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Natural Disasters and Business: The Impact of the Icelandic Volcano of April 2010 on European Logistics and Distribution – A case study of Malta

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ABSTRACT

During one week in April 2010, distribution of packages and cargoes by air were grounded throughout Europe, as the eruption of a major series of volcanoes sent toxic and metallic particles into the air in the form of gas clouds. Most airlines operating in the affected area, anxious to comply with safety rulings, suspended all flights during this time. The major 'express' logistics and distribution companies – such as TNT, FedEx and DHL – were profoundly affected. Most packages for TNT, for example, are sent to a distribution hub in Leige, in Belgium. This hub became log-jammed and undelivered packages accumulated.

In a study of the impact on the island of Malta (conducted by an MSM MBA student from intake 26 as research for an MBA thesis), it was discovered that an entrepreneurial approach – by using sea-based deliveries also incorporating land-based trucking services – enabled TNT to steal a march on its competitors. Although taking two or three days to make deliveries that might normally take one day, TNT were able to keep their packages moving, when their competitors' packages were holed-up in Leige. Otherwise packages were hand-carried on commercial airlines – anything to solve customer problems. Customers won from the competition were so impressed by the responsiveness and flexibility of TNT in Malta that they were subsequently retained.

The lessons here for global logistics in handling natural disasters are many. Crisis management planning needs to be firmly in place, especially as volcanoes can erupt at any time – and many other natural disasters can negatively impact logistics and distribution effectiveness. Alternative methods and approaches to ensure deliveries need to be explored. Otherwise the loyalty of customers can be compromised, as even though they may appreciate a positive customer service attitude and low prices, results are everything in this business.

1. WHAT HAPPENED? THE VOLCANO

On the 14 April 2010 the Eyjafjallajökull volcano located in the south of Iceland exploded violently - after some weeks of minor eruptions - spewing a huge ash cloud that forced aircraft to stop flying over most of the north of Europe (*Financial Times*, 16 April 2010). The Eyjafjallajökull volcano, located under a glacier of the same name in southern Iceland, started its activity in the late evening of 20 March 2010 after being dormant for nearly 200 years (*International Herald Tribune*, 16 April 2010).

The volcano's initial action was hardly noted because of its lack of great seismic activity; but in the following days jets of fire burst out through a dozen vents, some reaching an altitude of nearly 100 meters. These jets accompanied by lava flows of 20 meters thick created a spectacular scene becoming a tourist attraction (*International Herald Tribune*, 16 April 2010).

However, just as it seemed that the volcano was returning to sleep, on 14 April it had its most violent explosion, blasting 200 cubic meters of ash every second into the air (*The Times*, 16 April 2010). The ash clouds ultimately reached a height of 11 kilometers and caused massive disruption of air traffic in the northwest of Europe. The largest explosion, at 10.25 am on 14 April, also caused the evacuation of around 800 people who lived in the volcano's surrounding area (*Financial Times*, 16 April 2010).

The eruption melted a vast area of the glacier causing floods that damaged bridges and roads. By later on 14 April, the floods were receding (Armannn Hoskuldsson, a volcanologist at the University of Iceland, *International Herald Tribune*, 16 April 2010). The 10.25 am explosion was the climax of the most dramatic activity of the volcano, starting on 13 April at midnight. This was only the fourth time the volcano has erupted in the last 1,100 years; previous eruptions took place in 1820, lasting almost a year (Nordic Volcanological Center in Reykjavik, *The Wall Street Journal*, 16 April 2010). The 11 kilometer-high ash cloud was blown by the southeast wind toward United Kingdom, The Netherlands, Norway and Sweden, then causing the biggest air traffic crisis since the September 11th 2001 terrorist attacks in the U.S.

Basically, volcanic ash poses serious risk for jet engines since it can cause damage to fan blades and clog surfaces or "even melt and clog nozzles with molten glass". The

plane can immediately lose altitude and even crash; otherwise it can cause damage that, in the case of a Boeing 747 jumbo jet, can cost $100 million to repair (*Financial Times*, 16 April 2010).

The ash is composed of silica (which is the principal element of sand and glass) and the particles, fine as powder, are sharp and abrasive (*Financial Times*, 16 April 2010). It also contains sulfur, which can penetrate the ventilation systems, affecting passengers with respiratory problems. The silicates, once sucked into the engine, can melt and make the engine flame and stall. The cloud, at 5,500 and 10,000 meters, did not represent any threat to human health, but thus obviously hindered aerial operations (*International Herald Tribune*, 16 April 2010).

On the 21 April, the landscape started to return to normal with the decision of the European Air Authorities to ease the flight restrictions of the previous six days. However, a new ash cloud was spreading south from the same volcano, suggesting ongoing problems. Sarah Holland, a spokeswoman from the Meterological office, said that the Eyjafjallajökull had continued erupting with less power but the ash concentrations could still harm aerial operations. A sudden change of wind direction continued the bad news for British airports, stranded passengers and airlines since the ash cloud, moving the previous days in a southeast direction, started to move back toward the UK. It caused the closure of the remaining British and Irish airspace (*International Herald Tribune,* 21 April 2010). Eventually the situation returned to normal, but left a sense of unease among travelers and businesses.

The Economist (16-22 April 2011), reflecting on the first anniversary of Eyjafjallajokull, explained how a new visualisation system has since been created. A two-day drill was arranged, with 70 airlines and a dozen air-traffic control systems taking part. As we will see, the 2010 disaster resulted in 100,000 flight cancelations, airline losses of over 1.3 billion euros – then worth 1.7 billion.

Are we now better able to cope? In 2010, some regulators shut down completely – saying that the volcanic ash must be totally avoided – but new approaches to safety have been developed. A task force set up in July 2010 by the International Civil Aviation Organization aimed to do away with blanket bans and adopt a more targeted way of dealing with similar disasters. National regulators are now making decisions based on

assessments by the aircraft operators, which take into account flight plans, available equipment, the ash's disposition and direction, etc.

Scientific preparedness by bodies such as the UK Metrological Office has improved, with an increased ability to predict the movement of ash clouds, using a model built after Chernobyl. This weather-forecasting model involves the injecting of particles, and a study of where the weather takes the particles, which will be especially accurate with the setting-up of a new mobile radar station in Iceland and the development of the Met Office's 'contingency aircraft'. In the future, we may be more prepared scientifically, but will our businesses also be able to react more effectively?

2. IMPACT ON AIRLINES

The early development of the crisis between the 14th and the 15th April is summarized in the table below:

Wednesday 14 April 2010	
10:25 a.m.	Volcanic eruption in Iceland, the second in four weeks.
11:15 p.m.	The UK NATS says the ash cloud will spread across Northern Europe Overnight
Thursday 15 April 2010	
02:00 a.m.	Scottish airspace closes
05:00 a.m.	NATS restricts aircrafts flying into the UK
08:15 a.m.	Flight restrictions across Norway, Sweden and Finland
09:30 a.m.	NATS closes British airspace from midday to 7 am of the 16th

10:35 a.m.	Denmark and Finland both shut down airspace from 6 pm local time
12:30 p.m.	Sweden closes its airspace from 10 pm local time
02:00 p.m.	Amsterdam Schiphol Airport says that no flights will be allowed in after 7 pm local time
02:30 p.m.	Belgian airspace closed
04:00 p.m.	France closed Charles de Gaulle airport and 23 others at 11 pm local time
05:00 p.m.	Disruptions to flights across Europe continued for a further 48 hours (Eurocontrol, the regional flight authority).

Source: *The Financial Times*, 16 April 2010.

The most dramatic impact of the volcano was on the travelling public. Passengers were initially delayed and then stranded – and then faced issues of a lack of compensation, safety issues and political issues. Passengers were concerned that because of airline losses and the pressure put on the authorities through passenger and airline claims, the restrictions were being eased without strong safety reasons for doing so (*The Wall Street Journal*, 21 April 2010). The civil authorities based their decisions on evidence: "our way forward is based on international data and evidence from previous volcanic ash incidents, new data collected from testing flights and additional analysis from manufacturers over the past few days" (Dame Deirdre Hutton, The Civil Aviation Authority chairwoman, *The Times*, 21 April 2010).

By 20 April, 75 percent of European airspace was open, and flights at over 6,000 meters were allowed to fly over the region. Over 13,000 flights operated, of the 28,000 expected on a normal day. The losses of Europe's largest five airlines were estimated at €150 million in revenues per day (*International Herald Tribune*, 21 April 2010). From 17 April, only 30% of European flights had been operated, causing the cancellation of

more than 95,000 flights. More than eight million passengers were affected; 313 airports were closed, suffering losses of almost €200 million (*The Wall Street Journal*, 21 April 2010). It took several days for operations to get back to normal because of the huge backlog of stranded passengers over Europe (*International Herald Tribune*, 21 April 2010).

At this time, dozens of European carriers represented by three airline associations approached their governments and EU officials for financial help, asking for "a firm commitment to support airlines affected by the crisis" (*The Wall Street Journal*, 21 April 2010) "to ensure that the extra costs involved with the crisis and the loss of income to carriers do not threaten the financial viability of airlines to the point of bankruptcy" (*International Herald Tribune,* 21 April 2010) since the airlines' profits were reduced by more than 135 million each day. The European Union's executive body had said they may consider "updating state aid rules in the wake of Icelandic volcanic eruption to clarify how airlines affected by flight cancellations can benefit from national government help" (*The Wall Street Journal*, 21 April 2010), but the matter was not raised again; analysts suggested that the airlines should not to expect the kind of support given by Washington after the terrorist attacks on September 11, 2001 (*International Herald Tribune,* 21 April 2010).

At the start of the crisis, on 15 April, 5,600 and 7,000 flights (impacting 600,000 travelers across Europe) were cancelled (Lucia Pasquini, a spokeswomen from Eurocontrol, *The Wall Street Journal*, 16 April 2010). Eurocontrol is the 38-country agency that coordinates European flights in Brussels (*International Herald Tribune*, 16 April 2010). There are normally around 5,000 inbound and outbound flights from Britain each day (*The Times*, 16 April 2010). From 14-16 April, transatlantic flights from the US, operated by American Airlines and Continental Airlines, had to cancel 21 and 32 flights respectively to Europe affecting more than 4,000 people (*Financial Times*, 16 April 2010).

