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Who are the Navigators?

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The 2007 Annual General Meeting of the Royal Institute of Navigation was particularly significant; not only did it celebrate the 60th anniversary of the founding, but also celebrated the granting of the Royal Charter of Incorporation to the Institute by Her Majesty Queen Elizabeth II. Our President, Professor David Last, marked the occasion with his Presidential Address which is recorded here.

This is a special year for the RIN. It is our 60th birthday; the Institute was founded in 1947. The Second World War was over. It had been a period of quite exceptional development in every aspect of navigation technology. Some historians even claim that that technology had given the Allies their winning advantage over the Axis powers. They cite: radar that helped win the Battle of the Atlantic and defeat night fighters; shells carrying radar proximity fuses that shot down V1s; and what became Decca Navigator, guiding the invasion forces through the minefields to the beaches on D-Day; overall, an ability to determine locations on land, at sea and in the air, more precisely than could have been imagined 6 years before. It was young men and women who had achieved these great things who set up this Institute. We salute those few of them still with us today; we remember many who are not.

Our founders were engineers and practitioners in navigation. Many of them were forming the post-war companies that exploited the new technologies then pouring into the civil domain. They wanted an institution focussed on navigation, not just electrical or any other kind of engineering, or surveying, or timing, or astronomy – though all those mattered greatly – but navigation. It needed to encompass land, sea and air, and also both civil and military applications. They

created this Institute, and their companies helped support it and often provided its Officers because they valued it as the special meeting place for manufacturers, designers, and developers of systems, as well as for the practitioners of navigation.

Who are the Navigators? They – all of them – were the Navigators.

The practice of navigation in those days was mostly the specialised art of a fairly small number of highly-skilled people, who all wore uniforms! They had years of training. They drove complex, expensive, equipment. They bestrode the bridges of ships and the flight decks of the large commercial aircraft; they took star shots. They were, to a man – and they were all men – professionals. Clearly, that was how God meant things to be!

Then, quietly, a revolution started in this world of navigation. The first phase of that revolution brought us lower cost, smaller navigation equipment. Amateur sailors and aviators got technology more powerful than professional equipment, and very much cheaper: Decca Navigator and Loran receivers on yachts, for example. The second phase of the revolution was driven by GPS, satellite navigation that soon outgrew the navigators. Navigators were indeed the early adopters of GPS, but they were rapidly followed by surveyors, geodesists, desert travellers – all of them people with at least loose connections to traditional navigation.

But then came miners, farmers, even truckers – folk seeking not so much the high peaks of the great outdoors, as the delivery bay at McDonalds! Soon, these people outnumbered what we used to think of as navigators. Our global navigation systems stopped being primarily about traditional navigation; they became public utilities. And in a sense, all these people became navigators.

I see us now entering a third phase of this revolution, where the utility that is Global Satellite Navigation becomes universal – and largely invisible. The trigger for this phase was the US Government's requirement that mobile phone networks should automatically locate users who called the emergency number. Many networks chose "Assisted-GPS" technology: near-instantaneous location measurements made using a GPS receiver inside the phone, assisted by data passed to it via the phone network. This works, and the networks can now locate their users. Third-generation phones increasingly incorporate location technology. Soon, your phone will tell you where you are, download a map for you, guide you to your destination; it will locate the nearest police station, or hospital, the nearest pub for young men, the nearest toilet for elderly gentlemen! It will give you tourist information and tell you of traffic problems ahead. Phones will track your children or your girlfriend, or your boyfriend! Of course, think of the Internet and spam: as you walk down a street, your phone will try to entice you into sleazy hamburger joints, dubious cinemas, or Houses of Ill Repute! But worldwide, there will be soon be hundreds of millions of new users of global satellite navigation systems. Most of them will neither know nor care that they are using a satellite navigation system. Our sophisticated navigation technology will simply have become a location sub-system of a low-cost consumer product.

Has the UK yet come to understand this new reality? Has Europe? Have we as an Institute of Navigation? Do we not, in truth, still think chiefly in traditional navigation terms, of ships and aircraft alone? They are indeed still the focus of most of our Institute's Special Interest Groups. And do we not sometimes look back fondly to a Golden Age of Navigation? I have heard the view expressed in the RIN that "now any fool can buy a satnav from Halfords and measure his position, anywhere

on earth, accurate to metres, it's all over". Navigation is dead! Do we even need an Institute except to study its history?

