

16 How new technologies
may improve transport on highways?

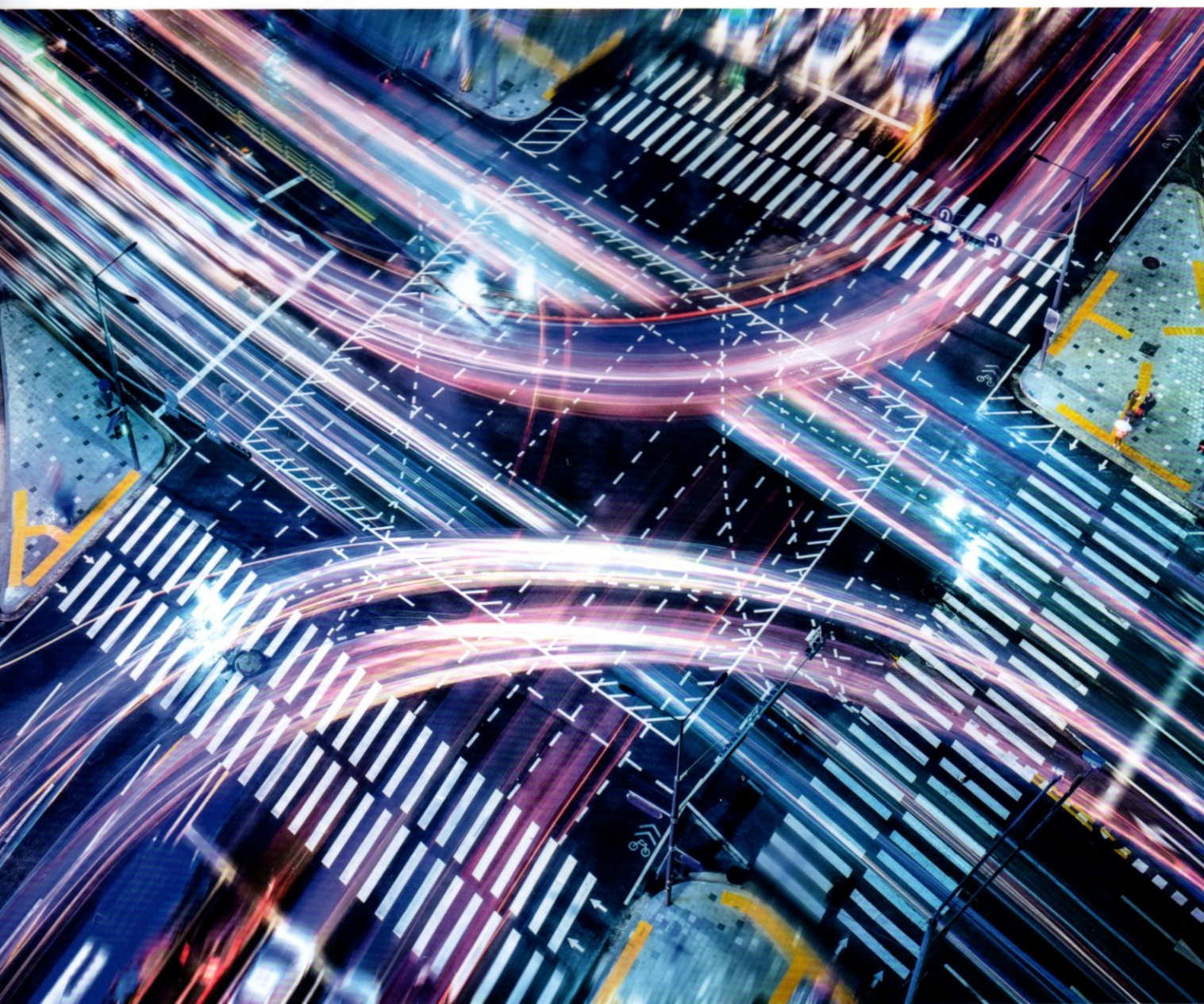
30 INTERVIEW
The future of modern technologies
on national roads

 **Elamed**
MEDIA GROUP

ISSN 2084-3380

Traffic Engineering

1/2018



Magazyn
AUTOSTRADY

Inżynieria
ruchu drogowego

Problems behind unification of signs on the EU roads

The problems related to differences in visuals, locations, and sometimes in meaning of various road signs in European countries is an element that hampers both efficiency and safety of road traffic. Without a doubt, unification of rules, but not necessarily all signs, is widely desirable.

