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European Explorers, Entrepreneurial Selection and Environmental Thresholds

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ABSTRACT *This article examines the activities of two early European explorers, Christopher Columbus and Henry the Navigator, in light of modern theories on entrepreneurship. These were Schumpeter-type entrepreneurs who revolutionised the world of trade and commerce. Their eventual success was the result of a number of factors including technology, access to capital, access to information, their skill-base, social/motivational factors and luck. All of these factors, in turn, were determined by their environment. Their reliance on knowledge and technology show these entrepreneurs as being one stage in a technological trajectory and growth of knowledge. This stage represented a major threshold in which a window of opportunity was opened. This illustrates a process of environmental selection whereby entrepreneurial success is determined by changes in the environment.*

Keywords: entrepreneurship; exploration; creativity; innovation; selection

Introduction

Jeffrey Timmons[1] states that one of the key differences between an idea and an opportunity is its feasibility, but many aspects of feasibility are beyond the control of an innovator or entrepreneur. They are determined by environmental features such as the size of the market or the state of supporting technologies at the time. Given that the business environment is usually given and cannot be changed easily, this paper explores the idea that environmental factors change and create threshold points, at which time windows of opportunity open. Those thresholds include favourable demand conditions and technological advance. This paper uses an historical example to illustrate how entrepreneurial success was determined by favourable conditions in the environment.

Henry the Navigator and Christopher Columbus are two of the most influential entrepreneurs in history, yet their achievements have never been viewed in the light of entrepreneurial theory. Both were Schumpeterian-type entrepreneurs, who created new markets and new trade routes. Their enterprises opened up opportunities for other entrepreneurs to create new ventures in their wake. Their break-

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throughs were at least as great as the Industrial Revolution and certainly more influential than Fordism. The opening of the routes to Asia and America heralded a commercial revolution that re-shaped the world of global commerce and shipping. This paper examines the activities of these two entrepreneurs with an underlying question 'what made these people succeed?'. It reveals that a key ingredient in their success was the changing environment in which they operated. Before their ventures could be achieved, a number of environmental thresholds needed to be crossed. The entrepreneurs who were in the right place at the right time when those thresholds were reached were the ones who succeeded. This could be viewed as a process of environmental selection.

The European Environment: Demand, Capital, Technology and Knowledge

Europe in the early Middle Ages, did not provide a favourable environment for the development of a shipping industry. Consequently, no entrepreneurs of the scale of Christopher Columbus existed. Market activity was practically non-existent. The dominant institutional form for utilising resources was the feudal manor.[2] There were few manufacturing industries and this meant there were few products to trade. The poverty of the region meant that domestic demand could only support small volumes of trade, while capital for major oceanic voyages was hard to find. This environment could not support shipping entrepreneurs of significance.

Over time necessary changes did occur whereby capital, technology, demand and knowledge reached a threshold on which international shipping could be launched. Throughout the Middle Ages, Europe underwent a process of agricultural, commercial and technological change that created a more favourable environment for maritime entrepreneurs like Columbus and Prince Henry. The process was long and gradual and involved both indigenous developments and imitation of Eastern technology and commercial methods. Europe's feudal institutions were gradually replaced by the market as the principle allocator of resources on the back of an agricultural revolution that involved an increase in land reclamation, drainage, irrigation and land clearance. These increased the amount of land available for agriculture and the resulting production increases provided surpluses which could be taxed or traded. The volume of market activity increased; temporary fairs growing into permanent market towns. Craftsmen who previously provided a handful of luxuries to the rich and a small number of essentials to the peasants could expand their range of activities. It became economical to introduce mechanical labour saving devices such as the windmill and waterwheel.[3] The result was a rise in production, consumption and wealth.

Many new production techniques were introduced from Islamic nations in the East. The list of production technologies acquired this way includes linen and cotton production, glass-making and mining.[4] The Islamic world also provided a great deal of intellectual wealth which raised Europe's base of knowledge capital. From the East came rediscovered ancient Greek classics and more recent Islamic scientific texts such as Al-Khwarismi's texts on mathematics, medical works of Galen and Hippocrates, and Ptolemy's *Geographia*. This last work had a great influence on European shippers and explorers. Universities were established based on the Islamic style of learning.

The process of technology transfer was strongest in Italy. Galleys from Venice and Genoa regularly visited Islamic trading ports, bringing back products and technologies from the East. These included the compass, lateen sails and navigational

charts. Commercial technologies included the 'commenda' form of business organisation, a vital ingredient in the rapid growth of European maritime trade[5] and double entry book-keeping, probably from the Hindus and Bills of Exchange, originally from China.

