THE BUSINESS IMPACT ANALYSIS

By Jacob Taarup-Esbensen, University College Copenhagen

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Abstract

This paper explores how an organisation can structure it's Business Impact Analysis (BIA) used to improve its Business Continuity capabilities and hence its overall resilience. The BIA is the first step that managers take to understand and prepare an effective response to events that can threaten the ability of a given organisation to create value. There have been many attempts to suggest how organisations can structure this analysis, but there is no set standard approach that can be taken off the shelf and used by managers and specialists. This paper proposes a structure which centres on the organisations' ability to create something of value and from there a stepwise analytical approach that ends in the estimation of recovery time and resource commitment to resume activities. The BIA follows a stepwise process starting with understanding what value creation means to a given organisation by determining its business model. Understanding value forms the basis for the next steps in the process: identification of critical activities, their interdependencies, robustness, internal and external resources needed, estimating maximum tolerable downtime and, finally, determining recovery time. The paper uses the example of a mining project in Greenland to illustrate how the individual steps play a role in the overall analysis of business continuity efforts of an organisation. However, it is possible to use the BIA approach in any organisation that faces hazards in the context where they operate.

The Business Impact Analysis

The number and scale of events impacting organisations and companies across the globe are on the rise. According to the World Health Organization (WHO), natural disasters kill around 90,000 people and affect close to 160 million people worldwide per year (WHO, 2020). Natural hazards include events such as earthquakes, tsunamis, volcanic eruptions, landslides, hurricanes, floods, wildfires, heatwaves, and droughts, as well as pandemics, as recently witnessed, which will dwarf these numbers. They have an immediate impact on human lives and often destroy the physical, biological and social environment of the affected people, thereby having a longer-term impact on their health, well-being and, ultimately, survival. But they also affect organisations and companies, who not only have to deal with the effect the event has on the people they bring together or employ but also the long-term economic and social sustainability of societies. It is thus in the interests of both the organisations themselves and governments to plan for disaster recovery, as not only lives, but also the ability of communities in general, depend on it (Elliot, Swartz, & Herbane, 2010; Ning & Wong, 2009; Sawalha & Anchor, 2012).

According to the World Economic Forum and Swiss Re Institute, the events of 2018 alone resulted in the total economic losses from disasters amounting to USD 165 billion (Swiss Re Institute, 2019). Insurance covered USD 85 billion of those losses, indicating that comprehensive insurance schemes do not entirely mitigate the scope and scale of disasters. The companies themselves will bear a significant part of the economic burden when disaster strikes. The example highlights the need for organisations to prepare themselves for the effect that a hazard might have on their ability to operate and the impact if it should materialise into a disaster. It is not to say that companies will be on their own, but rather that they will be increasingly reliant on their resources and capability to organise rather than on society or insurance companies to take them through a crisis.

At the heart of business continuity management lies the Business Impact Analysis (BIA) (Barnes, 2011; Elliot et al., 2010; Hassel & Cedergren, 2019) tool. The analysis is a tool that an organisation can use to understand the consequences and impact that a given event will have on its value-creating processes and provide input to management that enables it to decrease its vulnerabilities and enact plans for recovery. For managers of risk, the analysis provides insights into the interdependencies that exist across organisational barriers, providing hints as to the scale a given event might have on the organisation's ability to provide value to its customers and stakeholders. The BIA is in this way, a resource that managers can use when understanding how the organisation creates value and a foundation for decisionmakers to prioritise resources that will result in recovery.

This paper discusses the relevance and steps it takes to create a comprehensive BIA as a tool for decisions resulting in organisational recovery after a disastrous event. The central argument is that the analysis can be linked to the well-known bow-tie analysis and thereby support the strategic efforts to reduce uncertainties as to the effect hazards have on the organisation.

The bow-tie model

A good starting point in understanding the value of business continuity management (BCM) is the bow-tie model (see Figure 1). The bow-tie model is widely used in risk management and serves as an analytical tool in a wide range of industries (Jacinto & Silva, 2010; Markowski &

Kotynia, 2011). The analysis includes the complete event scenario, compounded by a fault tree (the left side), which identifies causes to the event, and an event tree (the right side) which deals with the consequences that an incident will have once realised. The bow-tie analysis identifies all connections between the hazard, the event and finally, the outcome, in the form of consequences. A series of preventive and protective barriers exist that will either prevent the event from materialising or protect the organisation if it does (Delvosalle, Fievez, Pipart, & Debray, 2006; Kurowicka, Cooke, Goossens, & Ale, 2008). These barriers are physical or organisational structures that, in different ways, prevent a hazard from becoming an event and further materialise into tangible consequences that result in a loss.

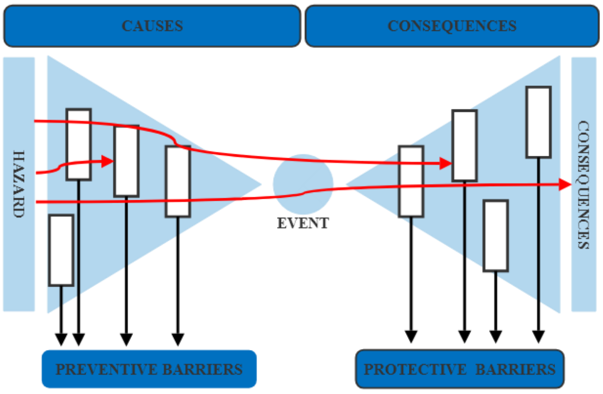


Figure 1 Bow-tie model

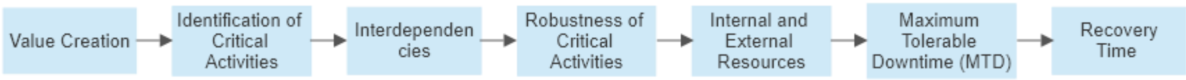
The red lines in the model depict how hazards can be stopped by the different barriers or materialise as a consequence that the organisation will need to manage. To be considered relevant as a barrier, they must have a realistic chance of preventing a hazard from becoming an event or an event from having consequences. The level of confidence regarding the preventive barriers effectiveness and response time will influence the protective barriers later as a cascading effect, which might overwhelm the system's defences. The ability of a given barrier to stop or reduce the impact of a given incident depends on its quantitative and qualitative characteristics.