The overall costs to the airlines caused by this disaster are hard to calculate. The closing of the British airspace from 15 – 19 April was estimated at more than £100 million (€119,815,643) (*The Times*, 16 April 2010). British Airways calculated losses between £10 million and £20 million per day, totaling £600 million for 2010, after

losing £45 million because of the cabin crew's strike in March 2010 (*The Times*, 16 April 2010). Market value losses are also important. Ryanair lost £70 million of its market value at the time, as well as BA and EasyJet, who lost £4.5 million and £5.6 million respectively (*The Times*, 16 April 2010). BA stocks closed down more than 3 percent, while Air France-KLM and Lufthansa closed down 3.4 percent and 4 percent respectively. US airlines - American Airlines and United Airlines - also closed down on 16 April. "Every day of zero flying takes on average about 0.25 percent off an airline's annual sales…" said Joe Gill of Bloxham stock brokers in Dublin (*Financial Times*, 17 April 2010).

Over 57 percent (over 16,000 flights) of scheduled services in Europe were cancelled on 16 April, as well as 33 percent of the 300 flights arriving in Europe (*International Herald Tribune*, 17 – 18 April 2010). Late on 16 April - and because of the wind movement - the ash cloud had moved slowly eastward affecting other countries in central Europe, including the Czech Republic, Finland and Poland (*International Herald Tribune*, 17 – 18 April 2010).

As the week progressed, more airlines announced greater and greater losses. Emirates announced daily losses of up to €25 Million. A total of 313 Airports reported losses for €136 million according to the ACI, an airline industry trade group (*The Financial Times*, 19 April 2010). The airline industry leaders said that losses up to Monday were close to reach €1 billion in lost revenue (*International Herald Tribune,* 19 April 2010).

On 18 April less than 20 percent of 24,000 flights operated normally while by 19 April the number of cancelled flights had risen to 63,000 (*The Wall Street Journal*, 19 April 2010); the number of affected passengers so far reached 6.8 million by this date (*International Herald Tribune*, 19 April 2010).

Pressure came from airlines and airports on the authorities, concerned with the restrictions. The trade groups who represented both airlines and airports, asked for an "immediate reassessment of flight restrictions" based on the fact that so many millions of people have been directly affected (*The Wall Street Journal*, 19 April 2010).

The Association of European Airlines and Airports Council International Europe also released a statement supporting the ease on bans saying: "The eruption of the

Icelandic volcano is not an unprecedented event, and the procedures applied in other parts of the world for volcanic eruptions do not appear to require the kind of restrictions that are presently being imposed in Europe" (*The Wall Street Journal*, 19 April 2010). Olivier Jankovec, the director general of ACI Europe (representing 400 European Airports in 46 countries), said "while safety remains a non- negotiable priority, it is not incompatible with our legitimate request to reconsider the present restrictions" (*The Wall Street Journal*, 19 April 2010).

The secretary general of the 36 member association of European Airlines, Ulrich Schulte Strathaus also asked the national aviation authorities to use different measuring mechanisms than computer generated forecasts (*International Herald Tribune*, 19 April 2010).

Most of the claims were supported by the Lufthansa and Air France-KLM initiative of making test flights on 17 - 18 without passengers to measure the impact of the ash in the aircrafts. The tests were operated under visual flight rules rather than relying on the cockpit instruments and took place at altitudes between 3,050 and 8,000 meters. At the end of the tests no adverse effects on the aircraft were reported. Peter Hartman, chief executive of KLM, claimed "it is completely safe to operate flights during hours of daylight" (*International Herald Tribune*, 19 April 2010).

"We are amazed that the results obtained from the test flights carried by Lufthansa and Air Berlin on Saturday did not have any influence whatsoever in the decisions taken by the aviation safety authorities" said Joachim Hunold, chief executive of Air Berlin, a low cost carrier which also conducted test flights (*International Herald Tribune*, 19 April 2010). The claims were also supported by the Volcanic Ash Advisory Center in London which said that on Sunday afternoon there was "no significant ash risk" above 10,500 meters.

On 20 April, due to the intense lobby made by the airlines, with reduced volcanic activity and favorable conditions (of ash cloud movement and due to the volcano's shift from pumping ash to lava) the European air safety authorities relaxed the bans over the ash disaster (*The Times*, 20 April 2010). Airlines started to announce new operations (*The Wall Street Journal*, 20 April 2010). Airports in Scotland and London started operations from 7 am on 20 (*The Times*, 20 April 2010). At that point, "the sky

will be divided into three areas, with the no fly zone immediately over the volcanic plume. A second zone, including much of the area deemed out of bounds until last night, will cover an area where ash may be present but flights will be allowed to operate under strict conditions. The third area will be open skies where normal schedules can resume" (*The Times*, 20 April 2010).

Up to this point, more than 80,000 flights had been cancelled and more than 8 million passengers had been affected. The sector losses calculations were maintained at €1 billion (*The Times*, 20 April 2010). The impact on the European economy was calculated at more than €1.5 billion and Royal Bank of Scotland economists said that the impact of millions of people stranded away from home cost €480 million a day because of lost productivity. BA announced losses of about €96 million, easyJet calculated its losses in €48-54 million. Air France-KLM also claimed losses for nearly €35 million (*The Times*, 20 April 2010).

European air traffic then rose between 10-15% over the next two days, but it took some days for the aerial operations to return to normality, once it was established that the favorable conditions were going to continue. European air space was mostly cleared by 21st night, however a single change in the volcano or the winds would have led to a deterioration of the situation again (*The Wall Street Journal*, 20 April 2010).

Many airlines complained about the weaknesses of the current system. "The Civil Aviation Authority will base their decision on what they are being told by the National Air Traffic Services (NATS). NATS say they base their decision on what they are being told by the Met Office and the Met Office say they are only making a weather forecast", exclaimed BA. Giovanni Bisignani, Iata's (International Air Transport Association) director general, said "we have seen volcanic activity in many parts of the world but rarely has it resulted in airspace closures and never on this scale", suggesting a level of mismanagement (*The Times*, 20 April 2010).

In the meanwhile other transportation providers, such as Eurostar and P&O Ferries, reported increases in their operations bookings. A P&O Ferries spokesman said they had a 40% increase in their bookings and that their prices had been raised from £60 to more than £150 for a return trip over the weekend (*The Times*, 16 April 2010). Eurostar also raised prices from £69 for a return trip to £179 single trip. Spokespeople from

both companies mentioned that the increase was not due to taking advantage of the situation, but because of higher staff costs to cope with the rise in demand (*The Times*, 16 April 2010). Over 150,000 Britons were stranded abroad, 40,000 Americans were stranded in Britain (*The Times*, 20 April 2010). The impact of the crisis on airline passengers led to four times the usual business for P&O Ferries. Eurolines UK, a coach company, said they had to add about 100 coaches for Britain-bound trips (*The Times*, 19 April 2010).

The impact on passengers was enormous, and the impact on logistics and the distribution of goods – the main focus of this paper – was even greater and more challenging to resolve.

3. IMPACT ON LOGISTICS AND DISTRIBUTION

Since 2005, European trade logistics have seen stable growth, especially in Italy and France. This growth has its origins in the U.S. economy problems as currency (American Dollar) devaluation. This issue has given the European logistics market a competitive advantage because while the transportation and logistics companies in the US suffered with rising fuel prices, those in Europe benefited from a strong currency and the experience of dealing with expensive fuel and operational costs for years. Eve Greb, a Standard & Poor's credit analyst, suggested in a report of February 2008 that "the mood in the European logistics sector is upbeat; the effects of a weak U.S. dollar are limited because the sector relies on locally-based business" (Dibenedetto, 2008).

The ash cloud crisis of April 2010 impacted this sector significantly, especially on industries such as fresh cut flower distribution, car manufacturing, and all perishable goods companies. Delivery companies were among the first to set off alarms, because of the continued grounded flights and the uncertainty on how much longer the crisis would last.

These companies were forced to look for alternative means of transporting and delivering high value components and perishables, usually moved by air. Dan Moriarty, the operations director of Early Bird Trans Global, said “our courier and express

services have been dramatically affected…it is an unusual situation. Most of our clients accept this" (*International Herald Tribune,* 17 April 2010).

Other logistic companies such as Germany's DHL announced several problems because of their heavy reliance on air freight (*Financial Times*, 17 April 2010). The Deutsche Post-owned company had shifted traffic to southern hubs were aerial operations were still open and in the north they were using more trucks and trains to deliver packages with the inevitable delays, said Stefan Hess, a spokeswoman of the German company (*International Herald Tribune*, 19 April 2010).

Other businesses that rely strongly on just in time deliveries were pushed to test multimodal mixes between ship, truck and planes (in these areas were flying was still possible); industries as the electronic and the pharmaceutical were among the worst hit ones by the impossibility of performing any aerial operation while the prices of container shipped by ship and truck were raising even further. The chief executive of Ceva Logistics, Bruno Sidler, said that the company was testing operations as flying goods to Turkey or Morocco (countries with no restrictions) and trucking from there. Alain Braithwaite, chairman of LCP, a logistics consultancy, said that the options would depend on how the situation develops; if the ash cloud moves away from a defined place, then this place may become into a main hub. Food supply was the main concern by these days, however this goods were widely moved before in refrigerated ships or container vessels and it would continue to happen the same way. Mr Sidler, the Ceva chief, also said that some premium vegetables as well as cut flowers would be worst affected "it may mean some scarcity, but nothing that would really disrupt people's lives". In his opinion worst consequences would be for manufacturers of electronic products and other air freighted components. Mr. Braithwaite, LCP's chairman, considered that "if you are producing and packaging pineapples in Ghana, you have rotting pineapples and no way to mitigate that in the short term at all" he said, meaning that small producers in developing countries which depends on exporting by air to Europe would be more seriously affected with the crisis. Mr Christopher Snelling, the head of global supply chain for the Freight Transport Association, agreed in his point of view with Mr. Braithwaite saying that not only businesses in Europe would be

affected but farmers in developing countries relying on exports to Europe would be also seriously harmed (*The Financial Times*, 19 April 2010).

