Counterbalancing Asymmetric Information: A Process Driven Systems Thinking Approach to Information Sharing of Decentralized Databases

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Abstract. This paper explores asymmetric information and how to counterbalance it. It utilizes the case study of a hypothetical company called "Hashable". The purpose of this case study is to exemplify a proposed solution to address the information asymmetry faced by buyers of residential real estate in New Zealand. A procedural response is provided for organizing the information needed to make an informed decision on purchasing a property. A causal loop diagram is introduced to develop an understanding of the various stakeholders involved in the proposed solution and their interaction with the information they provide. This paper highlights the core problems regarding information asymmetry within a transaction. It also provides procedural and technological solutions to counterbalance this information asymmetry while simultaneously reducing information costs and increasing reliability of the information provided.

Keywords: Information asymmetry · Transactions · Decision making · Integrated decentralized databases · Real estate · Disruption · System dynamic models

1 Introduction

The New Zealand (NZ) real estate market is estimated at approximately 1.1 trillion NZ dollars (see Fig. 1). The value of housing stock includes all private sector residential dwellings (detached houses, flats and apartments), lifestyle blocks (with a dwelling), detached houses converted to flats and 'home and income' properties. It does not include vacant land [1].

The number of NZ properties bought and sold in 2018 equates to approximately 200,000 transactions. On average, a person will purchase a property only a few times in their life and it's most likely the largest financial transaction they will ever undertake. These property transactions are often paired with mortgages and will have a lifelong impact on individuals. Thus, information pertaining to a "to be purchased" property is a highly monetarized and becomes a crucial part of buyers due diligence. Yet, the

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information presented to buyers can be hard to understand and there are many hidden risks that most are unaware of.

Further, a property purchase transaction comes with a certain amount of stress and logic is often subservient to emotional factors. Most of the information pertaining to a property is given verbally by a real estate agent and primarily consists of subjective criteria for purchasing it. One possible reason for this was established by Allmon and Grant [2] who suggested that the main intermediary, the real estate agent, does not always have the best interest in mind for both the buyer and seller for the sale to proceed.

The value of the NZ housing stock is in the trillion dollar range [3]. Buying and selling residential real estate in NZ is becoming more complex. New rules and regulations are being mandated resulting in more legal responsibilities delegated to real estate agents and buyers. For example, once the initial price negotiations for a property is concluded there is often a deadline to complete the due diligence of the sale by the buyer that, in turn, increases the pressure of the transaction. In the real estate industry many intermediaries are utilized to obtain a satisfactory transaction between a buyer and a seller. For buyers, there is the added complexity of finding all the right documents needed to make an informed decision on a real estate transaction and conduct proper due diligence. For instance, there is a property file that can be requested from the city council (CC). This file contains all the consent notices, forms, code of compliances and reports that the CC holds on file for a particular property. Also, a Land Information Memorandum (LIM) report can be purchased from the CC (NZ$200–NZ $400), which contains information regarding the legal description, lands use, zoning, utilities, consents etc. The property file and LIM report do not always correlate and often have critical information missing. Also, the buyer needs to obtain the property title that gives various caveats, and covenants lodged against it. Then there are a multitude of reports that can be requested, for example, a moisture report, asbestos report, electrician report, builders report, soil test, archeological test, drainage report, geo-tech report and valuation report. These reports are paid for by the buyer and are not reported back to the CC. This can result in the same report being requested multiple times by multiple buyers. When buying a property there are also a lot of other indicators that can assist the sale. These indicators are often verbally transmitted and once the sale is completed, typically, this information is lost.

2 Problems and Solutions

The primary contributor to the problem of information asymmetry faced by buyers of NZ residential real estate is information integration and its visibility. The integration of real estate information among government, CCs, property specialists, and real estate organizations. For example, as mentioned, there may be a discrepancy between the property file held by the CC and the LIM report. Then there are the various building experts, engineers, surveyors and other experts who collect enormous amounts of data relating to a particular property without the obligation to register this information against it. Often specialists are hired by a buyer for their services during the due diligence period. If the sale does not result in an unconditional offer and the property is re-listed this information is lost. Also, this specialist service can sometimes be performed on a particular property multiple times by multiple specialists with different outcomes. This

results in a discrepancy between the knowledge base of the average property buyer and the information presented to them, which ultimately contributes to asymmetric information favoring the seller.

