Driving Factors for Driving Simulators – A Feasibility Study

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Simulators are used for training purposes in many sectors where humans are required to perform in a safe and reliable manner and the costs and consequences of accidents are high (e.g., aviation, nuclear, oil and gas). Driving simulators are sparsely used in driver training, even though performing in a safe and reliable manner is without a doubt of high importance, and traffic accidents are among the most common cause of deaths around the world. This paper evaluates the factors influencing the development towards increased use of simulators in driving training, both enablers and barriers, discussing both current condition and future scenarios. Four different fidelity levels in driving simulators are presented; very low, low, medium, and high, and scenarios where these are used are discussed. The conclusion of the feasibility study is that there exist several potential markets for all four levels of fidelity in simulators, particularly set by demographic parameters and simulator content. The exploitation of this market depends strongly on the suppliers' willing to adapt their product to market-specific needs and opportunities. Many simulator solutions reduce interaction between student and instructor. However, the driver instructor is still considered important in forming the students' holistic understanding of driving, road attitude and understanding of risk.

Keywords: Driving simulator, training, feasibility study, enablers, barriers, technology adoption.

1. Introduction

Simulators are commonly used for training in several industries such as aviation (Salas et al., 1998), marine transportation (Wahl et al., 2020), petroleum (Klatt & Marquardt, 2009), nuclear power (Kluge et al., 2009) and medicine (Escobar-Castillejos et al., 2016). All these industries are handling safety critical situations and human error may cause severe environmentally and financially consequences as well as injuries and casualties. Hence, to reduce risk of incidents during training situations, simulators are used as an arena for training and learning. These industries have pushed the development of simulators forward making such equipment more available also for other industries and purposes.

Driving cars causes more accidents and have a higher death toll than any of the industries mentioned above (World Health Organization, 2018), but still simulators are sparsely used for training purposes in the world today. Up until now, simulators have primarily been used in driver education for basic driving skills (Lindheim et al., in review). There are only few cases, known to the authors, that use advanced simulators for the broad range of training elements in driver education. One is WAY (https://way.no), a driving school in Norway offering simulator training in a full-size car, on a moving platform, and with 360° field of view (FOV). Their students may complete approximately half of their training in the simulator before getting they're driver's license. One factor limiting the use is the Norwegian regulations defining several of the required elements of the driver educations as mandatory to perform in a regular car. WAY has been operating only for a couple of years, but their market share in Trondheim (Norway) has increased since the start-up. Despite some examples worldwide of simulators in use for basic driver training, and scattered occasions of more advanced use, researchers on the field claim a need for more research demonstrating the long- and short-term effects of simulator training on driving skills (Lindheim et al., in review).

One reason for the limited use of simulators in driver education is likely that very few accidents are reported to occur during training situations, and therefore the strong incentive to reduce risk is not present. Nonetheless, increased use of simulators could increase the work safety of driving instructors, in addition to having other positive effects, such as environmental savings, improved training for dangerous situations, and increased training efficiency (Sætren et al., 2018).

In this article we want to shed light on, and debate, different barriers and enablers for increased use of simulators in driver training from the practitioners'

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perspective – both the schools and the students. We do so by using case scenarios (Section 4) based on four different levels of simulator technology existing today (Section 2).

The market potential is a decisive parameter for the possible future use of simulator in driver education and is thus an important parameter discussed in all scenarios. We see demography and population density as the main influence on market potential in addition to the simulator's fidelity level, and the binary parameter rural vs urban is therefore included in the scenarios. All scenarios discuss whether there exists a potential for increased use for that specific fidelity in an urban and rural environment, and the barriers and enablers influence. In Section 5 we describe general reflections across the scenarios, the effect of public regulations, before we touch upon alternative business models for use of simulators in driver training.

2. Simulator fidelity levels

Driving simulators exists all along the fidelity scale. There is no universally accepted diversion between fidelity levels. In this paper we use four different levels: Very low, Low, Medium, and High.

