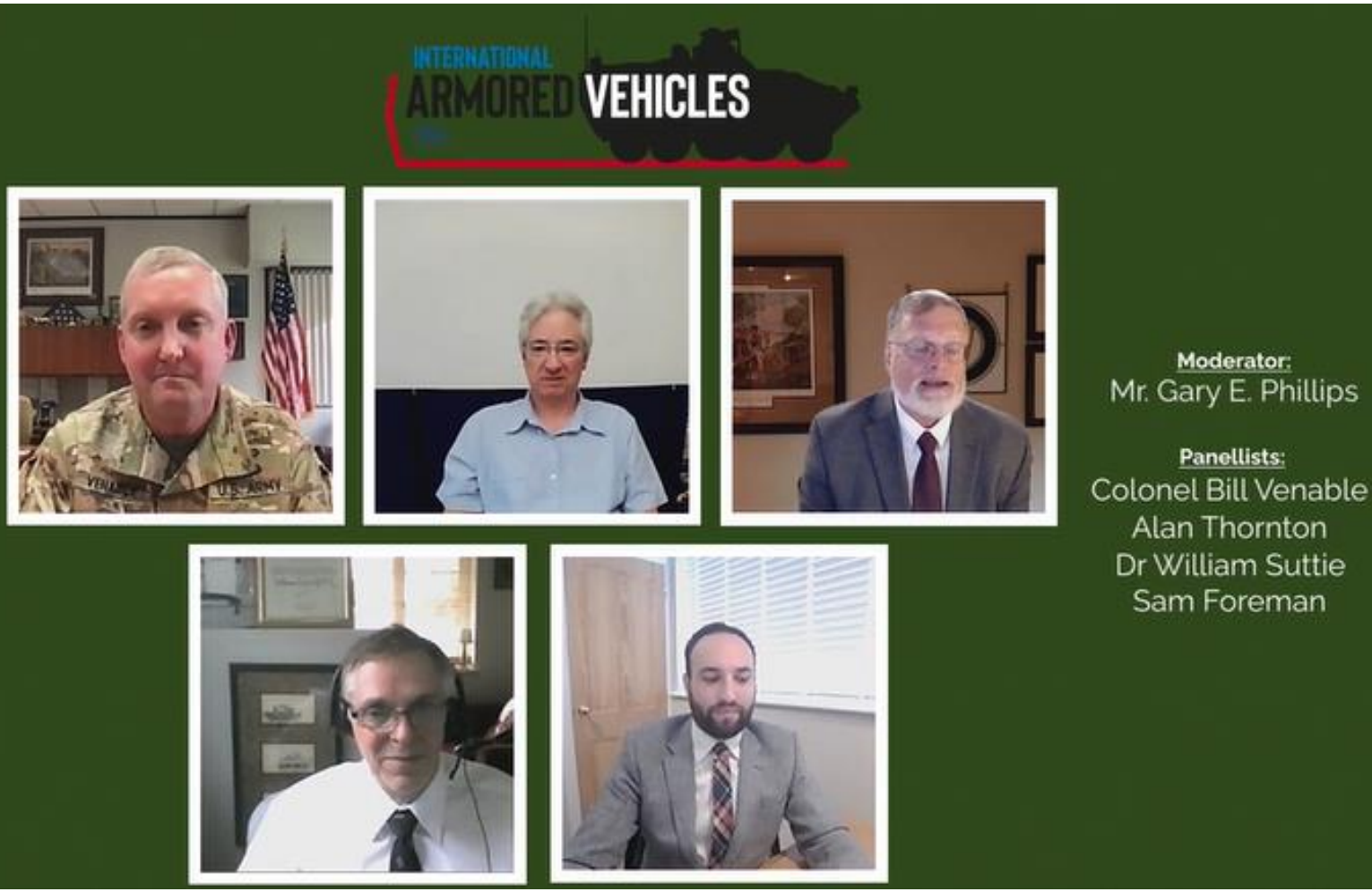
SAFETY AND SURVIVABILITY ON FUTURE OPERATIONS

Panel Discussion write-up from IAV USA

Published: July 2021



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FOREWORD

Following our White Paper on 'Armoured vehicle internal survivability' a panel discussion was held at the recent International Armored Vehicles USA Conference. This paper holds a transcription of that discussion which we are confident you will find interesting.