In addition, there is also a lot of subjective information communicated on a verbal basis often by real estate agents. For example, the agent may mention that "the house has just been painted." This information could become more valuable if the company name is mentioned, the date and cost of the work and any product and service warranties given. Then there is private information only known to the seller, which they are not legally required to share or submit to the CC for instance. This private information could provide a more accurate account of the property being sold. It is diverse in nature and could range from the date a new hot-water cylinder was installed, a recent repaint of the house including the paint used to the installation of new locks and alarm system.

The most effective solution for solving the aforementioned information asymmetry problems is the creation of a centralized property database supported by blockchain technology and administered by the CC. This property database would collate and synthesize information from multiple stakeholders and redistribute it, tailor-made, upon a customer order. This solution would address the information discrepancy while, simultaneously, increasing the accuracy and security of information presented to the buyer. This would ensure that information on a property is not lost and repeated multiple times and there is a chain of information that is traceable back to the origins of the property. The blockchain technology would provide reliable, verified, information on an asset [4]. Leading to a practical working tool for CCs, real estate agencies and buyers and sellers of real estate. Importantly, it would drastically cut the cost of paperwork involved in the due diligence of buying real estate and significantly enhance the added value of the property file.

The possibility of giving "owners" data set privileges to access the property database could further enhance the reduction of the information asymmetry. The property database would support user accounts for individual property owners. These accounts would allow property owners to upload additional information to the property ledger and administer this information as they see fit. Although this information would not be verified by blockchain it has the potential to improve the code of practice for installers and subsequent warranty claims. The information, for instance, would have a date, installers name, price and possible warranty and would ensure that warranties are transferable to the new owner. It would improve the code of conduct for a large number of trades as a warranty and the trade name is now recorded against the property.

The property database would primarily benefit three customer groups:

- Buyers of real estate: By lower the cost of accessing information to support the due diligence period of a transaction.
- Agents and Specialists: By providing detailed analysis capabilities.
- Government and CCs: By providing richer and more diverse information to support effective governance.

3 A Hypothetical Case Study

The goal of the proposed solution is to "create knowledge from data and information through technology innovation that contributes to the 9th United Nations sustainable

development goal[1]." To illustrate this solution, a hypothetical company, called "Hashable" is proposed. The purpose of this case study is to exemplify the current problems discussed as well as providing insights to develop a procedural response for collating and organizing information needed to make an informed decision on purchasing NZ residential real estate. This case study focuses on infomediating by collating information from the various stakeholders and redistributing it through specialized reports to customers. To achieve its goal, Hashable will have to partner with Government and CCs to gain access to the data it needs. This not only means access to public government and CC data but also implies that rules and regulations to encourage data sharing between the various stakeholders will be required. Together with a legal framework to support the reliability of the information provided.

Hashable is a hypothetical company operating in the NZ real estate industry. In 2018 approximately 200,000 properties were sold in NZ [5]. This statistic represents the potential market. In this market consumers require quality information to conduct proper due diligence in their property transaction. These consumers are Hashable's target customers. Hashable also provides analysis services and tools for several government organizations. These products and services include detail statistics on housing markets and associated trends and represents only a small part of the company's business. Hashable has several competitors that also provide a certain level of information to property buyers looking to support their purchase decision. These competitors are:

- REINZ: a nationwide registry that provides basic property facts.
- CCs: provide detailed property information (LIM report).
- Real estate agents: provide detailed property information and history.
- One Roof: nationwide app that synchronizes basic data for buyers.

There are no figures available, but industry specialists believe that information sharing is common among the various competitors in the market.

3.1 Customer, Suppliers and Partners

The company Hashable is reliant on data from a diverse number of sources to create its product and services. The company has identified four main suppliers:

- Government including CCs: provide all real-estate data that is publicly owned.
- Real estate agents: provide commercial data they have acquired. They are rewarded through checking their records with information stored on other databases.
- Specialists: provide specialist reports that are logged with a professional association to be valid. To enable this information sharing and validation, government regulation is required to regulate both the individual specialists and professional associations.
- Homeowners: provide information that meets the expectation of a seller prior to purchasing. Providing this information is market driven and would motivate homeowners to register assets relating to the property, including dates of purchase and valid warranties. This information has been uploaded to the current ledger of the CC personalized database for property owners.

[1] Goal 9: Build resilient infrastructure, promote sustainable industrialization and foster innovation.

In addition, the company Hashable has identified three main customers for its product and services:

- Government including CCs: Could access a more detailed report on the residential real estate market in NZ. This would give access to private information over and above the information they already hold on both properties and markets.
- Real estate agents: Could drill down to the individual property level to determine, for example, an accurate price or access information that would enable them to understand a local market in more detail.
- Buyers of real estate: Could access a more comprehensive, verified report on a property, which is reliable and at a lower cost than those available from other sources.