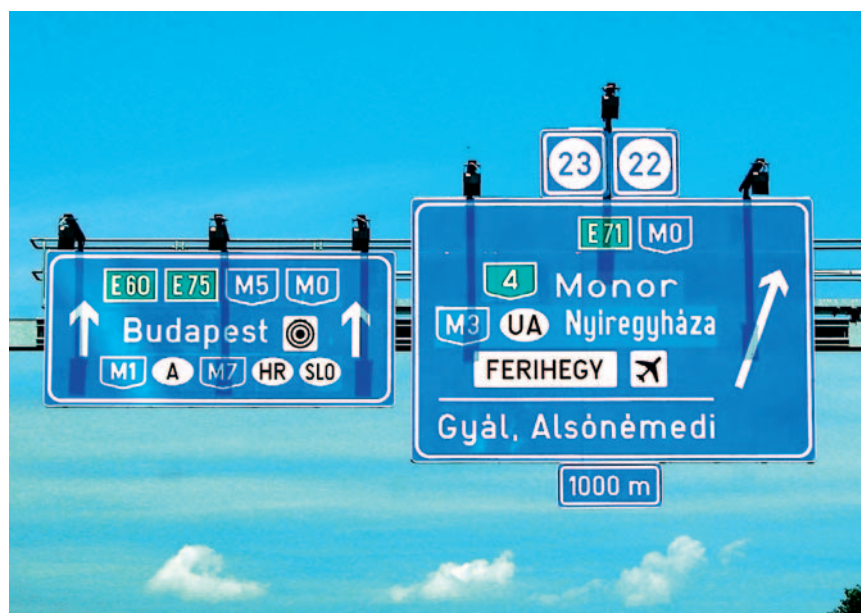
Contemporary development of automotive industry, which brings about easier traveling and allows to cross borders, enables drivers to travel to various regions of the world and drive on a large variety of roads. In case of the European roads, we observe an increase of international car traffic, especially after creation of the Schengen area in 1985, which facilitated crossing borders between signatory states.

Accessing roads of a foreign country forces a driver to adapt to local road infrastructure solutions, slightly different signs and differences in traffic culture. In time, the driver learns the traffic customs and gains more confidence.

Differences in road signs, even within Europe, are in certain scopes significant, despite the fact that all states are signatories of the Vienna Convention. It would be interesting to learn the degree of connection between accidents and collisions caused by foreigners and differences in road infrastructure, especially in signs in given countries, compared to the country of origin.

Problems with signs

Surveys among drivers show that they do not understand all signs [1]. Many signs, including warning and prohibitory signs, are understood by 90% of respondents, however, there are signs that are unknown to every third



Phot. 1. Signs above a motorway, at the ring road of Budapest, including an excessive amount of information exposed at the same time

driver or even half of them. However, the general problems related to signs result from an excessive number of signs, excessive amount of information on various signs (photo 1), signs with inconsistent or unclear information, and different meaning of the same signs in various countries, as well as obstructing of signs by plants and billboards.

On the basis of comparative researches of signs in various states of Europe, I come to the conclusion that there are interesting and valuable solutions in almost every country. However, at the same time we encounter redundant signs and observe lack of necessary ones. Why does this happen?

The conditions for automotive development gave rise to two road sign systems. European solutions focus around the Vienna Convention, the purpose of which was – and still is – to establish a common sign system for many states using various languages. The main emphasis is put on creating pictographs, that is a „language of icons,” to make the messages understandable for everyone and internationalize the signs.

The second system is based on the *Manual on Uniform Traffic Control Devices* (MUTCD) created and applicable in the United States, which is based and still relates mainly on text commands. Many countries have adopted



Fig. 1. Direction sign from Polish manual from 1938 (less distant town at the bottom)



Fig. 2. A signpost from a Polish manual from 1960 (less distant town at the bottom)

ed this system, for example Canada, Australia, South America to a large extent, and certain countries in Asia. We notice the influence of this system even in Ireland in a form of warning signs (a square with a vertical diagonal, so called "diamond signs"). Furthermore, we should also mention the third group of countries, which did not join the Vienna Convention, and draw both from the Convention and MUTCD system, and supplement them with their own solutions depending on needs.

Actions for road markings

In 2006, six European countries developed a document intended for the Trans European Road Network (TERN), called IMPROVER (*Impact Assessment of Road Safety Measures for Vehicles and Road Equipment*), which dealt with, for example, the following topic: *Harmonization of road signs and road markings on the TERN from a safety point of view*. While in 2013, a Group of Experts on Road Signs and Signals operating for the Economic Commission for Europe of the United Nations was appointed as a part of Inland Transport Committee. During its meetings, the group discusses the issues related to road markings, which means that it practically works on modification of the Convention on the road signs and signals.

