Dr. Holger Beckmann

CargoCap: A New Way To Transport Freight

Dr. Beckmann is at the Ruhr University, Bochum, Germany. His speech, "Automated Underground Goods Transportation: A Transportation Technology Scenario for the Future," was translated from German, and subheads have been added.

Ladies and gentlemen, I would like to present to you a vision, a vision of automated freight transportation underground. But I would like to start out with a historical view.

In the 19th Century we were faced with an enormous problem in our cities. This problem was the sewage, that was channeled from every household in open channels through the towns, creating a great stench and epidemics. It was a great problem, and a couple of people came up with the idea to discharge the sewage underground in canals or pipes. At the time, that was a utopia, in which nobody really believed. In 1843, some people took up this project, despite everything, and as we see today: It is absolutely self-evident to us, that sewage runs underground, where we cannot see it, hear it, and, in general, also cannot smell it. In principle, when we pour it down our drain, we can forget about it. That was absolutely not a matter of course 150 years ago; it was a total utopia.

Today, we are once more faced with a great challenge in our cities and urban areas: our traffic. I will read you a clipping from a newspaper: In North Rhine-Westphalia there were 338 km of traffic jams in one day. The entire traffic system had basically broken down. It's not like that every day, but we do witness traffic congestion in these urban areas, and they cause extreme delays. And then there is, of course, an enormous noise pollution, as well as emissions pollution, and recently, the problem of particulate matter. All these issues create health problems in our densely populated cities and urban areas, and they need to be solved by us in the near term. And it will not solve itself; as a matter of fact, if we do not find a solution, matters will just get worse.

If we look at the development of traffic, we project very significant increases in traffic, in particular, in the use of trucks. Added to that, is the rise of e-commerce, where a client orders his goods via the internet and has them shipped directly to his home, which will create an enormous increase in goods transportation in urban areas. Current traffic systems are no longer able to absorb the expected increased traffic. We already have a system that is overstrained and that creates competition for land area use. Citizens rightly complain, and defend their interests against new highways in already congested

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Dr. Holger Beckmann presents his Cargo-Cap underground freight transport system, a proposal as revolutionary today as the creation of underground sewage system was a century ago.

areas, and, of course, there are always also budgetary issues to consider, as the building of new traffic corridors in urban sprawl is extremely expensive.

There are some attempts to solve this problem by increasing the efficiency of existing systems, like the electronic drawbar, which would electronically regulate the distance between trucks. Another is telematics, that is, centralized traffic regulation; but all of these are mere drops in the ocean. They do not fundamentally solve any problems.

How then should a new traffic system look?

It would have to be technically and legally feasible in a relatively short time, without causing harm to the interests of the citizens. It would have to be able to be integrated into existing traffic systems, as we cannot change the entire traffic system from one day to the next, but would need to create compatibilities. Of course, it would have to be economically feasible: that is, it should not be prohibitively costly, so that public monies can be invested in it.

Under these premises a project-team from the Ruhr University at Bochum set out to design a new system as a solution to these problems. This was a very interdisciplinary team, which involved lawyers; technicians; civil, mechanical, and electrical engineers; and of course, also some economists. This team has come up with a proposal, a new concept, which bears the name CargoCap. We see it as the fifth traffic alternative, next to road, rail, water, and air. In principle, we are talking about a relatively small freight-railcar, a capsule, that rolls through underground pipes or tubing. These are not tunnels in the common sense of the term; it is much more like pipework or tubing. These capsules are loaded with pallets, which are made in the standardized transportation size for freight traffic in urban areas; all you need for that is a tube diameter of 1.6 meters [5.25 feet]. That is relatively small. You cannot even walk upright in them. And you would be able to transport in them almost all of the goods that are now carried on pallets.