2.1. *Very low*

The very low fidelity category is defined as having no permanent equipment required or only using equipment common in private homes. This includes mobile and desktop apps and simple VR-solutions. A wide range of simulation software is available in this category though online stores such as Google Play (Android mobile) and Steam (desktop). The software resembles games but are focused on learning how to drive. We have chosen a wide definition of simulator in this paper. Many of the applications in this very low fidelity category would fall outside of other driving simulator definitions.

2.2. *Low*

The low-range includes some hardware such as steering wheel, pedals, gear shift and/or VR-solutions in addition to the software solutions. The setup is easily transportable and generally uses commercial shelf-ware. The software can either be custom made by a driving school, or the same as in the very low category.

2.3. *Medium*

The medium range is defined as having permanent equipment of a stripped-down vehicle cab, including elements such as steering wheel, pedals and gear shift. The visual element typically consists of 1 to 4 screens. The medium range driving simulators are generally not commercial shelf-ware but can be bought through few vendors.

An example of a medium range simulator is the ECA Faros EF-X, with three monitors providing 120° FOV. Similar simulators can be found around the world as ECA has sold over 8000 simulators in 40 different countries, many of these would fall into the medium category. The software is adapted in language and local driving conditions (ECA Group, n.d.).

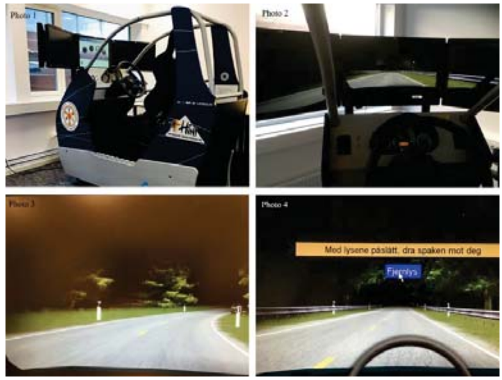

Fig. 1 The 2009 ECA Faros EF-X at Nord University used for the simulator training and screens in use. Photo 3 includes instructions (in Norwegian). Photo 1 by G.B. Sætren. Photo 2-4 by T.O. Holmquist.

2.4. *High*

The high-fidelity range of driving simulators include full or close to full cabins, 360° or close to 360° FOV, and simulated movements through thrusters or moving platforms. The high-fidelity range is large both in terms of size and cost, with the smallest being slightly larger than a standard vehicle cab and the largest being almost the size of a football field.

An example within the high-range of driving simulators which is used in the commercial driving education marked is the Norwegian WAY-simulator (WAY Traffic School, n.d.). The simulator uses a customized full-size vehicle cab on moving platforms in a room with 360° FOV (Fig. 2).


Fig.2 The WAY simulator (image from https://way.no/simulator/)

Among the largest and most expensive you find the NADS-1 Simulator as part of the National Advanced Driving Simulator at Iowa College of Engineering (Fig. 3). A full-size vehicle cab is placed within a 24-foot (7.32m) dome that moves within an area of 64-foot x 64-foot (approx. 19.5m by 19.5m). The dome includes 360° horizontal and 40° vertical FOV through 16 monitors. The dome setup allows for substituting the vehicle cab and interior to the research needs of the current study (National Advanced Driving Simulator, n.d.). It is unrealistic to imagine this setup as a potential part of students obtaining their driver's license.

Fig. 3 The NADS-1 simulator at IOWA College of Engineering (Image from https://nads.uiowa.edu/nads-1-simulator)

3. Enablers and barriers

This section describes the most relevant barriers and enablers for increased implementation and use of simulators in driver education. Section 3.1-3.6 describes enablers, while 3.6-3.9 present barriers. Most influencing factors are either a barrier or an enabler, but there are examples of being both (section 3.6). The likeliness for these barriers and enablers to have influence and impact are to some degree discussed in Section 4 where different scenarios are presented and discussed, but the complexity of parameters makes it impossible to provide unified answers to each scenario.