Another environmental shift came with the changing role of the state. With no agricultural base, the Italian cities became dependent on ocean trade. Consequently, the interests of merchants became so important that the state took charge of their protection and merchants became very active in municipal government.[6] High-level state support for merchants was a consequence of Europe's fragmented political landscape. The divided nature of Europe's political map also provided some advantages for technical and commercial advancement. Smaller political units meant rulers had less agricultural land to tax and were more likely to support merchants in an attempt to raise income.[7] Rulers were closer to merchants and the other people under their rule. This reduced information asymmetries creating a governance system in which rulers were more likely to be in tune with their subjects' needs.

To some extent, the divided landscape provided a political market where the consumer was left with a degree of choice. The existence of many divided kingdoms meant there was no central power to suppress commercial activity or original thought. If a government tried to stop someone's activities or suppress their thoughts, that person could move to another state. A continent of many nations provided Europeans with options, as Columbus would find to his advantage. There was a high level of competition between the states of Europe. The rivalry for resources so valued by Klein[8] and Porter[9] at the firm level was played out in Europe at the state level and contributed to a high level of innovation. The states of Europe were constantly fighting among themselves and a competitive arms race needed to be financed. Consequently, European rulers became dependent on their merchants as a source of income, and it was in their interests to support their merchants.

This decentralised competitive political environment had implications for technological advance. For example, gunpowder and blast furnaces were Chinese inventions that underwent further development in their new environment. The blast furnace meant that iron could be cast at higher temperatures and were used in Europe for casting cannon in 1380. A rising demand from competitive national armies and navies (and later geographic explorers) caused European metal workers to create the smallest, most mobile and accurate artillery pieces in the world. As we will soon see, this decentralised competition also affected shipping technology.

Early European Shipping and Technological Thresholds

In the early Middle Ages, European shippers did not have the technology to conduct trans-oceanic trade. The high point of European achievement had been the crossing of the Atlantic by the Vikings, but this was more of an island-hopping venture leaping from Europe to Iceland to Greenland before touching the North American coast. Most importantly, it did not lead to an emerging trade or expansion of knowledge. In fact, outside Iceland, no other Europeans even heard of this achievement.

A major problem was the limited capability of European ships that were incapable of facing severe storms or contrary winds. Consequently, voyages were made by sailing close to the coast rather than across open seas. Pilots worked on the basis of

experience and knowledge of land marks.[10] Eventually, a series of tools and methods were introduced to improve navigation, many of which came from the east. These included the Chinese compass, which by the end of the thirteenth century was being used in conjunction with portolan charts (charts with sailing directions). In the north, where there was greater tidal variation, mariners were using tide-tables by the late fourteenth century.[11] These improved navigational methods made sailing safer, more productive and reduced the number of losses.

Advances also came in ship technology. In many ways, development was an environmental selection process as market expansion opened possibilities for experiment by shipbuilders. However, the innovative process was limited by past investments in knowledge of what was technologically possible, a reflection of the path-driven development suggested by Dosi[12] and Nelson and Winter.[13] The slow and gradual process of technical advance reflected the fact that an innovation that failed could result in loss of life at sea. An example of that slowness is the hinged axle rudder, initially introduced in the late twelfth century but not in general use until the middle of the fourteenth century. The process of environmental selection is evident in that development occurred along several paths depending on the needs and circumstances a ship was intended to solve.[14] In this way, the environment a ship sailed in shaped the selection of design options. Skippers would, for example, have their own preferred style of rigging.

For centuries, European shipping had been evolving in two distinct spheres, a reflection of their different sailing conditions.[15] In the Baltic Sea and North Sea, the rough conditions created a demand for a heavier ship. Northern ship designs were also influenced by changing economic conditions, in particular the falling grain prices associated with the Black Death. Falling prices spurred German exporters to find more competitively priced shipping. The cog was the solution. With a rounded hull-shape and flat bottom, it had greater carrying capacity. The ship's shallow draught reduced its vulnerability to tidal change. Having only one mast holding only one square sail made it easy to handle with low labour requirements (labour being expensive after the Black Death). However, the single mast meant it suffered in terms of speed and manoeuvrability. Its high sides were good for defence and positioning archers.