I believe that this apocalyptic conclusion is untrue. It is perhaps a reflection of the fact that for a good part of our Institute's history the challenge was to measure positions accurately. In 1941, less than one bomb in ten had fallen within five miles of its target. By our Institute's 20th birthday – roughly when I myself began to take an interest in these matters – ships and aircraft were already being navigated electronically with an accuracy of hundreds of metres. By our 30th birthday, we had electronic surveying systems like Decca Hifix that were accurate to a metre or so. Was navigation dead by then? No! Those systems worked over just limited areas. We had really only tackled the easy places: at sea and in the air. The new challenge was to extend precise navigation worldwide. Thirty years later, we still cannot reliably measure positions with metre-level accuracy in the difficult places: the urban canyons of our cities, deep rainforests, or underground car parks. We are still facing that challenge of spreading precise navigation capability everywhere, from below ground and to out beyond the MEO orbit.

And something else started at about our 30th birthday. We had developed, chiefly in this country and driven by some people here today, aircraft automatic landing systems. For these, although accuracy was essential, it was no longer enough. They had to guarantee safety, with not more than one failure in many million approaches. And also integrity: knowing for sure that you are where the equipment says you are, being warned not to use it as soon as it goes wrong. Integrity, not accuracy, became the critical specification.

Navigation systems now had to meet ever-more demanding specifications of Accuracy, Integrity, Availability and Continuity, the four horsemen of our apocalypse – the bane of many of our lives! And 30 years on, our satellite systems on their own still do not come close to meeting those Category 3 autoland standards of the 1970s. Indeed, they struggle to meet the accuracy, integrity, availability and continuity of the Category 1 Instrument Landing System introduced in 1938! Navigation is dead? Still a little premature, perhaps!

At sea, the great challenge of the moment is e-Navigation. As ships become larger and faster, with only one or two to operate the bridge, and as officers cease to be familiar with traditional labour-intensive, highly-skilled, visual navigation, can we find ways of collecting and displaying all the information they need in electronic forms that are clear and utterly reliable? Can we simply do at sea what aviation did years ago, and which has made our skies so safe? To achieve that needs higher levels of integrity in position measurement than any present or proposed satellite system alone can deliver. The General Lighthouse Authorities are working on a combination of satellite navigation and a form of enhanced Loran with better than 10-metre accuracy. That pairing may have the exceptionally high integrity and availability to drive ships' bridge displays and automatic identification systems, and to give collision warnings; put simply, to enhance safety and security at sea and protect the marine environment. We just have to stop the shambles that is out there now, that led to the *Tricolor* colliding with the *Kariba* in the English Channel, and then the *Nicola* and the *Vicky* running into the wreck of the *Tricolor*, with nearly another 100 ships sailing right through the clearly-marked exclusion zone!

So, even in our Institute's traditional aviation and maritime heartlands, the challenges remain immense. It is here, of course, that the "four horsemen" are most vital

because they defend the safety of life by helping keep aircraft in the air, and the safety of the environment by keeping tankers off the rocks.

Yet shipping and aviation are now just tiny parts of the new world of navigation. So, too, is defence. Our world is dominated by car navigation on land, and location-based services for people. Are we really to say – and I have heard this view in the Institute – that because these are consumer industries they should be beneath our attention? Do accuracy, integrity, availability and continuity somehow not matter when an ambulance is sent to a critically-ill patient? Are the gifted professionals who design and create this new navigation equipment and those who use their products, professionals or amateurs, somehow less worthy to be part of this Institute than their forebears were? Are we really mainly interested in swords when the world of navigation is now about ploughshares? I do not think our founders, excited at the new peacetime technology of their day, would take that view at all!

Who are the Navigators? Are not these all navigators, too? So, let this Institute encompass the whole world of navigation.

Let us recognise, too, how vital navigation has become not only to our traditional transport systems but to our whole economy. Take GPS, which the public thinks of solely in terms of car navigators, and foreign juggernauts rumbling through pretty English villages, and Germans driving into the Rhine! The US Government's Volpe Report studied the vulnerability of GPS to interference – either unintentional interference or intentional jamming – and the spoofing of receivers to give hazardous, misleading information. It found these to be real hazards that could be reduced but never eliminated. It described GPS as a tempting target for individuals, groups, or countries hostile to the US. But even more: it identified the degree to which transportation and commerce and public services and manufacturing industry now so rely on GPS that to lose it would cause severe safety and national economic damage. In other words, our navigation systems are no longer solely – or even chiefly – about transportation, but have become embedded deep in our nations' critical infrastructures. In Europe, too, a recent report showed that fewer than 40 of 137 systems that use GPS would remain operational by other means if GPS were lost.