Barriers act as prevention and controls, which decrease the probability that a particular event will have consequences for the organisation (as depicted by the red lines). Preventive barriers will limit the impact of a hazard and, in some cases, prevent a hazard from becoming an event, thereby reducing both its consequences and the frequency that the organisation needs to deal with risks. A barrier can produce three types of outcomes; it can prevent, mitigate, or it can fail. Prevention means that the barrier acts as a dyke that is impassable and hence stops the possible hazard from materialising. Second, mitigation takes place when some of the effects of the hazard can get through while it stops others. The barrier is, in this way, acting like a reducer of impact and a delayer of frequency, diminishing the overall effect that the hazard might have later on. Finally, the barrier might fail, which leads to either the event materialising or becoming a challenge for another party to handle.

BCM works with both preventing and protecting barriers, as well as when the organisation makes plans for the impact of consequences. The BIA that will be described below forms the foundation for two types of plan; the Risk Reduction Plan (RRP) and the Business Continuity Plan (BCP). Analysis that results in RRP initiatives targets prevention and protection barriers, while the BCP focuses on accelerating recovery after an event has materialised into consequences. The BCM approach thus provides a holistic view and proposes remedies that will reduce, mitigate and handle risks. While other risk management systems target the events themselves, business continuity is focused on the processes that are impacted by an event. This shift in perspective is vital as it provides an opportunity for organisations to handle events that are not yet identified but have an impact on its value-creating processes.

The Business Impact Analysis

The following section describes the process of creating and using a BIA. While the literature describes many ways of conducting the analysis, and variations exist depending on industry and context, the method described here applies to most organisations whether private, public or part of civil society. The model below illustrates the sequence of activities that takes place to present a well-founded analysis of the business continuity challenges that the organisation is facing. The BIA forms the basis for preventive and protective barriers as well as the foundation for BCPs.



Value creation

The BIA starts with defining how the organisation creates value and is the centre of analysis for all the steps that will follow. Understanding the value-creating process is central for understanding what the organisation is trying to achieve and includes a description of activities regarded as contributing to its overall aims (Aven & Aven, 2015; Porter, 1985). These can be monetary but can also include other outputs deemed to be essential, such as cultural, human or social value. Hence the idea of value is taken beyond merely financial terms and becomes a broader definition describing what is deemed crucial and considered worth protecting. The literature describes different ways of defining how organisations create value, for example, through their business model (Osterwalder & Pigneur, 2009). A business model is an analytical tool that combines products or outputs, the organisation and its stakeholders, with the combined aim of providing a comprehensive understanding of how its activities produce customer value.

The business model canvas developed by Osterwalder and Pigneur (2009) describes nine elements that contribute to our understanding of how an organisation creates customer value. This starts with defining for whom or what market the organisation is creating value (customer segment). Customers can broadly be defined as people who benefit from the product or service that the organisation provides. The second element is the value proposition and the problems that it is trying to solve for its customers and how it aims to fill this need. In a market, other organisations (competitors) are seeking to solve problems for the same customers, and the analysis also includes the position of the organisation in relation to others in the same market. The third element is the channels that the organisation uses to communicate and provide the products to its customers. A channel can be a store, salespeople, a website or a business partner. The fourth element is the customer relations strategy and describes how the organisation puts its products to market, how it retains clients, and how it develops relationships with them. The fifth element looks at the revenue streams and can be categorised into three types, namely transaction or reoccurring revenues (one-time payments or regular payments) and usage fees (recurring but irregular income). The sixth element focuses on the resources needed to complete its processes. There are four types of resources, namely physical, human, intellectual and financial. The physical resources include materials, vehicles, buildings, processing equipment, etc., that all make up the infrastructure of the organisation. Human resources are employees with their competencies and qualities that ensure that the organisation is successful. Intellectual resources include the inventions and trade secrets but also the capabilities of the organisation, for example, management systems that make it possible to compete in the market. The financial resources centre on cash, credit, etc., but also options for providing economic incentives to critical personnel. The seventh element is key activities, which are actions that need to take place for the organisation to succeed in serving its customers. These can be logistics, the production of products, marketing, and services that aim to bring customer value.

Partnerships are the eighth element and include outsourcing to external partners or resources that the organisation needs but does not produce itself and has to buy on the market. These include ingredients or semi-manufactured products, spare parts for machinery, etc. The ninth and final element is cost structure, and involves describing the expenses that occur when conducting the organisation's business. By understanding the business model, it is possible to analyse how the consequences of hazards will affect an organisation's ability to produce value and subsequently, the design of safety barriers.

Identification of Critical Activities

The business model of a given organisation is central to how we understand and protect the activities that contribute to its value creation and, ultimately, its survival. Each element relates to the importance of customers, products, and infrastructure, and the financial viability provides valuable insights into how to prioritise resources for business recovery in case of a disruptive event. The value-creating processes impact all elements of the business model by focusing on the processes deemed a priority and thereby improving its risk identification competences and capability to evaluate the steps necessary for an efficient recovery. The second part of the BIA uses the business model to identify critical activities that are central to how the organisation creates value, and how, should they be disrupted, it would seriously affect the organisation's ability to perform the activities described in the business model (Barnes, 2011; Hassel & Cedergren, 2019; Tammineedi, 2010). Each element includes activities that are critical to the quality of output the organisation can produce and hence value to its key stakeholders. When conducting the analysis, it is vital to differentiate between each process, which is all the steps an organisation takes to complete an activity and critical activities that have a distinct focus on the output of the process. For example, the organisation has to communicate with customers and have a method for creating information that will serve the customers' needs. Marketing is a critical activity when communicating through channels that enable customer relations to develop. Others relate to in- and outbound logistics, producing the product or making sure that employees get paid. Within each of the elements that go into the business model, there will be hundreds of processes that are important and ensure that the organisation as a whole can provide customer value. However, the number of critical activities will be far fewer as they are focused on the output that these processes produce.

