Extracting Variables and Causal Links from Interview Data

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Abstract

This paper presents an approach to extract factors and causal influences from interview data with stakeholders within the Australian automotive recycling system during the model conceptualisation stage of System Dynamics. We first discuss problem articulation in the context of SD. Then provide an overview of how stakeholder interviews were conducted along with how interview data and field notes were processed and analysed. Next, we present the approach which was used to identify the variables and causal links from interview data resulting in a Causal Loop Diagram and a first cut Stock and Flow Diagram. A running example, the automotive recyclers' Workforce dynamics, is also provided. Finally, the difficulties faced and lessons learnt from running the interviews to handling interview data are discussed. The main benefit of the approach presented in this paper is to aid SD practitioners in model conceptualisation when relying on interview data.

Key words

System Dynamics, Model Conceptualisation, Qualitative Research

Introduction

This doctoral research project attempts to create a policy decision tool that helps stakeholders discuss policy options and their implications on the Australian automotive recycling industry or the End of Life Vehicle (ELV) recycling system. This unregulated industry handles in excess of 610,000 End of Life Vehicles ELVs per year (ABS 2011) employs 3410 employees and has a turnover of $1.1 Billion Australian Dollars (IBISWorld 2011).

System Dynamics (SD) is used as a systems thinking method to study the (ELV) recycling system in Australia. We adapted the Modeling Process from (Sterman, 2000), the Group Model Building from (Vennix 1996) as well as the qualitative research guidelines from (Richards 2009) in engaging with the stakeholders and analysing data.

While attending the 29th System Dynamics conference in 2011, the main author discussed aspects of his project with other SD practitioners who showed great interest in the method used to analyse and synthesize the interview data and field notes into grounded models. This paper demonstrates that approach with the aim to help other SD practitioners in model conceptualisation using interview data.

System Dynamics and Problem Articulation

Since incepted by Forrester in the 1950s, there have been several SD modelling heuristics proposed and applied to different problem situations. Notably the System Dynamics Modelling Procedure (Saeed 1994), System Enquiry (Wolstenholme 1990) and the Modeling Process (Sterman 2000). While the emphasis of these frameworks has been on the approach as a whole, the discipline is still expanding in terms of its methodology. In recent years research has looked at the application of SD to unique complex situations while attempting to build robust and tested approaches, that once optimised and refined, can be used in other situations.

The model conceptualisation, problem structuring or articulation phase of SD has been a hot topic among several system dynamists (Axelrod 1976; Barlas 1996; Lane 2010). It is the phase during which the problematic areas of the system under study are identified and the system boundary is set. Much of the debate has been on determining proven methods for tackling systems with complex structures and systems where social or human aspects come into effect. For simple systems such as a factory assembly line, this is not an issue, as the problem is often treated as an optimization exercise under specific constraints (e.g. maximise utilisation while maintaining minimum inventory).

Flood and Jackson (Flood and Jackson 1991) argue that SD may not be suitable for the structurally complex systems to begin with, suggesting instead other systems thinking tools such as the Soft Systems Methodology (SSM) (Checkland and Scholes 1990) or the Viable System Methodology (VSM) (Beer 1972). However, numerous counter examples (e.g. Limits to Growth (Meadows and Club of Rome. 1972)) show that SD can be successfully applied to structurally complex systems. These examples also show that valuable insights can be gained despite the high degree of difficulty in model conceptualisation and in obtaining data for the purpose of mathematical modelling.

Others like Forrest (Forrest 2009) view SD as a participatory qualitative tool, or a 'soft' systems tool, used to drive change in the participants' mental models. They propose to use SD solely in its qualitative capacity. On the other hand, SD purists (Forrester 1973; Sterman 2000; Lane 2010) and certainly other system scientists (Checkland and Scholes 1990) regard SD as a quantitative tool, a 'hard' systems tool used to study complex systems behaviour through modelling and simulation.

Regardless of the system's structural level of complexity, an effective application of SD necessitates both its qualitative and quantitative components (Luna-Reyes and Andersen 2003). Supporting this view are the numerous examples used in introductory SD literature showing simple systems that exhibit complex behaviour (predator/prey, hot shower, etc.). These examples tell us that the qualitative components of SD used at the early stages to describe the problem context and to form the dynamics hypothesis, fall short of replicating the insights gained from mathematical simulations. Furthermore, to construct the simulation models, the qualitative stages cannot be simply skipped; Hence the equal importance of both the qualitative and quantitative components of SD.

