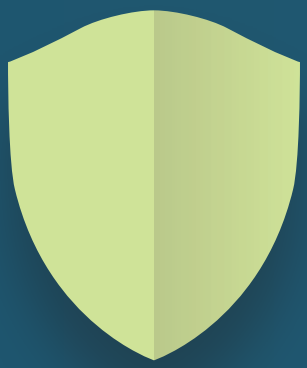

Inspiring a Mindset of Resilience

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An Interactive Qualifying Project of the Worcester Polytechnic Institute

For the Danish Institute of Fire and Security Technology

Advised by Professor V.J. Manzo and Professor Lauren Mathews

By Benjamin Freed, Kaitlin Travers, Estefania Trinidad, and Rachel Welch

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Abstract

The Danish Institute of Fire and Security Technology (DBI) aims to increase the business resilience of Danish companies by developing a new business area within DBI. In making this new business area, DBI found that most Danish businesses, as well as DBI employees, are generally unfamiliar with the topic and do not understand its importance. Therefore, DBI needs to educate Danish businesses about business resilience in order to inspire them to become resilient. We developed informational materials to address knowledge gaps that we identified among DBI employees regarding business resilience. We proved the effectiveness of the informational materials by testing them on DBI employees.

Acknowledgements

We would like to thank Professor Steve Taylor, Professor Nicola Bulled, Professor V.J. Manzo, Professor Lauren Mathews, Carsten Damgaard, Laura Melkunaite, Terese Urth, and our study participants who all helped us to complete our best work and gain a wealth of experiences through this Interactive Qualifying Project.

Authorship

The attribution of authorship to specific authors can in no way describe the level of teamwork and integration our team had in writing this report. All teammates contributed equally and collaboratively to this work.

Contents

Introduction

ADVANCES IN TECHNOLOGY TODAY allow people to live their lives at a global level. People cross national borders on a regular basis and companies organize retail operations in one country while buying parts from another. Globalization has not only expanded business networks for the good, but it has also increased interdependence and consequently the potential for shared risks. Companies are no longer affected solely by their local economy and environment, but face threats from cyber-attacks, terrorism, and foreign natural disasters. For example, in 2011 when intense flood inundated many areas of Thailand- the world's largest hard disk drive producer- data analysts expected the price of hard drives worldwide to increase by 10%. A similar global disaster occurred in the Nordic area, when the eruption in Eyjafjallajökull, Iceland in 2010 resulted in a 19% reduction in Danish airline passengers as compared to the same time the previous year (Copenhagen Airports A/S, 2010). Because of the increase in risks, both stakeholders and academics are researching efficient business practices as well as techniques for reducing the potential for disruptions.

Business resilience is the ability of an organization to successfully respond and adapt to disruption. By developing techniques to increase resilience, companies will be better prepared when disruptions occur and therefore efficiently solve problems and adapt to new conditions. Although literature and studies surrounding business resilience become more abundant, considerable ambiguity remains about the concept and its definition. There is no agreement on what a resilient organization is (Bhamra et al, 2015) or how the concept of resilience should be assessed within the context of an organization. There is also a general lack of understanding of how resilience varies from other related concepts such as vulnerability, adaptation, coping ability, and other topics (Bhamra et al, 2015). Consequently, there are a number of ways to analyze the resilience of an organization. One way to do this is through IBM's Resilience Maturity Asset Framework, which analyzes a business's environment in the context of six solution layers: strategy, organization, business and IT processes, data and applications, technology, and facilities and security (IBM Corporation, 2007). Each solution layer has specific attributes that are analyzed against industry standards such as Six Sigma and the IT Infrastructure Library framework (IBM Corporation, 2007). By analysis of each solution layer, management can gain greater information into it's current state and the steps needed to mitigate risks and continue to grow as a company (IBM Corporation, 2007).

Business resilience is ability of an organization to successfully respond and adapt to disruptions

Another way to analyze business resilience is through Snyder's (2013) subsets: continuity and crisis management. Business continuity is defined as the ability of a company to continue to offer normal services during a crisis (Snyder, 2013). In many cases, achieving business continuity is the next step in resolving an incident at a company once the immediate impacts of such a crisis have been controlled (Snyder, 2013). There are ways a company may ease the consequences they face due to interruptions in operation. For example, they can use multiple material suppliers or store excess stock

Business Continuity
the ability of a company to continue to offer normal services during a crisis
(Snyder, 2013)

in warehouses that may be sold during times of delayed production. Having multiple methods to access goods helps a business operate continuously at all times. On the other hand, crisis management includes responses to both man-made and natural events (Snyder, 2013). Man-made events and natural crises that require strategic response include terrorism, bomb threats, chemical attacks, and weather-related incidents, some of which can be forecasted and others that can happen with little to no warning (Snyder, 2013). Lack of crisis management has proved to be detrimental, as it can be seen with the example of the nuclear disaster at Fukushima, Japan. Insufficient preparedness led to led to the largest discharge of radioactive material into the ocean in history and massive radioactive contamination of the Japanese mainland (Funabashi, 2012).

Crisis Management
an organization's response to a disaster, whether a man-made or natural event

Business resilience can be applied anywhere in the world regardless of the risks a country faces and their severity. One country that currently is at a low risk of serious natural disasters but is prone to man-made events such as cyber attacks and terrorism is Denmark. Cyber attacks in particular are becoming increasingly relevant in Denmark because of valuable intellectual property in industries such as healthcare and energy (FireEye, 2015). In 2015, PricewaterhouseCoopers conducted a survey on 250 Danish companies regarding cyber threats that revealed 59% of businesses had been cyber attacked (Overseas Security Advisory Council, 2016). The threat of terrorism has also increased in Denmark since 2005 when offensive graphical representations of Prophet Muhammad were published in the Danish newspaper Jyllands-Posten (Center for Terror Analysis, 2013). This publication sparked protests in some Muslim-majority countries, resulting in over 200 deaths and boycotts of Danish goods (Berkeley Center for Religion, Peace, and World Affairs at Georgetown University, 2017).