European ships coming from the Mediterranean faced different sailing conditions and were more exposed to Arab shipping influences. The result was a very different ship to that in the north. From the Arabs, southerners adopted the lateen sail that enabled sailors to tack a zig-zag course against the wind, something that a square sail could not do. There were also differences in the construction process. In the north, the cog was clinker built which meant the sides were built up by placing wooden stakes on top of one another, slightly over lapping the one below it. By contrast, southern ships were built first by constructing a skeleton frame on which planks would be added to the outside. The internal skeleton added greater strength. The planks would not overlap but were placed edge to edge in a process known as 'carvel' construction, saving wood in the Mediterranean area, which had smaller wood supplies. The Mediterranean Sea experienced less tidal variation than the north so did not need flat-bottom boats. Their keels were curved.

In the last quarter of the thirteenth century, increased trade between northern and southern Europe opened interaction between shippers who had an increased opportunity to examine each other's ship types. This led ship-builders to combine the best features of the two shipping traditions, and by the closing years of the fourteenth century, a new ship-type had evolved. The earliest 'carracks' were two

masted, a square mast as per the north, a lateen sail as per the south, and early in the fifteenth century, a third mast was added. This allowed captains to balance wind forces on different sails, giving greater control of the ship[16] and manoeuvrability. What became known as the 'full rigged ship' enjoyed improvements that were not restricted to rigging. The ships hulls were carvel-built in the Mediterranean tradition, but contained several northern features, particularly a tall stem, marked sheer, and straight keel. A higher length-to-breadth ratio meant the ship could travel faster than the old round ships. From the cog (and before that China), a stern-post rudder was used for steering. The process of imitation and internal evolution resulted in a fast, strong, seaworthy ship that could sail close to the wind, and be more easily manoeuvred than its predecessors.[17] With more masts and sails, ships could capture more wind-power. Most important, Europe had its first ocean trader capable of long ocean passages. This was a slow and gradual process of improvement in which designers responded to environmental opportunity and constraint, but at the same time were limited by previous knowledge. Eventually, a threshold was reached in which they could venture out into the great oceans. However, advance did not stop once this threshold was crossed.

The external environment shaped the development of technological change, in particular demand conditions and factor prices.[18] As trade grew, a more established demand for cargoes allowed shipbuilders the luxury of building larger ships. At the same time, there was a constant desire to improve handling capabilities as this reduced manning requirements. Traders in Genoa, with more money, were particularly experimental in ship design and by 1500, the carrack constituted 90% of Genoa's merchant fleet.[19]

Supply-side changes also improved shipping technology. Advances in metallurgy resulted in better quality tools for cutting hardwood and boring holes.[20] Stronger ships could be built more quickly. An important supply-side advance was the placement of artillery on board. Competition between warring states had created pressure to improve the reliability and force of artillery.[21] The results of this process gave Europeans a strong advantage when they ventured in foreign and hostile waters. Powerful artillery reduced the risks and costs of shipping.

The processes of imitation and advance just described strengthened the European economic environment, providing surpluses for trade, education, demand and capital for investment. Most important, Europeans now had the ships to venture across the oceans. It was a far more favourable environment for entrepreneurs than that in the early Middle Ages, and key technological thresholds had been passed. Despite these improvements, by the fifteenth century, Europeans had not mastered trans-oceanic sailing. It was in this environment that our two entrepreneurs came forth.

Prince Henry 'the Entrepreneur'

The countries of the Iberian Peninsula possessed two vital differences from the states of northern Europe. First was their geographic position bordering both the Atlantic and the Mediterranean. Their Mediterranean connections put them in a handy position to tap the commercial and maritime expertise of the nearby Italians,[22] particularly the Genoese who from the thirteenth century regularly provided both capital and maritime expertise.[23] The other difference was that both nations had previously been occupied by Islamic rulers, an experience that filled these Christian nations with a crusading zeal against Muslims. It created a

'reconquista' mentality that can be characterised as a militant Christianity which placed high value on defeating the forces of Islamism. The knights who exhibited valour in such exchanges deserved the high status and title of 'gentleman' or 'nobleman'. This culture rewarded chivalric action with status. This reconquista belief system was embodied in the key institutions at the time; the crown, church and military orders.

In 1415, this reconquista mentality led the Portuguese King to attack and capture the Moroccan fortress of Cueta. To take an army across the sea to Morocco required 100 transport ships and the task of fitting and organising these fell to the King's third son, Henry. After the fortress was taken, Prince Henry was given the responsibility of funding, organising and arranging the flow of supplies shipped there. To do this, the Casa de Cueta was created, a purchasing, distribution and shipping agency based in Lisbon. It also included potters and coopers who made products for export to Cueta and a range of ship-builders. These experiences enabled Henry to acquire skills in maritime management with knowledge of ships and their capabilities.[24]

Henry saw himself as a crusader fighting against the Islamic enemy. In his eyes, the capture of Cueta was merely the first stage of a Moroccan conquest. However, his military exploits were disastrous. Throughout his life, Henry continuously earned a reputation as a rash and poor military planner, and many around him questioned his judgement.[25] If we accept Casson's[26] statement that an entrepreneur has judgement that differs from the norm, these statements open up the possibility that two characteristics of a successful entrepreneur might be stupidity and luck, not the generally accepted trait of superior insight. However, after Henry's maritime success, chroniclers and historians would describe him as being astute and full of foresight, the evidence being in his achievements.