This importance underlines the model conceptualisation method that we present in this paper. The approach builds on the stakeholder' knowledge and perspectives to construct grounded conceptual causal models that could be later refined into Stock and Flow models.

Problem Articulation and the project

In applying SD to the automotive recycling system in Australia, the reiterative Modeling Process (Sterman 2000) was chosen as an overall framework. It was proven in a similar context (Zamudio-Ramirez 1996) albeit with a different focus: Zamudio-Ramirez studied the effects of automotive design policies of vehicle manufacturers on the used parts trade in the United States.

Several issues complicated the Problem Articulation step in applying Sterman's Modeling Process to the Australian situation, namely:

- Lack of data captured around the system in Australia: Very little work has been done in this area. There is a lack of useful data about ELVs in Australia. There is also very little information on how the automotive recyclers operate and the decision frameworks that underline their behaviour and the behaviour of the system. How can relevant data and information be sourced and collected effectively?
- Lack of a cohesive industry: The automotive recycling system compromises hundreds of stakeholders spread all over Australia, across different juridical areas. Some are members of different industry associations each with different strategies and goals. Some are not members of any association as it is not compulsory by law. How can a good range of stockholders be selected and involved in this process?
- Problem identification: There are too many unknowns about the system that the initial perceived problem (lack of Australian policy for ELVs) appeared to be too broad in definition. After all, shouldn't the application of SD begin with a clear articulation of the problem(s) to guide the modelling process? Also what are the problems relevant to the stakeholders?

- Concerns on the scientific nature of this research: One of Sterman's guidelines concerning the problem articulation phase recommends that the analyst (investigator, researcher, etc.) needs to *triangulate* the information gathered from stakeholders with collected data and his/her own knowledge (Sterman 2000). How can this triangulation process be undertaken in a scientific manner? I.e. how can the researcher's knowledge on the process outcome?
- Lack of a clearly defined systemic approach for creating conceptual models: In what way can the information gathered from the stakeholders be utilised to aid in constructing a relevant SD model of the automotive recycling system?

Acknowledging the importance of stakeholder involvement in the development of a SD model based on real world views, several methods were investigated such as Group Model Building (Vennix 1996), Learning Labs (Maani and Cavana 2007), Collaborative Conceptual Modelling (Newell, Proust et al. 2008). But given the questions highlight above, it became clear that jumping straight into a workshop style model building exercise may not be the most time and cost effective approach. Especially there were large gaps data and information gaps. This meant that the approach needed to begin with a system exploration stage while engaging a group of stakeholders. Interviews were chosen as a form of stakeholder involvement to gain an understanding of the:

- Flows of materials within the system (sourcing of ELVs/materials, sale of parts/materials, disposal of waste), and
- Decision factors or business policies influencing these flows (company, industry, government), and
- Business characteristics of automotive recyclers (workforce size, years in business/etc.).

The information gathered from the interviews was intended to help develop the structures of the SD models (Stocks and Flows). It was also hoped that through these interviews we will be able to identify areas of concern, for the stakeholders, or problems within the system.

Interview Design

In order to increase the conversion rate for the voluntary semi-structured one-on-one interviews, it was decided to keep the running time to less than an hour. For this reason it was unfeasible to include any systems thinking or SD modelling activity. The interview questions were chosen to keep the participant interested (Schein 1999) while providing with the key information about the state of affairs in the automotive recycling business (Table 1 for a summary, Appendix 1 for the list of questions). The questions were designed with automotive dismantlers/parts recyclers in mind but can be adapted to other types of stakeholders such as scrap metal recyclers and car auction houses. General qualitative research guidelines helped in devising the interview format (Neuman 2006; Richards and Morse 2007). Two mock-up interviews were conducted with colleagues for practice and refinement.

Table 1: Summary of interview questions [and themes]

General Questions	• Challenges facing the industry and business [Industry Challenges, Policy Challenges, Business Challenges]. • Outlook of the industry and business [Industry Outlook, Business Outlook]. • [Effects of affordability of new cars on the automotive recycling industry and business]. • [Effects of emerging automotive fuel technologies] (such as hybrids, diesels, Liquid Petroleum Gas, etc.) on industry and business. • [Effects of possible policies on industry and business].
Business Focused Questions	• Business characteristics [Years in business, Links with industry association, Premises, Specialisation, Workforce size, Turnover, Business hours] • Business input [Factors considered when sourcing ELVs, Sources of ELVs]. • Business operations [Handling of incoming ELVs, Handling of hazardous waste, Factors for deciding on parts suitability for resale/recycling, Stock labelling, Use of ICT]. • Business output [Types of customers/revenue streams, Export streams].