3.1. *The Covid-19 Pandemic*

The Covid-19 pandemic has highlighted potentially important aspects advocating the use of driving simulators. The pandemic has impacted many students' path to their driver's license. Some are simply experiencing delays as driving schools and governmental institutions have shut down (Norwegian Public Roads Administration, n.d.), others have had their road-tests waived (Georgia Department of Driver Services, n.d.) or an extension of who can serve as an examiner on a road-test (Texas Department of Public Safety, n.d.). Both the impracticalities of delays, and potential safety risks of reducing requirements for new drivers, could be limited through extending the availability of driving simulators in the case of future pandemic events.

3.2. *The new driving world*

Driving today is not the same as it was 20 years ago, nor will it be the same in 20 years. New technology is influencing the role we have as drivers. This includes how we are helped (e.g. advanced driver assistance systems, ADAS) and distracted by new technology (e.g. phones and smartwatches, but also the technology made to assist driving; Bahaei et al, 2019), and simply how to interact with new technology (e.g. autonomous vehicles) that fundamentally change the driving environment. Driving simulators can provide training in how to drive with and without these technological elements in a way that is difficult to match in normal on the road training.

3.3. *Availability and efficiency*

Driving simulators can increase efficiency and improve availability to some training elements (Beloufa et al., 2019; Lindheim et al., in review; Mikkonen, 2007; OECD & ECMT, 2006; Pardillo & Troglaue, 2005; Robertsen et al., 2016; Wang et al., 2010). Efficiency can be improved particularly by the repeatability a simulator renders possible. If a student needs to practice getting onto the highway, a simulator makes it possible to practice on that situation repeatedly without having to drive between the ramps and hence save time. Roundabouts and overtaking are similar situations.

Simulators also make is possible to replay and watch your own driving from different views (e.g. aerial, another car, pedestrian) and to reflect on the driving performance alone or with a driving instructor. This could also contribute to increased learning efficiency (Sætren et al., 2021).

Simulators makes situations otherwise inaccessible accessible. Examples are dangerous situations like children and animals along the side of the roads, sudden obstacles, and other cars with surprising driving patterns – situations we cannot seek out and test in real life. It is also possible to stop *in* the situation (e.g., an intersection) and reflect on the situation before moving on. Other examples are situations and places we would like to practice but that are not easily available for all students, e.g., urban environments, rural environments, highways, tunnels, boarding a ferry, and dark driving. This also makes simulators useful for people who already have their driver's license but would like to practice for a particular situation – or just refresh their skills.

3.4. *Applicable technology and market potential*

The technology exits and is demonstrated to be applicable for the purpose (Section 2). By this, one could expect a technology push from the developers towards such use, but this seems not to be the case. The intensity of a technology push depends on anticipated market potential. There might not be sufficient market potential, or it simply is developers who do not see it or will not take the risk of entering it. It is also important to understand that in this case the market is threefold: the driving schools, the driver instructors, and the students/users. The view on simulators entering the driver training may differ both between market groups and inside the groups.

3.5. *Environment*

Life-cycle-assessment analysis is a comprehensive tool to assess environmental impact of a product, process, or service. It includes the entire value chain from raw materials to production, use and waste management (Bauman & Tillman, 2004). Without making any calculation and comparison of life-cycle-assessment analyses for the use of cars and simulators in driver education, our assumption is that simulators have less impact on the environment. Particularly when it comes to impact caused by operation of the unit due to reduced fuel consumption and asphalt dust. We also assume the lower technology level of the simulator, the lower the environmental impact – provided the lifetime for the objects are in the same range.