In 1420, Henry, was appointed Administrator General of the Military Order of Christ, a rich and powerful chivalric order of knights. Henry had a strong commitment to the values that the order enshrined, but his position gave him two other advantages. It increased his administrative experience and placed significant financial resources at his command.

Up until the 1420s Henry's mind had been focused on crusading in North Africa, then suddenly he revealed he had been looking at charts and tapping other sources of information about the Atlantic Ocean. His first movement was to send a fleet to conquer the Canary Islands. However, his force was beaten off by the inhabitants. The fact that Spain laid claim to the islands didn't put him off, and throughout his life he made many unsuccessful attempts to gain the islands. Drive may be an admirable quality in entrepreneurs, but as with many obsessives, Henry did not interpret his defeats as a need to change his plans. He just tried again in the same old way.[27] He did, however, show some variation in his choice of projects. After his first failure at the Canaries, he then tried settling the Madeira Islands. With no inhabitants to oppose him, settlement was highly successful, and the fertile islands provided many marketable commodities, including timber, wheat, dye and sugar.

As an experienced administrator, Henry was comfortable with delegation and introduced incentive systems to get what he wanted from his staff. He delegated the lordship of particular islands in the Madeiras to particular individuals including Bartolomeo Pallastrelli who later became the father in law to Christopher Columbus. Pallastrelli was one of many Italian seamen in the Prince's service. Henry frequently delegated the exploration and trading tasks to Italians who had superior

skills in the area. If the seamen provided and fitted out their own ship they would get three quarters of any profit. However, if Henry provided the ship and stores, their share would decline to half, Henry getting the rest.[28]

Henry combined his chivalric goals and maritime expertise in a series of voyages down the Atlantic coast of Africa. However, a number of psychological and physical barriers existed, preventing sailing down the coast. It was commonly believed that if a ship went past Cape Bojador, it would be overcome by a number of possible disasters, for beyond it lay boiling seas, terrifying monsters and a tropical sun that burnt sailors black.[29] The tales were re-enforced by currents and northerly winds that made returning difficult and presented a huge barrier to entry. The Cape represented a technological, and more exactly, a geographic frontier on maritime ventures, but Henry was not put off.

In 1434, his sailors reported they had passed Cape Bojador without being burnt, boiled or dined on by subterranean monsters. In reality, they hadn't passed the Cape. Their maps were wrong and it was some years before they realised the Cape was 140 miles further south. Nevertheless, believing they had overcome all barriers, the following year, his sailors continued their exploration and actually passed the Cape. The fact that Henry thought outside the box of accepted thought and believed the Cape was not a barrier would show him to have that greater insight that is attributed to entrepreneurs. It raises the question how did he know? Perhaps it was intuition, but it was intuition fed by other sources. It is most likely that he had read a Castilian account of geography called *Libro del conoscimento del mundo* which claimed there were trading ports south of the Cape. The book turned out to be fictitious and wrong but would have supported Henry. The second likely book that could have influenced him was *Le Canarien*, a chronicle of two French knights who attempted to take the Canary Islands. These chronicles recorded an earlier landing on Cape Bojodor in 1401. Henry claims he also had access to world maps. At the time, map-makers, receiving information on the Saharan gold trade, had placed boats in the Atlantic at the mouth of the famed Rio de Oro. This would have indicated to Henry that it was possible to sail this far south. These activities make Henry look like the Shackle-type entrepreneur who puts together existing notions in new ways. We can certainly see a synthesis of knowledge in the process of building an idea, or what Earl[30] would see as a connectionist approach to entrepreneurship. While Henry might have been going through his own process, piecing connections together, his final idea was not new. The chronicles of *Le Canarien* tell us that Henry was not the first to breach this bind. As is often the case with entrepreneurs, he was not the first-mover. Henry was an early mover who had the funds and political clout to secure the market.

When they passed the Cape, they had overcome what had been a frontier, turning it into a new threshold from which a new range of entrepreneurial ventures could be launched into the Atlantic Ocean. Despite breaching this bind on rationality and market entry, Henry's success was not immediately applauded. He faced criticism as an entrepreneur-dreamer spending resources on an untried project. But after some time his project began to pay returns.