Recruitment and the Interview Process

We approached via email, telephone and in person a number of automotive recyclers as well as automotive industry associations and car auction houses. These were identified through a public registry of automotive recyclers (APRAA 2010), the Yellow Pages, and personal contacts. Each of the business entities approached were provided with an information sheet about this research (Appendix 2). To maximise the conversion rate, they were given the freedom to assign interview dates and times.

Between December 2010 and March 2011, the primary researcher travelled to each respondent's workplace to conduct the interviews (Table 2 for a summary of participants' grouping and location). Some of these were audio-recorded using a digital recorder after receiving consent from the interviewees (5 of them opted out). Interviewees were asked to sign a disclaimer form as per the university's research requirements.

Table 2: Participants Grouping and Location

Stakeholder Group	Number of Interviews	Location (State)	Notes	Audio Recorded
Automotive Recyclers	8	5 in Victoria, 3 in South Australia, 1 in New South Wales	Interviews followed planned questions.	6
Auction Houses	2	2 in Victoria	Interviews used part of the planned questions to gather information about the flow of damaged cars at auctions.	2
Industry Associations	2	1 in Victoria and 1 in South Australia	Unstructured Interviews to gather information on the associations' role in the system.	No, only notes were taken.
Law Enforcement	1	Victoria	Unstructured interview to gather information the law enforcement agency's role within the system.	No, only notes were taken.

Handling Interview Data

In terms of the workflow, backup copies of the audio recordings (digital files) were made. Each taped interview was then transcribed into a text file along with its field notes. For those interviews where taping was not consented to, field observations were transcribed from hand written notes. Finally the transcripts were imported into NVivo 9 (QSR 2011), a qualitative research software to facilitate the analysis.

Because of the semi-structured nature of the interviews the participants were frequently prompted for more information and explanation which meant that for some straight forward questions (e.g. sources of ELVs), the answers extended into long passages of text. Participants often gave details more relevant to a different question. This meant that sometimes, information relating to a specific question was scattered across several segments of the transcript. From the above, we realised that word-for-word transcriptions of the audio recordings could later complicate our data analysis.

Hence, interviews were transcribed in a non-linear fashion: If a participant said something relevant to a different question than the one asked, this piece information is transcribed to the section/question it is most relevant. This approach prolonged the process of transcription considerably but simplified the process of analysis later.

Interview Data Analysis: Process and Example

Once transcription of all the interviews was completed, came the process of coding which we adapted from Richards (Richards 2009). Answers were first coded (grouped) according to the interview questions. Each question represented a node of information through which we can view the answers from all respondents to that particular question. For every node a memo was created and linked to that node. In each memo the following points were addressed in a sequential manner: Theme, Observation, Why is this interesting?, Relevance to SD model, Emerging Theory, Missing Data, Identified Variables, and Causal Links.

For better clarity and ease of access, the memo was formatted as a horizontal table with each heading in its own column (Appendix 3 for a snap shot). Below are these headings detailed along with the reiterative process followed to address them:

- Theme: Code the question being treated. E.g." Workforce"
- Observation: Summarise the responses in a systemic manner. Provide an analysis on the findings along with any relevant ideas. This reiterative process is as follows:

1- Review the answers given by all respondents.

2- Identify specific factors (codes) that can capture the information. E.g. for "Workforce": "Workforce Size", "Workforce Growth", "Improve Skill Level", "Causes for Workforce Size Changes", and "Labour Cost".

3- Identify the sub-codes for every code. Count how many respondents answered to each sub-code. E.g. for "Improve Skill Level": hire skilled workers (1 participant mentioned this), train current workforce (2), and dismiss unskilled (2)

4- Compare, analyse and discuss the findings for every code. E.g. for Workforce Size: "There first seems to be a correlation between the workforce size and the annual turnover volumes of ELVs. The UPI group with an average of 22 workers turns over 5100 ELVs per year, whereas for the SP with of 12 workers turning over 482 ELVs per year. We note, however, that the dismantling activity is prominent in the SP group, whereas for the UPI group the activity is minimal and relates mostly to the treatment of incoming ELVs (e.g. draining fluids, removal of batteries, etc.)"