3.6. *Public regulations*

Public regulation is mentioned as one possible barrier because public regulations in some countries hinder unlimited use of simulators for driving training. This parameter varies between countries/states. In the Netherlands there are no formal restrictions to driver training methods (de Winter et al., 2009), but in Norway it is mandatory to do several of the elements in driver training in a regular car in real life traffic (Norwegian Public Roads Administration, 2016). When regulations hinder simulator use for some parts of the curriculum, it reduces the possible profitability for simulator investments. This is not an argument in itself to loosen the national restrictions.

Regulations might also work as enablers by defining curriculums for driver training from which simulator training vendors could develop and adapt simulators to fit the public demands as well as the students' needs. It is also possible that future regulations will encompass elements mandatory performed in simulators due to the opportunities for safe training situations the simulators make possible or to documented improved effects. Such change is not likely as long as simulators are not commonly used in driver training and positive effects are thoroughly documented by credible research.

3.7. *Insecurity*

One possible barrier against implementation of simulators in driver education is insecurity - of school owners, driver instructors and driver students – all from different perspectives.

3.7.1. *New businesses – new risks*

To build business on driving simulators – either a new business or expanding an existing – involves risk. Today, there are few reference companies the has proven profit from such business, and to enter this segment is therefore to some degree to enter the unknown. The financial risk tied to investment is the most obvious for the business owners, but a failed simulator project could also damage the reputation of the school in general. Another risk is the driver instructors' reactions to the new technology and its implementation. An introduction or increased use of driving simulations will impact their daily work: some teaching elements may be removed, the students might learn more between instructor lessons, the instructors may have to follow up and review driver sessions retrospectively, their jobs get more "computerized" etc. The owners must reflect on this and decide whether this will have consequences for the business or not.

3.7.2. *Lack of documentation of training quality*

Research has reported positive effects from the use of simulators in driver training (Allen et al., 2007; Casutt et al., 2014; Lindheim et al., in review; Roenker et al., 2003; de Winter et al., 2009), but simulators in driver education is still a debated topic. Review studies are questioning the effectiveness in such training and the validity of the simulator studies (Blana, 1996; de Winter et al., 2007, 2012; Mullen et al., 2011; Wynne et al., 2019). The broad variety of simulators, technology and fidelity levels, experimental setups, and performance measures makes evaluating efficiency and validity of simulators in general complicated.

3.7.3. *Job prospects*

Increased use of driving simulators would shift jobs related to driving education. There would be an increased need for simulator development, maintenance, and administration, while it is likely that there would be a reduction in needed driving instructors. This might cause skepticism and resistance in the instructors' minds and cause fear of losing their jobs.

3.7.4. *Resistance to change*

Introducing new technology in the workplace is likely met with both excitement from some and resistance from others (Saghafian et al., 2021). This has also been seen in driver instructors' attitudes towards simulators (G. B. Sætren et al., 2019). A strong resistance from driving instructors would be a barrier which is hard to overcome. A possible solution is training in the new technology, as a lack of technological efficacy could lead to both a resistance towards using the new technology and job dissatisfaction (Freeze & Schmidt, 2015; Saghafian et al., 2021).

3.8. *Reduced human-human interaction*

Simulators can be used with or without an instructor present, or with a virtual instructor (digital feedback) replacing a live instructor. In several countries, including Norway, the driver training is based on the GDA framework (Hatakka et al., 2002) where the latter part has a focus on the driver's motivational and attitudinal aspects of driving, e.g. skills to deal with social pressure, risk tendencies, and personal skills for impulse control. These skills are developed through dialogue and reflection between the student and the instructor (and parents or other role models). It is still to be proven that such skills can be developed using simulators and virtual instructors.

3.8. *Physical discomfort*

Some experience physical discomfort when interacting with a simulator. The phenomenon is often called simulator sickness and is characterized by nausea and dizziness (Kennedy et al., 1993). It is likely that those who experience simulator sickness will loose the sense of immersion and the training effects from simulator training (Grassini et al., 2020). Those who experience it to a great degree are likely to opt out from using a simulator, leading to a potentially significant barrier. Both individual and technology related factors have been identified as predictors of simulator sickness (see Saghafian et al, 2020).