3.2 Industry Analysis

It is important to identify the forces operating in an industry to understand the problems and opportunities that exists that impact a company's competitive advantage. In the case of the company Hashable, and the greater real estate industry in which it resides, the assumption is that the industry is competitive and well established. However, Hashable is focused on occupying a niche within the greater real estate industry where the current rivalry among competitors is low. This lack of competition is due to the relative immaturity of the niche market and the barriers to entry raised by Hashable's ability to develop an extensive database of residential property information.

In an industry where the supplier power is extremely high, Hashable is reliant on data and information provided by third parties. Primarily, government and CCs that hold vast amounts of real estate information. For instance, Land Information New Zealand (LINZ) plays an important role in providing accurate and verified information on every property in NZ. The real estate industry and specialists need to be motivated to share their information. And, private information from individual property owners needs to be made available as it provides the detail and richness of information that sets Hashable apart from its competitors.

The threat of new entrants in the niche market is low, given that the entry barriers are relatively high in terms of time in particular. As mentioned, to make Hashable's product and service attractive, large amounts of information on numerous properties needs to be acquired from the various suppliers and property owners (potential customers/buyers) then verified and collated. In many ways Hashable's core business is similar to that of other infomediaries like Ebay. To entice buyers to its site, Ebay needs a large number of items to be listed and to motivate sufficient items listed it needs a large number of potential buyers. The longer Hashable is established the larger the database becomes, which means new entrants will face higher barriers to entry.

The threat of substitutes is medium. There are several possible substitutes that could disrupt Hashable's business model such as:

- Government regulations could change the way information on properties is shared.
- A change in real estate practices and the parties responsible for verifying the information.

- Law changes regarding which parties are legally required to provide information on a real estate asset.

As long as Hashable can provide accurate, verified, comprehensive, low-cost property information to buyers, the buyer power is low. Buyers purchase information for a one-off fee. Currently Hashable has few competitors that can provide verified, comprehensive information on specific NZ properties. The products and services offered by Hashable are:

- Buyers due-diligence support.
- Real estate market analysis and reporting.
- Government and CC reports that assist in the application of legal and governance compliance.

The Government and CC are both a large supplier and customer. Initially the Government and CC have high buyer power. But once they become established customers of Hashable their power diminishes as switching cost could prove to be too high. Likewise, residential real estate organizations initially have medium bargaining power, which diminishes over time as the amount of information available through Hashable increases.

3.3 Strategy

In 2018 a total of 200,000 properties were sold in NZ [1]. Of those 200,000 property transactions, Hashable estimates that only 60% conducted a proper due diligence. Hence, the company believes that by providing reliable information on properties throughout NZ there is an opportunity to corner the market it operates in by significantly growing its market share. While also growing the number of property buyers who conduct a proper due diligence before purchasing a property.

Using Porter's generic strategy model, Hashable has adopted a narrow focused, cost leadership strategy. The main reason for establishing Hashable is to provide detailed, verified information in the form of easy to understand reports at a low cost to buyers of residential real estate. Currently, the company operates in a niche market and its primary goal is to support buyers in the due diligence period by providing information relating to a specific property. The main product and service offered to buyers are:

- A basic data package: This product delivers all the basic data available on a property from government and CC records in an automatically generated easy to read report.
- A due diligence package: This product adds regional specific statistical data to the location (e.g. economic regional growth, school decile, history, etc.) and checks for missing data. This missing data also highlights the gap in information, which in turn raises a buyer's awareness.

4 Value Chain and Business Processes

Using Porter's value chain model [6], Hashable identified the main support and primary activities of its value chain (see Fig. 1). The support activities are IT infrastructure

and human resources. The IT Infrastructure is crucial in order to provide data security and uninterrupted service to Hashable's customers and suppliers. Within the real estate industry transactions are linked to deadlines, so providing on-time, updated information is essential. This is also applicable to information security as the information provided needs to be reliable to make informed decisions such as whether to purchase a property or not. Given that Hashable is an infomediary, it relies on highly skilled IT specialists. It is the responsibility of HR to train, hire and retain these individuals.