By that time supermarkets were already expecting scarcities on products such as avocado, pears, mangoes, papaya, grapes, limes, baby sweet corn, orchids and roses. Tesco and Marks & Spencer said that by this time less than one percent of those items were brought by air. Countries such as Kenya were expected to lose up to £2.6 million a day because Europe provides the main market for flowers and vegetables grown there. "Over the weekend we have had to dump somewhere close to 65,000 tons of vegetables and we are to dump 400,000 stems of roses" said Johnnie McMillan, operations director of one of the Kenya's leading vegetables and rose exporters, Vegpro Group (*The Times*, 19 April 2010).

The fear was the uncertainty about the strength of the crisis hit over the European economy. "Given that the recovery of the Euro area economy is anyway so weak, it might have an impact" is what Daniel Gros, the director of the Center for European Policy studies in Brussels, wrote in an e-mail message. However many economists were confident that the volcano effects would not push Europe back into a recession. The case of Greece was different as, deep in debt, the volcano threatened to disturb tourism right in the peak holiday season. "It could make matters worse for Greece, which obviously needs every penny from tourism" said Jacques Cailloux, chief European economist for Royal Bank of Scotland in London (*International Herald Tribune,* 19 April 2010).

Pharmaceutical and technological companies said they had enough inventories to not to be worried in the short run and some perishables retailers said that most of their goods are moved by refrigerated container ships. "Fewer than one percent of our products are air-freighted" said a Tesco spokesman (*The Wall Street Journal*, 20 April 2010). AstraZeneca PLC and Roche Holding said they were not concerned about shortages, but GlaxoSmithKline PLC was identifying "medically critical products" whose supply chain could be interrupted because of the restrictions (*The Wall Street Journal,* 21 April 2010). The Toyota Motor Corp and Honda Motor Co said that the volcano has not caused logistical problems, but Nissan and BMW said they had to suspend production in several factories (*International Herald Tribune,* 21 April 2010). Nissan

announced the suspension of Irish local production lines because of the impossibility of importing pneumatic sensors, and BMW said that the restrictions delayed production at three plants in Germany because they ran out of certain electrical components affecting more than 7,000 vehicles (*The Wall Street Journal,* 21 April 2010).

The components shortage reached companies as Airbus, the aircraft manufacturer, whose wing assembly facility in the north of Wales would have had to shut production if the airspace remained closed. Due to the same reason it was impossible to deliver complete wings to Hamburg and Toulouse for final assembly which could have caused the final assembly line to stop. By the 21st the estimates of economic losses over Europe due to lost productivity were about £400 million a day (*The Times,* 21 April 2010).

4. BACKGROUND TO TNT AND COMPETITORS

The main courier companies operating in Europe were profoundly impacted by the ash cloud disaster – but some have used it to review their operations and consider the way they might operate in a more optimal way in the future.

TNT, one of the main intra-European logistics companies, when faced with the ash cloud crisis, immediately started road operations to overcome the situation. As we shall see below, the company's experience in Malta – as an island – was to play a key role in the way it operated in the crisis across Europe, with many important lessons for the future.

TNT had landed a crucial flight from China late on the 15th, the only flight of three per week under normal operations, which carried high value electronics and automotive parts from Chinese suppliers to European manufacturers. That was the last one for some time.

Realizing that air transport was not going to resume shortly, TNT added extra trucks to its road hub in the south of the Netherlands since its main air hub in Liege, Belgium – initially congested with piles of undelivered packages – also started moving goods by

road, said Cyrille Gibot, TNT's spokesman (*International Herald Tribune*, 17 April 2010). The company also moved goods by sea – see the case study below.

Deutsche Post's DHL was doing the same, but later – setting up "an alternative and decentralized road based network" said Jörg Wiedemann, a spokesman from the company, who also said "we are progressively re establishing our air network, as flight bans are being lifted throughout Europe" (*The Wall Street Journal*, 21 April 2010).

The key to TNT's response was being early on in the switch to road use. The TNT Malta competitors were unable to operate during the ash cloud crisis period. DHL, UPS and FEDEX were relying on their strong logistic bases; however this strength was founded on their aerial operations and those operations were blocked by the ash cloud. The competitors' effectiveness in their current operations hindered them from exploring the possibility of having a different operation aiming to fulfill different client needs in crisis periods.

DHL, UPS and FEDEX's awareness about sudden changes was low and their preparedness for overcoming this sort of natural disaster was minimal, to the point that some time after the crisis had started, they were asking TNT Malta to move packages for their own clients (although TNT wanted to move the packages for the clients directly – see below).

With the competitors' advantages being reduced and with TNT Malta operations still running despite the disaster, the opportunity for gaining clients because of good service was a possibility. This was understood by TNT Malta Team, specially the sales team, who as soon as the solution was proposed, started using this advantage to attract customers from all over Malta, and filling their trucks.

Many new clients started to work with TNT Malta under the ash cloud restrictions and made new agreements. The customers heard that the truck operation was supposed to replace the aerial operation and was to run only during the crisis period. The restrictions/new agreements were: on time delivery but new timeframe, from overnight deliveries on the aerial operation to third day deliveries on the road operation. But at least the deliveries were guaranteed, and TNT was able to take a competitive advantage.

5. BACKGROUND TO MALTA

Malta, a 316 square kilometer island in the Mediterranean Sea, joined the European Union in 2004. The EU's smallest member, Malta is a free-market economy where tourism and international business, especially in complex manufacturing (electronics, pharmaceuticals) and in services (financial services, gaming, shipping), are predominant. Malta, a republic with a generally favorable tax environment and plentiful government incentives, is also attractive because of the presence of a skilled, loyal, well-educated and multilingual workforce (Jones, 2008).

Package deliveries in Malta are an important business due to its high level of imports. Malta lacks of natural resources, therefore over 75% of its food is imported. Exports from Malta are also important – exports to other EU countries count for around 50% of Malta's outbound trade. 70% of imports also come from the EU (Jones, 2008).

This issue is an important characteristic of Malta's trade environment; its principal partners are the UK and Italy, however links with China are stronger since China invested in major infrastructure projects in Malta, such as Grand Harbor.

Malta's Central Bank joined the European system of central banks and became part of the Eurosystem on May 1st 2004 and the Eurozone on January 1st 2008 respectively.

All the major courier and logistics firms are represented in Malta, including TNT, DHL, Fedex etc. – and the Malta post office.

6. CRISIS MANAGEMENT THEORY

Crisis management is defined as "a series of functions or processes to identify, study and forecast crisis issues, and set forth specific ways that would enable an organization to prevent or cope with a crisis" (Darling et al., 1996). It also relates to the way the company approaches, reacts and solves a problem when it comes, and the degree of success of the outcome.

Crisis management involves the act of planning for a crisis as well as how the company solves the problem according to the plan (if the plan was appropriate and helps in solving the problem). It also relates to how the management team reacts, decides and

solves unplanned or emergent situations that may arise along the crisis period. This act of making decisions under crisis periods is clearly more difficult than during normal times because of stress, anxiety and pressure.

One way of seeing the ash cloud disaster is as a form of crisis management, including emergency (humanitarian) logistics management. Tovia (2007) defines emergency logistics as "the bridge between preparedness and response, procurement and distribution –the critical role being coordination of all activities required to minimize the response time and to maximize the relief in a disaster zone".

Emergency logistics and corporate logistics share a common issue, the delivery of goods or services at the right time, to the right place, in the right amount at the right cost (the definition for emergency logistics usually avoids the inclusion of costs since it is based on a humanitarian frame). The difference is the demand triggers. While in corporate logistics the demand can be forecasted and approximated by a probability distribution, in emergency logistics the demand cannot be forecasted and "the events triggering the need of emergency response are unpredictable and overwhelming" (Tovia 2007).

Models, such as the locally-led, holistic and inclusive model of natural disaster planning (Perry, 2007) and the Emergency Response Model (Tovia, 2007) can be analyzed with change models such as the coping cycle (Carnall, 1990) to obtain optimal insights of how to manage crisis, or managing change under a crisis environment. Other relevant theories include Lewin's force field analysis (Lewin, 1951). The force field analysis is a management technique which looks at the driving and restraining variables when implementing a change program. It is widely used to analyze intra company drivers and barriers for change.

A major change such as a natural disaster will bring consequences for business and industry, and if it happens in a widespread manner it will cause reactions in different parts of the world. *The Five Minds of the Manager* (Mintzberg & Gosling, 2003) define an important mindset called the worldly mind set, which refers to the ability to understand that the world is not uniform but made up of all kinds of worlds. The difference between being global and worldly is that the worldly view focuses on particular responses to specific market conditions while the global view tends to

generalize the market values and the practices used to approach those markets. By setting Lewin's analysis into the focus of the worldly mindset and taking into account external forces for the driving and restricting forces we would have a strong framework to analyze the changes made in TNT Malta by the crisis period – and how the company could turn a disaster into an opportunity.

Companies know that there will be a time when they have to suffer a crisis (no matter what type of crisis, it can be a tornado, flood, earthquake or an economic or man-made crisis), the question is now when, what type and how prepared the company is to overcome the situation (Mittroff, 1996).

Crisis triggers analysis and crisis management are not the same; crisis triggers can be forecasted, tested and simulated in many different scenarios, but obviously it will not be possible to overcome crises with all the answers for every single problem. Firstly, because the probability of taking account of every single possible problem is very low, and second because analyzing every possible solution for each problem is a huge and expensive task.

Companies that plan for crisis periods can perform better under this kind of situation than companies that do not. "Decisions will be more rational and better received, and the crisis will be of shorter duration, for companies who prepare a proactive crisis plan" (Maynard, 1993).

Even though the detrimental effects that crisis brings to companies are well-known, only a few carefully prepare themselves for crisis periods. A survey of chief executive officers of *Fortune 500* companies showed that 85% of them agreed that some form of crisis is inevitable, but only 50% of them had spent time setting a plan for crisis times (Augustine, 1995).