With climate change, natural disasters are becoming increasingly common in Denmark. On July 2, 2011, Denmark experienced its second largest natural disaster (Højgaard, 2015). A cloudburst- a short, high volume rainfall- precipitated 135.4 mm of rain onto central Copenhagen in two hours (Højgaard, 2015). It took almost 12 hours to restore power to 10,000 homes and 50,000 people lost heat for up to a week after the cloudburst (Højgaard, 2015). Over 90,000 insurance claims were filed totaling over 6.2 billion Danish Kroner (over 1 billion USD) (Højgaard, 2015). Insufficient preparedness of the insurance companies and lack of state plans for coping with this type of event enabled unnecessarily high levels of damage from the cloudburst. Earlier this year on January, Denmark experienced "once-in-a-century" floods, causing water levels to reach 177 centimeters in parts of Copenhagen and 157 centimeters in southern Denmark (W, 2017). According to Danish Meteorological Institute, as climate change continues, these events that statistically occur only once every century are expected to become more frequent (W, 2017).

Researchers are exploring various approaches for businesses to effectively increase

their resilience. In 2011, Thailand suffered from its worst floods in over 50 years. Based on a business survey conducted by the Bank of Thailand (2012), some 43% of businesses reported that impacts would likely be short-lived and usual operations could be restored within three months, while 46% said they would be able to restore operations within four to six months (Chongvilaivan, 2012). About 11% of respondents said that the floods would have effects on their businesses that would last more than six months (Chongvilaivan, 2012). Chongovilan (2012) examined these floods and identified strategies for business to increase the resilience of their supply chain. The first strategy he considers is building up redundancy of suppliers and inventory alike. Another strategy is to build up flexibility so businesses are capable of anticipating disruptions and then responding to them well and in a timely manner (Chongvilaivan, 2012). Finally, management needs to perform vulnerability assessments and be aware of possible disruptions (Chongvilaivan, 2012).

Researchers at the University of Liverpool conducted an experiment with eight small to medium sized enterprise (SME) owners to evaluate the benefits of a collaborative approach among businesses to increase resilience (Dee Gray & Jones, 2016). The study analyzed the potential effects of three approaches to improving business resilience: business alliances, shared coaching, and a forum. The business alliance, a support network between participating SMEs, was created to increase resource sharing. Shared coaching involved employees of one company presenting to another company ideas on how to increase productivity, improve customer service, stimulate employee motivation, and improve collaboration. Finally, a forum provided a platform to stimulate conversation between participants on common problems the companies had experienced. The study revealed that resilience is not considered a priority by business owners because they reported difficulty justifying taking time away from their companies for programs they did not see as specifically supporting their businesses (Dee Gray & Jones, 2016). Their perception was that most organizations offering such resilience and strategy services were really trying to make money and were not truly passionate about the material. None of the eight companies saw value in workplace coaching, however, employees did see a benefit in short term support between companies in times of need. Most notably, ratings of confidence in expanding their businesses on a scale of one to seven showed an increase of one to four points after completing the program. All eight participants claimed increased motivation, idea generation, and improved communication skills as a result of the exercises. This study revealed that collaboration can be an effective method for SMEs to increase business resilience and efficiency. Since a large majority of industry in the European Union comprises of SMEs, collaborative solutions may be a viable choice for companies seeking to reduce risk.

Another method for increasing business resilience is laid out in the research of Ismail, Poolton, and Sharifi (2011). Their research covers two case studies in which his step-by-step process for increasing business resilience is put into practice. Ismail's form of business resilience integrates risk management and innovative business development (Ismail et al, 2011). Ismail's approach to increasing resilience uses the concept of "strategic agility" and "operational agility" (Ismail et al, 2011); this approach empowers companies to take a proactive stance when dealing with disruptions and increasing resilience. The process of implementation includes listing all

potential sources of disruption, current strengths and weaknesses of the company and potential products or services that the company could offer in the future (Ismail et al, 2011). These lists are then used to create growth plans for the company which allow the company to efficiently operate and seize opportunities (Ismail et al, 2011). During the study, one of the companies experienced reduced demand in its industry, yet fared better than its competitors. Although the overall quantity of sales reduced by 18%, they increased their number of active customers by 25% (Ismail et al, 2011). The other company in the case study achieved a 35% increase in productivity and improved customer ratings (Ismail et al, 2011). These examples show the power of the resilience mindset and active development of business strategies.

Private consulting organizations are beginning to expand in the business resilience preparation marketplace to fill the knowledge gaps. Private organizations are now offering consultancy-based services to increase resilience of other companies, and although there are variations among consulting groups, popular services include resilience reviews and improvement programs, accreditations, and online courses and workshops. An example of such an organization is the Resilience Advisors Network, a group of advisors that share their expertise and offer various resilience services. They offer reviews based on metrics set by the International Standards Organization (ISO), an organization that develops international industry standards (The Resilience Advisors Network, 2017). After this review, the Advisors create a personalized risk profile in which companies can see their best and worst practices and offer improvement programs for companies to strengthen their operations (The Resilience Advisors Network, 2017). Although Danish companies have access to resilience services through service providers located in other countries, currently there are no providers of resilience services in Denmark.

The Danish Institute of Fire and Security Technology (DBI) aims to develop solutions that will be implemented at the operational and strategic levels of companies to increase business resilience. DBI is not the first group to provide resilience services to companies but they are the first to do so in Denmark (DBI, personal communication, 2017). DBI will look at resilience within three main areas of an organization. These areas are the physical structures and IT systems, human resource resilience, and planning strategies. DBI will assess the resilience of physical structures and IT systems by assessing the effectiveness of emergency plans, emergency warehouse storage facilities, cyber security protection, and strength of infrastructure. Planning strategies focuses on plans designed to continue normal business operations in time of crisis by looking at external dependencies such as supply chain management. Human resource resilience refers to the mentality of the employees with respect to their ability to collaborate with one another, think critically throughout work tasks, develop throughout their career, and respond effectively in events of crisis.

DBI's business resilience program originated in October 2016 after Laura Melkunaite became involved in the European Union's IMPROVER Project which aims to strengthen the

resilience of critical infrastructure such as hospitals and railroads in the European Union (Improver Project, 2015). Working with this project sparked Melkunaite's and DBI's interest in developing an area of resilience that can be applied to businesses (Melkunaite, personal communication, 2017). Today, the business resilience program is led by Laura Melkunaite and Terese Urth, who joined the Business Resilience team at DBI in October 2016. Their work to date on this program revealed that companies in Denmark are largely unaware of what business resilience is or the value it can provide. They also found that companies are unable to differentiate business resilience from other risk management activities they are already doing. According to Melkunaite and Urth, outside of the business resilience team, DBI employees are largely unaware of business resilience and the program that is in development. Melkunaite and Urth work separate from other related groups such as security and risk management who could serve as good resources for the program. Since the program is in such early stages, most of DBI is not aware of it and as a consequence, DBI employees miss a valuable opportunity to educate other companies about the concept (Melkunaite & Urth, personal communication, 2017).