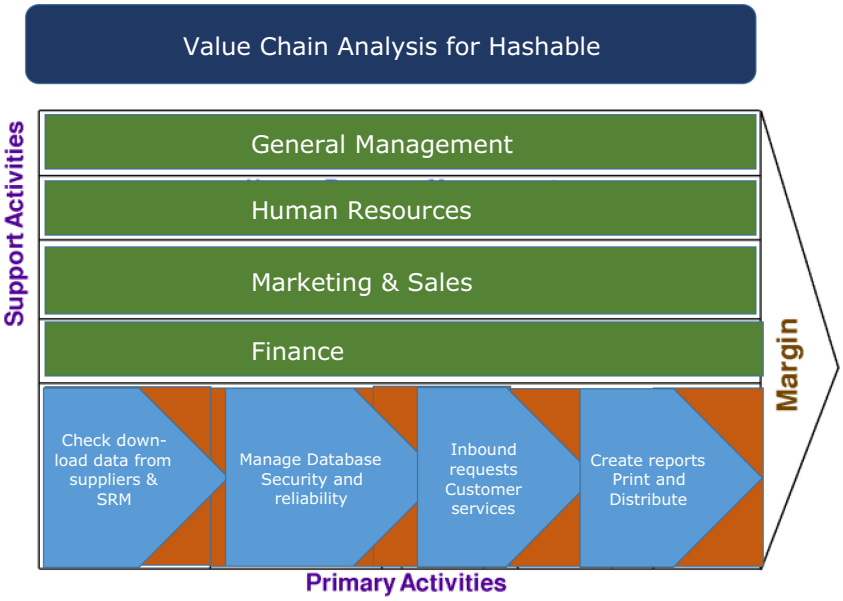

Fig. 1. Hashable's value chain

The company's main primary activities are marketing and sales. Hashable is a new specialized company looking to partner with new suppliers of data and information while maintaining existing suppliers' loyalty. Acquiring new markets and creating new information products for these markets is core to the company's value proposition to both its new and existing customers. Hence, there are five main activities that make up the marketing and sales activities, which are:

- Inbound data deals with aligning all the database information being collected from the data/information suppliers. It also involves the discovery of new information sources and converting it to Hashable's requirements.
- Data management is responsible for information security, structuring data, and looking for new ways to verify and present information.
- Inbound requests handle all standardized requests. This involves checking that the information presented aligns with the requested report and overall quality is maintained.

- Report creation handles all specialized reports and creates new standardized reports. This equates to the research and development activities for the company.

Using Sharp and McDermott [7] definition of business processes, Hashable identified three core business processes (see Fig. 2). Focusing on the primary activities of the company's value chain, the core business processes that follow enable the acquisition and processing of data and production of reports:

- Receiving data and information.
- Data management.
- Creating reports (customer-orders).

These three processes focus on linking suppliers with individual team members at Hashable and, in turn, individual team members with the company's customers. The core processes are designed in such a way that a supplier and a customer have a dedicated contact within the company. This allows Hashable to build strong relationships with its suppliers and customer. For instance, the team member who receives an inquiry from a supplier or customer will be responsible for responding in an appropriate way.

4.1 Receiving Data

Receiving data involves acquiring and verifying data received from suppliers. This determines the quality of Hashable's product and services. The main activates are:

- The inbound data team checks and verifies the data. They determine the supplier and if the data was sent by a verified node.
- The inbound data team is also responsible for supplier relationship management (SRM) and maintains close ties with the company's suppliers.

The primary contribution of the inbound data team is SRM. Hashable is totally reliant on its suppliers for its raw data. The company's most important suppliers are LINZ and CCs. Losing either of these two key suppliers has the potential to put Hashable out of business. Hence, Hashable has long standing contracts with both of these suppliers.

4.2 Data Architecture

Data management involves receipt of the extracted data from the inbound data team after which it is scanned for accuracy and viruses. The data is transformed and loaded into Hashable's database. The data management team is also responsible for locating missing and inaccurate data and communicating this back to the inbound team. This is an important activity because compromised data could result in legal challenges. For example, if a customer purchases a property based on data supplied by Hashable and the data is inaccurate the company could face legal proceedings (Fig. 2).