I prepared an animation here for you to see. (www.cargocap.com/)

So, these capsules would be driven in trains underground, similar to a rail train, except that they are not coupled mechanically but rather electronically, using electronic distance-retaining brackets. As I just mentioned, these pipes are 1.6 m in diameter. I will show how they can be built in a moment. In a second, you will see into an entrance to a station, and can watch as some capsules separate themselves from the train set and take a different track. That is technically no problem to realize, because they are not mechanically coupled. Some capsules go on to the next station, and some are processed in this station, i.e., they are the pallets automatically unloaded and conveyed to the distribution level or the surface, using a fine distribution system as we know it, with forklifts or similar systems.

On the surface, of course, you would not notice any of this going on. So you could integrate this CargoCap system of piping into the existing traffic system without creating anything visible on the surface. We specifically examined one of the largest and most dense urban areas in the world: the Ruhr region, looking at a track of about 80 km length going from Dortmund in the East, through to the Rhine in Duisburg in the West. Along the way there are several stations at city centers, shopping centers, and distribution centers of the likes of UPS or DHL, which would be connected and would aid in making such a project economically viable.

A Look at Construction Costs

The next question would be: How do the construction costs look?

A double pipe, that is, a two-track section, would cost about 3 million euros per kilometer, compared to about 13-15 million euros for a kilometer of highway in urban areas, which is on the surface, with all the problems associated with that. If you look at tunnels, a kilometer of tunnel would cost about 20 times as much, and a high-speed rail track about 15-18 million euros per kilometer.

How can such a system be built?

We already have construction methods today that are very widespread for constructing sewage systems. This procedure

CargoCap

An artist's illustration of the means by which the underground pipes for transport would be constructed under urban areas, with minimal disruption to the activity above.

is entirely underground; that is, one only needs a shaft at the beginning, and a shaft at the destination, with about 1 kilometer or more in between the two. The pipes are lowered into these shafts, where they are pressed through the soil. In front there is a machine that drills through the ground, and creates the hollow space into which the pipes are driven. If the track is fairly long, one not only applies pressure from behind the pipes, but there are so-called intermediate expanders that work the pipeline through the ground in the way a worm works.

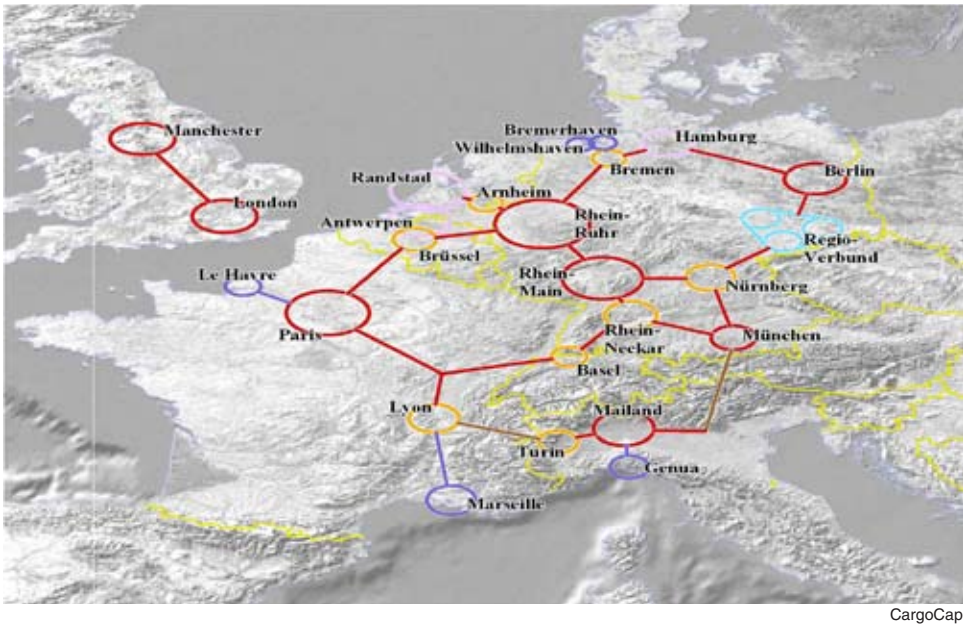
As I said, this is not a utopia. It is not even anything new. It is in use today. Many kilometers of piping are constructed every year in Germany alone, using this procedure for sewage systems. And it is very gentle on the environment. All you need is a shaft about every 1,000 or so meters into which the pipe sections are lowered.... There is currently a main sewage line under construction in the Ruhr region, comparable to our CargoCap track, with a length of 50 kilometers right through the middle of the urban area, this being for sewage effluents. It has dimensions of between 2,800 mm [approximately 9.2 feet] and 1,400 mm, so it is even larger than our CargoCap pipes.