Broadly speaking, the discussion fell into two categories: combat system survivability, and crew survivability. The first pertains to ensuring the survivability of on-board fire, mobility, and protection systems, while the second is concerned with protecting the crew from injury and death. Naturally the two are closely related, with mobility being a key factor of survivability, and the discussion dealt with the complexities involved in some of the trade-offs.

One of the key points of the discussion was the weight that comes with an item being measurable and assessable. Heavy armour, for example, is easy to assess, and is reassuring for the crew, but may not always be the right decision. While there are some threats that can only be countered with armour, there are interesting opportunities to look at lighter vehicles that rely on other survivability measures, including active protection systems (APS). However, until APS are 100% effective there remains a requirement for armour, because the consequences to a light armoured vehicle in the event of APS failure are catastrophic.

Safety measures, on the other hand, are very difficult to assess and demonstrate, so while everyone agrees they are important, they often lose out in trade-offs. A number of safety requirements have not been updated for decades, and so do not take into account possibilities offered by new technologies. For example, interior light requirements are limited to being able to read a map and do not consider the possibility of LED egress lighting automatically activated by an incident. There are also initiatives to examine data to understand where the greatest impact can be made, as well as looking to the automotive and aerospace sector for technologies that can enhance comfort and help design user-centric vehicles.

Vehicle design and layout also change depending on the operation. US forces are currently facing a paradigm shift in modernizing from undertaking counterinsurgency operations to facing large-scale combat, and this is changing vehicle requirements. In light of the many opportunities other than armour,to improve safety and survivability, and this ongoing paradigm shift, I hope you find this discussion as enlightening as I did.

Alexander Stephenson
Divisional Director, Defence iQ

Defence iQ

PANELISTS

Mr. Gary E. Phillips
Former Assistant TRADOC G2
Discussion Moderator

Mr. Gary E. Phillips commissioned from the ROTC at the University of Southern Mississippi in February 1974. After completing the Airborne School, the Ranger Course and the Infantry Officers Basic Course, he was assigned to Fort Sill, Oklahoma, as a Platoon Leader in the 4th Battalion 31st Infantry and subsequently as an Artillery Battalion and Artillery Group S2. After completing his detail as an Infantry officer he was assigned to Military Intelligence Branch and finally ended his active Army career as the Commander of the National Ground Intelligence Center in Charlottesville, Virginia. After his selection as a Department of the Army Civilian, Mr. Phillips acted as the Director of TRADOC G2 Threats Directorate where he oversaw the development and publication of the Army's Operational Environment (OE) Estimate in 2000, 2004, 2009 and 2012. In 2014 Mr. Phillips became the Assistant TRADOC G2. He retired from Federal Service in Dec 2020.

Alan Thornton,
CEO,
EELTEX

Alan Thornton has worked with the lighting industry since before the birth of the LED revolution and co-founded Earlsmann Lighting in 2006. Initially, Earlsmann was formed as a solution provider, energy-efficiency consultancy, and manufacturer of lighting fixtures. After winning contracts as defense and military OEM's, this part of the company was relaunched as EELTEX, of which Mr. Thornton is the CEO. EELTEX's main product offering is a cost-effective Emergency Egress Lighting System designed for military combat vehicles to aid crew survivability.

Colonel William R. Venable
Project Manager, Stryker Brigade Combat Team
US Army

Colonel Bill Venable currently serves as Project Manager, Stryker Brigade Combat for the US Army, headquartered in Warren, MI. He holds a Master of Business Administration and Master of Arts in Procurement and Acquisitions Management from Webster University. He also holds a Master of Strategic Studies from the U.S. Air Force Air War College. His previous project management leadership roles for the US Army include projects in unmanned aviation, network modernization, missiles & space, robotics & unmanned ground vehicles, and night vision & sensors.

Dr. William Suttie
Technical Lead Mounted Systems Research
Defence Science and Technology Laboratory - UK MOD

William Suttie has over 35 years of experience in the field of military vehicle research and development within the UK Ministry of Defence. He also spent four years as a scientific advisor at the UK Defence Equipment and Support Agency and one year as an advisor at Army HQ. He currently provides technical support to armoured vehicle procurement projects and is the technical lead for Mounted Close Combat research, which includes the Future Ground Combat System concept and technology studies. He has an Honours degree in Automotive Engineering and a Master's Degree in Military Vehicle Technology. He is a Trustee of the Bovington Tank Museum.

