Following the opening of the Hong Kong–Zhuhai–Macau Bridge, Cameron Dunn looks at the benefits and implications of fixed sea crossings.

On 23 October this year President Xi Jinping of China opened the Hong Kong–Zhuhai–Macau Bridge (HZMB). The 55 km route is the longest sea crossing in the world. Costing US$19 billion and constructed over 10 years, the bridge and tunnel system links Hong Kong, Macau and mainland China by bridging the mouth of China’s Pearl River Delta.

The HZMB is not alone in connecting countries and regions divided by wide stretches of sea. Advances in civil engineering technology make very long connections increasingly possible, and this has implications for all aspects of geography.

Boats, planes and trains

Traditionally, places divided by the sea were connected by ship, or more recently by air. Both types of connection have disadvantages:

- Specialised infrastructure (ports, airports) is required at either end of a connection.
- Flights and ferries operate to fixed timetables, which means passengers and freight have to wait.
- Most journeys are made by road and rail (see graph), so passengers and freight have to transfer from one mode of transport to another, twice.

These disadvantages mean connections across the sea by road or rail are often preferred. However, building tunnels and bridges is hugely expensive. This initial high cost can be offset by the longevity of such infrastructure: the HZMB is designed to last 120 years.
Completed and proposed fixed transport connections

<table>
<thead>
<tr>
<th>Connection</th>
<th>Places connected</th>
<th>Length (km)</th>
<th>Transport type</th>
<th>Date opened/planned</th>
<th>Cost ($ bn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel Tunnel</td>
<td>UK and France</td>
<td>50</td>
<td>Rail tunnel</td>
<td>1994</td>
<td>21</td>
</tr>
<tr>
<td>Øresund Crossing</td>
<td>Denmark and Sweden</td>
<td>16</td>
<td>Road and rail bridge</td>
<td>2000</td>
<td>4</td>
</tr>
<tr>
<td>Irish Sea Fixed Crossing</td>
<td>Northern Ireland and Scotland</td>
<td>21</td>
<td>Road and rail bridge</td>
<td>?</td>
<td>15–20</td>
</tr>
<tr>
<td>Saudi–Egypt Causeway</td>
<td>Saudi Arabia and Egypt</td>
<td>25</td>
<td>Road and rail causeway/bridge</td>
<td>2020s</td>
<td>4</td>
</tr>
<tr>
<td>Malacca Strait Bridge</td>
<td>Indonesia and Singapore</td>
<td>48</td>
<td>Road bridge</td>
<td>?</td>
<td>14</td>
</tr>
</tbody>
</table>

**Built and proposed**

The table gives examples of other fixed connections (both completed and proposed) that bridge long stretches of water. These are often international in nature. Proposals for connections like this are quite common, but completed examples are rare because:

- The initial costs are very high.
- The technical, and environmental, challenges are large — and so are the risks of unforeseen problems and cost over-runs.
- Political negotiations are needed, and governments change on a regular basis.
- Long construction times mean the politicians who planned the project may not benefit from the prestige when it is finally completed.

**Impacts**

Despite the costs, examples like the HZMB, Øresund Crossing and Channel Tunnel have significant benefits:

- Fixed connections dramatically speed up trade flows and reduce transit costs: lower-cost trade generally means more trade, and greater wealth generation.
- Political and economic cooperation between countries (or autonomous regions within countries) fosters understanding and collaboration on other issues.
- The technical engineering challenges can boost skill levels and innovation, with benefits to wider economies.

Fixed connections facilitate the movement of people, and can increase cultural understanding. For example, it’s common for Danes to live in Malmö in Sweden (where housing costs are lower) and commute to work in Copenhagen. There are down sides: coastal and seabed ecosystems risk being damaged or destroyed by engineering mega-projects.

**Questions**

1. Consider the costs and benefits of an Irish Sea Fixed Crossing between Northern Ireland and Scotland.
2. Engineers have proposed road/rail tunnels between Korea and Japan, Alaska and Russia and even Italy and Tunisia. How likely are these to be built, and what risks and benefits could they bring?

**Further research**

Details (including video) of the new HZMB: [https://www.hzmb.gov.hk/en/](https://www.hzmb.gov.hk/en/)

More on the Øresund Crossing: [https://tinyurl.com/yb2pk6gb](https://tinyurl.com/yb2pk6gb)

Data on how people travel around the UK, from the Government National Travel Survey, 2018: [https://tinyurl.com/j6pyvkv](https://tinyurl.com/j6pyvkv)