Henry wanted to obtain gold from the famed Rio D'oro . This (and Colombus's desire to reach the East) might imply some support of the Austrian view of entrepreneurs attempting arbitrage, the implication being that prices of a good are cheaper at its source. However, there is only limited support for this. Henry's motives for exploration were not just the pursuit of gold and were consistent with the incentive structure of the day.[31] Henry was a crusader. His caravels, adorned

with the cross of the Military Order of Christ and led by squires not merchants, sailed to inflict damage to the Moors along the African coast.

In 1436, his sailors returned with a cargo of pelts and oil obtained from seals on the coast. Given that Henry had a monopoly on soap manufacturing in Portugal, this was a welcome find. In 1439, another group of Atlantic islands was also colonised by Henry, the Azores. However, the voyages still had a strong military nature until they reached black Africa. Here, they encountered poisoned arrows and lances which created a level of discomfort that suggested they resort to more peaceful methods of increasing their wealth.[32] From this point on, the voyages became solely trade missions, initially trading horses for slaves. They provided the earnings and incentive on which further voyages could be based.

The early advance absorbed huge costs with little return and it is notable that in 1443 Henry sought and gained a monopoly on the African trade. This may reflect that he was incurring longer and more expensive voyages or it may be merely staking a claim to what appeared lucrative. Nevertheless, the monopoly would have brought out many of the advantages for R&D suggested by Schumpeter[33] in that it reduced the risks of competition and increased the chance of gaining a return. The monopoly bears some similarities to modern patents, in which inventors are rewarded with proprietary rights in their discoveries. This 'geographic patent' must have encouraged investment in what would otherwise be a very high risk venture.

Developing new routes was fraught with danger so advance was gradual, each voyage going further than the one before it. It was a case of learning-by-doing and the gradual accumulation of new knowledge. Learning was systemised by the use of logs in which the captain recorded his observations and experiences. These captain logs were used to help guide later voyages. Henry personally kept up with this growth in knowledge and frequently advised his explorers on what they might find in new regions. One of these explorers, an Italian by the name of Cadomosto,[34] described Henry as a practical and successful organiser of discovery and trade, who was directly involved in planning and control.

Henry's team was developing capabilities not only in maritime technologies, but they were also contributing to the growth of knowledge in geography which was a leading science of the day much as micro-biology is today. It involved a process of trial and error which was amalgamated with existing knowledge and resulted in a growth of knowledge of routes, winds, currents, coastlines, civilisations and markets. As with modern R&D projects, it involved a high degree of risk and clearly not all voyages were profitable as Henry had to draw on the reserves of the military orders which he led to fund them.

By the time of his death, his voyagers had discovered 2,000–2,500 miles of coastline; a pitiful amount by today's standards, but in its day, it was like going to the moon. Henry had become, at least on paper, the richest magnate in Portugal, although his propensity to spend also ensured he had significant debt. Henry was not the first Iberian prince to explore the Atlantic. However, he was the first who had the determination and funds to follow up his speculation. This does raise the question of why he had so much drive. In his will, Henry says that he devoted his life to Saint Louis, the French Royal Crusader. He seems to possess the 'will to conquer' that Schumpeter recognises as a characteristic of entrepreneurs, but he also seemed motivated by a spirit of scientific inquiry and the possible opening of economic opportunities.[35] He was also driven by fame, status and a concern that his reputation would last after his death.

State sponsored research continued after the death of Prince Henry. King John II, who took the Portuguese throne in 1481, financed a number of exploratory voyages and in 1487, Bartolomeu Dias became the first European sea captain to round the Cape of Good Hope. Finally, in 1497, Vasco de Gama went completely round the Cape into the Indian Ocean and reached as far as Calicut, India.[36]

The expansion occurred as a cumulative growth of knowledge; a case of the path-like development suggested by Dosi.[37] While new navigation techniques allowed ships to travel further, the resulting discoveries allowed cartographers the opportunity to make more reliable charts. This in turn gave captains greater confidence to sail out of sight of land. In this way the Portuguese built up capabilities and confidence in long oceanic ventures. With sightings of sun-height made by the captains, Portuguese experts developed the 'altura' system of navigation, in which the latitude of the ship was determined by examining the height of the sun at midday (not the pole star). To make this activity more reliable, new instruments (in particular the quadrant) and tables were introduced which related the height of the sun to degrees of latitude.