Sam Foreman
Head of Sales
Jankel

Sam Foreman is Head of Sales for Jankel, a world leader in protection solutions. For the past 12 years, Mr. Foreman has been supporting customers in developing and fielding occupant protection solutions for military vehicles. Having started out engineering systems such as blast mitigating seating and add-on armour during Urgent Operational Requirements (UORs), Mr. Foreman now works closely with a dedicated team of experts who push the boundaries with new technologies to protect against the very latest threats and challenges facing armoured and tactical platforms. He has worked with customers across the globe, with notable involvement in the USA, where Jankel has delivered over 100,000 blast mitigating seats into service.

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EELTEX Lighting Solutions

With over 50 years' combined experience in the design and manufacture of emergency egress lighting for MRAP vehicles, we have supplied over 2500 systems which are currently in service with USDoD and UKMOD.

Introducing our new 'Egret' EELS/VELS - designed to maximise crew safety while requiring minimal maintenance and dramatically reduced through-life costs. Egret is a truly cost effective and important survivability aid; the Eeltex range of Mil Spec LED lighting offers cost-effective lighting solutions for many applications, both ground and vehicle based.

We also distribute the Finborough Design tethered drone observation system, alongside our Osprey (AFV interior 2 or 3 color dome lighting), Hawk (IR floodlights and convoy markers), TACT4 (Festoon lights) and Swan (map reading lights).

DISCUSSION

"I see one of the biggest challenges at the moment, as we move to more and more software intensive vehicles, as being 'how do you certify those platforms'?"

Q1. We often worry about the fact that we're protecting a multimillion-dollar system. Even more important is protecting the trained crew. Can you share some opening remarks on how you are approaching the topic of safety and survivability?

Col. William Venable
PM Stryker BCT
US Army

Thank you for having me as part of this panel. I'm the program manager for the Army's Stryker combat vehicle program, which is a fairly robust and healthy program. Survivability is one of the core priorities for our platform modernization strategy, balanced against improvements in lethality and mobility, all exemplified in our third generation Stryker that we began fielding last summer and will continue to field throughout the rest of this decade. As we go through the questions, I can highlight our approach for vehicle protection, of which active protection is a component and how that integrates with the Stryker platform in particular.

Alan Thornton,
CEO
EELTEX

I'm Alan Thornton, CEO of a company which manufactures escape lighting systems. Initially we became involved in this because of a Urgent Operational Requirement from US SOCOM where they had lost some soldiers in a training accident who drowned inside the vehicle. They realized that they needed to protect those personnel, and so in looking for a way to do that they were able to find the experts. We manufactured a system that has been widely installed by both the UK MOD and US SOCOM. We believe we can assist by getting those personnel to the exits in the event of an accident or incident, whether that is due to enemy action or a training accident. There are a number of documented training accidents that, sadly, cost lives and there really is no reason for these vehicles to be this badly lit. It's a simple solution.

Mr. Gary E. Phillips
Former Assistant TRADOC G2
Discussion Moderator

You know, the first thing you spend money on is the firepower, so lighting comes lower than firepower.

Alan Thornton,
CEO
EELTEX

Yes, there's no point being there unless you have firepower. Having said that, as you correctly said at the beginning, you have to protect the personnel, because otherwise you run into this budget problem where you're having to continually train new personnel. It's not a workable solution.

Mr. Gary E. Phillips
Former Assistant TRADOC G2
Discussion Moderator

Yes. Unless you're conserving the force, you won't be able to man the systems.

Dr. William Suttie
Technical Lead
Dstl - UK MOD

I think we live in a very interesting time with respect to survivability; survivability is still an absolute key priority. Keeping the soldiers alive is paramount.

We are at an interesting time. Those who have been in the business as long as I have will remember all the attempts to go lighter. But with emerging technologies – such as active protection, some of the new stealth technologies, and exploiting un-crewed systems - I think we are getting to the point where we can really move away from passive armour as the primary source of survivability and start to look at alternative approaches.

