LIABILITY ARISING FROM AUTONOMOUS VEHICLES[*]

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Abstract

In the context of our rapidly advancing technological landscape, autonomous vehicles emerge as a prominent illustration of technological progress. This study centers on autonomous vehicles as embedded systems, combining computer software with vehicular systems, and explores the intricate of liability issues concerning drivers, owners, and manufacturers in this domain.

The article delves into two key facets of strict liability law: tort law defined by Section 437 of the Civil and Commercial Code of Thailand, and liability laws applicable to unsafe products, with a particular focus on level 5 of autonomous vehicles. Adopting an international perspective, the study draws comparisons with Estonia, a renowned hub for computer technology.

The findings reveal that Section 437 of the Thai Civil and Commercial Code can still be applied in autonomous vehicle cases, typically holding vehicle owners responsible in accidents involving individuals. However, this legal provision has limitations and does not encompass all possible scenarios. Consequently, the article expands its scope to encompass Thailand's broader product liability laws, which take a more comprehensive approach, covering all parties involved in the production and distribution of defective products.

A significant revelation is that manufacturers of computer software used in autonomous vehicles in Thailand may not bear liability under current legislation, especially in the case of packaged software. To address this gap in liability, the author recommends amending Section 4 of the Product Liability Act to explicitly include computer software within the legal definition of a product. Such an amendment would ensure that all entities in the distribution chain are held to the same liability standards as physical products, thereby holding them accountable for safety concerns associated with their autonomous vehicle software

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[*] This article is summarised and rearranged from the thesis "Liability Arising from Autonomous Vehicles", Faculty of Law, Thammasat University, 2022.

products. This amendment seeks to create a more robust legal framework that keeps pace with the evolving technology landscape.

1. Introduction

1.1 Terminology

Autonomous vehicles are categorized into different levels based on their automation and driver involvement. These levels are defined by the Society of Automotive Engineers (SAE)[1] as follows:

Level 0: No Automation - The driver is responsible for all aspects of driving, and there is no automation in the vehicle.

Level 1: Driver Assistance - The vehicle may assist with either steering or acceleration/ deceleration, but not both simultaneously.

Level 2: Partial Automation - The vehicle can control both steering and acceleration/ deceleration simultaneously, but the driver must monitor the environment and be prepared to take control at any time.

Level 3: Conditional Automation - The vehicle can manage all aspects of driving under certain conditions, but the driver must be ready to intervene when prompted by the system.

Level 4: High Automation - The vehicle can be fully autonomous driving under certain conditions or within specific areas. The driver may not need to be constantly monitoring the environment.

Level 5: Full Automation - The vehicle is entirely autonomous, and no human intervention is required for driving. There is no need for a steering wheel or pedals.

1.2 Components of autonomous vehicles

Some key components[2] of an autonomous vehicle include:

1.2.1 Sensors

Autonomous vehicles are equipped with a variety of sensors, such as radar, LIDAR (Light Detection and Ranging), cameras, and ultrasonic sensors. These sensors provide real-time data about the vehicle's surroundings, including the detection of other vehicles, pedestrians, obstacles, and road conditions.

1.2.2 Control system

The control system is responsible for processing the sensor data and making decisions based on it. It includes a combination of hardware and software components that analyze the sensor inputs, interpret the environment, and execute appropriate driving commands.

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[1] International, SAE 'Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles', <https://www.sae.org/standards/content/j3016_202104>, accessed 2 July 2023.

[2] Leiss, Peter J. 'The Functional Components of Autonomous Vehicles', <https://www.robsonforensic.com/articles/autonomous-vehicles-sensors-expert>, accessed 2 July 2023.

1.2.3 GPS and mapping

Autonomous vehicles utilize Global Positioning System (GPS) technology to determine their precise location. They also rely on detailed mapping data to understand the road network, lane markings, traffic signs, and other relevant information.

1.2.4 Onboard computer

The onboard computer is the brain of the autonomous vehicle. It performs complex calculations, runs algorithms, and controls the vehicle's operations, including acceleration, braking, and steering. It integrates the sensor data, outputs, and decision-making algorithms to guide the vehicles.

1.2.5 Connectivity

Autonomous vehicles often have internet connectivity, providing real-time data, updated maps, and communication with other vehicles or infrastructure systems. This connectivity facilitates vehicles to vehicles (V2V) and vehicles to infrastructure (V2I) communication, enhancing safety and efficiency.

1.2.6 Actuators

Actuators convert the computer's instructions into physical actions. In an autonomous vehicle, actuators control the acceleration, braking, and steering mechanisms. They ensure that the vehicle responds appropriately to the decisions made by the control system.

1.2.7 Redundancy systems

Autonomous vehicles often incorporate redundancy systems to enhance safety and reliability. Redundancy involves duplicating critical components, such as sensors, computers, and power supply, to ensure continued operation in case of a failure or malfunction.

1.3 Computer software and computer program

This article assumes that the terms 'computer software' and 'computer program' are interchangeable. Both these terms refer to sets of instructions and data that are processed by a computer to perform specific tasks or functions.