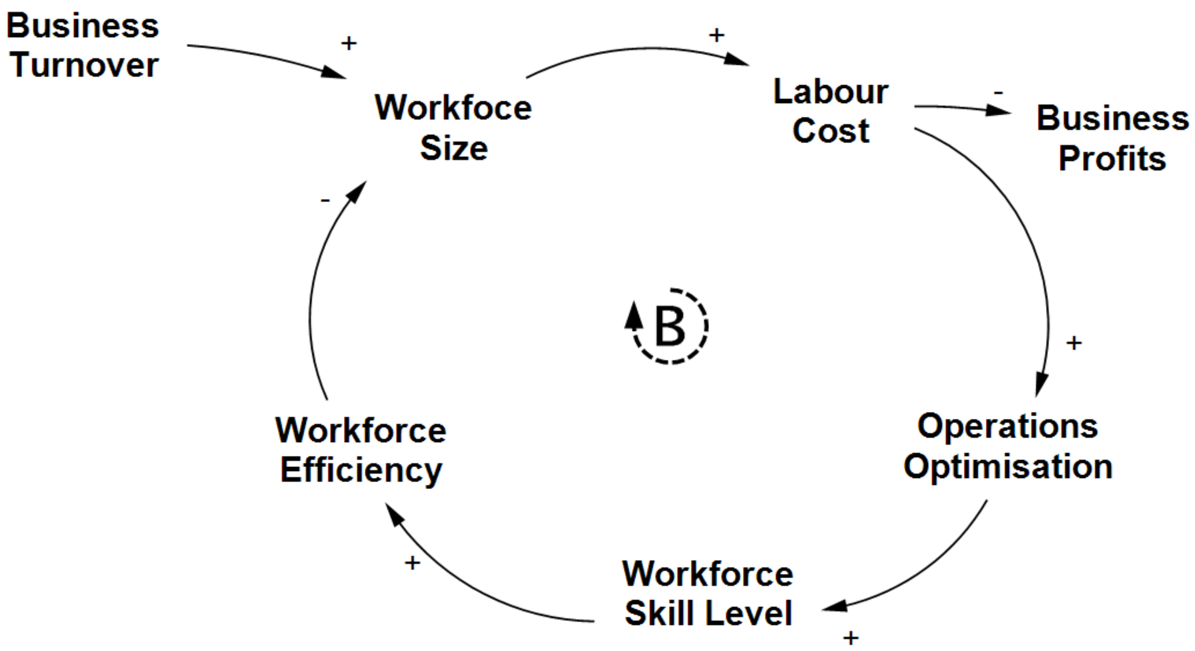
- Why is this interesting?: Reflect on the question and the resulting analysis from a higher perspective. E.g. "We asked this question not just to collect raw workforce data about businesses but also to try understand the underlying mental models that drive this factor and in what ways. We found that auto recyclers control their workforce size and skill level depending on their business financial situation (e.g. business is growing) and their drive to increase efficiency (achieve higher turnover with same workforce size, or maintain turnover while reducing workforce size). "
- Relevance to SD model: Indicate how such findings can be used when constructing an SD model focused on this area. E.g. "Identification of several causal links between workforce size/cost/skill level and business profits/turnover/optimisation".
- Emerging theory: Indicate the theory or generic observation which can be grounded in the data. E.g. "Automotive recycling is a labour intensive operation. Operators that are able to adapt their work force (whether size, cost, skill level) to changes are more likely to stay longer in business".
- Missing data: Highlight any data that may be collected and studied to further support the theory that emerged. E.g."A wider survey of automotive recyclers to study the link between historical changes in their workforce size and skill level and their business turnover".

- Identified variables: Using the codes identified earlier and from insights gained from this analysis, list the variables or factors that could be used in a SD simulation model to represent dynamic changes to this area. Indicate the unit where possible. Not all codes may entail sub-codes. Not all identified in the Observation step will make it to this list. Some codes may need to be renamed. New codes may emerge. E.g. "Workforce Size (Integer), Labour Cost ($/hour), Skilled Labour (Percentage), Unskilled Labour (Integer), Workforce Efficiency or Productivity (Business Turnover/Workforce Size)"
- Causal links: From the list of variables identified in this area and other areas (previous or later questions), indicate their relationships using a simple one way causality notation. Here Vennix' recommendations (Vennix 1996) for building causal diagrams during interviews to suit this purpose:
    1. Pick an identified variable to start with.
    2. Identify the variables that affect the chosen variable with the polarity. Previously unidentified variables may emerge. In this case, add them to the identified variables list. Variables names may need to be revised.
    3. Identify variables influenced by the variable with polarity where possible. Previously unidentified variables may emerge. In this case, add to the identified variables list. Variables names may need to be revised.
    4. Verify each causality link by comparing with transcripts.