Armour will always be absolutely core; there are some threats that you can only defeat with armour. There are some interesting opportunities to look at lighter vehicles that rely on other survivability measures, so I think that's an interesting thing to look at.

The safety issue, again, is very important. I see one of the biggest challenges at the moment is as we move to more and more software intensive vehicles, how do you certify those platforms? As we get more and more electronics-heavy platforms, how do we make sure we've got our electromagnetic compatibility correct?

So safety is becoming more and more important but also increasingly difficult to actually assess and demonstrate. We live in interesting times with some interesting challenges.

Mr. Gary E. Phillips
Former Assistant TRADOC G2
Discussion Moderator

Before we move to Sam, I'd like to explore that just a little bit. Sam, forgive me, but Dr. Suttie has intrigued me here. I'm going back to General Alizai's presentation [Major General Hibatullah Alizai. Commander, Special Operations Corps Afghan National Army] where he talked about the education level of his soldiers, and their limited ability to work with complex electronics. How do you see that that working out in the future where you've got a soldier force that's not highly educated in a very complex system you've bought from a foreign supplier? How do you handle safety and survivability in that kind of situation?

Dr. William Suttie
Technical Lead
Dstl - UK MOD

It has to come back to making systems intuitive. One of the things we find out is true in many nations is that actually, your uneducated soldier is very good at modern technology. They may not understand the complexities, but we've done experimentation, for example, with un-crewed systems, where you've given them a Gameboy controller, and they have been really good at doing that. So it's about recognizing limitations and playing to their strengths. But again, a lot of what our focus is on is making systems intuitive, easier to use, and bringing in the crew aides where applicable.

Sam Foreman
Head of Sales
Jankel

I'm working for Jankel, where I am very much focused on survivability systems - both active and passive in many respects - but here we're talking a little bit on the seating and survivability side as well as the safety. The safety element is interesting for us, especially when it comes to using the latest technologies. Looking at the data around how features of the vehicle are maybe affecting occupants - whether that's noise and vibration, or aspects like heat - and how all these different elements may affect the safety of that occupant, as well as the seats themselves.

Therefore, there are certainly lots of different and interesting areas from our perspective that fall under that occupant survivability and safety section.

Col. William Venable
PM Stryker BCT
US Army

I was going to make a comment on the complexity and operation of the vehicle protection systems. One of the approaches that the US ground combat vehicles has taken is to integrate the suite of capabilities that we call vehicle protection systems into a unified system. The complexity of combat vehicles has climbed a pretty steep curve in recent years: there's fire control systems, basic operation of the vehicle, digital mission command systems - there's a lot. There's a heavy cognitive burden on the crew just to operate the vehicle safely, much less actually execute their mission. So our Vehicle Protective Systems (VPS) approach will integrate all that into a central computing system for queuing various countermeasures that we'll talk about over the course of this discussion. The complexity is definitely one of the concerns, not so much because there is an expected education gap from the crew, but just from a number of things that they have to manage within the vehicle.

Mr. Gary E. Phillips
Former Assistant TRADOC G2
Discussion Moderator

All good points. So I'll just share with you that I'm not as experienced with what I would call US and allied vehicles than I am with threat vehicles - I will tell you that the inside of a T-72 may be more dangerous than the outside of it.

Sam Foreman
Head of Sales
Jankel

That's an interesting point, because lots of what we've been doing is taking automotive standards into defense, and that's not been the case for a long time. You mentioned that in the T-72, what you might hit if there's an RTA or what's around you that could be a threat in a blast. A big part of the safety element of occupant survivability is actually what the automotive industry talks about as passive safety. It's about putting crumple zones in equipment near where people sit and so on - but none of that kind of thing has actually been in defence requirements up to now, so there is an opportunity for improved safety, given that comment about what's around you that is physical and hard if something were to happen.

"There are quite a lot of opportunities now, with new technologies, to start understanding, monitoring, and then tweaking designs through the life of platforms"

Q2. Regarding enhanced interior safety as a method of directly reducing casualties in critical combat situations, not just training or in garrison operations - when you're in combat, the interior safety may directly reduce casualties. What do you see enhancing that? How much effect do you think that can have?