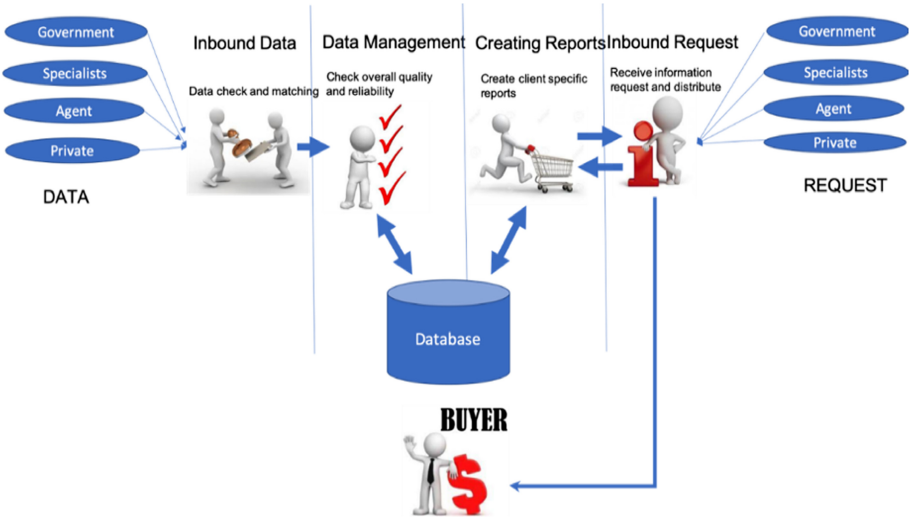

Fig. 2. Hashable's key business processes

Over time these key business processes can evolve into a blockchain based architecture. This would automate the inbound data and data management. The stakeholders can verify the information via different levels of attestation. This would allow a number of applications to be developed and the reports can be generated and presented via multiple apps depending on the users preferences and needs. This blockchain based architecture would increase reliability and significantly decrease the costs associated with creating the reports (Fig. 3). Hashable needs to control the decentralized database and the content. The longer Hashable stays in business the more valuable the database becomes.

4.3 Creating Reports

Creating reports involves receipt of a customer order, the processing of this order, and the collation of the report by the inbound request team. The inbound request team is also responsible for customer relationship management (CRM). They also check whether the funds have been received by the finance department and then send the report to the customer. Again, this process has the potential to result in legal challenges. The team creating the report will probably be the first to notice if the data they are working with is compromised and will raise the issue accordingly.

5 Counterbalancing Information Asymmetry in the Age of Disruption

Hashable relies on providing highly accurate information that customers rely on for large transaction decisions. When inaccuracies occur in reporting, whether they be large or small, it is a disruptive event and the root cause of these inaccuracies need to be ascertained immediately. Discovering the root cause can be difficult and requires a full