   E.g. "Workforce Size (+)→ Labour Cost,
   Labour Cost (-)→ Business Profits,
   Labour Cost (+)→ Operations Optimisation,
   Business Turnover (+)→ Workforce Size,
   Operations Optimisation (+)→ Workforce Skill Level,
   Workforce Skill Level (+)→ Workforce Efficiency,
   Workforce Efficiency (-)→ Workforce Size,
   Workforce Efficiency (-)→ Operations Optimisation"

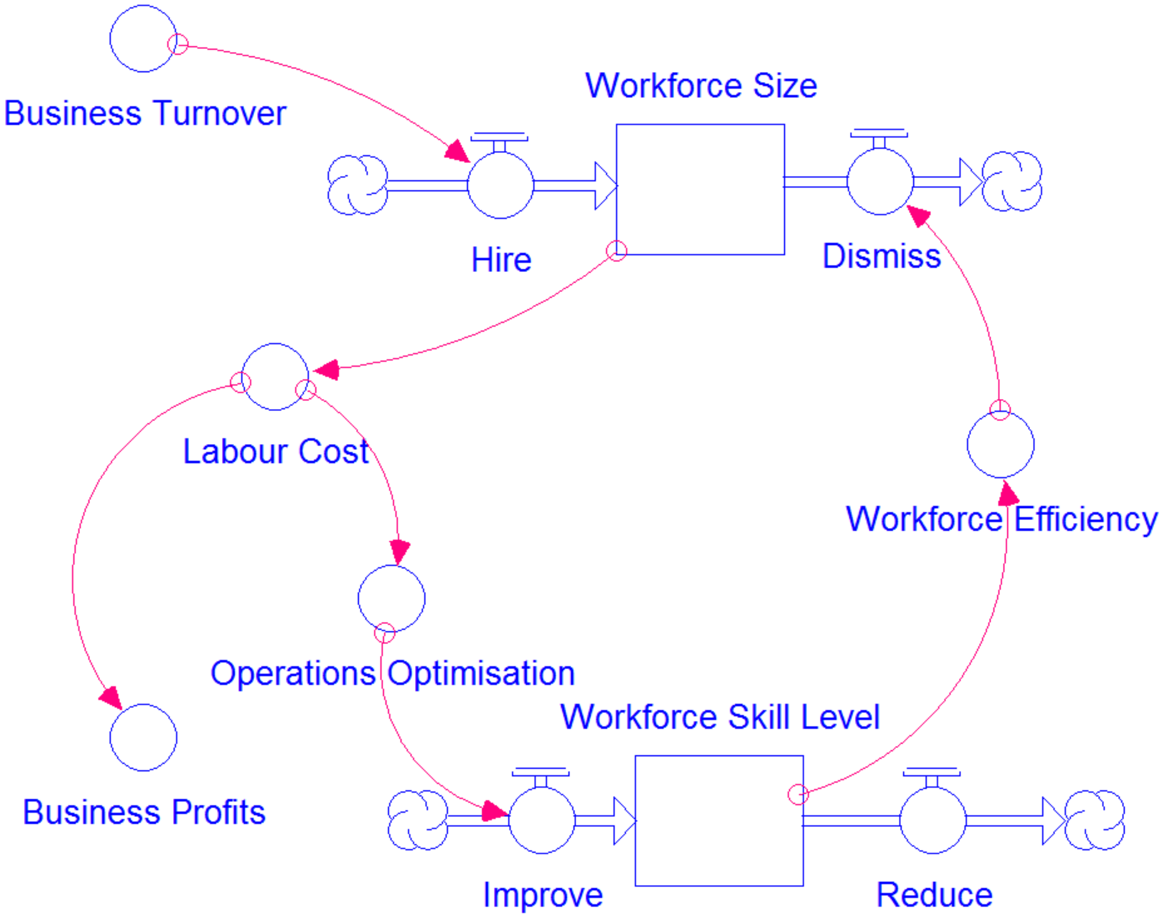
- Having identified the factors and causality links, construct an influence diagram for each question/focus area. During the diagramming process, variable names and even causalities may need to be revised (while still ensuring validity with interview data). In several themes, enough causal links were identified to form Causal Loop Diagrams (CLDs). A CLD of the workforce dynamics at automotive recyclers based on this process is shown in Figure 1 and articulated below:

Figure 1: A Causal Loop Diagram of the Workforce Dynamics for the Australian Automotive Recyclers



"As Business Turnover increases, auto recyclers increase their Workforce Size to keep up with the increased workload. Labour Cost is one of the main costing factors that affect the auto recyclers' profitability. As costs grow, auto recyclers tend to look for ways to optimise their business operations. They do so by adjusting their Workforce Skill Level in order to maximise the efficiency of their workforce. This includes hiring new skilled workers, retraining current workers, or dismissing unskilled workers. As a result, their Workforce Size dynamically changes. With the exception of a recycler who has been in business for less than 2 years, all other recyclers have indicated that their workforce size is constantly changing". This dynamic hypothesis highlights the importance of the workforce factor which now can be seen as a dynamic variable with known causes and influences. It is now possible to construct a first cut Stock and Flow Diagram (SFD) that can later be refined (Figure 2).

Figure 2: A First Cut Stock and Flow Diagram of the Workforce Dynamics for the Australian Automotive Recyclers



It is worthwhile to emphasize the reiterative nature of creating CLD and SFD from the emerging variables and causal links. As diagrams are created the variables names and definitions may need to be changed. This in turn forces a revision of the causal relationships as well as checking conformity with the observations made and the interview data.

It is also worth mentioning that in some themes did not result in identifying new variables or causal links. This was the case for questions where either there was so much detail information given by the participants that it wasn't viable to prompt them further, or the nature of the responses was speculative. For example: "Handling of Incoming ELVs", "Industry Challenges" and "Industry Oulook" themes.

Issues faced

There were a number of issued that we faced during this application of SD, namely was getting the stakeholders to agree to take part in the interviews. After initially speaking to 30 stakeholders about undertaking this study, in excess of 20 invitees did not show interest and tried to avoid follow up calls/emails. We eventually got 6 stakeholders confirmed through personal contact and through the endorsement of this research by the Victorian Automotive Chamber of Commerce (VACC) and the Auto Parts Recyclers Association of Australia (APRAA). The rest joined in through word of mouth from those that participated.

As a form of information verification, we initially wanted to send the interview transcript back to the participants within a week from the interview taking place to give them the chance to revise or modify their answers. But with each transcript being more than 3000 words long, it was a big ask for busy business managers to get them to read what they had said during the interviews. This approach was thus discarded.

Another issue was the handling of qualitative. Using a simple word processor to manage in excess of 35,000 words of transcripts and field notes proved to be difficult and time consuming to conduct the analysis. It took a couple of weeks to learn and adapt to the qualitative research software before being able to analyse the data more effectively.

Lastly, the task to analyse and code the data was time consuming. This was attributed to two reasons: firstly it was a learning activity adapting an approach in data analysis. Secondly, it was necessary to constantly revisit interview data while identifying variables and causalities.

Lessons Learnt and Conclusions

Overall there were several important lessons to take away. Firstly, from using SD as a systems approach we learnt that despite the lack of information about a complex system, a relatively small inquiry results in large amounts of data as well a large number of questions. This may seem overwhelming to process and analyse at first. But we’ve shown that approaching the qualitative data in a systemic manner can yield powerful insights about the system.

Secondly, we noticed that sending a copy of the questions ahead of time to participants will provide them with the opportunity to prepare for the interview. It will also allow the interviewer a better control over the process. In the two instances this was done, the participants provided us with more in-depth (and consequently valuable) information. Taking a guided tour of the facility also helped clarify and expand some of the information provided during the interviews. These observations and field notes proved crucial when analysing the data.

Thirdly, the use of a qualitative software package helped immensely in managing the large amounts of information/data gathered. The transcripts and field notes amounted to in excess of 35,000 words. Analysing this data would have been ineffective and time consuming if only a word processor was used. By switching to qualitative research software the data was managed much more effectively and saved a huge amount of time.