Lack of information stands as a barrier to the implementation of processes associated with risk reduction (Caring for Climate, 2015). Brosius and Donsbach (1996) conducted a study about that the use of material with a combination of text and pictures are an effective way to increase knowledge about a topic or event. The study investigated the use of text-picture combinations in the communication of information in television news and compared standard event photos to pictures that match and illustrate the news text itself. Participants viewed one of the four newscasts and then after completed a two-part questionnaire regarding retention of the news stories in the newscast immediately and later on as well. Brosius and Donsbach (1996) found that the combination of text and pictures enhanced the communication of information in television news. The results show that standard pictures, which suggest authenticity and actuality but do not correspond to the information in the text, do not facilitate retention of news content. However, corresponding pictures illustrating news text successfully improves the retention of information.

Ellis and Childs (1999) conducted a study in which the effectiveness of three different videos styles were analyzed with an audience of SME employees. All videos educated viewers on the laws regarding harassment and discrimination in the workplace. One video showed the "complete story," while the other showed short segments accompanied by questions. The format of the third video was "talking heads," and included a person speaking directly to the camera for a longer period. The effectiveness of the video was analyzed by conducting questionnaires and focus groups with the participants. Participants believed the video was more informative and interesting than reading, and enjoyed viewing the subjects as the narration occurred (Ellis and Childs, 1999). The participants believed the video with short segments and accompanying questions was effective because they "did something" with the information they received (Ellis and Childs, 1999). The participants did not believe that the "talking head" video was effective because it was hard to remember and monotonous (Ellis and Childs, 1999). It can be concluded from this study that videos are an effective and well-liked way to inform people about a concept.

Furthermore, it can be concluded that longer videos with people speaking about the same concepts are not as effective. Studies have shown that short educational programs,

videos, and text-picture combinations are an effective way to educate audiences about a concept (Ellis and Child, 1999; Brosius and Donsbach, 1996). After little success contacting companies themselves, Melkunaite and Urth are attempting to use DBI's large network of customers as a new resource to gain access to Danish companies. This network can be accessed most effectively through DBI's employees who interact with customers directly. However, since DBI employees are not knowledgeable on material is to inform DBI employees about business resilience so those employees can then inform customers about business resilience and its importance.

This project is intended to enable the Danish Institute of Fire and Security Technology (DBI) to increase knowledge about business resilience and its importance by developing informational materials for Danish companies.

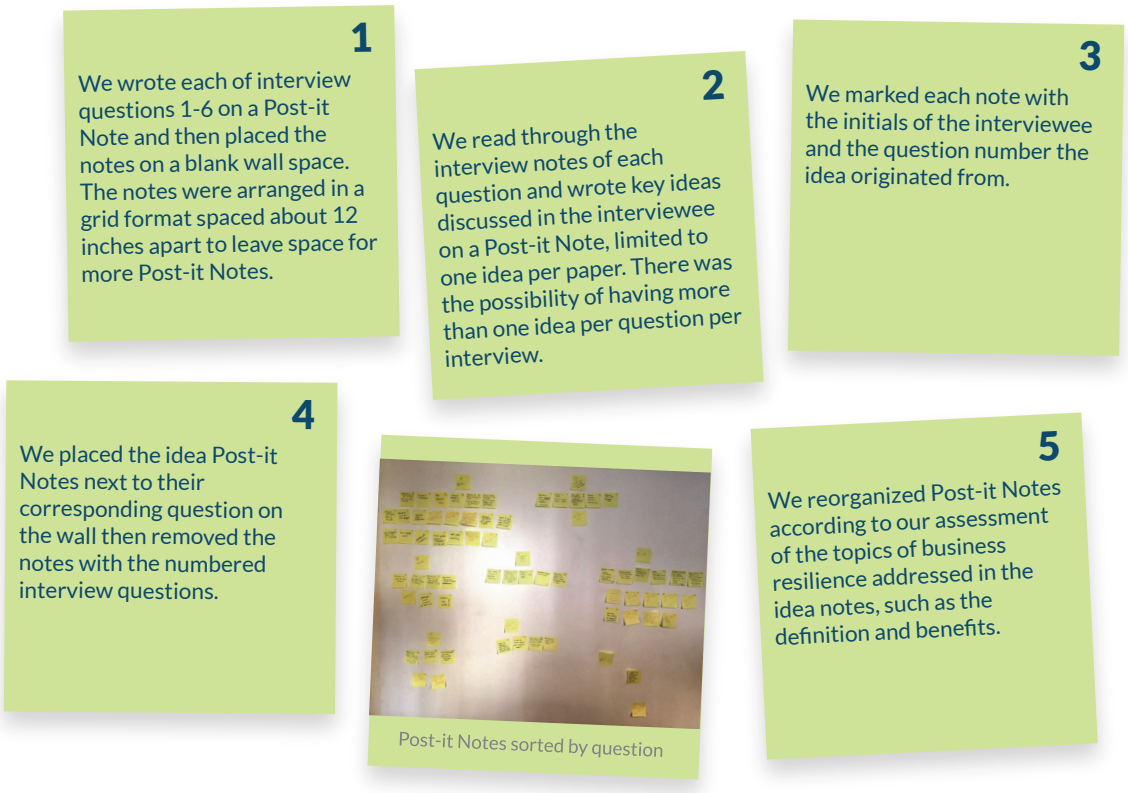
Methodology

Objective 1: Assess the current knowledge of DBI employees regarding business resilience

The purpose of Objective 1 is to assess the current knowledge of DBI employees in relation to business resilience. Please note that this is a summarized version of the methodology for this objective. See the Detailed Methodology chapter of the Extended Report for the extended version. Objective 1 was accomplished through one set of semi-structured interviews which helped us discover interviewees' knowledge gaps and/or misunderstandings about business resilience. We used the results of the interviews to guide the making of informational material prototypes that can teach DBI employees and people at other companies about business resilience. Topics addressed in the interviews included the definition of business resilience and familiarity with the three areas of an organization that business resilience can be applied to. See Appendix 1 of the Extended Report for all interview questions. We purposefully sampled six DBI employees with a variety of backgrounds and knowledge levels of business resilience in order to provide us with a wide range of perspectives on these interview topics. Interviewee descriptions are listed in Table 1 of the Extended Report.