Interdependencies

The third part of the BIA process focuses on how critical activities are connected and how they depend on each other. In this context interdependencies can be identified by mapping how in-and outputs of critical activities across the organisation are connected and contingent (Delmestri, 2009; Miller, 2009; Perri, 2005). For example, this could include the process of hiring new employees (a human resource-critical activity) that provides the different elements of the business model with access to qualified labour (for example, the operations department). Outputs can also be directly related to outside stakeholders either as input from suppliers and in- or outbound logistics, production, marketing or a service that the organisation needs to provide to serve the market. One way of organising the analysis of interdependencies is to take on a value-chain analysis approach, which consists of two parts, support and primary activities (Porter, 1985). Primary activities describe the flow of material and information within the organisation and how they add to the profit of the organisation. Support activities go across the primary activities and provide input by making IT, infrastructure, personnel and other resources available. Interdependencies are points where the output from one activity crosses from one to another within the value chain. For example, from inbound logistics to production there will be a series of processes that need to take place to produce the final product or where they rely on support activities to function, for example the availability of IT systems or qualified personnel. We can use a value chain approach to reduce the number of critical activities needing protection or in the case of an event recovery, by concentrating on the independencies and thereby the overall value creation.

The map of processes, critical activities and interdependencies helps organisations prioritise where to allocate resources before and during an event. It thus supports decisionmakers in planning for business continuity but also during a disaster to prioritise between different activities that are under threat.

Robustness of Critical Activities

The fourth element is to establish the robustness of each of the critical activities. Even during an event, there will be activities that will be able to produce output, not at the same level, but they will have an output described as a percentage of the regular operation. Robustness is the ability of a social or technical system to absorb disruptive events, and, at the same time, retain operational integrity (Hassel & Cedergren, 2019; Woods, 2015). For example, a company with only one central production facility will have lower robustness than one which applied a system with multiple production facilities that could take over some of the processes in the case of an event. A university can revert to online teaching in case the classrooms are not available and thus continue to educate, albeit at a lower level of activity. Other options could be to transition from a digital to an analogue system in the case of an IT system's failure, and, while the processes will not be at 100%, they will be able to produce at its robustness level. Estimating the robustness level is conditional on the occurrence of a risk event, which means that it is impossible to know the full extent of the system's ability to absorb a hazard without the event occurring.

The robustness analysis is critical for two reasons. First, it is needed to determine the vulnerability of the organisation and hence the minimum operating level for each critical activity, as described above. But it is also needed to identify activities considered fragile and in need of resources to increase their robustness. Increasing the organisation's ability to cope with adverse events means that it will make investments that will strengthen the preventive and protective barriers described in the bow-tie model above. While the robustness part of the BIA is intended to provide evidence as to the minimum functional level of a process, it also provides input to the analysis that follows by providing decisionmakers with insights into the vulnerability the organisation currently possesses.

The figure (2) below illustrates the level of robustness, how this will improve recovery time and thereby impacts performance. It consists of three phases before, during and after an incident has occurred. In the first phase, the critical activity will be at its maximum efficiency. Then the event occurs, and the organisation manages the hazard, for example, a fire might take some time to manage before recovery can commence. The final phase is recovery and depicts the time it takes from the hazard was managed to the critical activity is restored at its original efficiency level. The figure on the left shows how a process will be affected and in time recovered if the organisation takes no action (also called natural recovery time). In this example, the robustness is set at 20% efficiency. When an event occurs, it will tricker our vulnerability down to our robustness level, which is immediately is followed by the management phase. The critical activity recovers as the organisation strive to recuperate from the impact (given that the organisation continue to exist and have not succumbed to the event itself). The right side of the same figure shows the time it takes if robustness increases to 50%, which will significantly reduce the recovery period for the critical activity. As depicted, an increase in robustness level will also directly translate into an improvement in recovery time as well as the ability of the organisation to create value.

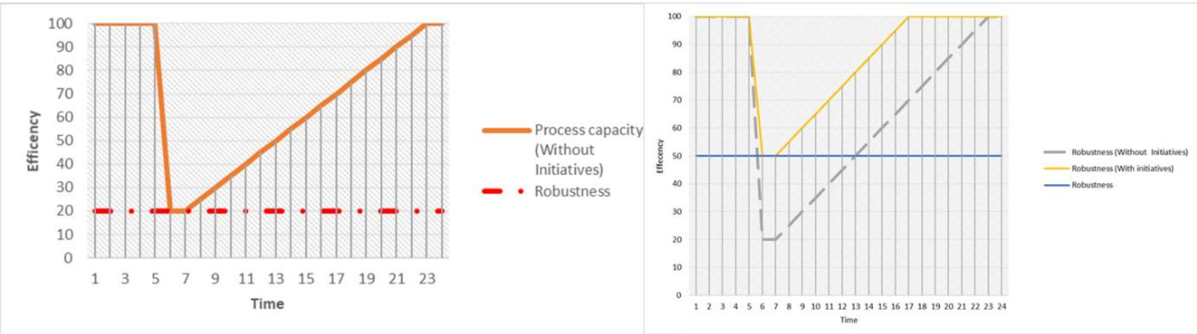


Figure 2 Robustness and recovery

Internal and External Resources

The identification of the robustness level is essential and constitutes the fallback position a critical activity will revert to in case of an event. However, it is also necessary to be aware of the internal and external resources required if the organisation is going to maintain its robustness. Internal and external resources describe the infrastructure, physical and intellectual resources needed if a critical activity is going to produce an output. Access to roads, water, electricity, gas, telephone and waste management systems are often services on which the organisation relies. As described, interdependencies focuses on explaining how outputs of processes were reliant on each other, while the analysis of resources focuses on what ingredients it takes to produce these outputs. While some of these services can be provided by itself, by having stand-alone systems, it is often the primary responsibility of societies to present these to the organisation. Infrastructure services are not necessarily available during or after an event and can have a significant impact on critical activities and hence need identification during the BIA process in regard to how their absence would influence value creation. Physical resources could be the ingredients required and that the organisation cannot produce itself, for example, fuel for vehicles, lubricants, supplied semi-manufactured goods, etc. Understanding the consumption of these products will help determine minimum storage requirements and hence how long there can be production at different levels of activity. Finally, intellectual resources relate to the availability of the competencies needed for continued operations. It does little good to have plenty of people available if they do not have the necessary skills to operate the equipment. Some personnel will be essential, and it would be difficult if not impossible for the organisation to produce value if their skills are not present. These could include people within IT support, human resource professionals as well as production specialists, middle managers who are responsible for processes and critical activities, etc.