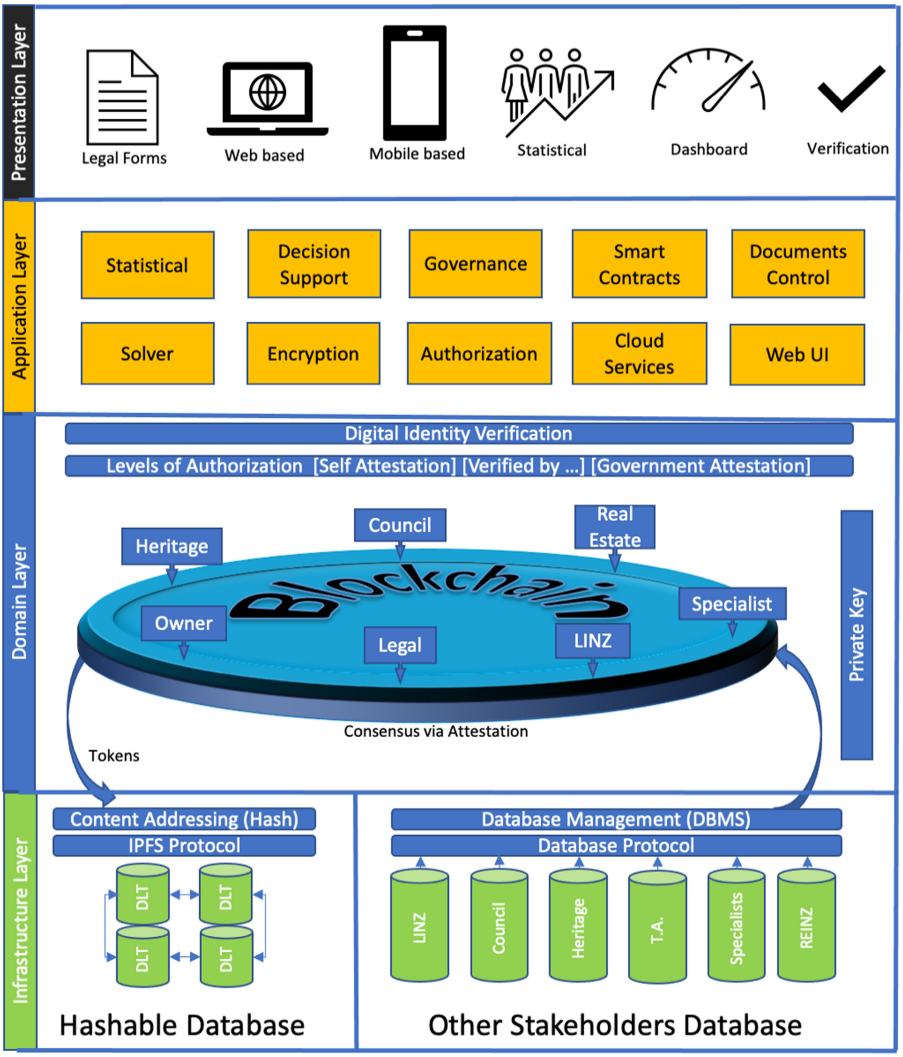

Fig. 3. Future Hashable blockchain based architecture

shutdown. It could be inaccurate supplier data, a virus, mistakes in search algorithms, or human error. These disruptive events negatively impact both Hashable's goal of providing reliable information and the company's reputation. There is a loss of trust that affects the company's relationship with its suppliers and customers. When inaccurate information is detected or provided to customers, regardless of its impact, the team leaders report this to the CEO. In such cases, and others, the Disruptive Event model (see Fig. 4) can be used to guide decision-making and remedy the situation.

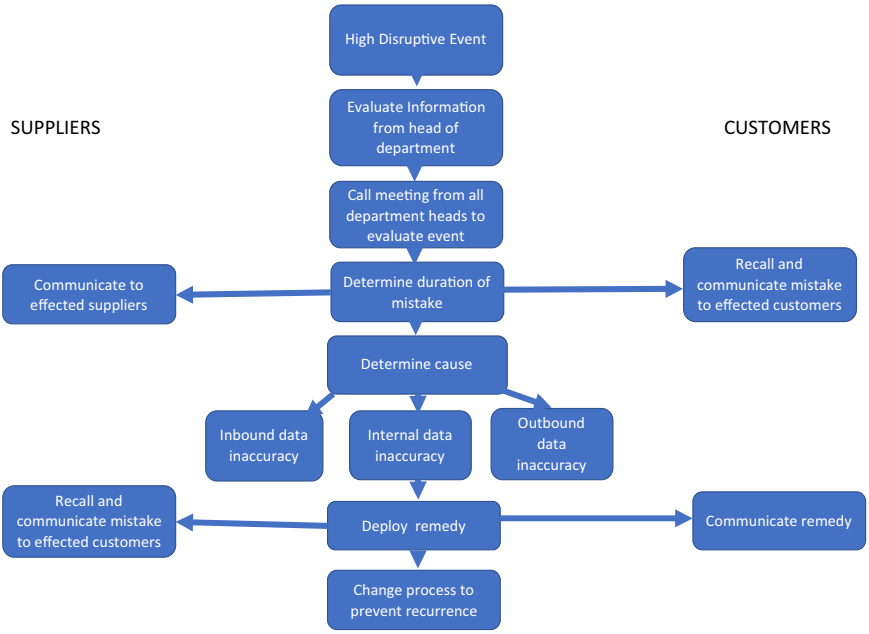

Fig. 4. Disruptive event model

The Disruptive Event model (see Fig. 4), highlights the importance of timely communication with both suppliers and customers to alert them to potential faults. Communication is essential, along with learning from the mistake and subsequent process improvement to prevent future disruptions and ultimately evolve Hashable's business model. In the short term, it is critical to quickly evaluate the information/report from the team leaders before customers (and staff) are informed and there is a full recall of reports. Long term action would be to invest in the company's IT infrastructure to keep it updated as well as staff training and development.

5.1 Procedural Response

As mentioned, a disruptive event is when large financial decisions are made based on inaccurate information. Often a disruptive event is not noticed and can be hard to detect. This is when reports are created with incorrect information, which is subsequently used by Hashable's customers for decision making. Even small errors in information could lead to large legal costs and severely damage the company's reputation [8].

To mitigate and prevent such damage the following procedural response of probe, sense and respond is advocated and explained as follows:

- Probe: information accuracy is a critical aspect of the company's product and service and as such, the system needs to be probed continuously to test its robustness.
- Sense: a close relationship with customers and their continuous feedback is essential.
- Sense: to encourage employees to report even the smallest mistakes.

- Respond: to incorporate a 100% quality and zero fault tolerance culture.
- Respond: to constantly check the quality and accuracy of the generated reports.
- Respond: implement a four eyes system, so that every report is checked by a different person.
- Respond: each report has the creator name on it.
- Respond: Implement an employees' training program to achieve the highest quality work.

5.2 Technological Response

A disruptive event is when reports are created with inaccurate information. This could be caused by a security breach whether it be internal or external [9].