Where do we drive

On the one hand, we deal with a local driver, who moves only within the area of his or her place of residence and workplace. He or she drives the same roads, knows them well and practically does not pay attention to markings.

On the other hand, we have a driver who keeps traveling, reaches various places and expects the markings to be similar in the entire country, so that identical situations were marked similarly. If he or she accesses the roads of other countries, he or she will often have to deal with different markings. The driver will gradually get acquainted to changes, however, he or she will certainly come across situations that will rise doubts, or even be surprising, and may feel uncomfortable at times.

A special case of a „traveling drivers” are professional bus or truck drivers etc., who constantly drive on roads of numerous countries and are generally familiar with the subtle differences between signs in various places in Europe and the world.

We should also mention a specific driver, who travels to a given country by plane and rents a car there. The situation of this driver depends on previous experiences, as the information environment may be unknown to him or her, forcing him or her to drive in a new, unfamiliar road and information sphere.

Driver’s needs

Taking into account the above considerations, we must assume that markings should be adapted not only to experienced drivers, but also to those who are less perceptive or have worse spatial imagination.

In short, road markings may be divided into two groups. One of them is responsible for the traffic safety and is similar in particular countries. This group includes warning signs that control the traffic, which are essentially similar to each other in different countries. The second group

comprises of signs that communicate directions. They allow driver to choose a proper road, inform him or her on which junction or node, from which lane and in which direction they should turn, to efficiently direct him or her through intermediate roads and towns etc. to the destination. And this is where the problems are most often encountered.

One of the major issues related to road markings is information overload. Drivers from outside a given region are often overwhelmed by the amount of information communicated by the markings and are often lost. The example of Hungarian marking above a motorway (photo 1) presents an excessive amount of information, and we may find similar congestions in markings in different countries as well. Despite the fact that such signs are usually repeated, someone who drives on a road marked in such a manner for the first time may struggle with finding the desired direction. He or she will often choose a wrong road and will have to turn back. He or she may also hesitate on crossovers or junctions or act in an unpredictable manner by suddenly slowing down or turning, thus posing a risk for traffic safety. For instance, accessing inappropriate motorway may cause the necessity to turn back and to needlessly travel for several or several dozen kilometers.

Markings reading

In order to understand contents of a sign and act accordingly, a driver must spot the sign and then read the contents. The very process of reading may differ depending on the case. Some signs are read extreme- ▶



Fig. 3. „The road route sign” applicable at the motorway in Choj-nów node



Fig. 4. Sequence of names of towns changes according to spatial location

► ly fast, that is „at glance,” however, more complex signs, especially those containing texts, are more difficult to read. Those are rarely read in a traditional manner – we do not read every information one by one, from up to bottom etc., but by glimpsing from one point to another, tracking the information through a zig-zag eye movement, which I will call „scanning” and detecting the most important fragments, and the time for identification of the contents of the sign is usually extremely short.

Moreover, there are also variable message signs, which are a specific types of signs, since they relate to plans, schema of junctions, branchings etc. I call them „map signs” [2]. These are vertical plans (mini-maps) of situations on the road ahead of us. We tend to read them from the bottom to the top, tracking the spatial schema we will pass in a moment. In the related order, this schema also governs the organization of names of towns on signs showing distances (fig. 1-4) – the furthest town at the top, the closest one at the bottom. Over a half of European countries design signs according to this rule, while many countries, including Poland, maintains a reverse order (fig. 1-4 present Polish signs from 1939 and 1960 and a contemporary sign in a current version and a version that should be applicable).

Arguments for unification

Probably no one expects that road markings will be replaced by other systems (for example by satellite navigation) in the coming years. As for now, it is the basis of information on roads and it is difficult to assume that it will vanish from roads completely. If unification of markings (harmonization – synchronizing them to create a functional system) would bring the European road traffic closer to „Zero Vision” then maybe, while considering costs of changes in markings, we should think about costs of accidents. According to Polish data for 2015, the cost of one fatality is PLN 2.03 million, and PLN 2.3 million in case of a severely injured person [5]. Therefore, it brings the question: can even the part of the amount we lose in Europe should not be invested in modern, cutting-edge markings?

To what extent should we uniform and to what extent should we differentiate

It seems that an ideal solution would be a complete unification of markings, however, firstly, it is unnecessary and, secondly, it is not a desired situation. Crossing the border is associated with change of language, telephone network, sometimes change of currency etc., and when we travel within states

of Schengen area we may not even notice that we have crossed a border. In such a case, at least the signs tell us that we are in another country. Therefore, it brings a question: what should be unified? Single signs, that is the warning, prohibiting, mandatory or information signs etc. could be uniformed, but they are not the most important ones. The fact that the picture of a car on „express road” sign is different in particular countries is less important. They must be legible. On the other hand, „level crossing” warning sign should be unified, so that every driver could easily identify it everywhere. However, this would require creation of a visually adequate pictograph sign, that would emphasize the threat and be widely accepted.