Through half a century of experience and trial and error, the Portuguese also gained knowledge of the Atlantic wind system. The Portuguese learned that the quickest route between two points was not a straight line down the coast, but to sail far west towards Brazil where they could catch the westward winds that would carry them into the Indian Ocean. In this light, we see entrepreneurial success as one stage in growth of industrial knowledge in which a threshold is required to achieve more ambitious goals.

Christopher Columbus

The success of Christopher Columbus illustrates the importance of the environment in providing opportunity for entrepreneurs. Columbus was very much a product of this environment and benefited from the changes mentioned in the first part of this article. He came from Genoa, the cradle of European seamanship where he gained considerable experience sailing in the Mediterranean and began to venture into the Atlantic. It was an ideal birthplace to develop the skills necessary to be an entrepreneur in this industry. Along with Lisbon and Venice, Genoa was the best incubator for entrepreneurs in merchant shipping.

In about 1476, he moved to Lisbon where he gained more experience of Atlantic winds and currents, sailing to the Madeiras and African coast. In Portuguese caravels, he gained knowledge of currents and winds, islands and shorelines that was not available to an earlier generation.[38] Like other Genoese living in Lisbon, he made a fortune from his work. Most important, his career provided him with capabilities that he would later exploit. He acquired experience as a businessman and deal-maker with ability to negotiate and sell ideas, and the capabilities to captain a ship.[39] Aside from these, he also seemed to possess important social skills, and received support from a wide circle of friends and family. His wife had influential connections that seem to have helped him gain access to royal courts to sell his ideas.

Columbus's skills and knowledge were a key part of his success. In a time when geography and navigation were the leading technical sciences, much as bio-technology or computer engineering are today, Columbus had the necessary capabilities. He was the equivalent of today's engineers. Yet he was also multi-skilled. He combined his navigation knowledge with business skills. Nevertheless he was not

the only person living in Iberia with the necessary skills and ideas. The last ingredient to his success was the drive with which he doggedly pursued his goals for a decade in the face of rejection and disappointment.

Christopher Columbus was driven by a number of motives that also reflected his environment. Like Prince Henry, this meant a culture of reconquista values. Columbus openly claimed to hasten the conversion of the world to Christianity and that profits from his venture should be used for the reconquest of Jerusalem. This was not just legitimisation. He clearly saw his voyage as an extension of militant Christianity.[40] He also wanted to become a nobleman. His drive for status can be seen in his request to Queen Isabel for nobility status on success (and may be one reason he sought royal backing for his venture). Columbus was also motivated by gold. 'Gold' he said 'is a wonderful thing! Whoever possesses it is a master of all he desires. With gold one can even get souls into paradise'.[41] However, these motivations were shared by others in Spain and Portugal and were not unique to Columbus.

By the time Columbus arrived in Portugal, the country had more than half a century's experience in exploring the Atlantic, so it is not surprising that it was in this environment that he started to piece together his idea for an enterprise to the Indies. He also benefited from the advances in technology made by Henry the Navigator's team. On his first voyage, Columbus carried the latest tables on solar declination and had learned the Portuguese innovations on measuring latitude.[42] Other important advantages available to Columbus were those in shipping technology outlined earlier. The ships he used embodied the latest technology and included two modified caravels (the *Pinta* and *Nina*) and one carrack (the *Santa Marie*). After modification, all were fully rigged ships with three masts and a combination of square and lateen sails.

He was also the product of the new age of printing. In Prince Henry's time only the rich and elite had access to books, but Columbus could benefit from the advent of the printing press which made knowledge available to common people. This provided him access to a wide range of ideas on geography relevant to his expedition. He had read Marco Polo and had used the wealth of Asia as a selling point in his proposal to the King. He owned copies of Ptolemy's *Geographia* and a work by Silvio Piccolomani that rejected the idea that the Indian Ocean was closed off from other seas.[43] He had also read *Imago Mundi* by Pierre d'Ailly, which suggested a westward voyage from Europe to Asia was possible and it was on this that he based his calculations (by this time, everybody was aware the world was round). He also used biblical passages as references to support his view of the world, remembering that at this time, the bible was not just a holy scripture but a source of knowledge.

Columbus read and selected ideas from the various writers he read and combined it with informal sources of knowledge. As a seaman, he heard stories of islands to the west and physical objects drifting on the sea from that direction which indicated there was human civilisation beyond the western ocean. He also spoke to sailors who told him how they had sited birds flying far out to sea, indicating that land must be nearby. As a navigator he clearly built on his own experience and questioned what he saw. In the fragment of a letter he wrote in 1495 which suggests he visited Iceland, he illustrates how he drew on his experience to question the geographic wisdom of Ptolemy.