Col. William Venable
PM Stryker BCT
US Army

I'll start by saying that for the US forces, we're shifting from a counterinsurgency modernization paradigm to a large-scale combat operations paradigm, and that changes the structure of the vehicle. For example, we are examining an ongoing requirement in which energy attenuation of seats is conflicting with storage requirements. The interior of the vehicle and the requirements for the interior of the vehicle change depending upon the operation and we obviously can't give up ground on the safety of the soldiers. However, some things do get sacrificed, like comfort perhaps. I'll leave it to the rest of the panel to finish answering the question.

Sam Foreman
Head of Sales
Jankel

I think that's a really interesting point, because when the automotive industry design a car, comfort is the first thing they look at, designing everything around the occupant. But, of course, needs must within a military platform, and therefore what's going to be the prioritization is a different issue. There are quite a lot of opportunities now with new technologies, as I think I mentioned earlier, to start understanding, monitoring, and then tweaking designs through the life of platforms. I think that actually understanding what is impacting the occupant from a safety perspective - or from a vibration, noise, comfort perspective - are all things that we are examining at the moment for exactly those reasons. Of course, there's got to be a trade-offs at some point, but what are the quick wins or the opportunities within the platform? How do you recognize those opportunities, not just during a design and requirements writing phase, but throughout the life of a platform and some of the feedback that comes during that?

Mr. Gary E. Phillips
Former Assistant TRADOC G2
Discussion Moderator

I said to an Engineer at TACOM once, 'I've never been comfortable in a military vehicle'. His answer to me was 'You can be safe or comfortable. Pick one'.

Dr. William Suttie
Technical Lead
Dstl - UK MOD

Making platforms inherently safe is really important. I think one of the things we often forget is soldiers in vehicles are operating under high stress for long periods of time.

They need to be able to do their job without thinking, and if there are unnecessary safety issues, which under stress could cause injuries, we need to avoid that. I think another aspect we need to be conscious of is the safety impacts of new technologies. A few years ago, we did trials with driving on screens, and we found that drivers tended to take more risks if they were viewing the road ahead on the screen rather than looking through a piece of glass. So there are many important human factors issues to bring in when talking about safety.

"All of these requirements are interrelated and they're difficult to solve sometimes; it is hard to get the right mix of survivability, safety, comfort, under all conditions."

Q3. Lessons can be learned from previous conflicts, and we've seen a lot of recent conflicts around the world. When a vehicle suffers heavy damage, what have we learned about evacuations and how to enhance crew survivability?

Col. William Venable
PM Stryker BCT
US Army

That is something that we're examining, as I mentioned, as we shift from this operational paradigm for which we need the vehicle to perform for large-scale combat operations. Battle day damage is certainly one of the considerations, but we also have just similar requirements and training from vehicle rollovers and accidents as well. So we're examining egress lighting, for example, and the ability for a soldier to actually get out of the seat and the seat belt harness safely and be able to evacuate the vehicle under various conditions.

And then warning systems that accurately communicate to the crew and the soldiers in the back of the vehicle what's going on with the vehicle. We have some significant updates for our fleet under review expressly for the purposes of helping the crew and the infantry soldiers in the back to get out of the vehicle in a critical situation.

Mr. Gary E. Phillips
Former Assistant TRADOC G2
Discussion Moderator

You heard from our Afghan General talk about the small doors, and I know the purpose behind small doors, but is it time to reconsider? You remember the old the exit ramp on the M-113 when you hit the ramp release, and the whole back was open? I wonder if that's not called for in the future.

Col. William Venable
PM Stryker BCT
US Army

We do have ramps on the back of Stryker, but as we've talked about previously, you're bumping up against survivability requirements sometimes when you address comfort. So larger doors create what we call ballistic windows that the armour has to perform against, and so you compromise the armour's performance against its requirements by providing for those kinds of things. Not that they are not important. To touch back again on the previous question, we have our energy attenuating seats, a two inch seat cushion, which is not very comfortable if you have to sit on it for four or five hours. We could increase it to a four-inch cushion, but then you increase the height of the soldier and his relationship to the roof of the vehicle, and you change the odds of surviving in the event of an underbelly blast. Therefore, all of these requirements are interrelated and they're difficult to solve sometimes; it's hard to get the right mix of survivability, safety, comfort, under all conditions.