Markings systems in every country include messages expressed in words, which require unification. As an example, we may provide a round sign that replaces the word „center” in several European countries, and there are at least several dozen word-messages of this type and they should be, sooner or later, replaced with appropriate pictographs.

An important element that has been globally unified is a three-color traffic light (red, yellow, green), which has been used for the first time in 1920 in Detroit. A similar example is the „Stop” sign, which is always identi-

cal in shape and color, but does not always contain „STOP” message. For example, in Turkey it is „DUR” etc. On the other hand, we also encounter an excessive unification. In 1949, „dangerous turns” sign („z” letter shaped) was changed into two signs that are applicable today: „dangerous... turn” and „two dangerous turns, the first one in the... direction.” Time has shown that this unification was excessive, since the „dangerous turn” sign warns about a slight curve, where you can drive with a maximum permissible speed, as well as a road turn by 180° that require a driver to slow down significantly [3].

Another example may be the question of colors of signs on motorways (fig. 5). When traveling from Kraków to Marseille, we have blue signs in Poland. When we enter Czech Republic – they change into green. While in Austria they are blue again, green in Italy, and back to blue in France. Of course, we may give many other examples, since there are numerous problems like this, and there are a lot of obstacles for unification.

Taking a broader view, certain signs, even in adjacent countries, have different meanings, which may be detrimental for international traffic safety. On the other hand, the same situation may be differently marked even in the same city, which may confuse drivers. There are concerns that the problem of lack of unification of markings in certain scopes will be more and more visible, as there are still at least three obstacles:

- drivers are not open for changes;
- lack of full understanding of the issues associated with markings and agreements concerning unification in a wider scope;
- costs of introduction of such changes in markings.

Perspectives for changes

Previous changes consisting in improvement of markings in both

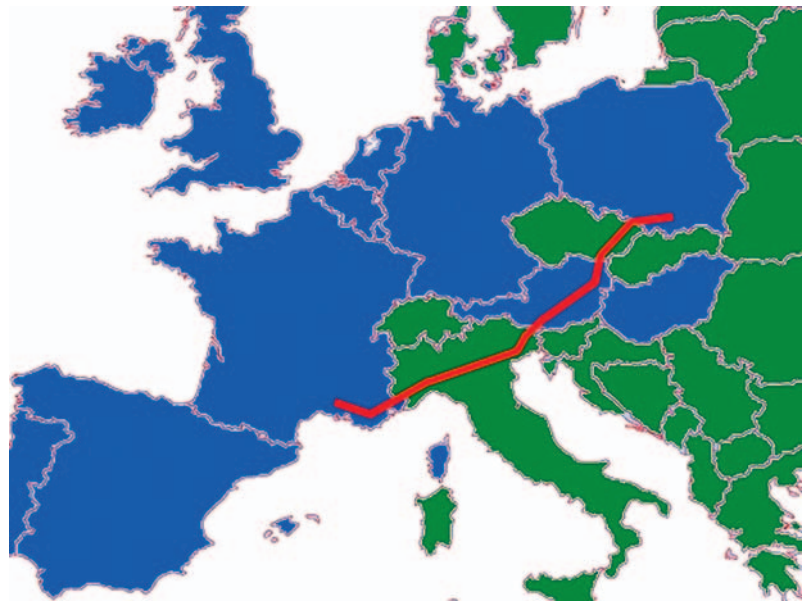


Fig. 5. Multiple change of the color of signs at motorways on the route from Kraków to Marseille

particular countries and in Europe generally are not well coordinated, sometimes even chaotic. The leading policy seems to be „every man for himself”, or „a little bit here, and a little bit there.” This especially applies to the countries of former Eastern Europe, and we encounter differences both at the local and international level. Beyond doubt, any decisions should be coordinated by the Vienna Convention, however, today, we may not be sure whether it is suited to fulfill that role. Introduction of pan-European changes in the road marking system would require the following:

1. Development of solutions – a full project that would, as far as possible to foresee, be applicable for everyone. It should be created by an international and multidisciplinary team of professionals based on well though assumptions. It should utilize existing, useful solutions. The entire system should be organized and optimized according to perceptive capabilities of drivers.
2. Planning of stages of implementation of this project taking into account the time needed for drivers to adapt to the introduced changes.

3. Establishment of costs of implementation of changes in markings, as well as methods of financing assuming more or less equal distribution of costs, considering the fact that the costs of certain countries that will have to adapt to others will be higher.