Lastly and most importantly, this paper demonstrated a method to analyse and synthesize the interview data and field notes to aid in the problem articulation stage of SD. The method shown in detail will be useful in situations to SD practitioners where conducting stakeholder interviews is a better alternative to group model building. The process remains a work in progress that needs to be refined and tested in other problem contexts to further prove its merit.

Future Directions

From here we would like to 'validate' the causal links deducted from the inquiry data with the views of the stakeholders. But with the breadth of information (in excess of 100 variables, causal relationships) that was uncovered, there needs to be a guided approach. We aim to do so as part of a lead in activity of a workshop involving a small group of stakeholders in the automotive recycling industry.

Participants will be asked to prioritise the themes (E.g. Workforce, Turnover, Premises, Sourcing of ELVs etc. refer to Table 1) in order to determine the most significant ones were the modelling effort would then to be directed. Vennix (Vennix 1996) proposes a method using a questionnaire where each causal link in the prioritised area is shown. The participant can agree or disagree with the causality and its polarity and comment on their choice of argument.

These forms will be collected and analysed. The causal links will be revised accordingly. Information that helps identify the new factors or links discovered as a result of differing perspectives. The prioritisation of focus areas along with the variables/causal links will guide the quantitative SD modelling effort for estimating or sourcing behaviour over time of variables.

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Appendix 1 Main List of Questions

Interview questions:

Open questions:

1- What challenges is the parts recycling industry facing today as a whole?
2- As a business owner/operator what challenges is your businesses is facing?

Business information questions:

3- Thinking about your business, how long have you been in operation for?
4- What associations is your business a member of? [Probe for accreditations, annual costs involved]
5- What is the size of your workforce? [Prompt for growth/decay]
6- What is the area size of the premises? [Prompt for growth/decay, whether they moved from somewhere else, or whether parts/materials are stored somewhere else]
7- What are the days and hours of operation? [Prompt for overtime work]
8- Do you specialise in any specific brands/models? [Prompt for brands/models, reasons for this specialisation, ongoing/recent, reasons for changes]

Open questions:

9- Thinking about the affordability of new vehicles, what challenges is your business facing as a result of the rising affordability? [Prompt for grey imports]
10- In what ways do hybrids affect your business? [Prompt for LPG/Diesel/other]

Business operation questions (sourcing):

11- Now focusing on the operations of your business, how many vehicles/tons of materials/carts of parts does your business handle a year? [Prompt for data collection, type of data, how long its kept, to whom is it reported, and if its accessible]
12- Where are vehicles/parts/materials sourced from? [Probe for frequency of sourcing; Classify sources by volume, cost; explain/give example for each sourcing process and logistics involved]
13- What factors are considered when sourcing vehicles/parts/materials? [Probe for location, condition, price, value/potential revenue]
14- What guidelines or processes do you follow to handle the incoming goods?

Business operation questions (dismantling):

15- Are dismantled parts/materials labelled?
16- What factors do you consider when deciding on whether a part is fit for resale/recycling?
17- What is your standard operating procedure when dealing with hazardous waste? [Probe for council directives/guidelines that are followed]

Business operation questions (output):

18- Now thinking about your clients, what are the types of customers that buy goods from you? (public/other wreckers etc.) [Probe for long term clients, percentage of revenue coming from long term clients,
19- Do you have clients in the export market? [Probe on demand for export how it has changed in the past 10 years, destination countries, exports share in revenues]
20- What ICT mechanisms do you use to facilitate your operation?

Open questions:

21- Where do you see the industry in 10 years? How about your business?
22- Scenario questions (In what way your business will it be affected if there was new policy requiring):
-forced depollution, reporting, zero dollar take back, incentives for disposal of vehicles offered, change in vehicle composition/weight.

Appendix 2 Information Sheet Provided to Interviewees

Interview Information Sheet

This voluntary interview is part of the End of Life Vehicle disposal system research project, funded by AutoCRC (Automotive Cooperative Research Centre) and the Australian National University, undertaken through the College of Engineering and Computer Science at the Australian National University.

The research project is collaborating with the automotive dismantlers and recyclers and associated operators to gain a better understanding of the vehicle disposal system.

The project objectives are to develop:

- A better understanding of the current state of affairs in the automotive disposal system and associated streams.
- A system dynamics simulation model that can be used to study the impact of various policy options on the automotive disposal system.

The research's results will be published in a doctoral thesis. Some results may also be published as journal articles and/or conference papers.