The fact of not being ready is even worse given that not all crisis are unexpected and that most of them give several and clear signals for being controllable from the beginning. This lack of attention is what causes the most damage to the company and what makes crises longer and more difficult to manage and overcome.

A company's ability or flexibility to read, analyze, measure and react to symptoms of crisis, as well as to evaluate the potential results, impacts on its performance in

business. An ability to read these symptoms is needed to allocate the crisis to a context or to decompose it into stages, such as by Fink (1986) when he mentions four different stages on a crisis: the Prodromal, Acute, Chronic and Resolution stages.

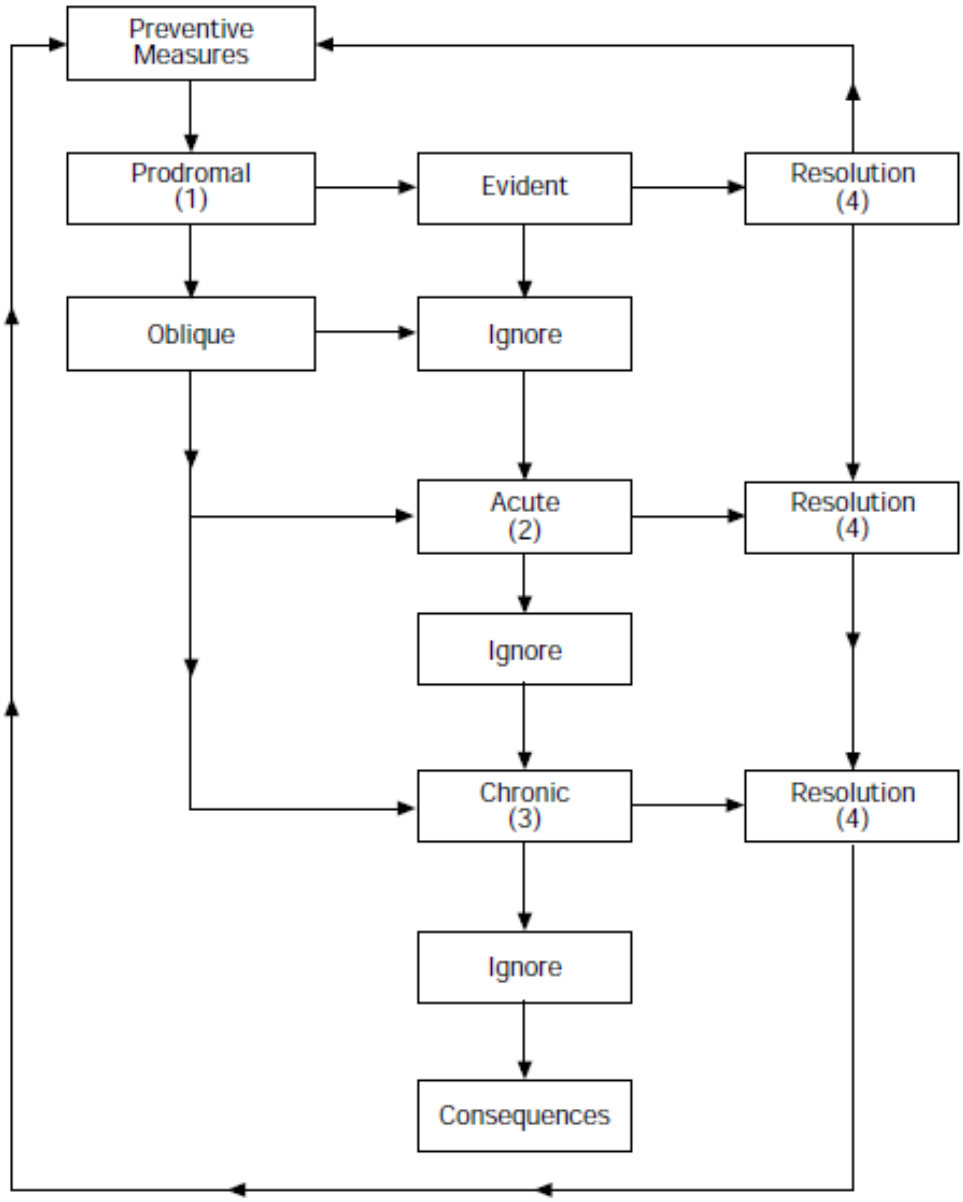
The Prodromal stage, as in medicine, is composed by the first warning signals that something is about to happen. It is the easiest, cheapest and most highly recommended stage to address to manage a crisis. However, in many cases it is difficult to spot because it looks like a daily issue which can be solved on the spot and may not be repeated again. A good way for noting signals on Prodromal stage is analyzing what is being repetitive and what can cause major problems to the company.

The Acute stage is defined as the stage where symptoms require urgent action, instantaneously, and which needs unrestricted action. In this stage the solution costs much more money and effort than in the Prodromal stage and the impact on the company (bad reputation, fines, and suits) is clearly higher. It is even more expensive not to treat the crisis at this stage and allow it to keep on growing and let it go into a Chronic stage.

The Chronic stage is the third stage and the most dangerous one in a crisis. At this stage the problem could have been within the company for so long that the organization may have got used to it and think it is tolerable. However, the crisis shows that the company cannot stand on anymore and that it is the ultimate spot for action. Therefore, the crisis is at a do-or-die stage, and it is the beginning of the recuperation for some companies as well as the final hit for some others.

The fourth and last stage is the Resolution stage. This stage is explained last but it can come at the end of any of the previous stages, whenever the company decides to take action to solve the problem.

However, solving the problem is not always that easy since symptoms may be confusing, and may be related to other causes, resulting in giving the wrong treatment and therefore allowing the problem to continue growing or causing eventual company destruction (Kash et al, 1998). The stages of the crisis can be seen in the figure below (Kash et al, 1998).



Source: Kash et al, 1998.

7. TURNING A DISASTER INTO AN OPPORTUNITY

The case study of TNT Malta and its performance during the ash cloud disaster was based on personal interviews, conducted in the TNT Malta offices 10-15 June 2010. This was almost two months after the crisis period, allowing time for reflection and analysis.

The impact of the crisis on TNT Malta started on 15 April 2010, just one day after the most violent explosion of the volcano. The impossibility of performing any aerial action

in northern Europe (all flights were cancelled) reduced TNT operational capacity causing several delays on deliveries from Malta to Europe and vice versa.

However, local collections in Malta remained normal those days because neither clients nor TNT were aware of the impact that the ash cloud could cause in their business. On 15 April, a Thursday, there were 107 collections in Malta to be delivered mainly in Europe; the on time delivered rate for this day was 4.7% (non delivered rate 95.3%). What this means was that from the 107 parcels collected, of which 102 were not delivered on time.

TNT's Global Information System was only able to give one reason for the delays at that time: "bad weather". TNT Malta's management team was already looking for possible solutions to the problem. They had no clue about how long the ash cloud could keep on hindering operations but they knew clearly that their clients were relying on TNT and that it was a big opportunity to out-perform competitors and show the TNT Malta flexibility and capacity – or at least that was how sales executive Mark Vella saw it (see below).

On the Friday 16 April the "bad weather" message was still appearing on the information system. The customers started to get nervous since there was no further explanation of what was happening with their packages, the current location of the packages or the presumed date to be delivered. The rate of failed deliveries increased on that day to 2.6%, with 97.9% non delivered packages. The number of packages this day was also higher, 143 parcels of which 140 were not delivered on time.

After two days of problems and with no solution coming from TNT Global the Malta team started finding a viable solution for their customers. TNT Malta was using trucks for non urgent-heavy load/volume parcels to their ground hub in Europe three times a week and these trucks were never used at full capacity, so the idea was to fill the trucks to capacity, according to the demand, and keep on shipping by road, while other operators as DHL, UPS and FEDEX were unable to ship a single box or package out of Malta.

The Saturday 17 April the collections number dropped as usual because of the weekend, from 143 parcels the previous day to eight. However, only one parcel out of

those eight was delivered on time. The non delivered rate of the 17th was thus 87.5%. On Monday 19 April the local solution was still being discussed with TNT Global, to start offering a parallel service to express shipments, and TNT Global had to approve it.

With the green light given by TNT Global on 19 April, the Malta team started gathering the load for the truck, to depart two days after. The rate of non delivered parcels that day was 88.3%, 91 failures out of 103 collections.

The worst rate of delivery achieved by the company was on Tuesday 20 April. The truck was still being loaded and delays on deliveries continued. Some customers were confident because they knew that TNT Malta was already working on the truck solution, some other were skeptical because they did not know how road shipments would solve the problem. Of 96 undelivered packages, only one was delivered. This rate really shocked Malta's team and pushed them to gather loads more quickly with the objective of moving the truck as fast as possible.

On Wednesday 21 April the solution started providing results. The truck was shipped and the promise of keeping the flow of operations was achieved. The new challenge for TNT Malta was to keep an accurate tracking of the parcels since they were packed into trucks and then into bags and with no possibility of individual identification along the road.

It was also a challenge to keep the increased volumes on the truck service flowing. It was close to be a totally new operation and the management and maintenance of it required much more effort than normal. The trucks passed from carrying 3 or 4 tons to be shipped to a full capacity of 12 tons each.

The results were also visible in numbers. The non-delivered rate changed from 98.9% the previous day to a 33.3% on 21 April and from an undelivered quantity of 95 out of 96 to 40 out of 120, signifying a great improvement, taking into account the increased number of the parcels this day.

The volcano disruption took place between 14-21 April, but the impact it caused on business remained, in terms of the TNT Malta operations, for nine more days. The time it took for the backlog to flow, for the customers to gain confidence again on the aerial operations and to reach 100% of operational activity again caused a continued high

utilization of the truck service. This lasted longer than the crisis period and accounts for the still high rate of undelivered parcels the following nine days.

The instability due to the increased operations was still visible on 22 April. This Thursday the rate increased again and reached a 40.7% with 46 non delivered parcels over 113. It was not as bad as the very first days of the crisis but this variation shows weaknesses over variables as shipments' destinations (due to a widespread number of destinations), conditions of the routes or topography of the area.