Maximum Tolerable Downtime

The maximum tolerable downtime (MTD) describes at which point in the future the organisation will no longer be able to sustain itself even after the event is over (Elliot et al., 2010; Hiles, 2014). The MTD is hence the time it would take for an adverse event, which might arise as a result of not providing a critical activity, to become unacceptable. The point at which something is deemed unacceptable is when the cost of recovery is higher than the value creation. Decisionmakers need to know when it is no longer in the interests of the organisation to recover a specific activity and change their priorities. For example, a company which is hit by a flooding event at some of its production facilities can choose to divert resources to other less compromised activities and thereby improve the recovery of less affected critical activities. When assessing the MTD for each activity, it is central that the organisations consider and justify their response as to the resources needed. As the recovery process involves path dependencies, where decisions made in the past become less relevant as circumstances change, a cue in the form of an MTD can indicate when it is time to switch priorities. A prevailing assumption is that the faster you recover, the more significant the value you preserve. However, this might not necessarily be the case, as the cost of recovery when, for example, moving staff from one location to another, changing suppliers, or setting up alternate production sites, might take longer and will incur a higher cost than the MTD justifies. Defining MTDs is thus a tool that can aid decision-making as to how to prioritise when handling an evolving event that leaves little time to debate where the organisation's spare resources should go.

The equivalent of the MTD for access to data is the Maximum Tolerable Data Loss (MTDL), which refers to how much information the critical activity can lose before it will be impossible to recover (Hiles, 2014). Some organisations require data as part of the value creation, so not having access to data might mean significant losses. The MTDL specifies how old the data may be if recovery is to be possible, without severely reducing the company's ability to compete. There are several cases where companies have had to pay ransoms as they were denied access to their data due to hacking or malware. For example, the shipping and logistics company Maersk was denied access to their shipping system in 2017, which caused a loss of millions of USD; a similar event impacted the facility service company ISS in 2020 (Goud, 2020; Greenberg, 2018).

Referring back to the bow-tie analysis, the MTD provides indications as to when it can be beneficial to invest in creating barriers and when it is not. A way to conduct such an analysis is by conducting a fault-tree analysis when investigating preventive barriers and an event-tree analysis when looking into protective measures (Delvosalle et al., 2006; Markowski & Kotynia, 2011). The analysis will show to what degree measures are useful when a hazard emerges in preventing it from becoming an event, and, if it should occur, protecting the organisation from its consequences.

Recovery Time

The final part of the analysis involves defining the recovery time for each critical process. There are two forms of recovery that decisionmakers need to relate to, namely the restoration of outputs of products or services, which focuses on time and information relating to the availability of data. First, recovery time objective (RTO) is an expression of the aspiration as to when a given activity needs recovery (Hassel & Cedergren, 2019; ISO, 2012). The RTO is a desire to restore processes faster than the MTD, given that interdependencies exist between different critical activities within the organisation. For example, hiring employees might have an MTD of several months for the human resource department, which would engender a long RTO for this activity. However, other critical activities within the organisation such as production, logistics or marketing are reliant (interdependent) on access to employees and competences. The RTO can, in practice, be significantly shorter – in some cases hours. A shorter RTO can also stem from an ambition to meet customer demands for specific products, thereby increasing market share during an event or other considerations related to the business model.

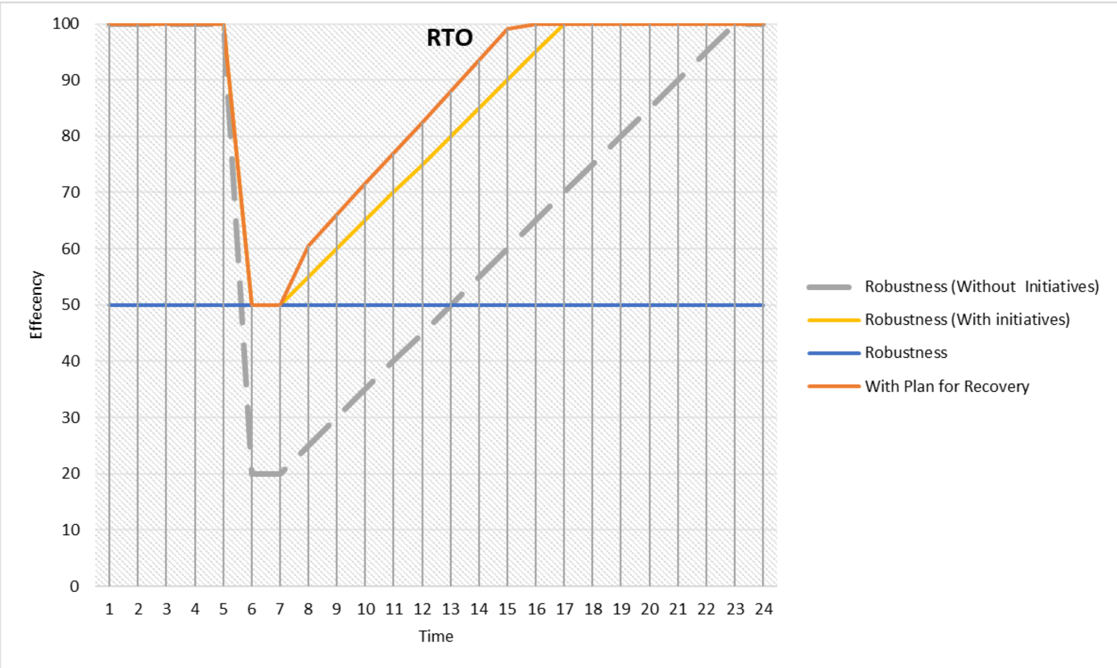


Figure 3 Recovery with plan

The recovery point objective (RPO) refers to the age of the data or information that the organisation works with (Gibb & Buchanan, 2006; Tammineedi, 2010). The RPO aims to restore access to data so that it does not affect the ability of the organisation to produce value. In some cases, this means restoring data to the status immediately before an event or an earlier positions hours, days or weeks prior. Many processes within the organisation and directly related to the business model require data to be processed. In some cases, it is possible to conduct operations with ease using data that is several months or years old. However, for many organisations, the business model is based on having access to up-to-date and readily available information about customers, suppliers and other stakeholders. The specific RPOs for critical activities requiring information as input depends on the maximum tolerable data loss (the equivalent of MTD for information), given how the organisation produces customer value.

The output of the BIA makes it possible for managers of risk to take a well-founded decision as to when a given process needs recovery. Placing value creation at the centre of the analysis acts as an anchor and baseline for all other points in the BIA process.

Process owners and critical activities – Risk reduction or contingency planning?