We recorded data from the interviews through typed notes with audio recordings when given consent from the interviewee (consent form may be found in Appendix 1 in the Extended Report). To analyze the interview results, we divided the interview questions in two sets. Questions 1-6 refer to concepts of business resilience and questions 7-9 refer to the informational material. We used the following process (Figure 1), repeated once per set of interview questions, to analyze the information gathered from the interviews:

Figure 1: Post-it Note Method Description



Post-it Notes sorted by topics of business resilience

6

Once topics were identified, we labeled each group of Post-it Notes with their respective title on another Post-it Note to organize them.

7

We individually addressed each cluster of Post-it Notes and identified key takeaways from the interviews. Key takeaways are defined as main ideas and themes from the interviews.

During analysis, we considered interviewees' knowledge level regarding business resilience when drawing conclusions. We especially considered information from experts regarding concepts of business resilience as well as information from less informed interviewees about areas of confusion. All interviewees, without consideration of their knowledge of business resilience, background, involvement in the business resilience program, or any other variable, were consulted in order to generate ideas about effective informational materials. Key takeaways from interview questions 1-7 guided the content of the development of the informational materials addressed in Objective 2.

Objective 2: Develop and assess informational material that DBI employees can use to self-educate as well as inform other Danish companies about business resilience

In order to make the informational materials, we used the key takeaways from the Objective 1 interviews as well as our own understanding of business resilience to establish learning objectives and therefore the content of the informational materials. Please note that this is a summarized version of the methodology for this objective. See the Detailed Methodology chapter in the Extended Report for the extended version.

We used these learning objectives (Figure 2) to develop two assessments which evaluated the effectiveness of the informational material. The assessments included one pre assessment administered one day before and one post assessment administered immediately after participants viewed the informational material. The assessments evaluated interviewees' preexisting knowledge and learned knowledge, respectively, of business resilience with respect to the learning objectives. In addition to conceptual questions, we solicited feedback for prototype improvement on the post assessment.

To identify media for the informational materials, we brainstormed possible options. Then, each team member used his or her own prior experience and knowledge to select one option he or she considered most viable and interesting. Each team member then developed a prototype of that option. We presented these models within our team and gave each other feedback. We modified our prototypes accordingly then consulted Melkunaite and Urth,

Figure 2: Learning Objectives

Learning Objectives

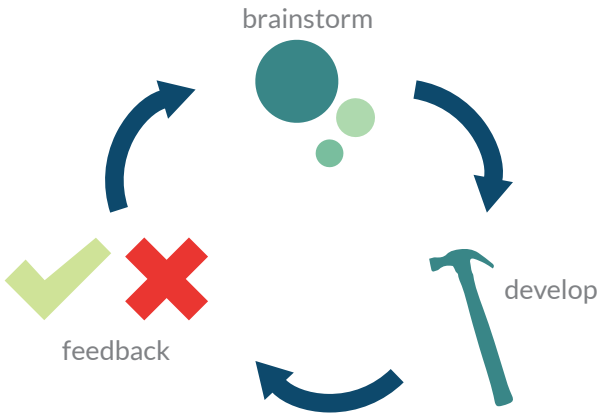
1. ***Define the concept*** of business resilience.
2. ***Describe the relationship*** between business resilience and related business and risk practices.
3. ***Describe the value*** business resilience adds to existing risk management fields.
4. ***Describe how resilience can be applied*** to different areas of an organization.
5. ***Describe the benefits*** of business resilience when it is applied to different areas of an organization.

repeating a similar process of soliciting feedback and making refinements (Figure 3). When appropriate, we eliminated prototypes that showed little promise of fulfilling the learning objectives or were otherwise perceived as unappealing to interact with. With this feedback, we narrowed down our selection to two prototypes for further assessment.

We conducted a pilot test to refine our initial pre and post assessments and prototypes. Pilot test participants were contacted through email and sent a pre assessment link to complete one day before viewing the informational material. We then followed up with participants in person to show them the material, give them the post assessment, and solicit feedback on the assessments and prototypes.

We graded the pilot test following the rubric in Appendix 2 of the Extended Report and then analyzed the results. For any given question, if the pre and post assessment scores were both high, either the learning objective was common knowledge or the wording of the question made the answer too obvious (I-TECH, 2008). Conversely, if the pre and post assessment scores were both low, the topic was not clearly explained in the informational material or the wording of the question was too difficult (I-TECH, 2008). Ideally, the pre assessment score would be low and the post assessment score would be high, demonstrating that our learning objective was not assessing common knowledge and that the informational material effectively explained the content (I-TECH, 2008). After completing our analysis of the assessment results, we made changes to the assessments and prototypes and prepared them for formal testing. The finalized assessment questions we developed can be found in Tables 12 and 13 of the Results and Discussion chapter.

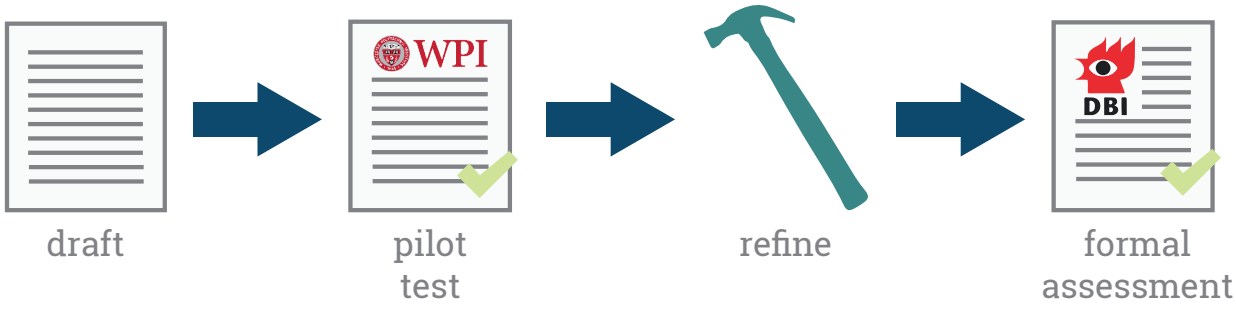
Figure 3: Prototype Development Process



With these revised materials from the pilot test, we formally tested the final two prototypes. To establish a sample population, we assumed that DBI employees approximately

reflect the average knowledge level of business resilience of employees at other Danish companies. We excluded any DBI employees from the sample population that previously participated in an Objective 1 interview or who were heavily involved in the business resilience program. We recruited participants for our study by emailing a request to DBI employees and leveraging personal connections of Melkunaite and Urth. This resulted in twenty DBI employees who we had sign up for one 30 minute viewing session each. Once signed up for a session, participants completed the pre assessment one day before their viewing session.