1.3.1 Meaning

'Computer Software'[3] (or simply 'Software') is nothing but just an assembly of instructions to the computer to get some work as an output.

'Computer Program'[4] is simply a collection of instructions or ordered operations for a computer to perform a specific function or perform a particular task and achieve a specific result.

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[3] Support3 'What is a Computer Software?', <https://www.geeksforgeeks.org/what-is-a-computer-software/?ref=gcse/> accessed 2 July 2023.

[4] Madhurihammad 'Difference between Software and Program', <https://www.geeksforgeeks.org/difference-between-software-and-program/#article-meta-div> accessed 2 July 2023.

'An embedded system'[5] is an application that contains at least one programmable computer (typically in the form of a microcontroller, a microprocessor or digital signal processor chip) and which is used by individuals who are, in the main, unaware that the system is computer-based.

1.3.2 Categorization of computer software by delivery mode

There are many types of software, but the types of interest in this article are packaged and custom software.[6] The details are as follows:

Packaged Software, also known as off-the shelf software, is pre-designed and developed by a software vendor. It is available for purchase and use by multiple customers or organizations. The functionality and features of packaged software are generally standardized and may not be tailored to specific individual needs.

Custom software is designed and developed specifically for a particular customer or organization. It is tailored to meet the client's specific requirements, preferences, and workflows. Custom software development involves building the application from scratch or modifying existing solutions to suit the customer's unique needs. It provides greater flexibility and the ability to incorporate specific business processes and features. Custom software is typically more expensive and time-consuming than packaged software.

2. Liability arising from autonomous vehicles in Thailand

In the case of level 5 autonomous vehicles, where the driver is replaced by computer software or AI (Artificial Intelligence), it raises the question of whether Thai law adequately supports this type of driving. It becomes essential to evaluate the existing legal framework and determine if it encompasses the unique characteristics and challenges presented by fully autonomous vehicles. Additionally, fairness to all parties involved should be a key consideration when assessing the law's compatibility with this type of driving.

2.1 Traditional tort law

For liability, the person in control of a vehicle is liable for any damage caused by the vehicle.

Section 437[7] of the Civil and Commercial Code:
'A person is responsible for injury caused by any conveyance propelled by mechanism which is in his possession or control, unless he proves that the injury results from force majeure or fault of the injured person.

The same applies to the person who has in his possession things dangerous by nature of destination or on account of their mechanical action.'

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[5] Michael J. Pont, Embedded C (London: Pearson, 2002).

[6] MKS075 'Difference between Packaged Software and Custom Software', <https://www.geeksforgeeks.org/difference-between-packaged-software-and-custom-software/> accessed 2 July 2023.

[7] Thai Civil and Commercial Code B.E. 2468 (1925).

In Thai Tort law, the conclusion reached is that in the event of an accident caused by a fully autonomous vehicle, the owner of the vehicle should be held responsible in accordance with Section 437.

Obviously, Section 437 cannot apply to machine-to-machine accident cases. When there is a vehicle accident, both parties cannot claim the provisions under this section to pass the burden of proof to the other party. Both parties did not benefit from the presumption of Section 437; therefore, using Section 420 is required to prove that any party is willful or negligent, which has caused the damage.

2.2 Product liability law

The product liability law in Thailand contains several essential details worth considering. These details may include:

Section 4 of the Product Liability Act[8] states that products refer to all kinds of movable properties that manufacture, import, and sell products in this Act, including agricultural products and electricity.

When examining the meaning of the term 'custom software', it becomes apparent that this software aligns with the definition provided in Section 4, which states that an entrepreneur refers to the individual who hires for production. In contrast, packaged software can be purchased generally. Consequently, a predicament arises if an automobile manufacturer purchases packaged software for their vehicles. Furthermore, it becomes apparent that computer software is not explicitly included as part of the product category. The provision defines products as all kinds of movable property, while computer software is generally recognized as intellectual property. As a result, several doubts arise:

1. Is computer software considered movable property when assessing its classification within the context of the law and its relation to other parts manufacturers?

2. If computer software (packaged software) is available on the market, can it be exempt from liability because it is not employed (hired) by other manufacturers?

3. Should computer software be the same product as electricity?

Computer software has been defined in two acts, namely the 'Computer-related Crime Act B.E. 2550'[9] and the 'Copyright Act B.E. 2537'.[10]

The definition of computer software is outlined in Section 3 of the Computer-related Crime Act B.E 2550. The definition of computer software is considered a subset of computer data, and it is often not explicitly referred to as 'computer software' or 'software'. Instead, it is described as a 'set of instructions', which essentially refers to computer software.

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[8] Thai Product Liability Act B.E. 2551 (2008).

[9] Thai Computer-related Crime Act B.E. 2550 (2007).

[10] Thai Copyright Act B.E. 2537 (1994).

The second definition defines a computer program as an instruction, a sequence of instructions, or something else that makes the computer work as intended. This definition is set forth in Section 4 of the Copyright Act B.E. 2537.

There are two issues concerning computer software liability within the Product Liability Act:

1. The classification of computer software as a service or product is defined in 'Section 4'[11] of the Act. According to the Act, 'Products' include all movable properties manufactured or imported for sale, including agricultural products and electricity, except those specified in the Ministerial Regulations.