The decision to pursue a strategy of risk reduction, rely on business continuity plans, or a combination of both, falls on the organisation's strategic level. A strategy that will create barriers, as described in the section on the bow-tie model, requires resources and a commitment to reducing vulnerabilities identified in the BIA. Process owners who are responsible for critical activities have an individual responsibility not only because they manage a given process but also because the output is essential to the organisation's value creation. Risk managers must ensure that the business continuity management system is functioning and continuously improving itself, while process owners must ensure that the allocation of resources to risk reduction and contingency planning is incorporated into the daily routines. RRPs only perform if they reduce organisational vulnerabilities identified in the BIA, and the only way of assessing if they are effective is through exercises that test if they produce the imagined results.

The bow-tie model can provide insights to the efficiency of the system, introducing and testing barriers through the use of a fault and event-tree approach. The BIA examines the individual barriers in regard to their ability to stop, reduce, or, if not working, let a hazard through. They thus supplement the bow-tie model by qualifying the quality of barriers put in place. These tests can be based on quantifiable solutions such as physical structures where assessment is relatively objective, or through quantitative methods such as quality and risk management systems.

In the section that follows a test of the approach is performed on a company operating in the Arctic. While the context and industry are very different from that which most organisations will experience, the example primarily illustrates the methodology and less so the context of specific challenges such a company might have in a region that most will never experience.

Case – Hudson Mining

The mining sector provides a good illustration of how a BIA is structured. The industry presents a useful example as the business model is relatively simple, and the processes are easy to understand.

Hudson Resources (hereafter referred to as Hudson) is a junior mining company operating in Sønderstrømfjord on the west coast of Greenland. The company is Canadian and focused on production at the White Mountain (Qaqortorsuaq) where it extracts calcium feldspar (Hudson, 2019b). The project started producing in February 2019 and primarily serves the North American market with its products GreenSpar and Anorthosite.

Value creation – Business model

Following the structure of the business model canvas developed by Osterwalder and Pigneur (2009), the analyses follow the nine elements that contribute to our understanding of how an organisation creates customer value.

The customer segment: Hudson serves the B2B market, shipping its product to Charleston in South Carolina and Tlaxcala in Mexico. The customers are found in the industrial minerals sector worldwide where Hudson continues to seek to identify partners that can help with identifying customers and distributing the product (Hudson, 2019c). The company had to ask for loan capital several times to support its operations in Greenland until a more diverse customer base could be developed.

The value proposition is, according to the company, the products produced at the White Mountain production site, GreenSpar and Anocrete, which brings significant green benefits and cost savings. Providing an alternative that produces less CO_2, the products have applications in the fibreglass, alumina, filler, paint and white cement markets, regarded as an attractive and more environmentally friendly ingredient than traditional materials. GreenSpar can replace kaolin in the production of E-glass fibre used in the reinforced polymer composite industry in high-end fibreglass for wind turbines, car and boat parts, and sporting equipment (Hudson, 2019d). The expectation is that the White Mountain project contains an Indicated Resource of 27.4 million tonnes and an Inferred Resource of 32.7 million tonnes. At the anticipated rate of extraction, which includes a second phase expansion of the White Mountain processing plant, these resources are considerably more than sufficient for 50 years. The product can offer significant technical, financial and environmental advantages, including energy savings of more than 10%, a reduction of melt times by up to a third, a lower heavy metal content, reduced wear and tear on refractories, and reduced NOx, SOx and CO_2 emissions. The mining sector is highly competitive, and margins are narrow. Both GreenSpar and kaolin are relatively low-value bulk materials where the costs of transportation by ship, rail or road and therefore the logistics of available distribution routes are a primary factor in commercial success. Hudson has signed a 10-year off-take agreement with a leading fibreglass producer in a market expected to be worth $17.4bn by 2024, which will make the company very profitable if realised.

Hudson communicates and maintains relations with its customers through connections established by its management, but is aspiring to create a network of partners who will be able to reach a broader audience (Hudson, 2019c, 2019b). The hope is that by participating in trade fairs and conferences like the PDAC (Prospectors & Developers Association of Canada) it will be able to reach potentially interested customers and expand its client base. However, the company has had some difficulties with its supply chain, "On August 30, 2019, the company reported that the unloading of its first shipment in Charleston was terminated before completion for reasons outside the company's control." (Hudson, 2019c) The dry bulk anorthosite could not be unloaded as the handling company was unprepared to deal with the dust associated with the product. Simultaneously the impending arrival of Hurricane Dorian caused an emergency closure of the port, forcing the bulk carrier MV Happy Dragon to put to sea for safety, thus causing a further delay as the shipment was offloaded later at Savannah.

The revenue streams: Hudson only has one major client, which makes it vulnerable to transaction costs, and having trouble delivering its first batch of products did not improve this relationship. At this time, the revenues can be characterised as transactional, aspiring to be able to develop a supply chain which can ensure recurring revenues as risks become better managed.

The resources: The Hudson site is situated around 5 hours by boat from Greenland's second-largest city, Sisimiut (see MIN 2015-39 on the map below). While the logistical and supply chain challenges are smaller than in other regions of the country, hazards will arise if not appropriately managed. As no roads lead to the site, all resources used in production and maintaining life need to be either transported by sea or helicopter. Hudson competes with other mining companies for the acquisition of mineral claims in Greenland as well as for the recruitment and retention of qualified employees, contractors and mining equipment. The project facilities consist of a housing complex for up to 40 people, offices, workshops and a processing plant. Physical resources include consumables such as food, water, ingredients such as lubricants, spare parts, fuel and explosives consumed during daily production at the site. Other resources include vehicles, the production facility, warehouses, workshops and internal roads. As regards human resources, some of the employees come from the Greenland School of Minerals & Petroleum located in Sisimiut, who also supply continued education and interns. The school is thus a key partner for Hudson in providing qualified employees. Access to skilled labour is especially vital in Greenland as there are plenty of opportunities to work in the major cities, considered a better alternative for many Greenlanders. Intellectual resources include data associated with the White Mountain project as well as other sites managed by Hudson (see MEL 2010-40 on the map). This resource provides information to site managers and forms the basis for drilling and explosive schedules, production planning and staff allocation. A challenge for Hudson has been in accessing financial resources. In several instances, the company has been on the market to make loans to continue operations and has until now been unable to show a profit, with an accumulated loss of 76,221,137 Canadian dollars (Hudson, 2019a).