Sam Foreman
Head of Sales
Jankel

Just something to add as you bring it up - we've done some work recently on seating cushions and their relationship to comfort. What is quite interesting is we've been working a lot with the aircraft industry. As you can imagine, you sit on an aircraft for 12 plus hours in some cases, and you look at the cushions and the designs on those seats for those aircraft, and they're actually fairly thin.

I think some of it comes back down to form and structure and being able to design for comfort, which is what we're doing at the moment. What is interesting is that's where the automotive and other industries can actually help with defence. There's lots of technologies out there that are actually helping in those areas where traditionally any company would have said 'let's add some thickness to that, that'll do the trick', whether it's from a protection or otherwise. There are definitely some technologies out there, but I absolutely agree with you that there are trade-offs between space of blast mitigation, and the need for that amount of space to protect against a blast, and all of the functions for evacuation from a vehicle, which have their space requirements as well.

Dr. William Suttie
Technical Lead
Dstl - UK MOD

What's really important is to have a dialogue in this space between the users and the designer, because like so much of vehicle design, it's a compromise. You can have a perfectly reasonable requirement to be able to evacuate an injured soldier through a hatch of a vehicle - a 95th percentile soldier wearing body armor - and then you end up with a very big hatch, which causes ballistic problems and can be really difficult to open.

I think a lot of these areas are not given the priority that they deserve. I think the user worries about how thick the armour is or how big the gun is, and there's a lot of detailed design aspects where you really need to understand the traits if you are going to optimise the vehicle for survivability.

"We believe that the best solution is to use an LED system...there's absolutely no doubt they will save lives."

Alan Thornton,
CEO
EELTEX

There's a problem with getting people out of a vehicle after the accident or incident. There's a lot of information that says that people are remarkably poor at performing in the dark. You get lost very quickly and, if the vehicle happens to be lying on its roof, you will have absolutely no idea where the exits are. So it is probably very difficult to try and find your way around in the dark with all the obstructions that are in the vehicle, which aren't necessarily where they were when you last saw them. It's almost impossible, I'm sure. The solution is to have some lights that come on for whatever reason: you could have them activated by rollover; you can have them activated by blast, or by water ingress. It's all fairly straightforward stuff. It makes a massive difference to how quickly folks orientate themselves towards where the exits are. You're talking a significant number of seconds, and if the vehicle is filling with water, or if it takes you an extra 30 seconds to work out where you are, that might just be too late.

There are good, definite reasons to fit lights. The UK MOD have done so - they believe that's the case. A number of other forces are looking at it, but very few of them have actually made the plunge to spend the cash, which is a bit of a tragedy because it is not exactly a big pile of cash.

There has been some nodding towards the idea and some vehicles are fitted with photo-luminescent tape on the door hatches and on the door handles. However,

photo-luminescent materials are really very poor. They do not emit a lot of light: they have technical problems; for example, they do not like being cold. So there are good reasons not to use them. Moreover, if they are all nice and bright and then you open the door, you can't turn them off - so if there's an enemy there, he can see you now. Electrically controlled lights, therefore, are clearly a better solution.

The obvious replacement for photo-luminescent is to go the way the helicopter escape light systems work. A lot of those are electro-luminescent, which is a very similar material but collectively powered. Again, they have problems in that they're not very bright, nor do they penetrate turbid water or penetrate smoke. So, there are better solutions.

We believe that the best solution is to use an LED system. Again, there are questions as to what colour you have the lights: some forces are using colours to indicate locks and handles and openings so that they know where the opening is. One force I know insists on using green lights for everything, presumably on the basis that it penetrates turbid water better. But why not put white light in there? White light is made up of red, green and blue. So if only the green penetrates, that's fine, the green is still going to get there. But if it isn't turbid, you've now got white light, which is much, much kinder to the occupants. So there's quite a lot of work to do to get these systems in place. There's absolutely no doubt that they will save lives.

Col. William Venable
PM Stryker BCT
US Army

This is an area overall that the US Army is looking at, particularly for the Stryker Program, to improve in. In fact, we have senior army leadership discussion coming up next month to discuss this very topic.