Figure 4: Testing Process



At the time of each viewing session, participants arrived at the predetermined meeting room to view the informational material and then take the post assessment. These sessions were completed in person to ensure timely completion of all parts of the test and to reduce the influence of extraneous variables on learning, such as independent participant research on the topic of business resilience. One member of our team who was available for each given session acted as a proctor and arbitrarily assigned one of the two prototypes to each participant, either the video or infographic, such that an equal number of participants were assigned to each. The proctor showed participants their assigned prototype and allowed them to view the material without time constraints in an effort to simulate the choice of actual users to decide how much time to view the material. After completing the post assessment, the proctor answered any questions the participant had. Two team members scored each assessment following the rubric in Appendix 2 of the Extended Report. If the graders scored different results on a given question, a third grader scored the question without knowledge of the original grader's scores. Once we completed scoring, we calculated the total number of participants that answered correctly for each question. We performed a chi-square test of independence in Microsoft Excel to determine if participants met the given learning objective. The test determined if significantly fewer participants answered a question incorrectly on the post assessment than on the pre assessment. For this analysis, we grouped all partially correct and correct answers to compare them collectively against incorrect answers. We did this because our informational materials were intended to help people gain basic knowledge, not expertise, on business resilience. Such basic knowledge was accomplished through partially correct answers. This grouping enabled us to perform a chi-square test with two nominal variables. For this study, the two nominal variables were the pre assessment and post assessment scores and the two possible values were correct and incorrect. We tested the null hypothesis that the proportions of the correct and incorrect answers between the pre and post assessment were different. For this test, we chose a significance level of 0.05 because it is the convention in research (MacDonald, 2008). This

significance level means that there is a 5% probability of rejecting the null hypothesis when it is true.

To analyze quantitative data, we performed a paired t-test. We chose this over a generic t-test because we tested the same subjects twice, once before viewing the informational material and again after viewing the informational material. Once again, the level of significance was 0.05. The two nominal variables were the pre assessment and post assessment, and the measurement variable was the rating of their enjoyment that participants provided on a Likert scale. The null hypothesis for this test was that the mean difference between paired observations is zero (MacDonald, 2008). Also, we performed correlation analyses between the Likert questions asked on the post assessment only and two measures of knowledge about business resilience: participants' percentage of correct answers on the post assessment and participants' percent improvement between assessments. We decided that, in order to conclude that there is a significant relationship between two variables, the p-value for the correlation analysis must be below 0.05.

Results and Discussion

Objective 1: Assess the current knowledge of DBI employees regarding business resilience

The following section presents a summarized version of the results and discussion for this objective. See the Detailed Results and Discussion chapter of the Extended Report for the extended version. The interviews we conducted allowed us to assess the current knowledge of business resilience in DBI. By selectively interviewing employees with varying levels of involvement with the business resilience program, we detected a substantial gap in understanding between employees who are heavily involved in the program and those who are not. This information aided us in the development of the content for our informational material prototype.

The data obtained from Objective 1 interviews through the Post-it note method is displayed in Tables 2 and 3 of the Extended Report. By analyzing each Post-it cluster, we created key takeaways. Key takeaways can be seen in Figure 5.

Figure 5: Key Takeaways from Interviews

Definition of Business Resilience

A shorter definition is better

People want to learn more about all parts of business resilience

Benefits and Function of Business Resilience

The majority of benefits of business resilience are financial

Business resilience turns disruption into opportunity

Human Resource Aspect of Business Resilience

The extent of the resilience program depends on the company

A company is only as resilient as its employees

Increased training of employees can increase resilience

Collaboration stimulates employee engagement and diversification of skills

Implementation of business resilience

It starts with a resilient mindset; it is more than just a resilient business

Most people think that resilience is only applicable on a strategic level

What Makes Business Resilience Different from related fields?

An umbrella for other concepts

Positive spin on risk management

Differences are not obvious

People don't know the difference in part because they don't know what the parts are (ex: Business continuity management vs resilience)

Telling Others about Resilience

Most people are comfortable talking to friends about resilience, but not talking to customers

Effective Types of Materials

Video and interactive materials are appealing

Quality is king: any medium can be good so long as it is good quality

Closing Remarks

Preference for materials that have examples, good graphics, a clear purpose, and are short

The more complex the idea, the shorter and simpler the material needs to be

Concrete examples can help us convey our message

As a result of the interviews, we found that employees who are not heavily involved with the program have some accurate ideas about business resilience but their understanding of the concept is limited. They were correct in assuming business resilience can help a company during

times of crisis but did not address the aspects of disruption prevention, adaptability, or growth before and after a disruption. All participants that were not already heavily involved with the program said they were interested in learning more about resilience.

All participants, regardless of their previous knowledge, saw benefits in implementing business resilience in an organization. Economic benefits were the most obvious to all participants and they identified different ways a company could benefit economically. For example, interviewees mentioned business resilience can help with an increased market share, greater investor confidence, and less downtime.

We found that it was difficult for participants who are not heavily involved with the business resilience program to explain how business resilience is applied specifically in an organization's physical infrastructure and IT systems, human resources, and planning strategies. Participants who are heavily involved in the program did not have difficulty explaining these areas, however they acknowledged their complexity. To explain these areas effectively, they suggested we use examples.

We found that all participants reported feeling comfortable discussing business resilience amongst their peers. However, those not involved in the business resilience program reported that they felt uncomfortable discussing business resilience with customers because the concept was too vague in their minds. They could not clearly explain the value which business resilience services bring to a company or how it differs from existing risk management practices.