Now, let's look at the economic viability of this system, because it might sound somewhat fantastic at first. We have looked at the total quantity of goods transported on pallets in the Ruhr region, which would be relevant for our track. It is around 10 million tons per year. What we would need to break even with our project, including all initial investment costs, would be no more than 350,000 tons per year, which is a small fraction of the total. What does our capacity look like? If we were to operate a double track line, then the capacity naturally is several times what we would need to break even. As soon as we pass the 350,000 mark, we are economical, including all of our investment costs to build the line. And that is considering only the track in the Ruhr region.

We did another study on a line in the Rhine region, around Cologne, and then also on the connection between the two, with respect to networking effects. We found that the connection creates the greatest benefit, although construction costs for it are lowest. This is similar to the beginnings of rail. As an isolated application, rail transport was relatively costly, and not particularly economical, but in connecting the different rail sections into a network, the whole thing became an extremely important traffic carrier, which can operate very economically.

We also did a legal evaluation on the question of whether it would be possible to just go ahead and build a pipeline straight across the Ruhr region. And it is actually very unproblematic legally; we do not need all kinds of permissions you would otherwise need. Because we are building a supply line, we can declare it legally as a supply line, and then it is no different from building a water pipe. And we also avoid tunneling under private properties, where the owner obviously also has claim on his undersoil. Because with the high flexibility in the pipeline routing of our system, we can just stick to staying underneath public roads so that we don't run into any problems on that front either.

Another big advantage is that we don't run into any environmental regulations, because we are operating an electrically driven vehicle. It doesn't make any noise, and it is underground, so you can't see or smell it. Like our sewage system today, it would be entirely invisible.



CargoCap

Although CargoCap is located in the Rhine-Ruhr area, it would easily integrate into a Europeanwide, or Eurasian, network, as this graphic presented by Dr. Beckmann shows.

Efficient, Flexible, and Reliable

So, there are many advantages to this solution. It is highly efficient; it is very flexible; and, very important, we can operate it very precisely according to schedule, enabling us to guarantee to the minute when the goods will arrive at their destination. This is mainly because there is no interference from outside—no weather dependency, no interference from other traffic carriers. We can always operate according to schedule, even at very short notice, and therefore we can always inform the client as to exactly when his goods will be expected to arrive at their destination, or we can deliver them according to the client's specifications. It would be immediately implementable, expandable, environmentally sound, and highly efficient regarding land use, as we intersect only the surface at the respective loading stations.

I don't have a slide on the disadvantages, because there really aren't any, and that seems to be our greatest disadvantage. There are no citizens' committees opposing it, so that when the political decision is made to go with this, then no one can reverse it. That is the problem that we face at the moment [laughter].

How far are we along with this project? Well, we have already built a model track, at the scale of 1:2, that is, at half the normal size, in a hall donated to us by AEG [German General Electric] some years ago. There we have built a large oval track, and now we are building the switches on which to demonstrate the feeding in and feeding out of capsules while in transit. The idea is for the capsules not to travel at a very high speed, perhaps around 40 to 60 km/hr, but that is far above anything a truck manages in an urban area, and we can feed capsules in and out of the respective trains, while they continue travelling, in order to load and unload them at their respective destinations.