The lighting requirements have not been updated for decades for the types of things that we are talking about. Essentially, the lighting requirement is to provide some sort of visibility for reading a map or a document. So you'll have a couple of overhead lights, and the extent of the technology extends to turning the light off when the ramp or the door hatches are open so you don't expose your position. That's about as technical as it gets.

We are pursuing improvements in this area for the Stryker program. Budgets, like all the other requirements, are all interrelated, so we are pretty much in a zero-sum environment for our program. If we buy this, we have to give up that.

We are doing things like examining the Army's Safety Center data, the causes of accidents, and then looking across all possible solutions - not just materiel, but also the training and what otherwise can be done to improve. I do agree though, that it is time for an update on egress lighting in particular.

Alan Thornton,
CEO
EELTEX

There is no reason you can't integrate the egress lighting with the crew lighting and the cab lighting. You can easily switch between one and the other nowadays. So you can enhance the vehicle lighting at the same time as improving the egress lighting.

Dr. William Suttie
Technical Lead
Dstl - UK MOD

As I said earlier, part of it is at the requirement stage, and making sure these things are discussed and they're not neglected, and that lessons learned are actually remembered when developing new vehicles. I think these sorts of things can easily get neglected.

Sam Foreman
Head of Sales
Jankel

I really like that comment about analysing all of the data; that was going to be my question actually. I think that if the data can be analysed and the areas where the issues are being seen can be prioritised, that sounds like an interesting piece of work.

"It is going to be difficult, absent a 100% success rate on APS against all threats, to get armour off those vehicles... There's nothing like a thick piece of composite armour between you and the threat to make you feel better about it"

Q4. In the opening remarks we talked about the balance of protection, mobility and firepower. In the case of survivability and safety, we're focused on the protection aspect. So how do you balance those three to provide a combat vehicle that not only protects the crew and system capability, but allows it to be mobile and influence enemy action?

Dr. William Suttie
Technical Lead
Dstl - UK MOD

I think the opportunities to reduce the weight of future platforms are there, especially as we move away from just the sole use of heavy armour for protection, and with that gain increased mobility.

Again, there's been mention today of recent conflicts which all point to the fact that slow moving masses of heavy armour are very vulnerable in the deep battle. Therefore, I think that there is a big argument for swinging the pendulum towards mobility as a key survivability enabler.

Sam Foreman
Head of Sales
Jankel

I'll add to that as well: as well as occupant survivability, a big part of our business is light tactical vehicles. I know it's slightly out of the heavy armoured piece, but those are also asked to be armoured almost all of the time. And that triangle of tactical mobility and protection is even more of something we have to look at daily. All I would add today, as it comes to something that the colonel said earlier around those trade-offs, is that there's definitely a lot of opportunities in the short term with the technologies that there are coming through. Everyone always talks about armoured glass and how that can be reduced in weight, that would be a huge saving across many of these platforms. The technology is being worked on, but is just not there yet. So in the meantime, with all of the different platforms, where are there trade-offs that are acceptable that meet that middle ground of that triangle - that's it. It's an obvious statement, but it's one that is an everyday one for most categories of vehicle depending on where they need to go and what they need to do.

Col. William Venable
PM Stryker BCT
US Army

It is difficult to have the conversation at the vehicle level without considering the larger context of vehicle protection. When we consider the area in which these formations operate, the success of that operation is dependent upon accurate assessments of intelligence and possible threats, and how to reduce those threats before you expose the combat vehicle to the threat, and so forth. So, at the vehicle level, Stryker has a suite of capabilities. We call it the layered onion

that manages detection, threat, mitigation, identification across all aspects of the threat timeline.

With regards to future opportunities associated with active protection systems, I have stated publicly that I think that it's a paradigm shift, not so much from a vehicle design perspective, but the way in which Light Armoured Vehicles operate on the battlefield and deliver their mission, equipment packages and soldiers to the battlefield.

From a design perspective, it is going to be difficult. I can tell you that having been through the future Combat Systems program, in which we were going to put light armoured tanks on the battlefield, protection was enabled by many of the technologies that we're talking about here. It doesn't go over well with the operational community, because if you look at risk in terms of likelihood and consequences, the consequences to a light armoured vehicle are catastrophic if there's a failure of an active protection system. It is going to be difficult, absent a 100% success rate on APS against all threats, to get armour off those vehicles probably within my lifetime, but maybe 100 years from now, there'll be a new paradigm.