4. Scenarios

4.1. *Very low – External actors*

The very low-fidelity technology is available to anyone who owns a smart phone or desktop computer. The accessibility opens for quantity training at low cost for the users.

Due to technical limitations (e.g. not physically interacting with elements resembling those found in the vehicle cabin), it is likely that this solution will have a narrow training and learning focus limited to only some parts of driver education. Even if the quality of the product is good, it is unlikely that the solution provides sufficient realism to teach broad scope needed to fully drive a car. The very-low fidelity simulators can be useful for learning theory (e.g., signs, rules), and practical skills such as road placement and timing (e.g., use of full lights and flasher, overtaking), as well as to provide a conceptual understanding of driving. All of which might be viewed as "medium range learning skills" – somewhere between basics motoric driving skills and holistic understanding. It is difficult to control and regulate important learning elements as attitude, situational awareness, holistic understanding, risk perception, interaction with others in traffic, etc. The technology renders possible group sessions or "multiplayer" session facilitated by driver instructor that could be useful for reflection on performance, but this does not cover the needs described above.

Use of this level of simulators might save some milage on the road for the driver students, and hence contribute to environmental savings. Still, the overall enablers described in Section 3 will not likely push a future implementation of very low fidelity simulators.

Being available outside the driving schools, these simulators does not necessary lead to contact with the schools, and hence no secondary sales (lessons, courses). Due to this detachment, it is less likely for the schools to build business from such technology. The fidelity and availability level of these simulators are comparable with apps and games and are more likely to be a potential business for app and game developers rather than driving schools.

The very low-level fidelity simulators are not influenced by demographic parameters and has balanced potential in urban and rural areas. It is an interesting additional element in learning how to drive but is unlikely to replace driver instructors in any areas. Because of the limited potential for second sales, we believe this primarily will be the marked for other actors than the driver schools.

4.2. *Low – Secondary sales*

The equipment for low fidelity simulators is in this paper defined as not common in private homes, but possible to use in such (Section 2.2) and includes at least steering wheel and pedals. It is closer to realism than the "very-low fidelity simulators" (Section 2.1) and introduce the possibility to learn hands-on steering and pedal use, in addition to "medium range" skills as described in Section 4.1. It provides a training situation to learn interaction with traffic, and the possibility to practice skills like lane shifts, overtaking, roundabouts, and acceleration on to a highway. As for the very low-fidelity simulators, it is still quite difficult to control and regulate important learning elements as attitude, situational awareness and understanding, and so forth which all are learning elements that require student's reflecting on their own performance together with qualified instructor.

The equipment opens for some sort of interaction by introducing the possibility to multi-player situations and on-line interaction with an instructor. This is more relevant for low fidelity simulators than the very low level since the driving schools are to a larger extent in a position of making business of the equipment and secondary sales. Being in the price-range of 100-1000 EUR (in Norway), it is manageable for some households – but not all. One possible business model for driving schools is rental to private homes with or without guided instructor sessions. This calls for some need for market potential in proximity, but low investment cost gives a very low breakeven point. Potential customers are particularly those who do not have the opportunity to train outside of driving school (e.g. practicing with parents after receiving a learner's permit) or for those where the driving school is located far from their home.

4.3. *Medium range – Opportunities and business models*

Driving simulators with medium fidelity level are probably the best suited for driving schools in general. As mentioned in Section 3 there are several factors supporting the use of simulators in general: reduced environmental impact, applicable technology, increased availability, and effectivity (in some areas), and the Covid-19 pandemic (or future events leading to similar restrictions) reducing the opportunities for human-human interaction. The mid-fidelity level simulators provide training situations and physical training environment closer to real life driving compared to low-fidelity simulators, and learning are hence more transferable to real-life-traffic. The technology is available and when proven positive effects for driver training, the medium range is often the fidelity level of use (Baten & Bekiaris, 2003). The simulators provide positive learning effects in some areas, particularly for basic driving skills such as vehicle operation, manual transmission, use of pedals, maneuvering, road placement, interaction with traffic, and the theory on night driving (Lindheim et al., n.d.).