> In the year of 1477, in the month of February, I navigated 100 leagues beyond the island of Tile (Thule), whose southern port is 73 degrees from the equator,

> and not 63, as some say, and it is not in the line where the West begins, as Ptolemy says, but much more westerly. And to this island, which is as large as England, the English go with merchandise, especially those of Bristol, and at the time I was there the sea was not frozen, although there were tremendous tides, so much so that in some parts they rose twice a day 25 fathoms and they fell the same amount.[44]

We cannot be sure of the method by which Columbus developed his ideas, but his biographers William and Carla Phillips state it was most likely that 'his geographic hypotheses grew incrementally, beginning with a fairly simple idea of sailing westward to reach the Indies and later adding evidence from academic geographers to buttress his case'.[45] In which case, it shows Columbus to be, like Henry, engaging in the synthesis of ideas that Shackle[46] said was part of the entrepreneurship process.

Columbus approached King John II of Portugal to finance a trip to India by travelling west across the Atlantic. There was nothing new in Columbus's idea, and he was not the only European to venture out into the Atlantic during this time. Between 1452 and 1487, at least eight commissions were issued in Portugal, and from Bristol, English seafarers searched the Atlantic for the mythical island of Brazil.[47] Supporting Columbus's logic was a map from the Italian Toscanelli which the Portuguese court possessed. The map showed it was possible to reach Asia by sailing west for 5,000 km. Toscanelli's and Columbus's estimation of the size of the earth were not the only ones available, but they were the most optimistic (like Columbus, Toscanelli had based his map on Marco Polo's book which exaggerated the size of China and the distance between Asia and Japan). However, after some consideration, the Portuguese King decided not to finance the project. Columbus turned to Spain.

The Iberian economy had grown to a point where others had the money to finance the venture which only required three ships. In fact, the Duke of Medinaceli agreed to finance the voyage, but they did not get the necessary approval from the Spanish court who wanted to control all Atlantic trade. Unfortunately, for many years the court refused to fund the voyage, leaving Columbus in a frustrating situation.

This situation finally changed in 1492, after the Spanish had finally beaten the Muslims in a war for Grenada. The final decision illustrated how the decentralised political environment in Europe assisted technological advance. Ferdinand and Isabella were won over on the basis that if they didn't support Columbus, he would go to a foreign power. They did not want to lose the possible benefits to a rival.[48]

Columbus did not just seek funds from the crown. As stated earlier, he also sought nobility status and the crown would reward him with the positions of admiralty, viceroy and governorship over the lands and seas he discovered. He sought a ninth of the profit from the voyage, and a right to invest and share in the profits in any future voyages. This last factor illustrates an interesting motive of Columbus. He was seeking a future proprietary right from this expedition. Although not as favourable as patent rights that innovators can gain today, it was obviously an important factor in his motivation.

It is questionable whether it was luck or good judgement that eventually led to Columbus's success. Spain had already developed the Canary Islands as its first maritime colony. By good fortune, these islands were close to the prevailing northeast winds. Columbus reached America because, in having a starting point at the Canary Islands, he was closest to the trade winds that could power him across the

Atlantic.[49] Whether Columbus chose this route because of the knowledge of winds he had gained sailing in the Atlantic, or whether it was luck, we cannot be sure.

Columbus eventually made four voyages to America and made great wealth for himself in the process. However, Columbus's R&D venture had failed to find a route to Asia, and the wealth he found in the Indies was not enough to compensate the crown for this failure.[50] Columbus had to modify his plans from trading with Asia to a colonising venture. It would take 30 years before the New World would yield substantial returns.[51] Nevertheless, until his death, Columbus publicly claimed he had found Asia. His success was based on an extremely flawed view of the world.

As part of his agreement with the crown, Columbus had been given the governorship of the young colony. Unfortunately, this revealed the limits to his ability. He turned out to be an inept administrator. Nothing in his background as businessman/navigator had provided him with the capabilities to fulfil this role as colonial administrator. He could not control his troops or colonists. He disobeyed rules about taking slaves and conducted wars against the local Indians, as a result of which he was taken back to Spain in chains. As the enterprise grew, it required administrative skills that Columbus did not possess. It is an example of the early phases of growth recognised by Greiner[52] in which an enterprise eventually outgrows its leader and goes through a leadership crisis.