There's nothing like a thick piece of composite armour between you and the threat to make you feel better about it.

Alan Thornton,
CEO
EELTEX

If your active protection systems is only 95% effective, then you're not going to want to be in that vehicle.

Mr. Gary E. Phillips
Former Assistant TRADOC G2
Discussion Moderator

So what you're saying is that the vehicle is going to have to take at least one hit if the active protection system fails, and if you haven't planned for that one hit you're going to have a catastrophic event.

"Trade-offs are difficult topics to discuss, and they typically start with the mission at which the vehicle will be employed, which leads you down the road of talking about the gun and the armour"

Q5. We've had an interesting discussion about crew survivability and vehicle survivability, and how the two push and pull on each other. Can we talk a little bit about how you balance crew and combat system survivability to build an armoured vehicle that both protects the crew and can take a first round hit and still continue the fight?

Sam Foreman
Head of Sales
Jankel

I'd start by coming to something we touched on earlier. If you're talking about building a vehicle from scratch, then what lessons could be learned about taking this forward from scratch? A very easy one to say - but a very difficult one to do - would be starting with the occupant. Viewing this from the occupant survivability space would certainly be a step forward. There are some recent programs we've been involved with where even 95th percentile males just couldn't physically fit in the space available. If there was a from-scratch position to look at the risks to the occupant and start from there, notwithstanding unmanned options of the future, then I think that would be a nice step forward and would help to try and start that mitigation process on the occupant survivability side, and then work upwards from there.

Dr. William Suttie
Technical Lead
Dstl - UK MOD

I think this is a very challenging area. It has always been interesting that in terms of mine and buried IED attack it has always been accepted that the vehicle will be immobilized, or at least it is is highly likely the vehicle be immobilized, the absolute priority has been on controlling the acceleration inputs to the crew to minimise injury to the crew. Other areas of survivability, it is more about keeping from being hit, keeping the threat out if you are hit, and minimizing damage.

I think in the future, the priority will always be crew survivability. I cannot really see that changing. However, there is a challenge in terms of maintaining mission availability.

I see fall back modes as really difficult with the increasing complexity of equipment, and I've heard some users say that fall back modes are a thing of the past; if the equipment is damaged, then that's it. It is very challenging. I've seen some work with my U.S. colleagues in Detroit looking at putting in fall back modes, putting in redundancy and they said 'yes, you can do all that, but it adds quite a lot of weight to the platform' so I think, like a lot of things, there is a hierarchy. That actually if you're damaged you'd like both your Active Protection Systems and your mobility systems to carry on working so I think it's a case of focusing on what do you need to get home safely and making those as robust and damage resistant as possible

The nice thing about armour is that it is there and it is very easy to measure and quantify. You have to remember if you do vulnerability analysis, you always have ballistic windows. Even with armour, you tend to have your heavy armour over the frontal arc and you will probably have some ballistic windows. It has always been accepted that you will never get 100% survivability from every threat from every direction.

Col. William Venable
PM Stryker BCT
US Army

I think a theme that we have had throughout the conversation has been trade-offs of requirements across mobility versus survivability; in particular, you cannot achieve 100% against all requirements in both areas. The Stryker vehicle is a light armoured vehicle, a derivative of the Canadian LAV, and its limitations impact the area in which it can operate and the missions in which it can be employed. It is not designed, for example, to enter into a heavy armoured battle with tanks. It does have those capabilities on the lethality side, but it is not the first force that you would employ against that type of threat. Heavy mines, for example; while there is protection, you cannot protect against all threats.

It has been a long time since we clean-sheeted a vehicle. The 3rd Generation Stryker was not clean-sheeted - it was an evolutionary acquisition development from the first generation, with many of the same shared components and hull structure and so forth. We bought back mobility, which increases survivability in certain situations, by putting a bigger engine in and beefier suspension and a slightly larger hull, but it is essentially very closely related to the previous generation of vehicles. We do have some opportunities within the US fleet with emerging developments, but again those trade-offs are difficult topics to discuss, and they typically start with the mission at which the vehicle will be employed. That then leads you down the road of talking about the gun and the armour before you start talking about other things.

Photograph by: Sgt Wes Calder RLC