The medium range fidelity driving simulators are developed with driving schools in mind. The price for such simulators in Norway is in the range of 10 000-60 000 EUR, which is less than a car set for driving lessons (approximately 100 000 EUR). The investment cost is manageable for most driving schools, but for the smallest ones (1-3 instructors) this depends strongly on other factors. The smaller the school, the more likely it is that they need to invest in additional infrastructure, like suitable area, technology to give customers access to the simulator without employees being present, and a booking system. The smallest schools also depend on an increased market to cover the investment costs. With only a few employees, and most likely the owner also being an instructor, they lack the possibility to reduce wage costs. In rural areas, there might not exist a potential for extra customers. For mid-size to large driving schools, the investments are manageable, and the size of the school opens for more flexibility in instructors' working hours. Here, it could be preferable to replacing driving sessions in real life traffic with the use of simulators.

Hourly price for use of simulator depends on a set of factors (simulator investment costs, salaries, house rentals, potential savings, etc.) and any calculations will case specific. We find prices for non-assisted simulator use for medium range simulators (illustrated in Figure 1) down to 1/6-1/3 of the price of instructor assisted training in a car (being 60-75 EUR/hour in Norway). This makes it possible for students to practice driving also for those who do not have access to a car for practicing between driving lessons. Price for instructor assisted simulator training is not available in Norway for this level of fidelity. The instructor's wage is the cost driving element in such training, so the hourly cost is estimated to be only a bit lower than regular driving lessons.

There are several ways to investigate the possibility of making such an investment, especially through alternative business models: simulator use with or without driver instructor, leasing of simulator, shared ownership with other driving schools in the proximity, expanded use to include the market for licensed drivers (refresh general skills or practice specific situations), expand opening hours (e.g. 24/7 drop-in), and training area for those who do not have a car available for private practice between sessions. Potential customers are both driver license students and licensed drivers.

The conclusion is that it is economically feasible to introduce medium range simulators in both urban and rural areas, with some limitations in rural areas. It is of particularly importance for small driving schools in rural districts to seek business models that makes the most of the simulators, exploiting the possibilities in the market, and at the same time keeping the fixed cost to a low level.

4.4. High – Distant opportunities

The high-fidelity simulators are close to real life experience with 360-degree screen view and moving platforms. The sense of driving a real car provide learning opportunities like other simulators do not. In addition to all training features from medium level simulators, high-level simulators also provide an additional feature we have not seen in lower fidelity levels of simulators: The recording of the driving from different perspectives. This renders the possibility for the student to replay, go through, discuss, and reflect on their driving performance together with an instructor.

The high-fidelity simulators are operating in a price segment that makes the it inaccessible for most actors, including most traffic schools. The price exceeds the cost of a car prepared for driving lessons, and the most advanced ones are not even available at the open market. The two examples described in section 2.4 are both non-commercial. The WAY-simulator (Figure 2) is developed by the driving school (WAY) for own use and the NADS-1 (Figure 3) is developed for research use only. At WAY driving school a 30-minutes lesson in the simulator with instructor cost 39 EUR and 45 minutes in a car costs 69 EUR. The price of instructor assisted simulator training is slightly lower than regular training, and as described in Section 3.3. The sessions have a high potential for efficiency and availability in training situations.

The WAY company is now building multiple units of the same simulator expanding their business by establishing new driver school units in Norway. This illustrates one – or more – possible business models:

Business models 1: Develop the simulator.