At the end of this second week the consolidation of the operational performance took place. Rates like 23.3% on the Friday 23 April (32 undelivered on time parcels out of 137) and 12.5% on the Saturday 24 April (two undelivered on time parcels out of 16) show that, by that time, TNT Malta had understood the magnitude of the operation and was able to cope with it more effectively, if not perfectly.

The third and last week of the crisis timeframe we are analyzing was more stable in terms of collections in Malta and deliveries around Europe. The numbers show a higher number of collections which may indicate the increased confidence the customers were gaining in the service. New clients who started working with TNT because their current operators were incapable of shipping their parcels also contributed to this increase.

On the Monday 26 April the operation reached a rate of non-delivered on time parcels of only 25.6%; only 28 failed parcels out of 109. The following days rates are 26,4%, 25,1%, 22,6% and 35% on the 27th, 28th, 29th and 30th respectively. The overall number of collections and deliveries from Malta to Europe in these two and a half weeks was 1472; the failures on deliveries were 728 for a rate of not delivered on time parcels of 49.4%.

OUTBOUND MALTA			
DATE	PARCELS COLLECTED	PARCELS NOT DELIVERED ON TIME	PERCENTAGE OF NON ON TIME DELIVERIES
15/04/2010	107	102	95.33%
16/04/2010	143	140	97.90%
17/04/2010	8	7	87.50%
18/04/2010	SUNDAY	SUNDAY	SUNDAY
19/04/2010	103	91	88.35%
20/04/2010	96	95	98.96%
21/04/2010	120	40	33.33%
22/04/2010	113	46	40.71%
23/04/2010	137	32	23.36%
24/04/2010	16	2	12.50%
25/04/2010	SUNDAY	SUNDAY	SUNDAY
26/04/2010	109	28	25.69%
27/04/2010	106	28	26.42%
28/04/2010	135	34	25.19%
29/04/2010	119	27	22.69%
30/04/2010	160	56	35.00%
TOTAL	1472	728	49.46%

The inbound operation showed the first crisis signals on the Friday 16 April. TNT Malta was expecting to get 108 parcels to deliver in the Maltese territory but due to the delays caused by the ash cloud crisis they only got 20. It means that 81.4% of the parcels were not delivered in Malta (88 parcels).

On 16 April there was no on-the-ground operation, and TNT Global was still not reacting to the crisis; at least not regarding Malta because of the volume of the operation, the size of the area and the revenue of the Maltese operation (seen as fairly slight).

On 17-18 (Saturday and Sunday) the operation dropped naturally because of the weekend. However the percentage of the non delivered packages remained high and,

most important, the number of undelivered parcels was shocking TNT Malta because of the customers complaints and their poor perception of the service.

The rate of undelivered parcels for these days was 73.3% (11 undelivered packages out of 15) on the Saturday and 27.7% (5 undelivered packages out of 18) on the Sunday. On Monday 19th the situation started being even more critical due to the increase of the parcels coming into Malta and due to the increasing rate of undelivered parcels. The number of parcels that Monday was 130 not delivered ones over a total of 139; the undelivered rate reached a disturbing 93.5%. By the 19th the TNT Malta team had developed the trucking solution for the outbound operation, but TNT Global team had not designed a solution for the inbound operation and was still relying on TNT Malta to solve the problem themselves.

TNT Malta solution was planned for the outbound operation. The inbound operation had, on principle, to be managed by TNT Global until reaching Malta. Once in Malta the deliveries were done through the TNT Malta network. However, as mentioned, TNT Global was not really interested in solving the Malta issue as a high priority; this caused an extra delay on offering a solution to the customers.

The inbound deliveries could run on the truck operation normally because the average number of packages going into Malta is less than the number of outgoing parcels. The problem was that at that time TNT Malta was just offering the truck service and the first truck was supposed to depart on Wednesday 21 April. The first truck would then be back in Malta on 23 April – in the best case scenario. This reason influenced TNT Malta to ask TNT Global for an inbound truck which could solve the problems they were facing, and retain customer confidence.

TNT Global heard the Malta team's suggestion and decided immediately to pack Malta's parcels into a truck and ship it the same day with the aim of reducing customer complaints and the perception that TNT Global was not approaching Malta's operation.

Although this was good news for TNT Malta, they knew that the backlog would cause them several problems for the next two or three days, but they could explain that the rate of undelivered parcels would decrease consistently after the backlog of shipments were cleared.

On 20 April, the undelivered rate reached the highest point in the ash cloud crisis for TNT Malta, with 98.2% with 108 non-delivered parcels out of 110. By 21 April there were no tangible results yet; TNT Malta knew it was still due to the big backlog, but the customers expected the undelivered rate to decrease substantially. This day the rate was 90% of undelivered parcels with numbers of 81 undelivered ones out of a total of 90, the rest of the packages were delivered only on 26 April due to problems with tracking parcels due to the crisis.

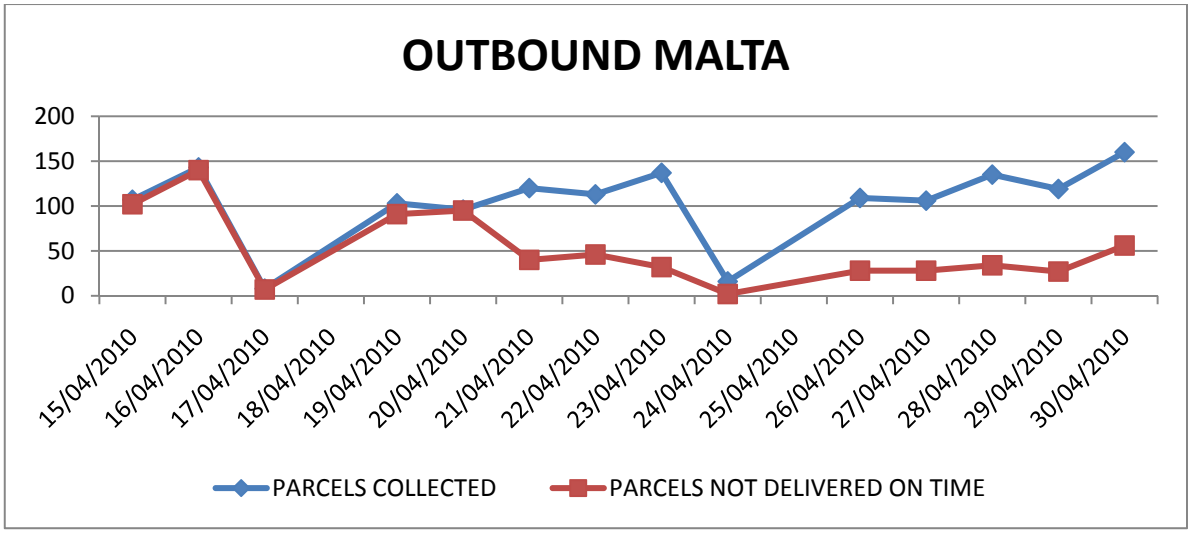
On the Thursday 22nd the situation started to change. The undelivered number of packages dropped down to 42 out of 112 reaching a rate of undelivered parcels of 37.5%. The reduced number showed that the inbound truck operation was operating successfully. Undelivered parcels were delivered on the 23rd and on the 26th. Again, as in the inbound operation, the lack of stability due to the increased number of shipments being carried by the trucks hit performance. On the Friday the 23rd the undelivered rate raised up to 44.11%, not as bad as the first crisis days but high enough to get customers nervous. The problem was that the parcels which were not delivered on that day were delivered only on the 26th because of coordination issues in the truck's route time and among TNT offices.

The weekend was coming and the number of parcels decreased. Saturday the 24th and Sunday the 25th had five and seven respectively, but no parcels were delivered on time, due to a lack of operational coordination, a blow for TNT even despite the small number of shipments.

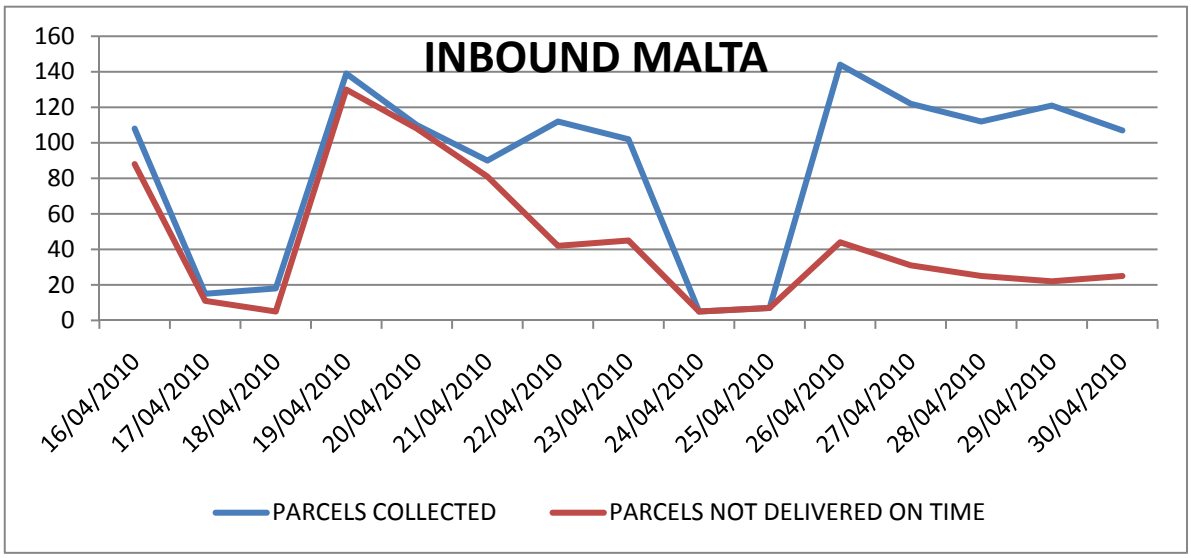
On Monday 26th the rate kept on going down with only 44 non-delivered parcels out of 144. TNT Malta was able to show that no matter how long the ash cloud stayed, the company was able to ship and deliver to a reasonable standard of efficiency. Some of these undelivered parcels were delivered on the 27th, only one day late, compared with the three days that it was taking before. The 27th the delivery rate was still improving, with only 31 undelivered parcels out of 122, which were delivered only one day later. The 28th, 29th and 30th, the last three days impacted by the ash cloud, had rates of only 22,3%, 18,1% and 23,3% respectively for undelivered parcels (summarized below).