Conclusion

Both Henry the Navigator and Christopher Columbus were talented entrepreneurs. Both were Schumpeterian-type entrepreneurs, who created new markets and new trade routes. Henry certainly became involved in arbitrage trade, but this was not by moving closer to the market in a way suggested by Hayek and Kirzner. It was the creation of a new market. Their enterprises opened up opportunities for other entrepreneurs to develop capabilities and build wealth. Their breakthroughs were at least as great as the Industrial Revolution and certainly more influential than Fordism. The opening of the routes to Asia and America heralded a commercial revolution that re-shaped the world of global commerce and shipping. In analysing their achievements, several environmental features stand out over which they had no control, but were vital for their success.

The first environmental feature was the state of the domestic economy. The European environment would not support this type of entrepreneurship until it achieved a certain level of economic growth. Once this was done, it provided entrepreneurs like Henry and Columbus with financial capital, products to trade and a domestic market to sell the products they brought back. Second was technology. Both ventures relied on a number of technologies to succeed. This included ship-design, navigation and geography. Thresholds needed to be reached before they succeeded and through their success new thresholds were created from which other entrepreneurs could benefit. Entrepreneurs are part of a technological trajectory to which they form a step on the way.

The environment was also important in determining what sort of skills they acquired and what information they had access to. It is notable that Columbus came from one of the two towns in Europe that had the strongest sailing capabilities. The two entrepreneurs had different skills. Henry was a maritime manager while Columbus was a hands-on practitioner. Nevertheless, both had the maritime knowledge necessary to succeed in this business. Where Henry lacked the

skills, he delegated. Where Columbus lacked the skills, in administration, he failed.

In both cases, their enterprises were informational/cognitive processes and were reliant on advances in knowledge and their dissemination prior to their venture's launch. Henry, as a member of the elite, had access to maps and books that were not available to the majority of the population, and with the invention of the printing press, Columbus gained access to information that seamen would not have had in earlier days. While they might have thought 'outside the box', there was nothing new in their ideas, nor were they the first to pursue them. Nevertheless, the ideas to which they committed themselves were not widely accepted. Their experience shows some support for Shackle's view of an entrepreneur as someone who is not necessarily rational but imaginative.

In terms of the McClelland theory on achievement, it is worth noting that a society determines not just if people strive for achievement, but where they channel their energies. Columbus and Henry both came from societies embedded in the reconquista mentality that encouraged people to make enterprises that could be used against the Moors. The fact that the earliest voyages were taken by knights not merchants suggests that the profit motive was not sufficient by itself to raise the necessary on-going commitment. To do this a combination of motives is required; a situation not too dissimilar to the modern engineer who is inspired both by profit and technological curiosity and the desire to solve a problem. In the same way that we should not over-emphasise the uniqueness of the idea, the uniqueness of Columbus's drive should not be over-stated. The courts of Europe received a constant stream of dreamers with schemes they wanted backed, and after the Portuguese had gained some success in ocean travel a demonstration effect existed in Iberia to show what could be achieved.

Another key factor beyond their control was luck. The role of luck is most obvious in the case of Columbus, particular given that he prospered even though he was wrong. Imagine for example, if the Atlantic Ocean was the same size as the Pacific. Columbus's journal shows that his men would not have lasted a trip the length of the Pacific. Columbus would have had to return home. He may have tried again later, or his voyage may have contributed to the knowledge of other mariners who one day would go that extra step and reach land. This shows entrepreneurship as an accumulation of knowledge with which success can depend on circumstances beyond the control of the entrepreneur.

Many modern clichés about success accurately describe the situation with these two entrepreneurs, in particular 'luck is where opportunity and preparation coincide'. Columbus was well prepared for such a voyage, with his wide range of skills and research. It was a matter of persisting until an opportunity opened, and that happened after Spain had beaten the Muslims at Grenada. They 'were in the right place at the right time'. The converse of this is the many voyages that left from Bristol and Portugal and failed to find land. It seems fortune only favours some of the brave, and for every successful entrepreneur, there were many failures. With success dependent on so many important factors beyond their control, their experience lends itself to an interpretation of environmental selection.

Both entrepreneurs formed new markets, creating connections and, in so doing, resemble the type of entrepreneurial process identified by Earl.[53] According to Earl, entrepreneurs develop markets by forming new connections between technologies and consumer demand. As technology and demand changed, so too did the opportunity to make new connections. This aside, there is one point that stands

out. Neither of our entrepreneurs ended up in a situation which reflected their original ideas. Their entrepreneurial action occurred under conditions of great uncertainty, but with flexibility they prospered. It is a view that suggests future research on entrepreneurship should place less emphasis on personal traits of successful entrepreneurs or the 'great man' view. It suggests more emphasis on environmental factors at the time they succeeded.

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