Are there opponents to this? We thought at first that naturally we would find the entire logistics branch seriously opposed to this, but it turned out very differently, because transport in urban areas actually is not very profitable for logistics companies, mainly because it is very unpredictable. For example, the director of the logistics center for Quelle AG [a major mail order retailer in Germany], which is based in Bochum and services all of North Rhine-Westphalia with refrigerators, household electronics, and the like, told us that he cannot estimate how long his truck will take to make a delivery in Dortmund. It could take 20 minutes, or it could take up to 3 hours. Therefore it would be a great competitive advantage for him, if he could tell his client precisely when he can expect his refrigerator. It is not only industry that wants to be supplied "just-in-time," but also the consumer; the individual household demands a very narrow window of time.

That's why traffic in these congested urban areas is so unprofitable, because you have to build in all kinds of time buffers, and most would be very happy if we could do the job for them. The railway is also not in competition, because the director of the rail company has stated that he would very much like to leave distances of under 150 km to the competition—that is, trucks—without a fight. Now, that is exactly where our system begins to really show its strength, in the final distribution at the end of the line. It would be an ideal complement to conventional rail.

The Urban Area of the Future

You can imagine how an urban area would look in the near future. We already see tendencies in this direction today. You have a goods distribution center (GDC) on the periphery; these are called railports today, when they are serviced by rail.

These GDC are supplied from outside by rail or truck. Of course, some trains or trucks directly service large customers in the urban area, but the final distribution occurs by regional goods traffic, and in this area there is virtually no alternative today to the truck. This is precisely the sector that CargoCap could take over. From the GDC, where the goods are broken down from container to pallets anyway, is where CargoCap could have an interface with long-range transportation systems.

We also have thought about how transportation systems

work in the sector of long-range freight hauling: that is, how do goods get to the GDC. We had a research project looking specifically into the connection of the German ports with urban areas; in our case, the connection of Hamburg and Bremen with the Ruhr region. This is the so-called coast-to-back-country traffic, which is also increasing very significantly.

Currently, it is cheaper to haul a container from Thailand to Hamburg, than it is to transport it from Hamburg to Bremen. Here, you naturally would require a different kind of vehicle. It would be a cargo rail train, that can be loaded with containers, or, using an intermediate module, truck trailers. But most important is the fact that this vehicle would also be self-driven, and therefore track its destination individually.

…The vehicle is not a regular rail car; it is an automated system, so the individual vehicles are guided automatically through the tunnel. Therefore, there are no persons on board who could be harmed in case of disturbances like a fire, for example. So one could keep the diameter of the tunnel relatively small. One would only need a diameter of sufficient size to fit the vehicle—much smaller than a rail tunnel, because there are no escape routes, and so on, necessary.

As we were mainly tracing a track in flatlands, one could remain relatively close to the surface, and therefore it would not even be necessary to have circular tunnel cross sections. This is necessary for reasons of static stability when tunnelling under the sea or in mountainous areas. There are also technologies already developed, tunnel construction machines, that can excavate rectangular cross sections. In a certain sense, one would just have to combine these technologies that exist globally. This particular technology, for example, hails from Japan.

Now where would one place such a track? At least in Germany we have the possibility of using disused rail tracks, that cannot be rededicated. They may be overgrown, and some have become almost invisible, but for this purpose, we could reactivate them. Therefore you could build such a system either encased or underground along the existing, disused rail lines.

So that is the vision of supra-regional transportation. You have here the Rhine-Ruhr region or the Rhine-Main, where we are gathered today. Such a system could easily be imagined connecting all of Europe and, of course, extending it toward the East, integrating Eurasia. One of the ideas discussed here was the Bering Strait Tunnel project. In that context, one could easily integrate automated freight transportation into all of Eurasia. This is the vision I wanted to present to you, and I thank you for your interest in it.

Helga Zepp-LaRouche: Thank you very much. I think one thing you did not mention, which is one of the biggest saving factors of this project, is the nerves. Because the jams on the highways do a lot of damage to the nerves of the people who are stuck in them every day!