All participants provided valuable feedback regarding effective informational materials. Six of the seven participants said that a video or animation is an engaging way for them to learn new material. Five participants said that printed material is also effective. Notable comments from participants include two people that said learning styles and preferences vary among people and that the quality of a given material is more important than the medium.

4.2 Objective 2: Develop and assess informational material that DBI employees can use to self-educate as well as inform other Danish companies about business resilience

The following section presents a summarized version of the results and discussion for this objective. See the Detailed Results and Discussion chapter of the Extended Report for the extended version. We developed various prototypes before deciding on two to proceed with for the pilot test and formal assessments. The initial prototypes included a Prezi presentation, a flyer, a booklet, an infographic, and a stop motion video. After discussion among the team members and other feedback, we decided not to continue with the Prezi presentation, flyer, or booklet. For more information on the preliminary development of these prototypes, see the Detailed Results and Discussion chapter of the Extended Report. The two prototypes we continued to develop were the infographic and stop motion video.

We chose to create an infographic which is a type of image that combines graphics and text to communicate data or ideas. They generally communicate large amounts of information combined with many visuals, addressing feedback from Objective 1 interviews to use compelling

visuals. Another feedback we addressed was to use a practical example of business resilience application. For this, we chose the example of financial services company Morgan Stanley's reaction to the terrorist attacks in New York City on 11 September 2001. Morgan Stanley's story describes how business resilience helps organizations learn from past disasters to better prepare for the future. One team member drew a first draft of the prototype and showed it to the other team members for initial feedback. The team made appropriate changes before pilot testing.

We decided to begin developing a video because we received feedback from our initial interviews saying that videos are an effective way to learn new concepts. We also received feedback from our initial interviews that stories and examples can help effectively convey a message. After discussion among the team members, we decided to develop a stop motion video. The first step in creating the stop motion video was developing a storyboard to help us visualize the scenes and the storyline better. We then created a script to go along the storyboard. We discussed the script among the team members and assured that all the learning objectives were addressed in the stop motion video. After completing the stop motion video, we believed that it met all the learning objectives in an appealing way. We chose to continue with this prototype for our pilot test because it met all the learning objectives, and we felt that a stop motion video would be an effective format for our informational material.

After developing our prototypes, we conducted the pilot test to identify and revise questions that were unsuccessful in evaluating participants' knowledge according to the learning objectives. The revisions from the pilot test resulted in the questions we used in our formal pre and post assessments. The finalized questions that are repeated in both the pre and post assessments can be seen in Table 1 and questions only asked in the post assessment can be seen in Table 2. For a complete explanation of the revisions we made to the questions refer to the Detailed Results and Discussion chapter of the Extended Report.

Table 1: Finalized Questions in the Pre Assessment and Post Assessment

Number	Question	Learning Objective
1	What is business resilience?	1
2	What is the relationship between business resilience and other fields such as business continuity management, supply chain management,	2
3	**Pre assessment:** How does business resilience deal with risk differently than other related fields? (Such as business continuity management, supply chain management, crisis management, etc.)	3
3	**Post assessment:** What does business resilience add to an organization that other related fields do not? (Like business continuity management, supply chain management, crisis management, etc.)	3
4	Why does the process of increasing business resilience include a review of physical infrastructure, equipment and IT systems?	4
5	How are workers and managers involved in the process of increasing business resilience?	4

6	How do practices for increasing business resilience affect existing risk mitigation plans such as emergency plans, business continuity plans, supply chain management, etc.?	4
7	**Pre assessment:** List some benefits of increasing the resilience of IT systems and physical infrastructure:	4
7	**Post assessment:** How can more resilient infrastructure and IT systems give a company competitive advantage over its competitors?	4
8	**Pre assessment:** List some benefits of increasing the resilience of workers and managers:	5
8	**Post assessment:** List some benefits of increasing human resource resilience below:	5
9	Why is one risk plan preferable compared to individual risk plans such as emergency plans, business continuity plans, supply chain management, etc.?	5
10	How would you rate your understanding of business resilience?	N/A (Likert Scale)

Table 2: Finalized Questions in the Post Assessment Only

Number	Question
11	How much did you enjoy using this tool?
12	How much did you learn by using this tool?
13	Rate how likely you are to show this material to a customer
14	Do you have any suggestions on how we could improve the tool?
15	For the infographic, what did you think of the introductory example used?

Table 2 displays the questions that were asked on the post assessment only and their respective numbers. These questions were used to gather feedback once the informational material was viewed. Questions 11-13 are Likert scale and questions 14 and 15 are open ended. Question 15 was directed at infographic viewers only.

We assessed the effectiveness of each prototype by looking at their ability to increase knowledge for a statistically significant amount of people. We used statistical comparisons of the number of correct responses for each question on the pre and post assessments to assess whether or not the infographic and the stop motion video were successful in helping participants to meet each learning objective. We used chi-square tests to determine if the number of correct responses was significantly different between pre and post assessments. A learning objective was met if there was a statistically significant difference between the pre and post assessment scores. Learning objectives 4 and 5 were divided in three parts: physical infrastructure and IT systems, human resources, and planning strategies. In order for these objectives to be met, all separate parts must be met.

Based on our statistical comparisons of the pre and post assessments, we found that the stop motion video was effective at meeting learning objectives 2 and 3. For both learning objectives 4 and 5, the stop motion video was only effective in meeting one of the three parts: human resource resilience. The stop motion video was not effective at meeting the remaining learning objectives.

The infographic showed to be effective at meeting learning objectives 2 and 3. It was also effective at meeting two parts of learning objective 4: human resource resilience and planning strategies. The infographic was not effective at meeting the remaining learning objectives.

Figures 6 and 7 represent the learning objectives met for the stop motion video and the infographic, respectively. The green check marks designate learning objectives that were met, while the red X's designate learning objectives that were not met. Checkmarks and X's for the three parts of learning objectives 4 and 5 are in the following order: physical infrastructure and IT systems, human resources, and planning strategies. For a detailed discussion on the effectiveness of each material, see the Results and Discussion chapter of the Extended Report.