2. Even if computer software is utilized to produce a product as per the guidelines of Section 4, certain types of software still fall outside the entrepreneur's scope. Specifically, packed software is one such category.

3. Liability arising from autonomous vehicles in Estonia

3.1 Traditional tort law

Section 1056[12] of Estonian law addresses tort liability for negligence, which is applicable to conventional vehicles. Section 16 subsection 1 states that:

> '(1) If damage is caused resulting from danger characteristic to a thing constituting a major source of danger or from an extremely dangerous activity, the person who manages the source of danger shall be liable for causing damage regardless of the person's culpability. A person who manages a major source of danger shall be liable for causing the death of, bodily injury to, or damage to the health of a victim, and for damaging a thing of the victim unless otherwise provided by law.'

When the driver is a computer program, the individual responsible for issuing commands or instructions to the program assumes liability. This liability provision is stipulated in subsection 1 § 1056 as stated: 'A person who manages a major source of danger shall be liable for...'. The conclusion reached is that the existing Estonian tort law continues to be applicable in the context of autonomous vehicle utilization.

3.2 Product liability law

Estonian law (Law of Obligations Act)[13] explicitly defines computer software as a product in the same way as electricity, and also added that whether the movable property will be a component of movable property or other immovable property, it shall be considered a product. The details of Section 1063 are as follows: '§ 1063. Product (1) Any movable is deemed to be a product, even if the movable constitutes a part of another movable or if the

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[11] ibid.

[12] Estonian Law of Obligations Act 2001.

[13] ibid.

movable has become a part of an immovable, and electricity and computer software are also deemed to be movables…'.

3.3   Analysis

1. One notable advantage of Article 1063 of the Estonian law is that it recognizes computer software as a product, placing it on equal footing with electricity. This provision encourages programmers to exercise caution when developing software, not only for the benefit of autonomous vehicles but also for other embedded computing systems, such as medical devices or washing machines. The law promotes accountability and quality assurance in software development across various industries and applications by treating computer software as a product.

2. This provision helps eliminate various interpretation issues, as it clarifies that movable properties installed within other movable properties or incorporated into them are also considered products. By extending the definition to encompass such cases, the law provides clarity and consistency in treating these movable properties as products. This ensures that they are subject to the appropriate legal standards and protections applicable to products, regardless of their installation or incorporation into other movable properties.

3. At the moment, Thailand's product liability law does not explicitly categorize computer software as a product, unlike tangible items like electricity. Given this ambiguity, manufacturers seeking to exercise caution when producing computer software could consider adopting guidelines similar to those outlined in Estonian law. Estonia's approach involves holding all members of the distribution chain liable.

By following such guidelines, software manufacturers, distributors, and other entities in the supply chain would be held accountable for any defects or harm caused by the software. This broader liability framework would potentially enhance consumer protection and encourage software companies to take extra precautions in ensuring the quality and safety of their products.

Adopting a comprehensive liability system for computer software in Thailand could provide clarity and consistency in addressing potential issues related to software defects and their consequences. It would also align with emerging global practices in the technology industry, where software is increasingly central to various aspects of modern life.

4.   Conclusions and recommendations

Based on the research findings, the Thai tort law can be effectively applied to autonomous vehicles, similar to the legal approach in Estonia. This similarity is particularly

evident when accidents occur between fully autonomous vehicles and pedestrians on the road, where the vehicle owner is generally considered liable.

The research highlights the limitations of tort law in both Thailand and Estonia concerning autonomous vehicles. It becomes evident that tort law only applies to particular events or situations and may not fully address all liability concerns related to autonomous vehicles in these jurisdictions.

Considering the constraints of tort law in Thailand and Estonia concerning fully autonomous vehicles, it is evident that applying unsafe goods liability laws becomes essential. These laws offer a suitable legal framework to address liability concerns, ensuring accountability and safeguarding against potential safety risks associated with autonomous vehicles.

Product liability law holds all members in the value chain responsible for any harm caused by a defective product, whereas tort law focuses solely on controlling the negligent party liable.

Computer software, especially mass-market or packaged software, might not be liable due to its exclusion from the definition of a product in the Thai legal system. In contrast, Estonian law defines computer software as a product. This researcher proposes legislative amendments to address the issue. These recommendations aim to close the liability gap and ensure better protection for all stakeholders in the software value chain.

4.1   Proposed solution

For all the reasons mentioned above, Section 4 of the Product Liability Act B.E. 2551 (2008) of Thai law should be amended by defining computer software as a product. Furthermore, it is recommended to add clarification that movable property, as well as other movable property or other immovable property, shall also be regarded as products in accordance with the laws of Estonia.

From:

"Products" means any kind of movable properties manufactured or imported for sale including agricultural products and electricity except the products specified in the Ministerial Regulations.

To:

"Products" means any kind of movable properties, even if the movable constitutes a part of another movable or if the movable has become a part of an immovable, been manufactured, or imported for sale including agricultural products and electricity and computer software except the products specified in the Ministerial Regulations**.**