INBOUND MALTA			
DATE	PARCELS SHIPPED	PARCELS NOT DELIVERED ON TIME	PERCENTAGE OF NON ON TIME DELIVERIES
16/04/2010	108	88	81,48%
17/04/2010	15	11	73,33%
18/04/2010	18	5	27,78%
19/04/2010	139	130	93,53%
20/04/2010	110	108	98,18%
21/04/2010	90	81	90,00%
22/04/2010	112	42	37,50%
23/04/2010	102	45	44,12%
24/04/2010	5	5	100,00%
25/04/2010	7	7	100,00%
26/04/2010	144	44	30,56%
27/04/2010	122	31	25,41%
28/04/2010	112	25	22,32%
29/04/2010	121	22	18,18%
30/04/2010	107	25	23,36%

The outbound operation is further shown in the diagram below, where the blue line represents the number of parcels collected and the red line represents the parcels which were not delivered on time. In the first days of the crisis (from the 15th to the 20th) there is no gap between the two lines - the difference between what was collected and what was not delivered was small. The average number of parcels delivered on time these first six days of the crisis was only five while the average number of collections was 92. From the 21st, the day where the backlog was solved through the trucks operation and the shipments started to be normalized, the gap becomes wider because the number of delivered shipments is bigger compared to the number of collected parcels.

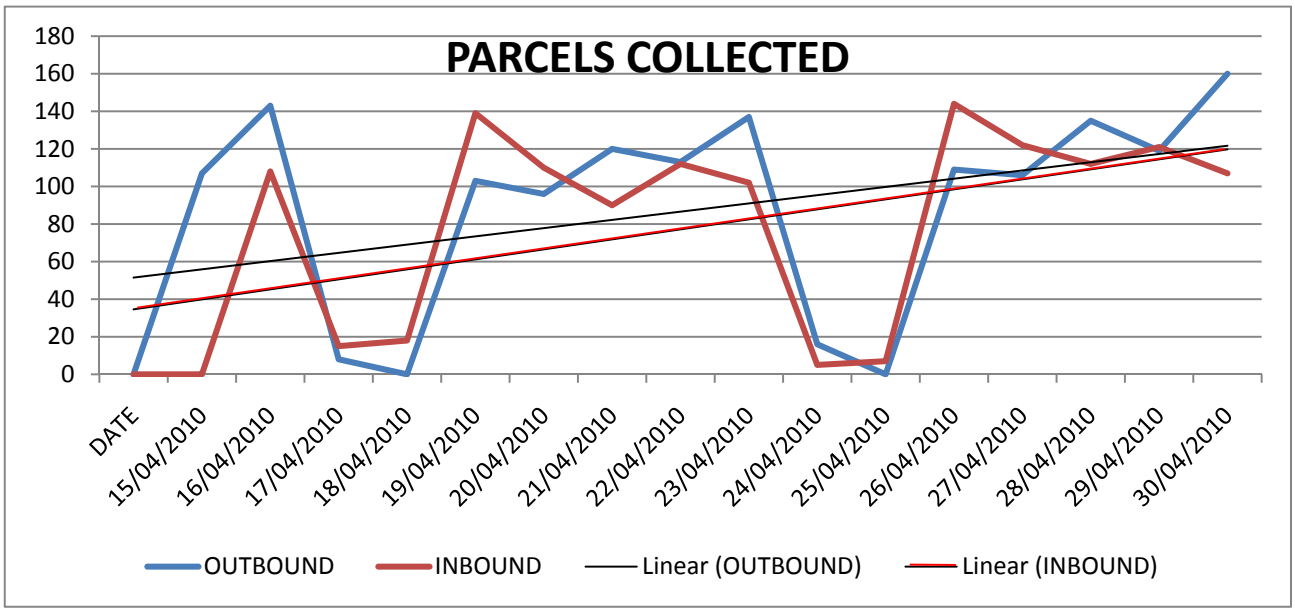


The inbound operation has two characteristics. The first is that it was the responsibility (in principle) of TNT Global. The second one is that the deliveries also take place on Sundays (the outbound operation did not run on Sundays). The first six days (from the 16th to the 21st) of the crisis timeframe under analysis showed an average number of successfully delivered parcels of 10 with an average shipments number of 80. The gap these first days is not as wide as the outbound operation. The number of non-delivered parcels was almost the same as the number of shipped parcels. The last nine days the gap becomes wider due to the implementation of the trucking solution.

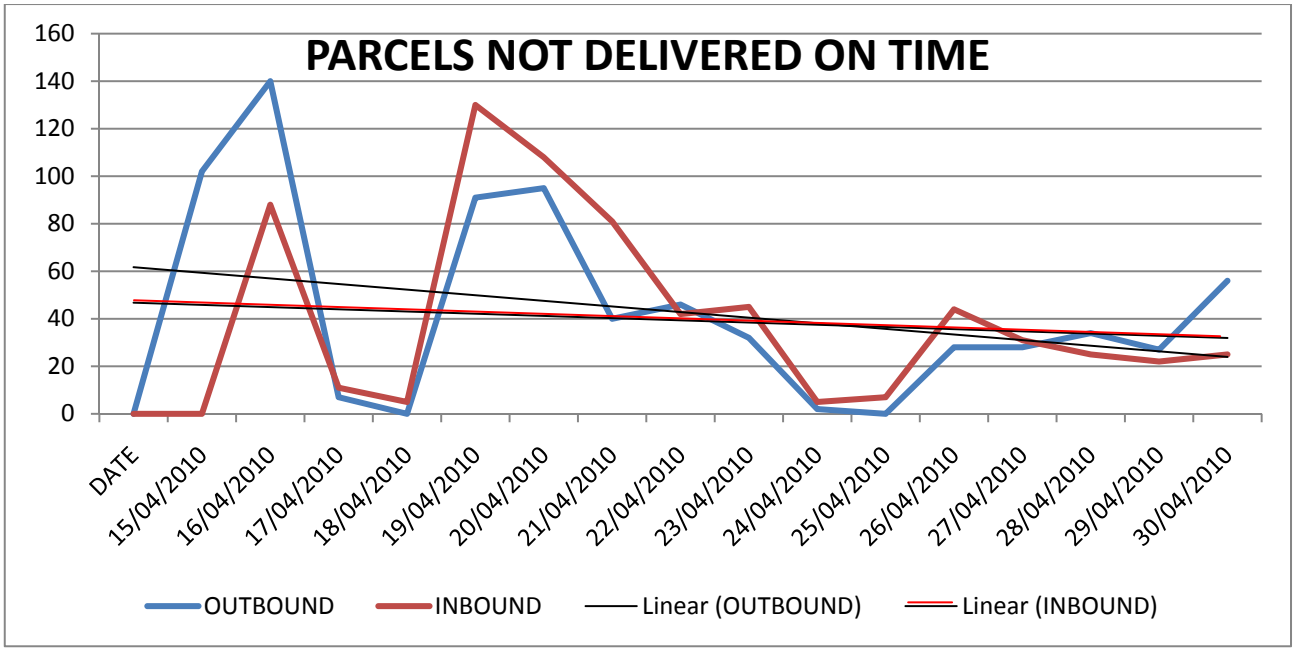


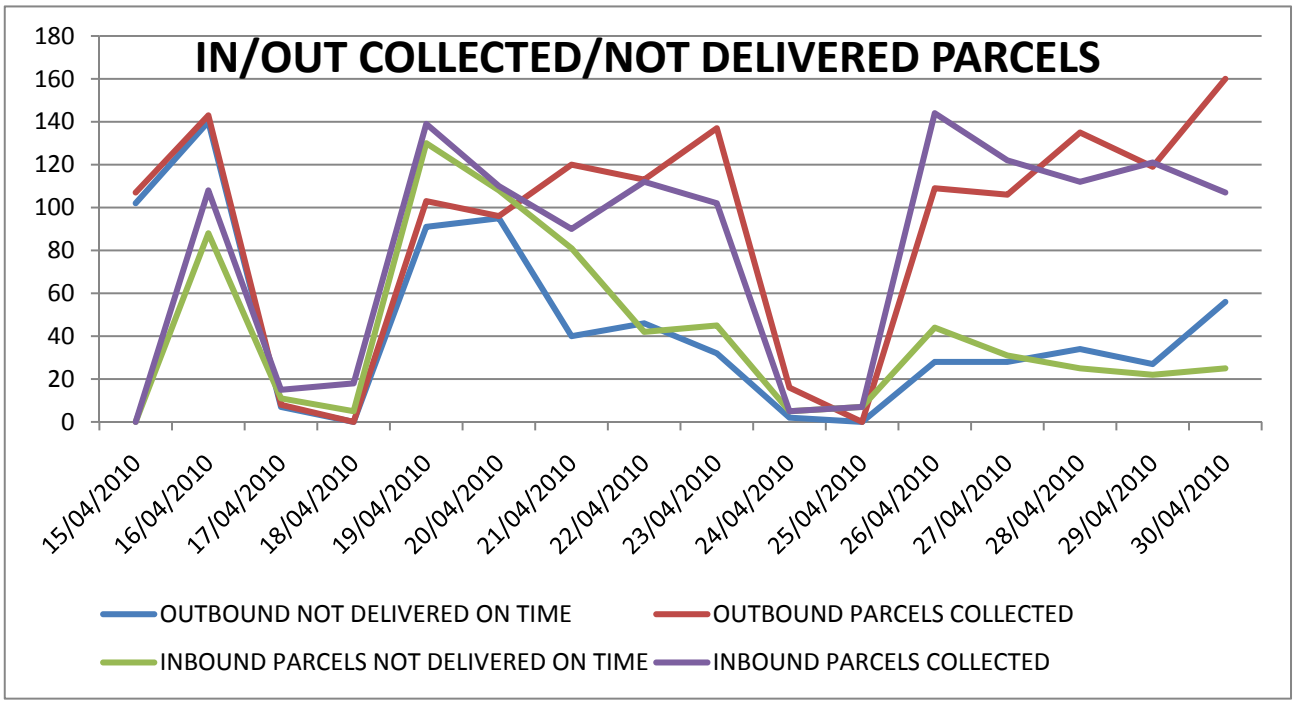
So far we have analyzed the data chronologically for each day and analyzing the actions taken by both TNT Global and TNT Malta. The outbound operation regarding parcels collected is bigger than the inbound operation. It means that parcels going out of Malta are constantly more than the parcels coming into Malta.