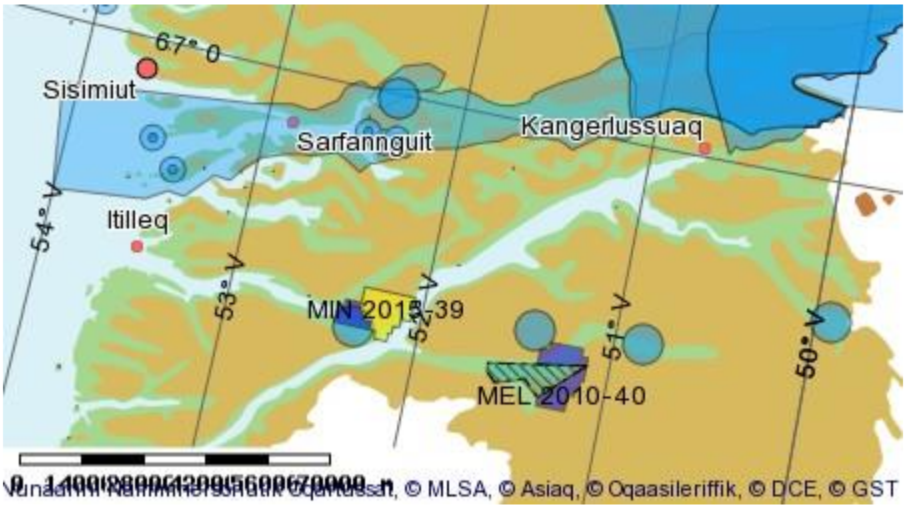


Figure 4 Hudson Resources license

Key activities include logistics, the production of products, marketing, and services that aim to bring the two products to market. The main processes include inbound logistics of material, spare parts, fuel, ingredients and other consumables such as food. The production facility (see Figure 3) is based on physical separation and located at the port site. At the processing plant, the material is fed into a tertiary crusher and a magnetic separator. The process plant in Greenland will operate on a 24 hr/day, 7 days/week schedule for 300 operating days/year (Hudson, 2015). At the plant, the ore will undergo additional crushing and magnetic separation. The material will go from the process plant by conveyor to a covered storage facility adjacent to the dock. Two 400 kW diesel generators will provide power for the process plant, truck shop and accommodation buildings. A separate 25 kW generator will meet power requirements at the quarry.

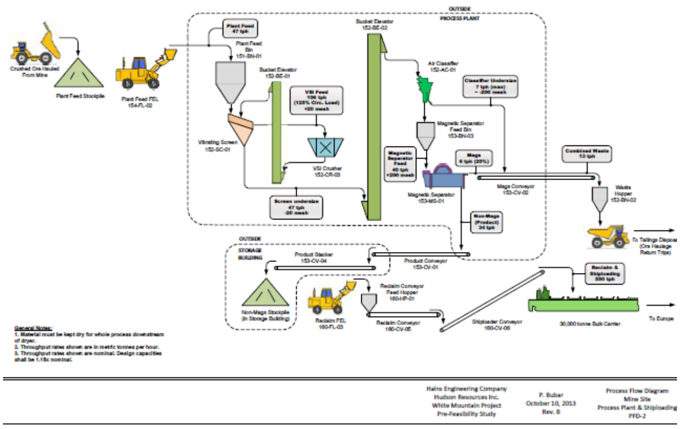


Figure 5 Process diagram - Hudson resources

Outbound logistics are performed by boat, aimed at the North American market (see Figure 4). The first ship carried approximately 14,400 tonnes of the product but was first delayed at the port of destination and later diverted to an alternate site for offload, as described earlier. The aim is that the project will involve the annual mining of 285,000 tonnes and the shipping of approximately 200,000 tonnes of material to Europe, North America and Asia. The shipping season will last for ten months due to icy conditions and inventory-balancing requirements, and the maximum storage requirements for the final product is approximately 30,000 tonnes (Hudson, 2015).

Figure 6 Loading - picture from Hudson resources

Figure 7 Storage - picture from Hudson resources

The strategic partnerships include companies providing financial services, equipment for the mine, and expertise with working in the Arctic (Hudson, 2019c, 2019d). Hudson is also working towards a strategic initiative to identify partners outside Greenland who can help advance the product lines and customer base as well as add balance sheet strength. Mineral exploration and development involve many risks, which even a combination of experience, knowledge and careful evaluation may not be able to overcome and can increase costs. The operations are subjected to all the hazards and risks generally associated with the exploitation of resources, which can result in work stoppages, damage to persons or property and the environment, as well as possible legal liability for any damages. Fires, power outages, labour disruptions, flooding, explosions, cave-ins, landslides and the inability to obtain suitable or adequate machinery, equipment or labour are some of the risks involved in the operation of mines and the conduct of exploration programmes. Moreover, there are risks associated with operating under Arctic conditions, which also can increase costs and delay production as well as the delivery of products to customers.

Identification of critical activities

The process of identifying critical activities includes all the elements that contribute to value creation. Here, as an example, the processes associated with outbound logistics will be used to illustrate how these activities are identified.

Outbound logistics encompasses all the processes that Hudson controls from when the finished product leaves the processing plant until it reaches the end customer. This process includes the transportation of material from the production facility to the storage, or the tailings for waste material. The warehouse facilities ensure that the product is dry and has a holding capacity of 30,000 tonnes of the finished product (Hudson, 2015). The company estimates that 85,000 tonnes of magnetic waste and dust material are to be stored in the tailings area annually. As the plant can produce an output of approximately 43.75 t/hour, this corresponds to 315,000 tonnes per year given the plant operates for 40 weeks. With an average ship carrying capacity of roughly 14,000 tonnes it would be equal to 22.5 ship turnarounds per year or 2.25 per month, given that all of the product is marketed and that the plant can run at full capacity. While the estimates from Hudson are lower than this number, it is essential to ensure that value creation can endure even if production exceeds targets. As the focus is on outputs, there are four critical activities involved in outbound logistics (see Figure 6). Firstly, There is the transportation of the finished product from the plant to the storage facilities (1a). The handling of waste material is also a focal point as it will create a backlog and clog the system if not handled effcietntly in the process, and thus it includes transportation from the plant to the tailings (1b). Secondly, there is the loading of the ship from storage onto the boat (2). Thirdly, there is the shipping from the dock to the delivery point, which is the port closest or most convenient for the end customer (3).