We asked participants to rate their understanding of business resilience on a scale of 1 through 5 on both the pre and post assessments. We used paired t-tests to determine if there were statistically significant differences between ratings on the assessments. For the stop motion video, the mean rating on the pre assessment was 1.8 out of 5 (SD = 0.6), while the mean rating on the post assessment was a 3.5 out of 5 (SD = 0.4). The paired t-test showed that the difference between pre and post assessment ratings was statistically significant (t = 6.53, degrees of freedom = 9, p-value = 0.00005). For the infographic, the mean rating on the pre assessment was a 2 out of 5 (SD = 0.7), while the post assessment rating was a 3.5 out of 5 (SD = 0.9). The paired t-test showed that the difference between pre and post assessment ratings was statistically significant (t = 5.09, degrees of freedom = 9, p-value = 0.0003). The data from this test can be found in Appendix 3 in the Extended Report.

We performed correlation analyses between the Likert questions in Table 2 and two measures of knowledge about business resilience: participants' percentage of correct answers on the post assessment and participants' percent improvement between assessments. We performed these analyses separately for participants who viewed the video (Table 33 in the Extended Report) and the infographic (Table 48 in the Extended Report). The analyses indicated no significant correlations for any comparisons for the group that viewed the stop motion video, but did indicate significant correlations for two comparisons for the group that viewed the infographic. The two significant correlations were: participants' reported enjoyment level viewing the infographic and percent correct answers on the post assessment and participants' self-reported amount learned and their percent improvement between assessments. For a detailed discussion on the results of the correlation analyses, see the Results and Discussion chapter of the Extended Report. The graphs showing the relationships for the two significant correlations are presented in Figures 15 and 16 in the Extended Report.

Figure 6: Stop Motion Video Formal Assessment Results

Stop Motion Video Formal Assessment Results

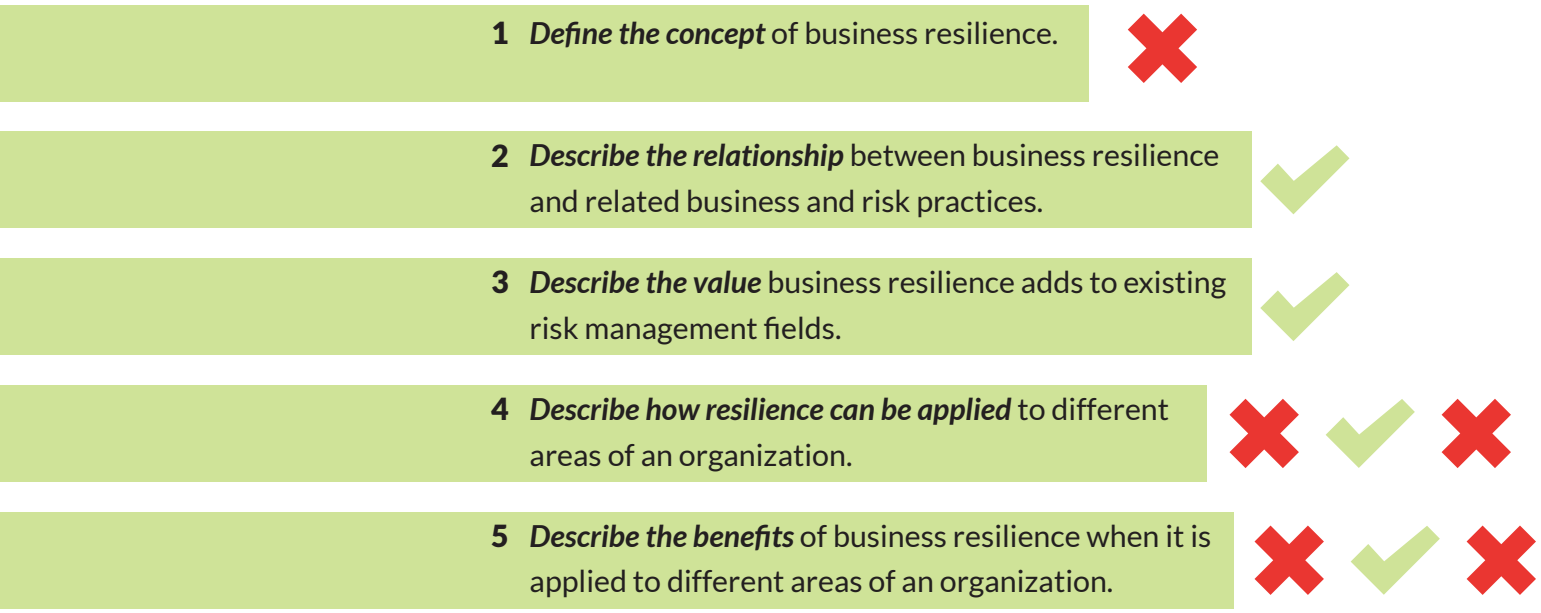
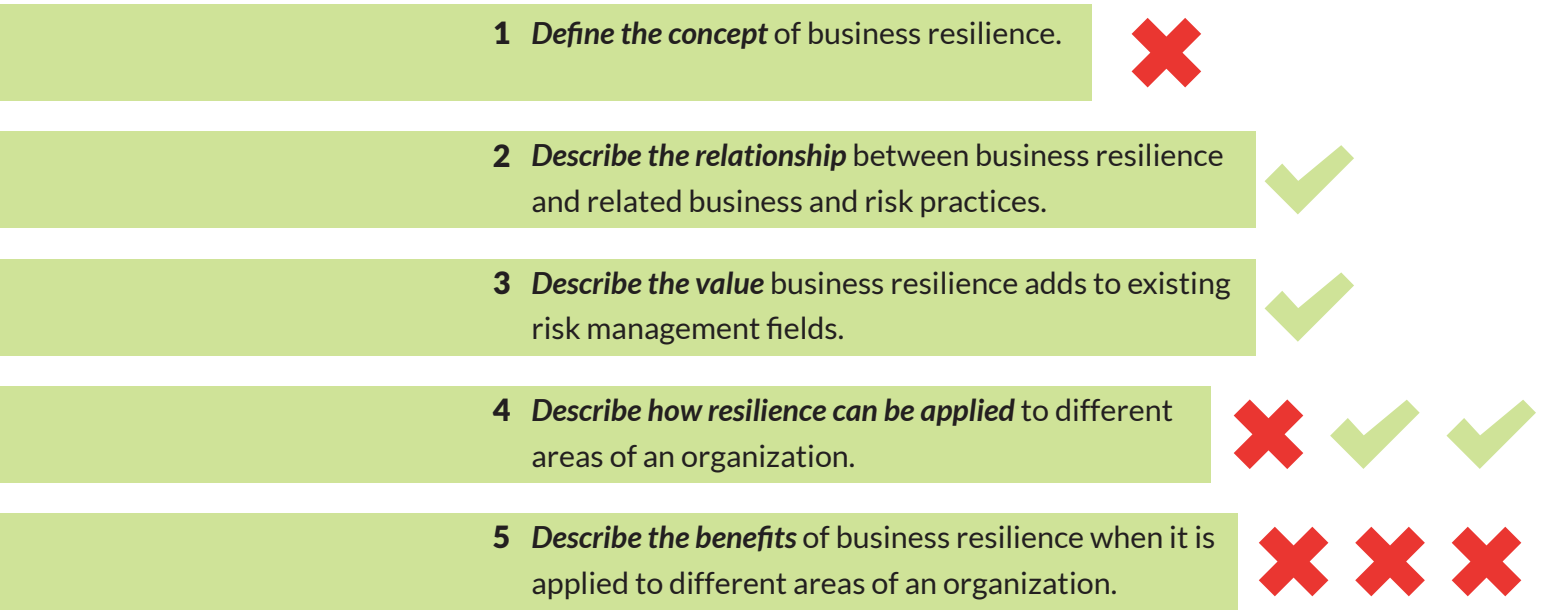