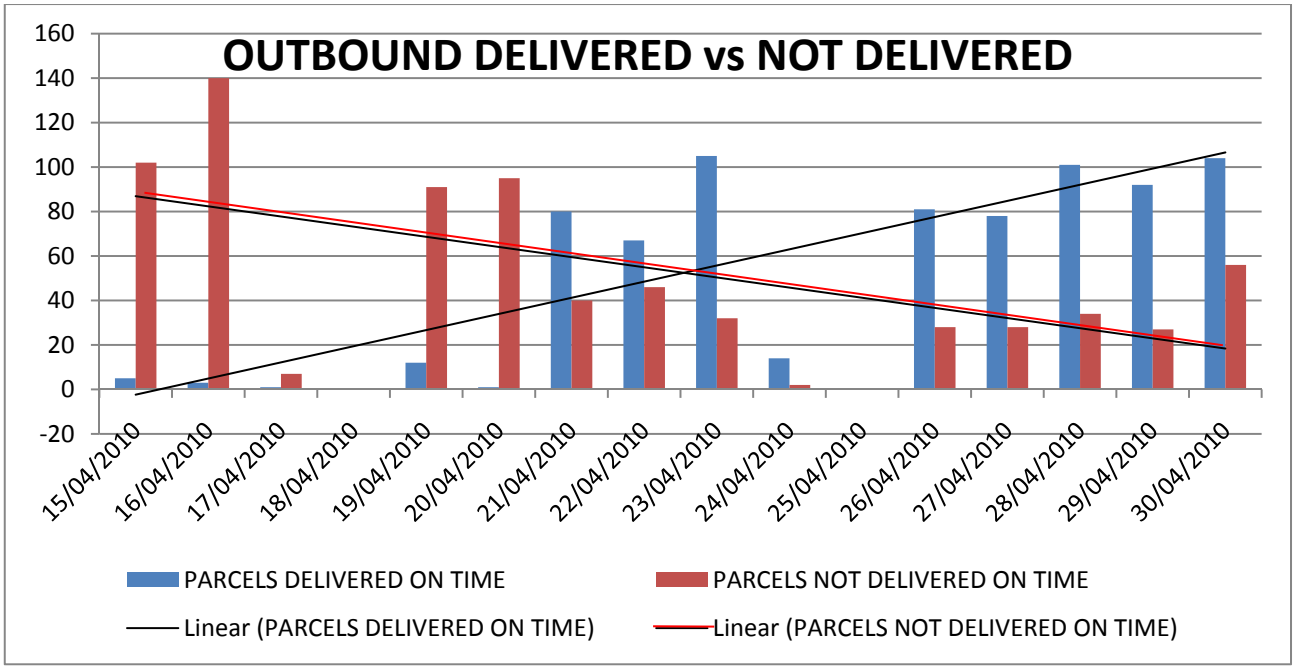
The total of the number of parcels on the outbound operation was 1,472 while the inbound operation registered 1,312 parcels. The average is 92 and 82 for outbound and inbound respectively. It explains why the TNT Malta team had to find a solution to the ash cloud crisis and why TNT Global was delaying finding a solution for Malta. With the solution that TNT Malta found for the crisis and continuous shipping (whilst competitors were stacked up without operating) the customers' confidence in the operation was growing. This was reflected in the growing number of shipments for current customers as well as the growing number of shipments for new customers.

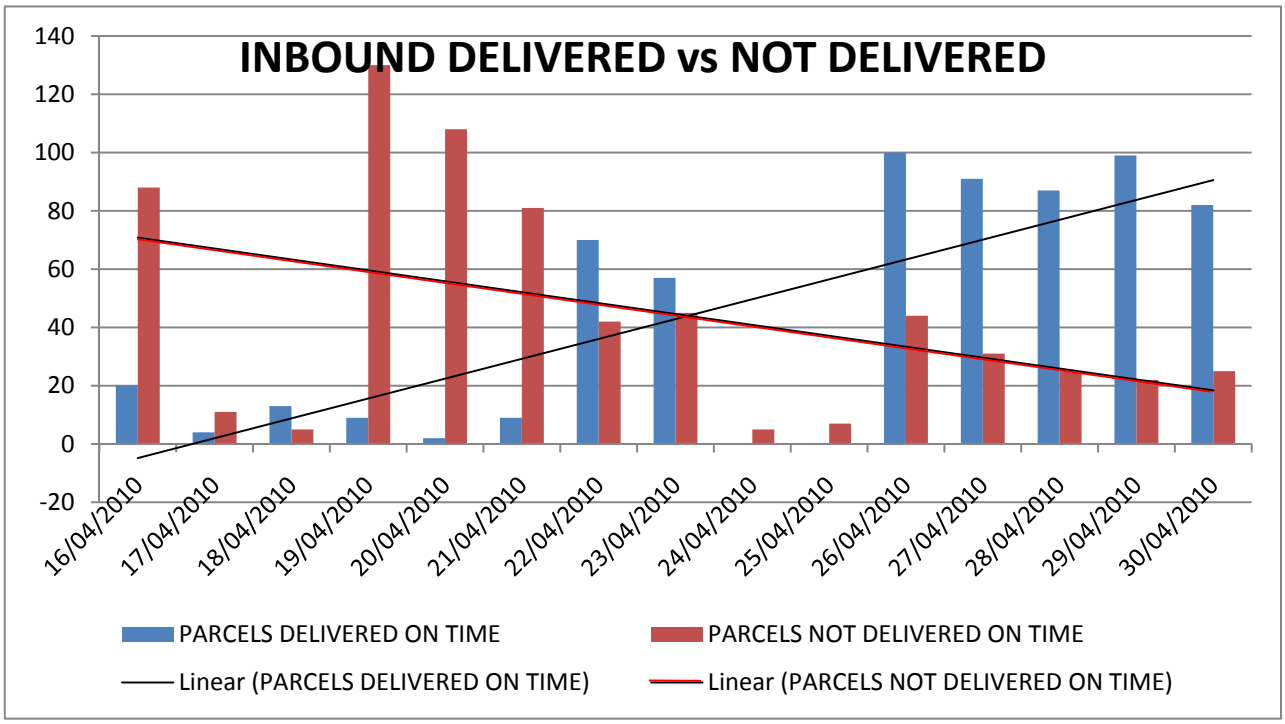


The outbound and inbound operations regarding parcels not delivered on time also show a bigger outbound operation compared to the inbound operation. It was to be expected because the number of collections in Malta was bigger than the shipments from outside Malta to Malta. The linear regression shows a decreasing tendency of parcels not delivered on time in both operations, so the solution was working.


PARCELS NOT DELIVERED ON TIME
160
140
120
100
80
60
40
20
0
DATE
15/04/2010
16/04/2010
17/04/2010
18/04/2010
19/04/2010
20/04/2010
21/04/2010
22/04/2010
23/04/2010
24/04/2010
25/04/2010
26/04/2010
27/04/2010
28/04/2010
29/04/2010
30/04/2010
OUTBOUND
INBOUND
Linear (OUTBOUND)
Linear (INBOUND)


IN/OUT COLLECTED/NOT DELIVERED PARCELS
180
160
140
120
100
80
60
40
20
0
15/04/2010
16/04/2010
17/04/2010
18/04/2010
19/04/2010
20/04/2010
21/04/2010
22/04/2010
23/04/2010
24/04/2010
25/04/2010
26/04/2010
27/04/2010
28/04/2010
29/04/2010
30/04/2010
OUTBOUND NOT DELIVERED ON TIME
OUTBOUND PARCELS COLLECTED
INBOUND PARCELS NOT DELIVERED ON TIME
INBOUND PARCELS COLLECTED


OUTBOUND DELIVERED vs NOT DELIVERED
160
140
120
100
80
60
40
20
0
-20
15/04/2010
16/04/2010
17/04/2010
18/04/2010
19/04/2010
20/04/2010
21/04/2010
22/04/2010
23/04/2010
24/04/2010
25/04/2010
26/04/2010
27/04/2010
28/04/2010
29/04/2010
30/04/2010
PARCELS DELIVERED ON TIME
PARCELS NOT DELIVERED ON TIME
Linear (PARCELS DELIVERED ON TIME)
Linear (PARCELS NOT DELIVERED ON TIME)


INBOUND DELIVERED vs NOT DELIVERED
140
120
100
80
60
40
20
0
-20
16/04/2010
17/04/2010
18/04/2010
19/04/2010
20/04/2010
21/04/2010
22/04/2010
23/04/2010
24/04/2010
25/04/2010
26/04/2010
27/04/2010
28/04/2010
29/04/2010
30/04/2010
PARCELS DELIVERED ON TIME
PARCELS NOT DELIVERED ON TIME
Linear (PARCELS DELIVERED ON TIME)
Linear (PARCELS NOT DELIVERED ON TIME)

8. THE PHARMA COMPANY CASE

Pharma Company (not the real name of the company, for reasons of confidentiality) is a pharmaceutical company based in Malta. The company was a UPS customer and their shipping lines to Europe were stacked up because of the ash cloud disaster. On the Monday, the 19th of April, Mark Vella, senior sales representative of TNT Malta, called the company to offer them the use of the TNT truck service. The Logistics Manager of Pharma Co was surprised to hear the news that TNT was still shipping packages, with no interruptions, despite the volcanic ash crisis. However, Pharma, as with many other companies, preferred to wait because of the uncertainty about how long the crisis would go on for (many companies thought that the crisis wouldn't last much longer).