Internal Security Breach: This is the worst kind of security breach especially if it is an internal breach by one of Hashable's own employees. To sense this, enterprise system (SA) HR job satisfaction reports could be used to identify disgruntled employees.

External Security Breach: A close relationship with customers and their continuous feedback is required to sense this type of breach. Using the enterprise system (SAP) SRM and CRM reporting functionality supplier problems and customer dissatisfaction could be identified respectively.

In addition, Hashable could respond by configuring a company specific enterprise system to enable the above mentioned reporting together with the use of Pyramid Analytics and artificial intelligence to identify and analyze disruptive events. Bundling all the high, medium and low disruptive events together for analysis could generate new insights into proactively preventing potential disruptions [10].

Using Stella software, a causal loop diagram (see Fig. 5) was created to understand the effects of a high disruptive event on one of Hashable's intrinsic values, that of 'trust'. In the context of Hashable, the intrinsic value of trust applies to the company's suppliers, customers and employees. The causal loop diagram has been scoped to focus on the core issues for the purpose of clarity rather than drilling down to minor issues. For example, if the company experiences a security breach it negatively effects the level of trust, which impacts the company's brand. Conversely, brand strength can have a positive effect on the level of trust. Trust and brand also influence supplier availability. Both brand strength and supplier availability will increase the profitability of the company.

In addition, a stock and flow (SF diagram) was created. Stella supports the simulation of models (casual loop diagrams) and graphically represent them using four fundamental building blocks. These four blocks are;

- The variable that effects the process.
- The stock or sink represents the cumulative effects the variables have on the process
- The flow, which is the pipe that indicates the changes that can occur over a period time.
- The converter is the regulator of the flow. It can increase or decreases while the value 1 indicates no change.

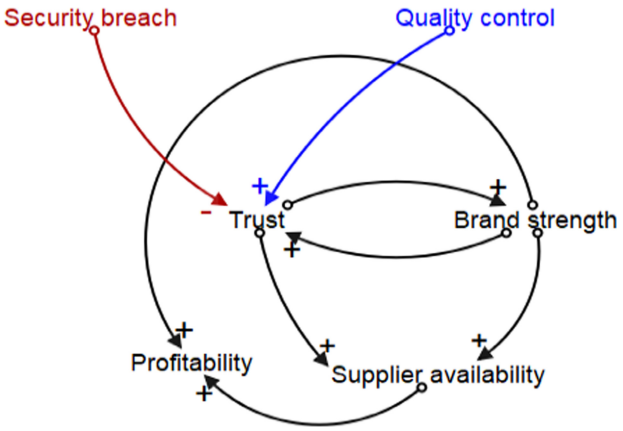

Fig. 5. Consequences of a security breach

In the SF diagram (see Fig. 6), profitability is the measurable activity (sink) and the values were set as follows:

- Security breach at 0.6 stemming the flow.
- Supplier availability at 1.1.
- Brand strength at 1.3.
- Quality control at 1.1.

