled "zero sugar." This means not

all sugar-free beverages on the market are completely free of sugar.

Most sugar-free beverages currently use "sugar substitutes" to give the taste of sugar. These include artificial sweeteners such as aspartame and sucralose, as well as natural or semi-natural sweeteners such as steviol glycosides and erythritol.

Tong said that compared to traditional sugar, "sugar substitutes" are lower in calories and have a lesser impact on blood sugar levels, making them a useful occasional sweetener for people with diabetes. However, studies

have shown that long-term excessive consumption of sugar-free beverages may stimulate the brain through sweet taste receptors, affecting insulin secretion via neural pathways. This is associated with an increased risk of diabetes, stroke and cardiovascular disease.

"Sugar-free beverages can be beneficial for controlling blood sugar levels when used as a substitute, but the metabolic safety of long-term consumption has not been fully established. Therefore, using sugar-free beverages as a source of 'daily hydration' is not recommended," said Tong.

15th FYP to Advance Innovation-driven Development

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The mechanisms under which major scientific and technological innovation projects are organized will be improved, driving the systematization, institutionalization and coordination of scientific and technological capabilities, innovation resources and personnel.

The principal role of enterprises in scientific and technological innovation will be reinforced, and the fostering of leading technology enterprises will be accelerated. Reforms will be deepened on granting researchers corresponding rights over the scientific and technological outputs produced on the job and placing these outputs under separate management.

Discipline adjustment mechanisms and talent training models to meet the needs of China's scientific and technological development and national strategies will be developed. A science and technology financial system compatible

with scientific and technological innovation will be built.

• **New productive forces will be developed in light of local condition**

The Ministry of Science and Technology will strengthen macro-level guidance and coordination of local scientific and technological innovation and industrial layout, and guide local places to leverage their resource to forge technological strengths and industrial specialties, achieving differentiated development.

Cross-regional innovation collaboration and industrial cooperation will be enhanced to build a batch of world-class industrial clusters. Eligible local places will be encouraged to deeply integrate scientific and technological innovation with industrial innovation, boldly explore and pioneer new approaches, and establish hubs for original innovation and highlands for industrial technological innovation.