Figure 7: Infographic Formal Assessment Results

Infographic Formal Assessment Results



Conclusion and Recommendations

Throughout our time working at DBI, we studied effective means of educating Danish employees about business resilience. While we found the infographic and stop motion video to be effective at fulfilling some of the learning objectives, we have additional recommendations on how to communicate the importance of business resilience better and share the materials we have created.

5.1 Modification of Materials

The informational materials we made and tested are subject to continued refinement and adaptation in response to user feedback. We invite DBI to continue modifying the materials in whatever ways are most useful to them. At the conclusion of our study, we identified areas for future material development in response to assessment results and feedback.

To continue developing the video, we suggest adding a final slide to summarize the main concepts and provide users a way to find additional information on business resilience, possibly by showing a phone number or email to contact or DBI's website. Alternatively, the final slide could have an excerpt of someone involved in DBI's business resilience program such as Laura Melkunaite speaking about business resilience, giving a recap of the main points from the video and speaking about what DBI is doing in terms of business resilience and the services it plans to offer. To continue developing the infographic, we suggest a few changes. First, we believe that it would be appropriate to switch the order of the term "business resilience" and its definition to list the term first. Doing so could help viewers identify the definition as important information before reading it and would be more likely to pay special attention to it. In addition to this change, we suggest using an example other than the terrorist attacks of 2001 that relates more directly to Denmark. This could significantly help improve viewer engagement and enjoyment from viewing the informational material. Finally, we recommend that the bottom portion of the infographic is revised to include more graphics. While the text is highly explanatory, it does not excel in viewer engagement as evidenced by feedback we received.

5.2 Distribution Recommendations

For the informational materials to be effective, they must not only communicate concepts of business resilience but also be distributed to people who can benefit from and potentially implement business resilience. Both the infographic and the video could be distributed online several ways. It could be posted to social media accounts such as LinkedIn, where it would directly reach above 3,000 followers and be subject to continued sharing. Both materials could also be posted to both DBI's general website and the business resilience website. On DBI's general website, where all DBI's services are explained, we suggest that the infographic and the stop motion video are attached to the page explaining the business resilience workshop. Due to the versatility of the infographic, it can be printed and distributed in several ways. It can be displayed along with other fliers in the DBI lobby. Placing the infographic in the lobby would allow all employees to see it as they pass through it as well as guests to DBI's facility. Having multiple copies would encourage people to take one and read about business resilience further. Printed copies

could also be distributed for DBI employees to bring with them when visiting customers. We ultimately recommend that DBI take advantage of their existing network of employees and Danish businesses to promote both materials and encourage sharing.

5.3 Increased Interdepartmental Collaboration

During our seven weeks at DBI, we formed relationships with employees from various departments and learned more about their roles and responsibilities. We met employees from the Marketing and Sales, Security and Investigation, and Research and Incubation departments. We noted that employees from these departments have diverse skills that could benefit the business resilience program. For this recommendation, we considered in more detail the work of employees that we found overlapped with the business resilience program at DBI (detailed version in Extended report). We acknowledge that since we did not talk to all employees at DBI, there may be more employees beyond those listed that could be valuable resources for Melkunaite and Urth in the development of the program. We believe that since business resilience encompasses many risk fields, it would be beneficial for the resilience team at DBI to spend more time understanding what the disciplines offer so they can more easily develop the resilience services.

5.4 Interactive Teaching Material

Through our research, we found that business resilience is an extremely complex concept and that there is a lot of ambiguity surrounding its meaning. After analyzing our formal assessments, we determined that our two prototypes were successful at educating employees on the basic concepts of business resilience. However, there is a need for a more in depth informational tool. We received feedback in our initial interviews that an interactive material would be extremely engaging and useful. This is consistent with the research of Hockicko, Krišťák, and N'mec (2015) and Yang, Wang, and Chiu (2015) that supports interactivity as a pedagogical tool. While a promising method, we chose not to pursue this type of informational material because implementation was not feasible given our project constraints. Interactive programs can be complex to make and require more time than we had in our project to learn the tools necessary to make such material. Given the challenges of implementation, we pursued other types of materials, but because business resilience is a very complex topic, we recommend that DBI continue educating people about resilience through an interactive material.

One way to make the interactive material more engaging is through gamification. In gamification, elements of video games such as point-scoring and badges are integrated into non-game activities to promote engagement and productivity (Huan and Soman, 2013). The steps to apply gamification effectively in an interactive material are described in the Extended Report.

5.5 Conclusion

Organizations in Denmark need to understand business resilience so they can be prepared to manage disruptions. Through our interviews, we found that DBI employees are largely unaware of business resilience, but are interested in learning more about it. We believe that employees of other Danish companies will also be interested in learning more about business resilience and will benefit from an informational material. We believe Danish businesses will be able to benefit greatly from business resilience services and the added stability they can provide to an organization beyond existing risk management practices. Our work has shown the effectiveness of both a video and infographic in explaining business resilience and shown that there are many ways to develop and deliver business resilience services to Denmark.

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