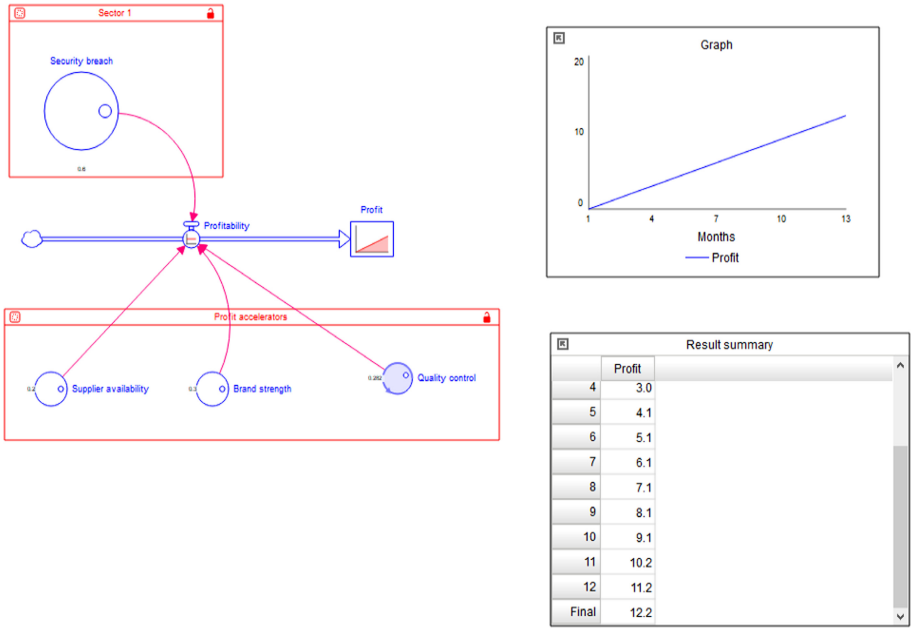

Fig. 6. Quantifying the security breach

The SF diagram will help quantify a security breach and support the decisions by management to increase IT spending to minimize the chance of it happening. It will also allow management to further enhance their quality control program and invest in a quality training program. Only six variables are used in the SF diagram to visualize the disruptive event at one level of abstraction. As mentioned previously, trust is directly associated with the company's brand. Suppliers are only interested in sharing their data with a trusted brand and need to trust the handling of data [11]. The suppliers are also scrutinized by the public when sharing their data. The main control on trust is the ability to perform exceptional quality control. And the greatest disruptive event is when the data is compromised by a security breach.

6 Conclusion

Hashable's core business is providing information from data for potential buyers in the NZ residential real estate market. This will, hopefully, provide knowledge and wisdom to buyers in the due diligence process through the creation of verified reports generated from real estate data gathered from multiple sources.

In essence, the hypothetical company Hashable created a three-tier structure to secure information on a property. First, it links centralized verified data from national and CC records using blockchain technology. Second, reports created by specialists, which have been accredited by the government, are linked to the property giving a historical record of all the reports on the property. Third, it links a personalized database generated by the homeowner to convey all the warranties and maintenance work carried out on the property (see Fig. 7). This three-tier approach enables a verified account of the property that ultimately leads to enhanced decision-making for prospect buyers of residential real estate in NZ.

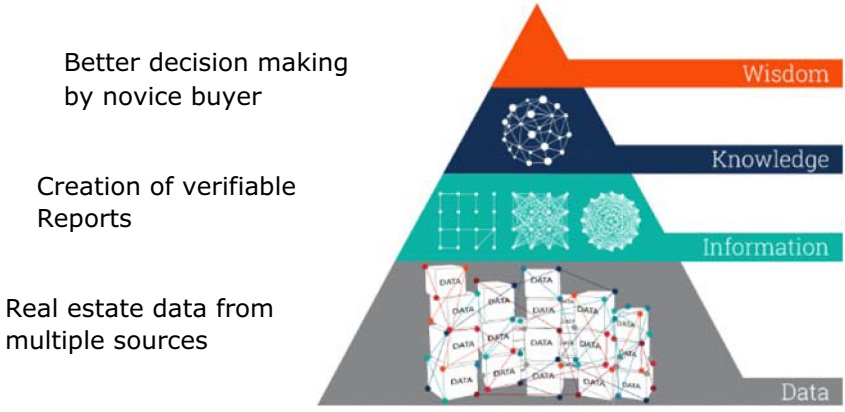

Fig. 7. Data information knowledge wisdom model

References

1. New Zealand General Social Survey 2018: Objectives of the Housing and Physical Environment supplement (2016)
2. Allmon, D.E., Grant, J.: Real estate sales agents and the code of ethics: a voice stress analysis. J. Bus. Ethics **9**, 807–812 (1990). https://doi.org/10.1007/BF00383279
3. Reserve Bank of New Zealand. https://www.rbnz.govt.nz/statistics/key-graphs/key-graph-house-price-values. Accessed 28 July 2020 (2020)
4. Swan, M.: Blockchain : Blueprint for a New Economy. O'Reilly Media Inc, Sebastopol (2015)
5. The Real Estate Institute of New Zealand (REINZ). https://www.reinz.co.nz/
6. Mozota, B.B.: Structuring strategic design management: Michael Porter's value chain. Des. Manag. J. Former Ser. 9, 26–31 (2010). https://doi.org/10.1111/j.1948-7169.1998.tb00201.x
7. Sharp, A., Mcdermoot, P.: Workflow Modeling: Tools for Process Improvement and Applications Development, 2nd edn. Artech House, Norwood (2009)
8. Afzal, W., Roland, D., Al-Squri, M.N.: Information asymmetry and product valuation: an exploratory study. J. Inf. Sci. **35**, 192–203 (2009). https://doi.org/10.1177/0165551508097091
9. Chen, P., Cuzzocrea, A.: Editorial Board Knowledge Management in Organizations (2018)
10. Williamson, O.E.: Transaction cost economics, Chapter 3 (1989)
11. Cyran, M.A.: Blockchain as a foundation for sharing healthcare data (2018)