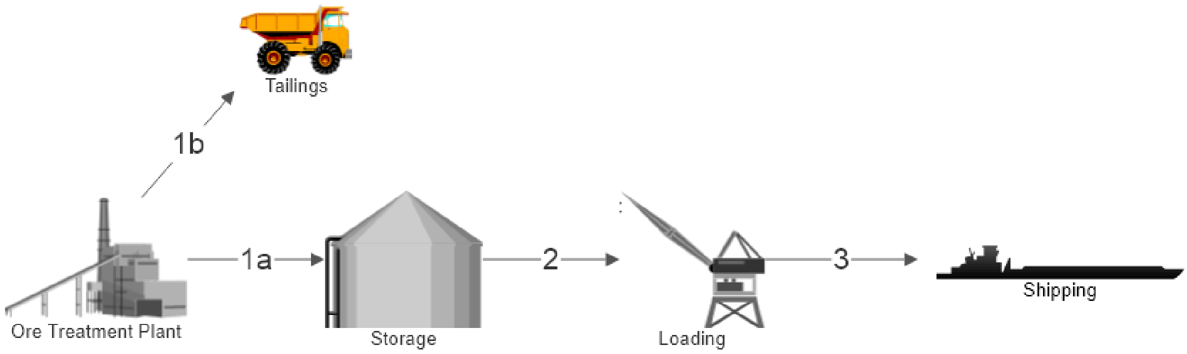


Figure 8 Outbound logistics critical processes

Identification of interdependencies

All of the critical activities identified in outbound logistics are dependent on the output of other internal and external processes. The primary input comes from the treatment and production of ore, as this relates directly to value creation. However, logistics is also dependent on the output from other activities to function, which includes maintenance of the equipment that transports ore from the production site to storage and further to the loading facilities. Transportation of waste also needs to be maintained to ensure that material coming from the production sites does not clog the system. Therefore the output of maintenance of equipment is an interdependent critical activity for outbound logistics. Human resources ensure that the right competencies are present at the site and that work schedules can be maintained. The output from processes related to IT enables an optimal production output, and safety parameters are supported.

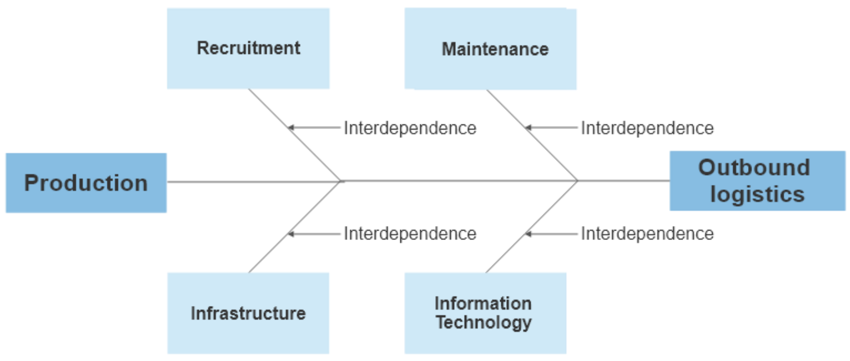


Figure 9 Interdependencies

Robustness of Critical Activities

This element evaluates the robustness of the activity as its ability to absorb disruptive events and, at the same time, retain operational integrity. The output does not need to run at optimal capacity but the robustness looks at how the activity would perform if put under maximum pressure, expressed as a percentage of its standard output. For example, the lack of qualified labour may have an impact on outbound logistics, but the degree of how it will impact the business in terms of value creation is unknown.

We still create estimates on the level of impact and thus our total robustness of an activity based on past events, expert opinion and the contingency plans in place. For Hudson, the ambition is to primarily recruit labour from the local Greenlandic workforce. However, if this becomes a problem, and it might cause delays, the fallback position is to import its workforce from abroad. Hence the robustness of the company when it comes to access to qualified staff is based on a levelled model where decisionmakers can continuously explore alternatives. While such thinking might work well in situations where you know the risks (lack of qualified local labour), it becomes more complicated when working with unknown risk or where you can see the threat but can do little on terms of mitigation.

Internal and external resources

While it is essential to evaluate the robustness of critical activities, it is also necessary to be aware of the internal and external resources required if the organisation is going to realise this robustness. Outbound logistics include the refined product which needs to be shipped, physical equipment, energy, and communication tools, as well as people who engage in the activity. The product itself comes from the production ore treatment plant, and, by way of the storage facility, makes its way to the ship waiting in the harbour. The processing equipment (conveyors, trucks, loading cranes, etc.) ensures that the material is moved in a timely and efficient manner. This process requires energy for the production equipment, in the form of electricity, and vehicles, in the form of diesel fuel. For the activity to be carried out, it also needs people who are physically present to monitor and operate the equipment. Finally, the different parts of the activity need to be connected through effective communication channels either digitally through information technology or by analogue means. If these internal resources are present, the critical activity can run at its most efficient level.

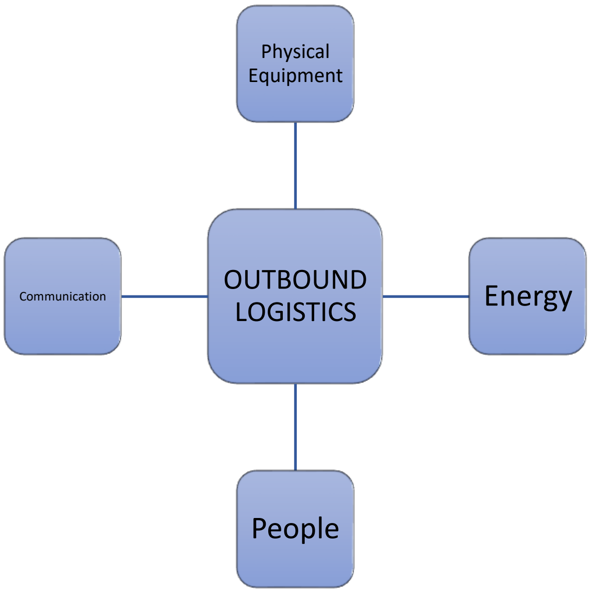


Figure 10 Resource diagram

Maximum Tolerable Downtime (MTD)

Based on our knowledge of processes, activities, robustness, resources and their interdependencies, it is possible to calculate the maximum tolerable downtime (MTD): the time it would take for an event that stops the organisation providing a product/service or performing a critical activity to become unacceptable. For outbound logistics, this would be the time it takes for Hudson to stop being profitable because it is unable to ship the product to its customers. The assumption is that the time when an event impacts a given critical activity, the value that it creates will be equal to its minimum robustness level, as described above. As time progresses, the organisation will start to recover, and things will begin to return to normal; this recovery time will also cost the organisation a certain amount of profit. In the case of Hudson, this means that if it is unable to move material from production or storage, it will have an impact on its ability to serve its customers.