On Wednesday the 21st, Pharma finally called back and said that they had 30 Kg to ship to Spain urgently, so TNT made the collection and shipped it from Malta to Pozzallo in Sicily by sea, and then to Milan by truck. From there the parcels were grouped in Milan's hub and shipped to Spain by air, but avoiding Leige – still stacked up. The package arrived in Madrid by truck and from there went to a local destination within Spain, by bullet van to the factory just outside Barcelona.

The challenge was that these products had to have an exact delivery date, because of the nature of the products as healthcare items, and logistically the operation had difficulties, as the final destination was not Madrid but a local destination within Spain, just outside Barcelona. This added an extra link with extra time and extra costs.

The trailer rate is the cheapest one in the TNT structure, but it does not guarantee delivery date; for this reason it was impossible to use it. The express service was only for main cities, not the case for the current service, so the solution was a mixture of road/air services including a franchised delivery rushed in a bullet vehicle for the final destination in Spain.

The customer had to pay an extra overhead charge for the delivery to a local destination guaranteeing the exact delivery date, and TNT delivered the products on time finding flexible inter-regional solutions to a singular problem in a crisis time. The operation exceeded Pharma Company's expectations because of the lack of

compromise to the quality-sensitive orientation of the company's products, and because the final price paid by them was justified by the benefit they received. They were impressed by the willingness of Mark Vella, and the sense of urgency and the coordination showed by TNT, to give an excellent and problem-solving service to their customers in times of need.

9. THE SEAT CASE

Malta Car Parts Manufacturers (not the real name of the company, for reasons of confidentiality) makes spare parts for cars, is located in Malta and one of their main clients is SEAT.

The company heard early on the 19 of April from SEAT in Spain that their client urgently needed a shipment of 20 boxes with spare parts to Barcelona, each box weighing 10 kilograms. By that time TNT Malta was the only logistics operator running on a constant basis in and out of Malta. This was a unique status in Malta, and the challenge to maintain it was getting bigger day by day. The goodwill generated by being able to perform difficult operations was now playing against TNT Malta, since the customers were asking for more difficult solutions.

SEAT was asking for, as much as possible, a next day delivery. The lead time from Malta to Barcelona in normal conditions is three days, or one day in express shipping. There was no load service to fit into the required lead time and the possibility of getting to the hub at Liege was very low, and in any case the shipment would then have been stacked-up in Liege for at least two days, if not longer.

So, how to send 20 boxes or 200 kilograms under the current crisis conditions, with no load service available and an urgent need to deliver the next day?

The solution came from the sales department through Mark Vella; the only way to get the boxes to Barcelona was through the TNT 'diplomat service'. This service was designed mainly for very urgent and regular shipments. The procedure is that a TNT employee at origin takes a commercial flight carrying the parcel. Once the employee reaches the destination he/she must go to the customer's offices and personally

deliver the parcel. The parcel is usually just a few kilos; this time it was 200, or in-flight luggage or about ten people. Luckily the airlines were being equally flexible.

The challenge with the current situation was not only the number and weight of boxes to be transported but, the fact that even though commercial flights were flying in the south of Europe, the chance of getting onto one of those planes was very slight, due to the quantity of desperate, stranded passengers trying to get on any plane taking them nearer home.

Mark Vella called the commercial airlines and planned a trip Malta-Rome-Barcelona, based on one open airport (Malta) and two airports open intermittently (Rome-Barcelona). The phone call from SEAT's suppliers was at 10.00 hours on the 19 April, and at 13.00 hours Mark Vella was taking off from Malta to Rome. At 21.00 hours he left Rome and at 23.00 hours arrived in Barcelona. At 01.00 hours of the 20 April he met with a representative of TNT Barcelona and at 03.00 hours he was delivering the shipment at SEAT Barcelona – less than 24 hours. The bill was more than $4,000 euros, but TNT Malta had another satisfied customer.

10. CONCLUSIONS

- TNT Global and TNT Malta succeeded in finding solutions during the crisis. The rates of successfully delivered parcels increased for both inbound and outbound operations after the solutions were implemented.
- The linear regression analysis supports the success of the solution found by TNT Malta showing a decreasing trend of undelivered on-time parcels after the mentioned solution was implemented, and an increasing trend of the number of parcels delivered on time in the same time frame.
- TNT Malta took advantage from an existing service to overcome the crisis situation; this eased the possible disruptions normally caused when implementing a new operation and allowed low negative impact on both company and customers.
- TNT showed flexibility in providing an alternative service when needed.

- The availability of resources combined with the will to serve as many customers as possible made it possible for TNT Malta to stabilize the crisis situation and offer a cost and time efficient solution for the customers.
- TNT Malta found a solution to the crisis because the crisis nature itself fitted into one of the current available services; however the company was not necessarily structurally ready to manage an operation under natural disaster circumstances.
- According to the persons interviewed, the readiness shown by the company, regarding the management of operations in a crisis, was low. The company had no plans to overcome natural disasters situations and, as the in the case of competitors, was dependent of their current operational structure.
- The company would have done even better if the management team had placed sufficient importance on setting plans and training people for a crisis.
- The fact that TNT Malta was the only company still operating deliveries under the crisis (as competitors stopped operations) supports the success of their approach.
- The number of clients gained during the crisis period is another measure of effectiveness, especially that they were retained when things got back to normal.
- The company's resources were not excessively challenged during the crisis because an existing solution was implemented. Their resources were usually underutilized having slack capacity, so the crisis led to a better utilization of operational capacity.

11. THEORETICAL FRAMEWORK CONCLUSIONS

- The ash cloud crisis is from the immediate type (Parsons, 1996). The crisis showed no warning of appearing but it is a company's responsibility to have a plan in place.

- The change process perspective used in TNT Malta was the Goals Perspective (Goodman & Pennings, 1980). Here the organization had preset goals and was able to measure the effectiveness of accomplishing these goals.
- TNT Malta's mood for change is located at a median point between a frozen enterprise (Hannan & Freeman, 1984) and "rapid, time-paced changes" (Brown & Eisendhart, 1997). The company is somewhat change-oriented, but would probably not find and make changes where they are not needed.
- The tempo of change (Weick & Quinn, 1999) of TNT Malta is standard for a logistics services provider company. The change happens because it is needed but, as mentioned, it does not reach the point of driving the company into constant transformation (Weick, 1979).
- Kotter's Eight Steps for Change (Kotter, 1995) was also followed by the company along the crisis time frame. It helped the company to cope with the unplanned change, although Kotter's theory is mostly aimed at achieving planned change.
- The framework of emergency logistics can be used to explain how preparedness must be brought to a company aiming to overcome difficult situations.
- The supply chain of emergency logistics theory (Thomas, 2003), which includes preparedness, assessment, resource mobilization and transportation, can be applied here to help improve the outcome of an structured plan for managing operations under natural disaster conditions in TNT Malta.
- Information and communication are the two basic pillars for surviving a crisis period (King, 2005). TNT Global did not manage them properly at the beginning of the crisis with the global network message "bad weather" inadequately explaining the real cause of the parcels' delays. Yet TNT Malta coped well with both information and communication, especially in updating existing and potential customers.

- Preparation and implementation of action plans for the crisis period did not appear to happen in TNT Global or TNT Malta because of the apparent lack of prepared plans before the crisis struck, when preparedness has been seen as one of the main important characteristics in overcoming with a crisis situation.
- Effective collaboration between parties is essential in managing disaster or crisis situations (Oloruntoba, 2005; McIntyre, 2002). This collaboration between TNT Malta, the Ferries Company – providing the service to Italy by sea – the trucking company – and Air Malta, all helped to support the operation.
- The fact that TNT Malta team was the provider of the solution was important because even though the problem was global, there were wide-ranging local consequences on Malta. Local solutions for local problems/consequences are often recommended. This empowerment also increases local logistics expertise for further crisis periods in the future.

12. RECOMMENDATIONS

- The change process in TNT Malta, especially the goals perspective (Goodman & Pennings, 1980) needs development and to be related to other perspectives, such as the systems and the global arena perspectives.
- The company must maintain the current tempo of change. It is important for a company to recognize when change is needed and start the process without making unnecessary actions because of fear of not changing.
- The readiness of the company regarding crisis situations must be more fine-tuned. It must be planned, implemented, trained and simulated.
- The company must set more detailed plans for operating under crisis situations like the ash cloud. It is imperative for TNT Global, especially. The current Malta success depended on an existing service, but the situation would have been different in the case of other natural disasters (such as tsunami, earthquake or flood).

- So the plan that TNT must further develop must be able to cope with different types of natural disasters. Several actions regarding each natural disaster type must be contained under the same plan.
- TNT must further use the framework of emergency logistics to develop the action plan under crisis situations. This will allow the company to build a more change-oriented plan to cope with real crisis situations and therefore the plan will be more effective.
- TNT must consider the relevance of the supply chain of emergency logistics to improve the effectiveness of the crisis operation plan.
- TNT Global must implement more communication channels to spread urgent information within the organization. Is the responsibility of the company to communicate in an accurate and timely manner.
- TNT must simulate the actions required in the crisis operation plan before the need of a real go-live. This pre-implementation will ensure that the actions are viable, achievable and effective. This will also help to reduce costs and problems in the go live.
- TNT must maintain the strategic collaboration with current partners as Air Malta, the trucking services and the ferries company and increase the number of logistic partners/providers aiming at strengthening the company's position in the market and to backup the weaknesses that arise in crisis situations.
- TNT Malta employees must work in a more integrated way. In the current crisis period the lack of coordination between workers/departments was not visible because the solution used was at hand and did not cause implementation problems, but the individual approach of TNT Malta employees to solving their own problems may cause more damage than good in crisis situations.
- The service culture shown in TNT Malta during the crisis period must be sustained through training processes directed to all level of employees, and reinforced with incentive programs.

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