The intent of this interview is to gain understanding of the processes involved in sourcing end of life vehicles (or parts of), dismantling them and recycling the resulting parts and materials. Interview questions will revolve around the business of dismantling, parts recycling, materials recycling, factors (business and government policies) governing these processes, perceptions about past and current business operating conditions, perceptions and reaction to potential future policies and changes in vehicle composition. Interview will seek historic data (if available) and will include questions about the business history (workforce size, annual turnover, quantities of vehicles/materials). The interview should take less than an hour to complete.

The interviewer will take notes of the discussion. All information collected will be only identifiable to the researcher and the supervisor. No quotes or attributed opinions will be used without permission by the interviewee. Given permission, interviews will be audio recorded to back up written notes. Participants may refuse to answer questions, withdraw from the interview at any time, or request that material not be used. Participants will receive a typed copy of their responses via email or fax, to verify the accuracy of the responses; at that point, participants may withdraw from the process and the collected data will be promptly deleted. Participants may opt-in to receive a summary of the results once they are published.

This research operates under the research ethics protocols of the University, and any questions or complaints can be forwarded to:

Human Research Ethics Committee
Research Services Office
Chancelry 10B
The Australian National University, ACT 0200

Tel: 6125-7945 Fax: 6125-4807
Email: Human.Ethics.Officer@anu.edu.au

Thank you for your help with this research. If you have any further questions, please do not hesitate to contact me or Dr. Matthew Doolan.

Regards

Ezzat El Halabi

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Appendix 3 A Snapshot of the Analysis Grid

Automotive Recyclers Business Characteristics

Theme	Observation	Why is this interesting?	Relevance to SD Model	Emerging Theory	Missing Data	Identified Variables (Codes)	Causal Links
Years in Business	30 (UPI)+ 30 (SS) + 30 (LS) +20 (SP) + 20 (SP) + 12 (SP) +18 (UPI) +2 (SP), or 162 years in combined experience. Interviewed automotive recyclers have been in business for 20 years on average. They have well established businesses with strong commercial presence and links with providers and customers. They are generally proud of their line of work and are constantly on the lookout for ways to improve things. Most perceive their work as doing good for the people and the environment by being the essential link in recycling parts and materials.	The industry has long been given a bad reputation for its less than desired practice. Practice and perception is changing, however, to the better.	To consider, how will operators established in the 1980's, when environmental awareness was low, can adapt to the requirement of new policies?	Automotive recyclers with strong supplier/customer links are more likely to stay in business for longer.	A survey of operators' years in business Australia wide (in percentages and turnover).	- Business Age (years) - Business Profits ($/time) - Business Links (int) - Business Survival (Likelihood of Staying in Business) (%)	Business Links (+)→ Business Profits Business T (+)→ Business Survival Business Survival (+)→ Business Age Business Age (+)→ Business Links
Industry Connections	Auto recyclers can be classified as either - Member of an industry association or more. - Not a member of an industry association. Only 1 out of 8 interviewees is not a member of an industry association. All others are members of at least an association. All of the 7 are members of their state's automotive/motor trade association. One participant expressed his dissatisfaction with the industry association he is member of, in terms of lack of campaigning against illegitimate operators. Another one sees the association meetings as	Professional accreditation/membership is often associated with best practice/legitimate operations. We see that the association works both ways: - as a gateway for operators to address common concerns, - as a platform for associations to assist operators in adopting a standard 'best practice'.	Membership is not to be confounded with licensing from an authority. These are two different things. <How can consensus be reached among operators (both members and non-members) on the kind of problems facing the industry? How do members view the non-members? and vice-versa?>	Automotive recyclers that are active members of an industry association are more likely to care for the environment, their image and stay in business for longer. Membership, however, is not a condition of business longevity.	Historic association membership data (by each state).	- Business member of an Industry Association (y|n) - Illegitimate Practice (%) - Environmental Damage (TBD) - Environment Friendly Practice (%) - Automotive Recyclers belonging to an Industry Association (% population of recyclers) - Membership Cost ($/time) - Licensing Cost ($/time) - Industry Reputation (%) - Recyclers Joining an Industry Association	Automotive Recyclers belonging to an Industry Association (-)→ Illegitimate Practice Automotive Recyclers belonging to an Industry Association (+)→ Environment Friendly Practice Automotive Recyclers belonging to an Industry Association (+)→ Industry Reputation