The development of a simulator could be done alone, or in collaboration with other companies like driving schools, investment companies or the automobile industry. High development costs call for commercialization of simulator solution to get the most out of the investments. To create further income from the developed simulator the company might multiply the simulator for own use, establish franchise companies, or sell the simulator on the open market with or without maintenance deals and software updates.

Business models 2: Increased market potential.

It is also important to search for diversity in market potential to increase the number of potential customers - independently of whether you develop the simulator yourself or buy/rent from other developer. The simulator could be rented on an hourly basis as entertainment or as a training device. The customers could be driver students, experienced drivers or just people looking to be entertained. It is also possible to seek long term agreements with company customers like other driving schools and their student population, police, fire fighters, and ambulance drivers in the need of training in emergency response driving. Another opportunity is to establish other sorts of collaborations e.g., with research institutions for research on the topic or health personnel tasked with evaluating peoples' driving capabilities related to according to health issues or old age. Akinwuntan et al. (2005) found simulator useful for training after stroke.

The investment costs for a high fidelity simulator are so high that a proximity to a large pool of potential customers is required. It is unlikely to be economically feasible in a rural area.

In high-level fidelity simulators available today, it is possible (if local regulations allow it) to carry out the entire driver education using only the simulator – if interaction with instructor to learn advanced driver awareness is included. The lack of commercial availability of such simulators, the high investments cost, and the insecurity of the unknown (both schools and students) still makes this unlikely a common scenario the years to come. In some countries, like Norway, regulations must be changed in order to allow simulators as equals training device to traditional cars.

5. Reflection and discussion

In some way or another, simulators will be used for training purposes in the future. At least the simulators that we have defined as the very low level. These are already available and in use. The expectance of being able to learn anything through a mobile or desktop app is already strong in the main age group learning to drive today. This is a trend that is likely to grow in the future. If the assumption that these will be used is correct, then driving schools have an incentive to be part of this training to ensure that all important aspects are included. A requirement for this is that driving schools see an economic possibility to get involved. This seem to be most likely in the low and medium fidelity simulators – if possible, in combination with the very-low fidelity level to draw upon the students' experience from this arena. Increased technology expectations and efficiencies in both current and future generations could create a pull factor if new students expect or demand driving schools to use new technology. However, this effect is not certain, as students might be excited about driving an actual vehicle and want a learning experience which is as hands-on as possible.

One major concern in using simulators in driver education is whether the students will learn aspects that go beyond technical skills and relevant rules, such as the correct road attitude, interaction with other drivers and the understanding of risk. To be able to assess simulators as a replacement for certain elements in traditional training or as a supplement to today's traditional car training, it is important to shed light on the role of traffic instructors. Documented learning effects from simulator training on driving skills or knowledge is not sufficient. Traffic instructors play an important role in developing students to become responsible drivers. The instructors motivate the students to learn subjects they are not tested on. Among other things, instructors contribute to the students establishing good attitudes in traffic, develop the ability to reflect on their own action, and on their own driving behavior. This is included in curriculums based on the GDE matrix, but it is very difficult to measure or control in a standardized test. The curriculum therefor contains several learning objectives that are not covered by the final driving test, but should be subjectively evaluated by driving instructors during the education. When assessing alternative forms of education, it is important that these elements are included, especially if the alternative form does not involve an instructor. Using a simulator does not necessarily imply training without an instructor present. WAY Driving School, described in section 4.4, use their high-fidelity simulator with an instructor present.

We have experienced arguments such as "the regulations need to be loosened" for implementation of simulators in Norway, and we believe similar sayings exist in other countries with restrictions to simulator use. We believe this is a question of "what comes first" – implementation or less regulations – both depending on each other to change. In many countries, regulations do not hinder implementation, and the question is rather if companies sees the potential and whether the market is willing to accept simulator solutions. We believe it is necessary to assess radical changes in the driving schools' business models if increased use of simulators in driver education is desired. This goes for all levels of simulator fidelity. The companies should widen the search for market potential, take chances, and include live instructors in the simulator training.

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