To sum up, unification of markings would be an extensive and long-term operation, but its results would certainly be positive. □

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Problematyka unifikacji oznakowania na drogach UE

Problematyka różnic w wyglądzie, lokalizacji, a niekiedy i w znaczeniu znaków drogowych w różnych europejskich krajach jest elementem utrudniającym zarówno sprawność, jak i bezpieczeństwo ruchu drogowego. Bez wątplenia unifikacja zasad, a niekoniecznie wszystkich znaków, byłaby ze wszech miar pożądana.

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Współczesny rozwój motoryzacji, za czym idzie, łatwość podróżowania i przekraczania granic powoduje, że kierowca może się poruszać w dość różnych regionach świata i po bardzo różnych drogach. Na drogach Europy obserwujemy wzrost międzynarodowego, samochodowego ruchu drogowego, zwłaszcza po powstaniu w 1985 roku strefy Schengen, ułatwiającej przekraczanie granic między państwami – sygnatariuszami.

Wjazd każdego kierowcy na drogi obcego państwa powoduje konieczność dostosowania się do lokalnych rozwiązań infrastruktury drogowej, do nieco odmiennego oznakowania oraz do różnic w kulturze na drodze. Z czasem kierowca poznaje drogowe zwyczaje i w miarę upływu czasu porusza się coraz sprawniej.

Różnice w oznakowaniu, choćby w ramach Europy, bywają w niektórych zakresach znaczące, pomimo że prawie wszystkie kraje są sygnatariuszami Konwencji Wiedeńskiej.

Interesującą kwestią byłoby znać odpowiedź na pytanie, na ile wypadki

i kolizje spowodowane przez obcokrajowców mogą być powiązane z różnicami w infrastrukturze drogowej, zwłaszcza w oznakowaniu w danych krajach, w porównaniu z krajem ojczystym.

Badania kierowców wykazują, że nie wszystkie znaki bywają przez nich rozumiane. Sporo znaków, w tym ostrzegawcze i zakazu, są rozumiane przez 90% respondentów, niemniej bywają też znaki, których nie rozumie co trzeci, a nawet co drugi kierowca. Jednak problemy ogólne w oznakowaniu sprawia zbyt duża liczba znaków, zbyt duża ilość informacji na niejednym znaku (fot. 1), znaki ze sprzecznymi lub niejasnymi informacjami oraz różne znaczenie tych samych znaków w różnych krajach, a także zagłuszanie znaków przez roślinność bądź billboardy.

Robiąc badania porównawcze oznakowania w różnych krajach Europy, autor doszedł do wniosku, że praktycznie w każdym kraju istnieją interesujące i wartościowe rozwiązania. Równocześnie jednak napotykamy na znaki zbędne i zauważamy brak znaków potrzebnych.

Pojawia się zatem pytanie, co powinno być ujednolicone. Otóż pojedyncze znaki, czyli ostrzegawcze, zakazu, nakazu czy informacyjne itp. mogłyby być ujednolicane, ale nie jest to najważniejsze. Mniej istotne będzie to, czy sylwetki samochodu na znaku

„droga ekspresowa” będą się różnić w poszczególnych krajach. Ważne, żeby były czytelne. Z kolei znak ostrzegawczy „przejazd kolejowy” prędkiej nadawałby się do ujednolicenia, aby każdy kierowca identyfikował go bezbłędnie, gdziekolwiek jest. Tu jednak potrzeba znaku – piktogramu, który będzie wizualnie adekwatny, podkreślający zagrożenie oraz możliwy do szerokiej akceptacji.

W oznakowaniu każdego kraju istnieją przekazy wyrażane słownie, wymagające ujednolicenia. Bez wątplenia ważnym elementem, który doczekał się ogólnoświatowej unifikacji, jest trójkolorowa sygnalizacja świetlna (czerwone, żółte, zielone). Przykładem pokrewnym jest znak „Stop”, który ma zawsze identyczny kształt i kolor, ale nie zawsze zawiera napis „STOP”. Następnym przykładem może być kwestia kolorystyki oznakowania na autostradach. Dotychczasowe zmiany polegające na ulepszaniu oznakowania zarówno w poszczególnych krajach, jak i w Europie, powstają w sposób niekoniecznie skoordynowany. Bez wątplenia „koordynatorem” powinna być „Konwencja Wiedeńska”, jednak można mieć wątpliwości, czy dziś może spełniać taką rolę. Unifikacja oznakowania byłaby szeroko zakrojonym i długofalowym działaniem, ale z pewnością jej skutki byłyby pożądane. □