We know that the mine at maximum capacity is running 300 days with an output of 43.75 t/hour year, which translates into 315,000 tonnes per year. We also know that storage capacity is 30,000 tonnes. It would take approximately 29 days to fill the storage, and if an event occurs which hinders outbound logistics, production will have to cease as it will have nowhere to put its output. Production will thus stop at 29 days for outbound logistics in case Hudson was to be unable to ship the product to customers. However, as we have certain robustness for each critical activity which will impact this number, the MTD can be significantly longer, for example, alternative storage or lowering the production rate (without causing production to meet its MTD). Let us take the example above where the robustness level without any initiatives is at 20%; in this case, the MTD would be 34 days, while if the robustness level is at 50% it would be 42 days, which could have a significant impact on profitability. It should be kept in mind that the robustness level is based on assumptions about past events and expert opinion.

Recovery time

The final element in the BIA process is to decide on possible recovery times. Knowing that until this point the main focus of the analysis has been to create a baseline for decision-making the last element is to provide managers with different options to choose from knowing what the impact will be on the value-creating processes. The recovery time is regarded as the basis for managerial decision-making concerning evaluating the consequences of a given event, time and the resources needed to create practical barriers that will mitigate or stop these.

Using the MTD example above, the recovery time would be 34 days. Meeting this recovery time would require little effort or use of resources to reach as it relies on the natural robustness of the organisation to cope and recover from an event. However, as we know that the maximum capacity for outbound traffic is 2.25 ships per month with a carrying capacity of 14,000 tonnes a lot of capacity would be unrealised if Hudson continued with this level of recovery time. Hence, management usually assigns a recovery time objective (RTO), which is shorter than the MTD. Such a decision will require resources to be committed to the recovery effort with the clear target of meeting the RTO.

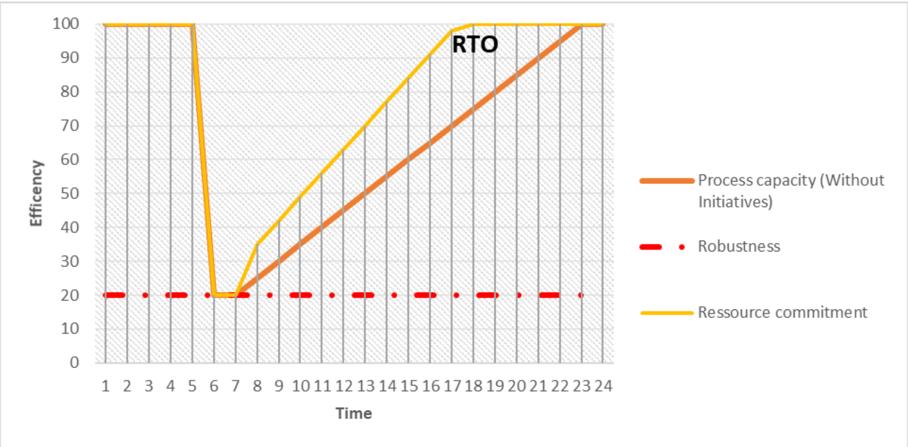


Figure 11 recovery time for Hudson

Hudson can choose between different initiatives that will increase recovery time and hence meet a given RTO. Two strategies come to mind; redundancy and alternate site. An approach based on redundancy is generally more expensive as it requires investments in equipment and access to human resources that, for most of the time, will remain idle. However, redundancy in the case of outbound logistics does not necessarily mean that equipment and people are on permanent standby but rather that decisionmakers think in the line of dual or multi-functional resources. The inventory of Hudson includes a variety of different resources that can be converted or altered to take over some of the process of moving the product from the production facilities or from storage to the ship. At the same time, such a conversion might not be as efficient as the original loading system, but it will be a better alternative to not loading at all. It should be kept in mind that the critical activity is not the loading itself but rather servicing the end customer and that, while it might be a slightly longer process that normal, the effect might be that the end customer might not see any deterioration in service from Hudson. The redundancy strategy can also be supplemented by having dual training of staff so that individuals can take care of more than one process. Such an approach would mean more education and competence development. Still, it would be a relatively cheap way of restoring processes that would either be unmanned or would need to increase output in shorter periods to catch up due to production stops.

The alternate site strategy would mean that the harbour is not available for loading, and an alternate location would need to be found. Contingency planning, in this case, would mean the establishment of infrastructure that could act as an alternative to using the harbour's facilities, for example, building roads to other locations where a ship could be loaded and supplies transported back to the camp.

The decision as to the strategy used is up to the managers responsible for the critical activities in the company. Both of the scenarios described above require significant resource commitment, where the return on investment is uncertain. It will be the task of these managers to evaluate the output of the BIA, and, based on the information provided, the possible consequences and actions that can be taken to mitigate these will decide the number of resources that will be invested to ensure recovery.

Concluding remarks

As initially stated, there is no set way of conducting a BIA, and there is plenty of advice in relation to which structure to follow based on sector-, industry- and company-specific needs. This paper has sought to explore what a standard approach could look like given that the overall aim is to restore critical activities that create something of value for the organisation and its stakeholders. While the example used focuses on a specific industry and company situated in a context which is considered abnormal by most, it does provide some valuable insights. The structure of the business model offers a simple structure for determining when something that the company does is a critical activity. Using this approach simplifies and reduces the number of key focus points that will later be analysed in the following steps of the BIA but also provides a strategic focus for decisionmakers during an event. During such an incident or when multiple hazards occur at the same time, a structured way to reduce complexity is vital for the process and, in the end, recovery. One of the most dangerous things during an event is to develop a "tunnel vision" where you focus on just one or very few things taking place in your surroundings, making you less receptive to alternatives or information that contradicts your assumptions. A good and thorough BIA can hence act both as a way to analyse business continuity challenges and vulnerabilities and also as a tool for effective crisis management.

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