What few outside our profession realise as well is that large areas of our telecommunications systems – mobile phones, emergency communications, the Internet – are synchronised by GPS. So, too, is the electric power grid. If we in this Institute focus on aviation and shipping alone, we ignore all these vital areas of our national life and systems that support millions of new users. Whole swathes of industry, commerce and communications, as well as transportation, have now committed to the cost savings and efficiency benefits offered by GPS. And they no longer run their old inefficient systems alongside the new. It is too late to go back to what we did before. I say: all this hugely-expanded navigation world, with its present and future satellites, with its continuing terrestrial components, falls within the compass of this Institute!

That combination of radio and electronics and navigation technology that I glimpsed as a young man and which so excited me, which I played a small part in helping develop and which has dominated my professional life, has proved to be unimaginably more powerful than I could have believed. It has transformed the world of navigation, releasing possibilities none of us dreamt of.

Among our duties as an Institute now is to ensure that Government is aware of these changes. When our government responded to the Volpe Report it was clear that

they understood and had responsibilities for shipping and aviation – the traditional safety-of-life transportation systems. But, as so often, they thought in those terms alone. No single department considers all the multiple applications of satellite navigation. Only now are governments starting to realise the magnitude and importance of this industry.

The current confusion over Galileo arises largely from European governments' failure to understand this new world of navigation and create institutions to serve it. For instance, the view that Europe can truly be independent of the US in satellite navigation has been shown to be a myth: the future of Galileo depends on its being compatible with GPS, and with the several other satellite systems now being born, and on US insistence on control of its own national security. The idea, too, that operating a satellite system somehow guarantees you a huge share of the satellite navigation industry, is another myth. You make your money out of user services and equipment sales, not out of operating satellites – as the Japanese have shown!

Galileo has been based on those two myths. Sadly, it has now thrown away its potential lead over GPS in trivial disputes about which country gets which bit of the pie, and in an attempt to recover revenue by a user-pays mechanism that simply will not work. The reality is that Europe needs more satellites and higher-quality services. Galileo should be built! But the programme must be based on what satellite navigation really means to our transportation, the distribution of goods, manufacturing industries, the public services, to the relationship between government and citizens in our economies, and not on myths. As Pope Pius 12th said memorably: "One Galileo in 2000 years is enough"!

So, at this 60th anniversary, we again find ourselves at a time of quite extraordinary growth in navigation. What in 1947 was a very specialised set of professional techniques has expanded into a consumer industry with millions of users. However, navigation continues to be a unique place where bright engineers – hardware and software – work alongside systems analysts, geographers, surveyors, geodesists, map-makers, and those who design, manufacture, market and support navigation equipment, and those who use their products.

Who are the Navigators? These are the Navigators! These are the people who should make up the Royal Institute of Navigation in this its 60th year.

And as you know, this year something else very special in the history of our Institute has happened. At midnight, as New Year struck, the RIN ceased to be! In an instant it was reborn as a new company with the same name, but now with modern rules of governance as befits a body created by Royal Charter. This is something only given exceptionally, and then in recognition of the pre-eminence of an organisation in its field. That judgement of the RIN was made by the Privy Council, based on the words of other high-level bodies whose interests border on, or overlap, those of the RIN: government departments and agencies, academic institutions, companies, societies of national standing, professional bodies in the UK and across the world.

So, the Institute set up 60 years ago by those far-sighted individuals and companies has become a National Institution! It now has more than 3000 members – by far Europe's largest institute of navigation, and similar to the US ION. It is, as we have seen, a body in rapid transition, realigning itself as the world of navigation changes and develops with that breathtaking pace at which many of you live your

professional lives. I believe strongly that this Institute must play its role in those developments, as it did in the heady days in which it was formed.

And so let all of us who call ourselves Navigators, traditional or new, at this time of change, in this second Golden Age of Navigation, celebrate this exceptional year for the RIN: a Big Birthday and a very special gift of a Charter from Her Majesty the Queen!